Is it possible to forecast the short-term supply of second-hand containers using quantitative forecasting techniques?

A research for CARU containers to deal with the dependency on their main supply partner, shipping line MSC

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PREFACE

Well, here I am, sitting at CARU containers Rotterdam, working on the final pieces of my thesis, finishing my second research for CARU. I would like to thank Rob Tromp for giving me the chance (and trust) to do a container oriented research instead of a more “private” soccer oriented research. Besides Rob I specific want to mention and thank Wesley van Nes, my colleague graduate student, for the fun we had during our internship and the table football lessons. Furthermore, I would like to thank all CARU employees for the time they made free to talk with me about this research. I have learnt a lot during both my internships at this beautiful company. And most important; for as far back as I can remember I always entered and left the building with a smile on my face.

Besides the CARU employees, I would like to thank Bart Kuipers, my supervisor from the Erasmus University, and Merijn Zondag, my coach, for their guidance during this research and life lessons during lunch breaks and meetings. Merijn helped me a lot with focussing on the right things in both, personal and business life. Bart’s energy and enthusiasm worked contagious on me and helped me in the times I saw my thesis life a little bit less bright.

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ABSTRACT

This paper analyses the possibility to use quantitative forecasting techniques to forecast the supply of second-hand containers. The main goal of this research is advising CARU containers, a world-wide operating container trader, in how to deal with their dependency on their main supply-partner MSC. It starts with a literature review about forecasting which describes the need for forecasting, the difference between judgemental and quantitative forecasting and different forecasting techniques. As this thesis is written for CARU containers, the role of CARU in the second-hand container market is analysed and the way they operate is described. Based on interviews with employees and market experts the factors that influence the supply of second-hand containers are analysed. The main conclusion made is that forecasting the supply of second-hand containers by making use of quantitative techniques is not possible on a global level. A lack of available data and the way the second-hand container market is constructed, with huge geographical differences, leaded to this conclusion. However, a case study about the USA market, in which the geographical level is narrowed down, showed that it is possible to get useful insights based on quantitative data when there is enough data available. Besides the quantitative analysis, a second case study further analyses the possible future developments regarding CARU's main partner MSC and gives a recommendation about how to deal with the dependency on them.

CONTENTS

1. INTRODUCTION

This thesis is written in combination with an internship at CARU Containers (CARU). CARU, established in 2000, is a globally oriented container trader with its origins in Rotterdam. The core activities of CARU are trading, leasing and hiring new and second-hand containers. Over the years CARU took over several companies and expanded rapidly. With depots all over the world and offices in Europe, Asia and North-America, CARU can be seen as a major player in the container industry. This research will focus on the trading of second-hand containers. The main purpose is to find out where CARU's supply of second-hand containers depends on. CARU is engaged in an alliance with the Mediterranean Shipping Company (MSC), a shipping line. MSC is by far the biggest supplier of second-hand containers for CARU which makes their influence of great importance in this research.

1.2 BACKGROUND AND PRESENT RELEVANCE

Exactly knowing what the future brings us would completely change the world. Companies are more and more trying to get better insights into future developments and anticipate on them. According to Sanders and Manrodt the role of forecasting has become particularly important because competitive market pressures increasingly create the need for improved forecast accuracy (Sanders and Manrodt, 2003). In many industries researchers and consulting firms provide companies with market analysis and consulting services like forecasts. Drewry is such a consulting firm, specialized in maritime research.

During the first two weeks of my internship at CARU Containers I focused on finding a problem that employees have to deal with. In several interviews with employees came forward, when looking at standard containers, that sales employees depend to a large extend on the supply of the second-hand containers from shipping line MSC. Having insights into the short-term future developments of this supply would be of great value for CARU. Based on this is concluded that the need for predictive value within CARU is the greatest on the short-term supply of second-hand containers. Reefers, tank containers and other container type variants are neglected in this research. The conducted interviews are presented in the appendix.

By analyzing the existing literature, it seems that there are many different forecasting techniques and visions on these techniques. Webby and O'Connor wrote a literature review

on the contributions of different methods on the forecasting process (Webby and O'Connor, 1996). Besides the different techniques there could be a difference in focus on the short-term or the long-term. Van Weenen and van der Geest emphasized that long term predictors are mostly used for investing purposes. In their report about market observation of inland shipping they also explain the need for short and medium-term forecasts (de Leeuw van Weenen and van der Geest, 2016). The growing availability and use of big data in present business analyses enlarges the forecasting possibilities, which make this research social relevant and extremely relevant for CARU. Besides this, forecasts focused on the second-hand container market are scarce. Articles with the specific aim of forecasting the short-term supply in the second-hand container market have not been published yet, which makes this research of high, academic relevance for the container branch.

1.3 PROBLEM DEFINITION AND RESEARCH QUESTIONS

CARU has to deal with the dependency on MSC. To tackle the problem sales employees, deal with, the main purpose of this research is to find out where the supply of second-hand containers depends on and to analyze the possibility of using quantitative forecasting methods to forecast the short-term supply. The research question that will be answered is as follows:

"Is it possible to forecast the short-term supply of second-hand containers using quantitative forecasting techniques?"

In order to answer the research question, the following sub questions are formulated:

1. Why forecasting and which techniques could be used?
2. In which way is the second-hand container market constructed and what is the role of CARU?
3. Which factors influence the supply of second-hand containers
4. Are quantitative methods a suitable option for CARU?
5. How could be dealt with the dependency on MSC?

1.4 METHODOLOGY

This thesis starts with a literature review about forecasting. By analyzing articles from journals like the *Journal of Forecasting* the basis of the theoretical framework is constructed. This first substantive chapter, chapter two, explains the need for forecasting, the development about big data analytics and discusses the difference between quantitative and judgmental forecasting. Chapter three gives an outline of the second-hand container market and explains the role CARU plays in this market. Qualitative research and input of employees and field experts is used to construct this outline to answer sub-question two. In chapter four the factors that influence the supply of second-hand containers for CARU are enlightened. Interviews with experts in the market form the basis for the answer on the third sub-question. These first three substantive chapters together build the theoretical framework of this thesis. To underline how CARU can benefit from the information provided by this research, chapter five presents a case study in which the answer on the research question is explained for a local market. Chapter 6 contains a second case study in which different options and scenarios are analyzed to deal with the dependency on MSC. Finally, the conclusion, limitations, implementations and recommendations for further research are discussed in chapter seven.

2. LOOKING INTO THE FUTURE

In this first substantive chapter a review on scientific literature about forecasting is done to get an answer on the first sub-question: *Why forecasting and which techniques could be used?* Section 2.1 describes the history of and need for forecasting. In section 2.2 the different forecasting terms are being discussed and compared. Examples of models with different forecasting horizons are given and the need for CARU is explained. In section 2.3 the difference between quantitative models and judgmental forecasting is discussed. Section 2.4 describes the rise of big data and section 2.5 provides an overview of the most used forecasting techniques in scientific research. In this overview pros and cons of different techniques are reviewed. Section 2.6 gives a conclusion of the literature review and an answer on the first sub-question.

2.1 THE NEED FOR AND HISTORY OF FORECASTING

"The desire to know the future is a deep human psychic need. It lies at the foundation of virtually every religion created.''(Sherden, 1998). We as people are characterized by curiosity. Sherden continues in his work *The Fortune Sellers* that even though the title of 'second oldest profession' usually goes to lawyers and consultants, prognosticators are the rightful owners (Sherden, 1998). More than 6000 years ago people were already trying to forecast the future with varied techniques. Some of these techniques were even practiced before the written history. Fortune-tellers in Ancient Egypt fed people's desire to know the future using techniques as cartomancy (fortune telling with cards) and chiromancy (palmistry, reading of the palms). Whether these techniques worked is very doubtful. Even though fortune-tellers have been valued advisors for a long period, they lost their respect and esteem during the rise of logical thinking in the 17th and 18th century. Later on, the scientific community dismissed fortune-telling and concluded that it is nothing more than cold reading (Evans, 1946).

Besides the fortune-tellers there are other kinds of forecasters with its roots before Christ. In 650 before Christ the Babylonians started with making weather forecasts. Where fortune-tellers were mostly engaged in predicting the future for a particular individual, weather forecasters served the common interest. Based on cloud patterns and astrology they

predicted the weather of the coming days. Some centuries later Aristotle wrote about weather phenomena. He gave explanations about when tornadoes and lighting occur and how they could be forecasted. In contrast to techniques of the fortune-tellers, the techniques of weather forecasters are developed over the years and of great value for today's society. Not only weather forecasts are of great value for modern society. In more recent years forecasting techniques are developed which are widely used in all different kind of fields. The picture below describes the evolution from no forecasting to statistical forecasting and from demand planning to machine learning.

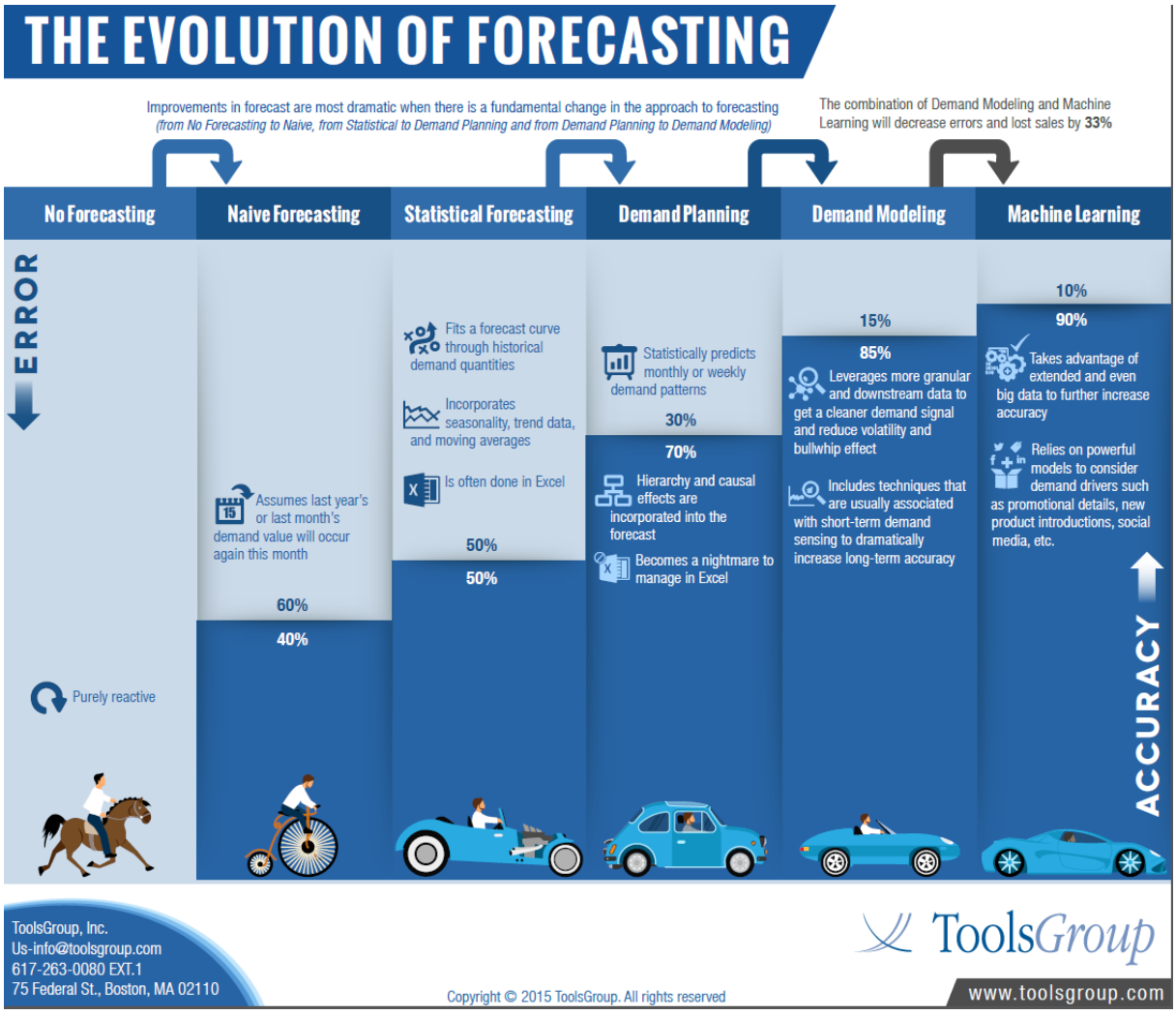

FIGURE 1, THE EVOLUTION OF FORECASTING (TOOLSGROUP, 2015)

In the late 1930's the scientific foundations of the field of forecasting were laid. The least squares estimation procedure proposed by Gauss and Legendre (Abbe, 1871), the development of autoregressive models (Yale, 1927) and moving average models (Slutsky, 1937), the decomposition of time series (Macauley, 1930) and the application of regression techniques to real life (Snedecor, 1937) were instrumental to all subsequent work. Around

1950 a rapid growth in both the theory and practice of forecasting took place. This process continued uninterrupted until today (Makridakis, 1986). Forecasting has become a critical organizational capability for both tactical and strategic business planning (Armstrong, 2001). Assumptions about the future and predictions are essential for many business decisions. Forecasting leads to a prediction, assumption or viewpoint on a future event, which could form the basis for taking action. Managers, but also other employees of firms, can benefit to a large extend from good forecasts. The use of forecasts in business, as in most of life, is inevitable (Lyneis, 2000). Customers increasingly demand shorter response times and improved quality. This makes effective forecasts becoming critical in helping organizations identify new market opportunities, anticipate on future demands and reduce inventories. The current advancements in data analysis and modeling, coupled with today's software capabilities have the potential to offer greater forecast accuracy and business insights than ever before (Edwards, et al. 2001). Despite of this developments and the potential forecast accuracy, managers sometimes use the naive approach. Which means that they assume that the future will be like the past, or the past trend. But, more often, companies devote significant effort to estimating future demand, supply and other diserable things on the basis of models to improve their supply chain management (Lyneis, 2000).

Supply chain management is built on the principles of partnerships and the use of the existing connections between the links of the chain. Good forecasts of supply and demand amounts will increase the efficiency of all members in the chain. As mentioned, CARU has an alliance with MSC. Superfluous MSC' containers are bought by CARU on several locations worldwide. MSC and CARU are thus members in the same supply chain, where MSC is one layer above CARU. Forecasting the amount of superfluous containers would not be necessary if MSC would forsee CARU form these numbers long enough in advance. This is an example of information sharing within a supply chain and could lead to collaborative forecasting. Collaborative forecasting uses available information and technology to force a shift from independent, forecasted supply to dependent, known supply. According to Helms et al. the future of forecasting may evolve to the point where forecasting is not even necessary any more. This would be the case when demand and supply information will be completely supplied by supply chain partners. In a situation like this, the need to predict supply and demand would be eliminated (Helms et al., 2000). The problem is that MSC is not

able to for see CARU from this supply information. The number of superfluous containers depends on their own needs and orders and MSC does not care about forecasting or planning this amount. MSC basically just sells their leftovers and they are not triggered to forecast this amount for CARU (Ijzerman, 2017). Since the procedure is constructed this way, the number of superfluous containers can change every period, which makes it hard to anticipate for CARU employees. Since the supply chain design is constructed as described above, the theory of Helms et al. will never work for the alliance between CARU and MSC. This underlines the need for forecasting to forsee CARU employees from the needed supply information.

2.2 DIFFERENT HORIZONS

A forecast could be made for different time periods. The most used terms in nowadays economical thinking are the short-term, medium-term and long-term. The separation of these three terms is sometimes a little bit vague, even economists do not always find consensus in determining the different horizons. Economic scholars in the first half of the 20th century only distinguished the short- and the long-run. In classical economic thinking, the way of defining the terms differs for micro- and macroeconomics.

Microeconomics in general based the difference between the short- and long-run on fixed and variable production factors. The long-run is the conceptual time period in which, concerning the output level, none of the production factors are fixed. The use of labor and capital can be adjusted in all perspectives, and there is no exit- or entry boundaries for an industry. So, in the long-run everything can be adjusted and every decision can be made. In contrast to the long-run, in microeconomic thinking, the short-run is characterized by not only variable, but also fixed production factors. This causes restrictions for entry and exit a certain market or industry (Viner, 1940).

In macroeconomic thinking, scholars determined the long- and short-run in a different way. The long-run is the period in which the overall price level, the contractual wages and the economic expectations are fully adjusted to the state of the economy. On the contrary, in the short-run not all these things as the price level and the wages are adjusted to the actual state of the economy (Samuelson, 1947).

As mentioned, the most used terms in nowadays economical thinking are the short-term, medium-term and long-term. The separation between the terms can differ and depends on the circumstances of the case. Schwartz et all. worked with a period of 3 year to indicate the long term in their research in variations between short and long term commodity prices (Schwartz, 2000). The short-term is most of the times indicated by a period less than one year, for an example see (Gibson, 1990). The most disputable period is the medium-term, which could be different per type of research (Blanchard & Illing, 2009). The statement that the short-run is a period from less than one year is someway undisputed. As in most of the published literature this line is followed. Since the aim of this research is to foresee CARU employees from usefull short-term supply information of second-hand containers, the focus will be on forecasting the supply in the coming months upto one year. The medium- and long-term supply, so the supply for periods more than one year ahead, will be neglected.

As described, classical economic thinkers thought about different time horizons and ways to define them. Models to predict the future also have different time horizons and subsequent purposes. Predictions of the long-term future are mostly used to meet business objectives as investing purposes and long-term vision planning. However, there are other business objectives that require estimates to be made over shorter timescales. Such a short-term forecast does not by definition require a different approach than a longer-term forecast. A distinction between the two different terms is not in every case helpful or useful. There is surely noticeable overlap, especially because techniques for creating forecasts are not time-bound in any way. Nonetheless, the underlying factors affecting the forecast will differ for a short-term forecast compared to a long-term forecast.

2.2.1 EXAMPLE OF A SHORT-TERM FORECAST

The main objective of an urban water supply authority is to match the supply and demand at a level of service acceptable to consumers. To minimize costs, very frequent adjustments in response to demand variations are required. Relative demand variation is influenced by various factors as the day of the week, the season, the weather of the day, and holiday patterns. Predicting the demand, taking account of the earlier factors, is necessary for system optimization. Zhou, McMahon, Walton and Lewis made a forecasting model of the hourly water demand 24 hour in advance for an urban zone within the Melbourne water

supply system (Zhou et al., 2002). The model has two modules, a daily and hourly, which makes is at model that extremely addresses the short-term. A time series forecasting technique is used and the daily module is formulated as a set of equations representing the effects of seasonality, climatic correlation and autocorrelation on water. The hourly module is developed to disaggregate the estimated daily consumption into hourly consumption (Zhou et al., 2002). This article shows the need for a short-term predictor and how such a model is constructed. Other published articles illustrate short-run forecasts for electricity prices, nominal exchange rates, oil prices and more. These are typically volatile markets with a high need for short-term forecasts to anticipate on market fluctuations.

2.2.2 EXAMPLE OF A LONG-RUN FORECAST

Next to the sectors and markets with a high need for short-term forecasts, there are circumstances where a long-run forecasting horizon is required. The global warming and environmental effects are a much-discussed issue. Political leaders worldwide have this on a high position in their program. The agricultural industry appears to have a big contribution on worldwide global warming (Malhi et al., 2008). The rapid growing world population accompanied with a growing demand for food ensures that the impacts of the agricultural industry will continue and probably enlarge. Tilman et al. used past global trends and their dependence on global population and GDP to empirically forecast the potential global environmental impacts of agriculture. The forecasts are not predictions, but are rather estimates of environmental impacts. They explore the global environmental impacts of agricultural expansion during the coming 20 to 50 years (Tilman et al., 2001). The model created in this article is a good example of a long-run forecaster. Univariate and multiple regressions are used by the authors to forecast future global trends for each of the seven environmental variables related to agriculture. The difference in time horizon compared to the model created by Zhou et al. can be explaind by the less volatile character of the analysed phenomenon. Where the water demand basically changes every second, the environmental impacts of the agricultural industry become visible after a certain period.

2.2.3 SHORT-RUN FORECASTS VERSUS LONG-RUN FORECASTS

Following from these two forecast examples, the characteristics of the forecasted phenomenom seems to influence the time horizon of the forecast. Besides the

characteristics of the forecasted variable the core of the desired information plays a role in deciding the time horizon of a forecast. In the first example the high volatility of the independent variable and the desire to get insights in short-term demand variations, lead to a forecasting model with a daily time horizon. The second example shows a forecasting model with a less volatile independent variable. Additionally, the aim to forecast the potential global environmental impacts of agriculture requires a longer horizon. This led to a forecasting model with a horizon between 20 and 50 years.

It is not surprising that the length of the forecasting horizon affects the accuracy of the forecast. Just as in weather forecasts, the weather of tomorrow is easier to predict than the weather of next week. The relative performance of forecasting methods varies depending upon the length of the forecasting horizon. The short-term future is more foreseeable and in a shorter time period the chance of drastic changes is smaller, which lead to on average higher accuracy of short-term forecasters. Next to this, inertia in business and economic trends makes short-term forecasting easier. When abrupt changes occur, it takes time to deviate from the established course. The oil embargo of October 1973 is a good example. It took many months to enter the steep decline of the 1973/1975 recession. As the time horizon of forecasting increases so do the chances of systematic changes that can affect the future. Such changes cannot be predicted by quantitative methods; thus, the need for judgmental forecasting increases, the greater the horizon. Judgmental forecasting is further illustrated in section 2.3. Besides the difference in performance, different forecasting techniques are used for different time horizons. For longer horizons methods which dampen the trend extrapolation outperform methods which do not (Makridakis, 1986). Section 2.5 further describes the different forecasting techniques.

2.2.4 CARU'S HORIZON

Since the main goal of this research is to predict CARU's short-term supply of second hand containers, the created model will have a short-term horizon. The interpretation of short-term in this case is based on (Gibson, 1990). As mentioned they express the short-term as a period less than one year. The choice for a short-term forecast can partly be explained by the relative volatile character of the supply of second-hand containers. For example, the current period is characterized by a very low supply. Of course, the main reason for the

short-term horizon is the importance for CARU. Employees benefit most from insights into the short-term future.

2.3 MODELS AND JUDGMENT

The development of forecasting is shortly addressed in section 2.1 already. Over the years the number of forecasting techniques grew. Different models are developed to try to forecast the future in the most accurate way. In current business environments, information technology (IT) has enabled forecasts to drive entire supply chains and has created an environment of compressed cycle times (Handfield, 1999). Despite the development and refining of sophisticated forecasting techniques, about 15 years ago it was generally acknowledged that the use of forecasting methods in practice lags their development (Sanders and Manrodt, 2003). The disappointing progress toward implementing forecasting developments in practice created a gap between forecasting theory and business practice. Some authors even suggested that the use of formal forecasting methodologies in business environments reached its peak level already (Lawrence, 2000). The influence of judgmental forecasting seems to be the main cause for the gap between the forecasting theory and the use of forecasts in business practice (Sanders & Manrodt, 2003)

2.3.1 THE GAP BETWEEN THEORY AND PRACTICE

The claims that the use of formal forecasting methodologies in business environments reached its peak level seem to be outdated and wrong. During the last years the use of forecasting in business environments has grown with the rise of big data (Section 2.4 deals extensively with the development and use of big data). Despite we are a decade further in time and the use of forecasting has grown over the years, the gap described by various authors still exists. The size of the gap may be a bit smaller, but still the possibilities of quantitative methods to forecast the future are not used in an optimal way in many business environments (Leitner & Leopold-Wildburger, 2011). In previous years the disappointing progress towards the implementing of forecasting developments in practice has been discussed in academic literature. Various authors concluded that judgmental based business forecasting is performed a lot, despite evidence of serious biases inherent their use (Arkes, 2001). The role of judgement in forecasting is designated as the main cause for the

abandonment use of quantitative models in forecasting and thus creates the gap between theory and practice. The forecasting literature has shown concern for this problem and called for research to gain better understanding of business forecasting.

2.3.2 QUANTITATIVE METHODS VERSUS JUDGMENTAL METHODS

Quantitative forecasting is a way of forecasting in which the numbers are dominant. When firms primary use quantitative forecasting, their visions on future developments are based on data and models. Judgmental forecasting is characterized by the influence of human judgment. There is less value attached to the outcome of data analyses and the vision on the future is more based on human instinct. Mentzer and Kahn concluded that managers overwhelmingly favor judgmental forecasting methods over quantitative, and often lack familiarity with quantitative methods. One of the findings of their study is that only around 10 percent of the firms they surveyed primarily use quantitatively based forecasting techniques (Mentzer, J.T. & Kahn, K., 1995). A shocking finding is that this percentage, indicating companies using quantitative forecasting methods, does not have changed in the years following their research. This could be called shocking because during those years the use of computer technology advanced a lot and a growth in quantitative methods would be expected (Lawrence et al., 2000). Judgmental forecasting techniques were thus preferred in last two decades. Dalrymple concluded that especially smaller firms make more use of judgmental forecasting. In general, smaller firms have less financial opportunities and manpower to make use of extensive data driven forecasting techniques. This explains why they rely more on human judgement (Dalrymple, 1987).

The preference for judgmental techniques is doubtful. Many articles describe the information processing limitations and biases inherent in human decision making. For example: optimism, wishful thinking, lack of consistency and overreacting to randomness could lead to biases in judgmental forecasting. Various authors discouraged the use of judgment in forecasting because of these shortcomings (Armstrong, 2001). Also, judgmental revision of quantitative generated forecasts has received a lot criticism due to its potential to degrade accuracy (Goodwin, P and Fildes, R., 1999). Other authors showed different thoughts on the combination of judgmental and quantitative methods (see section 2.3.3).

Sanders and Manrodt (Sanders, 2003) built a conceptual model to help understand the reasons behind the reliance on judgmental methods. Their study profiles differences between firms identified as primary users of either judgmental or quantitative forecasting methods. Based on a survey conducted among 240 firms they statistically analyzed differences between the two sorts of users. They believe that information access and use, product and environmental uncertainty, and software access and use influence the primary forecast methodology used. Besides analyzing factors that influence firms to choose their forecasting methods, they compared the forecast error rates of the two groups. Based on the forecast error rates the accuracy of the different techniques is measured. The design of their used model is shown in figure 2:

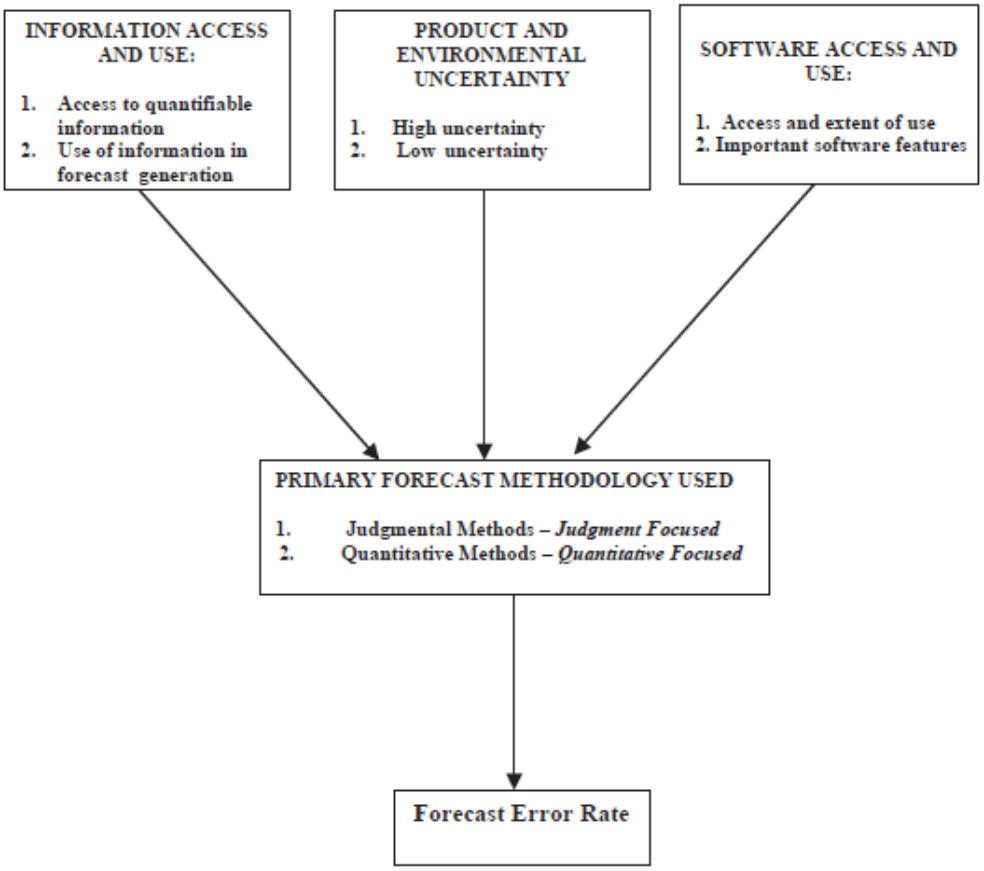

FIGURE 2, MODEL TO ANALYZE THE CHOICE FOR EITHER JUDGMENTAL OR QUANTITATIVE METHODS (SANDERS & MANRODT, 2003)

One of their main findings is that firms using judgmental methods in general operate in environments characterized by higher uncertainty. The fact that these firms have to deal with a high level of uncertainty contributes to a greater reliance on subjective information

and less trust in quantitative models. They concluded that a significantly greater number of judgment focused firms are dissatisfied with their current forecasting software than quantitative focused firms. Their survey also pointed out that judgment focused firms are equally prevalent regardless of industry, firm size, or product positioning strategy. This shows support for the successful use of quantitative methodologies in a variety of settings. The most crucial finding is the significant differences in forecast accuracy between judgment and quantitative focused firms. A significantly greater number of quantitative focused firms experiences lower error rates, which underlines the benefits associated with quantitative model use (Sanders & Manrodt, 2003).

2.3.3 COMBINING DATA AND JUDGMENT

Even though quantitative methods are better received in literature, both forecasting techniques are used in business environments. They seem both to have value for firms. Webby and O'Connor analyzed ways to combine the different methods. They suggest that statistical (objective) and judgmental (subjective) methods could perhaps be synthesized to gain the dual benefits of objective mechanical precision and subjective human interpretative abilities (Webby and O'Connor, 1996). In their article, they discuss four approaches to integrate objective forecast based on data and subjective forecasts based on human judgement. The four mentioned approaches are not mutually exclusive and interact most of the times.

Model building

The first discussed approach is model building. Human judgment is used to select the variables, specify model structure and set parameters based on contextual factors. Actually, this is used a lot in business setting and is not seen as a revolutionary approach. The incorporation of contextual factors involves quantifying those factors to make an econometric model. With a model like this, credible forecasts could be produced. A con is that set-up costs are high in some circumstances. Model building interacts with the three other approaches in almost any case.

Forecast combination

In this second approach mentioned by Webby and O'Connor an 'objective' forecast is combined with a 'subjective' forecast. The outcomes of two different models are combined. This could be done in an objective way, like just taking the average of the two outcomes, or in a more subjective way in which the models are weighted in a different way. This is a relatively practical and simple approach that could improve the forecast. Criticism is that it suffers from duplication of effort, redundancy of information and it could lose resolution when the dependent variable is volatile (Clemen and Winkler, 1985). Wit

Judgmental adjustment of objective forecasts

The name of the third approach mentioned by Webby and O'Connor speaks for itself. A quantitative forecast based on an econometric model is simply adjusted for any contextual factors that influence the forecast. This approach is obviously the easiest and most cost-effective one of the four addressed approaches. The pitfall of this approach is the bias that could occur form the information processing limitations and biases inherent in human decision making, like mentioned before.

Judgmental decomposition of objective forecasts

This last approach is the most complicated approach. It is a three-step process which starts with decomposing the model, forecast it again and then recompose with future-oriented information. It brings structure, defensibility and backward inference to the task of forecasting with contextual information. But sometimes it could be risky and ineffective (Webby and O'Connor, 1996).

Following from this article by Webby and O'Connor, combining the different forecasting techniques could be of value in some cases, which will be taken into account during this research.

2.3.4 WHAT IS USED, WHY IS THIS USED AND WHAT IS NEEDED?

In section 2.2 is already confirmed that the short-term horizon fits CARU's needs best. The literature analyzes about the use of quantitative and judgmental forecasting could also be addressed on CARU's needs. The three variables that explain the primary forecast

methodology in the model of Sanders and Manrodt (see figure 2) are now analyzed for CARU. Interviews with employees pointed out that judgmental methods predominate. Based on the findings of Sanders and Manrodt an analysis will be performed why this method is used more and what is most suitable for CARU.

Information access and use

With regard to the first factor that influences firms to choose their forecasting methods, 'Information access and use', it can be stated that CARU employees have little access to quantifiable information. Past data of second-hand container supply is an example of available quantitative data. Besides historical data, sales employees do not have access to many data sources. This data is not sufficient to make a good forecast of the short-term supply. Based on interviews with sales employees it also follows that quantifiable information is not used a lot in forecast generation. Sales manager Wim de Bos mentioned that he relies on his feelings and experience in making decisions and forecasts (Bos, 2017). This underlying factor partly explains why judgmental methods are the primary forecast methodology used by CARU employees.

Product and environmental uncertainty

Second-hand containers are available due to different circumstances. Some require a lot of repair work and some can be resold directly. In general, the quality of the containers received by CARU does not fluctuate extremely. This leads to the conclusion that employees deal with (semi) high product uncertainty.

The level of semi high uncertainty does not apply to the environment. The second-hand container market fluctuates a lot and is currently characterized by very low supply. The high environmental uncertainty is probably one of the main reasons why most employees work on base of their feelings and act intuitively. And because of this environmental uncertainty, the product uncertainty could also be seen as high instead of semi-high.

Software access and use

CARU employees do not have access to special forecasting software. Employees work with some specially designed software for operational use but forecasting supply is not featured.

This also explains why judgmental methods are the primary forecast methodology used by CARU employees.

The interviews conducted with sales employees pointed out that judgmental methods are mainly used in forecasting second-hand container supply for CARU. Looking at the explanatory factors addressed by Sanders and Manrodt from CARU's perspective, their created model would also expect that CARU is a company with judgmental methods as primary forecast methodology used. This can be concluded since there is little access to quantifiable data, high product and environmental uncertainty and no specific software to use. Various authors showed concern for the use of judgmental forecasting methods. Quantitative methods on average appeared to have lower error rates and thus higher accuracy. Given these findings the introduction of quantitative methods would be very beneficial for CARU. Combining these quantitative methods with the current used human judgment of employees is probably the best way of dealing with the uncertain short-term future for CARU. Model building, as described in section 2.3.3, can be used with input of human judgment from employees to create a model. In this way, the quantitative techniques are introduced to CARU in a smoothly way. The rise of 'Big Data', which took place in recent years, could play a part in increasing the quantitative possibilities.

2.4 THE RISE OF BIG DATA

Big data refers to the explosion of the quantity, and sometimes quality, of nowadays available relevant data. The existence of this huge availability of data is the result of the recent advancement in data recording and storage technology. Big data is a revolutionary trend with a huge impact on the economy, science and society at large. People are being monitored more and more with help of different IT techniques. Using big data, researchers intend to explain where we are, trace how we got here, and offer the needed guide to the benefits and dangers that lie ahead. Big data also refers to the ability to analyze a large quantity of information, and draw conclusions to benefit from (Vincent Mayer-Schönberger and Cukier, 2013). The rise of big data thus consists of two technical entities that came together. First there is the explosion of the quantity and quality of available data. Second the advanced analytics tools to analyze these big data sets, which makes together big data analytics.

“You can’t manage what you don’t measure’’ (Deming, 2000). This quote underlines the importance of the recent explosion of digital data. Based on insights obtained from big data managers can measure more and get to know more about their business environment. These obtained insights can help to improve decision making and boost the performance of a company.

2.4.1 WHAT IS NEW?

Sometimes it is argued that big data is just the same as ‘analytics’. Like analytics, big data also tries to gain intelligence from data and translate that into business advantage. Besides this similarity McAfee & Brynjolfsson addressed three key differences. The first difference is the volume. As already mentioned the amount of available data has grown rapidly. In one second on nowadays World Wide Web, more data is gathered than were stored in the entire internet 20 years ago. The second addressed difference is the velocity. The speed of data creation is not left behind compared to the development of the volume of data. In many circumstances, the speed of data creation is even more important than the volume. Real-time or nearly real-time information gives a company the chance to make faster adjustments to beat competitors. The third difference is the variety of nowadays available data. Data is available in all kind of forms, from messages and images posted on social networks to GPS signals from cell phones and more (McAfee & Brynjolfsson, 2012). Through the digitalization of business activity and normal life, new sources of information came available. These developments brought us in an era in which each of us is a walking data generator. Big data is more powerful than analytics because of these three differences. As Google’s director of research, Peter Norvig, puts it: “We don’t have better algorithms. We just have more data.”

2.4.2 BENEFITS AND POSSIBILITIES

The explosion of available data and the new tools to analyze these data creates a lot of benefits and possibilities to firms. The Data Warehousing Institute (TDWI) conducted a survey to analyze the use of big data analytics and its potential benefits (Russom, 2011). In total 325 respondents among IT professionals, business sponsors and consultants from all over the world shared their visions. The respondents could pick out maximum five benefits from a list of 15 benefits constructed by the author. The results of this part of the survey are presented in the figure below:

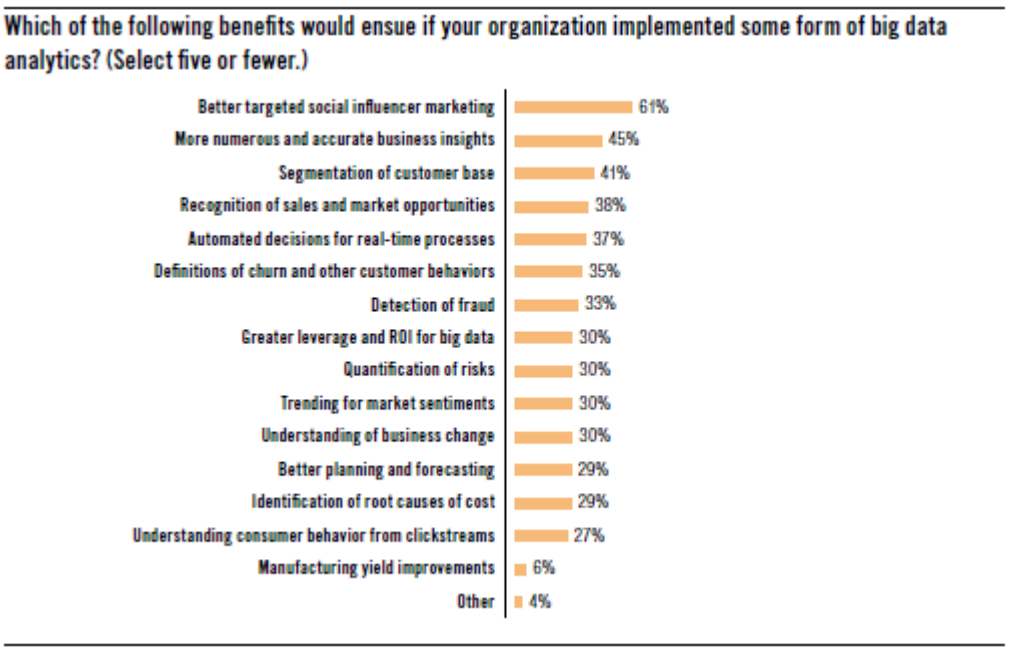

FIGURE 3, THE POTENTIAL BENEFITS OF BIG DATA ANALYTICS, (TDWI, 2011)

The presented results can be divided in things related to anything involving customers and things related to business intelligence in general. "Better targeted social influencer marketing", "Segmentation of customer base" and "recognition of sales and market opportunities" belong to the group of things relating to customers. These benefits of big data analytics could help firms to get bet customer understanding. The group of benefits relating to business intelligence in general consists of "More numerous and accurate business insights", "Understanding of business change" and "Better planning and forecasting". The last-mentioned benefit is an interesting one concerning this research. Nearly one third of the respondents indicate that using big data analytics will help to improve planning and forecasting.

Big data is currently used in all sort of business environments and companies. One example is the use of big data by a car manufacturer to investigate its supply chain management and get better understanding of why defect rates suddenly increased. Another example is the use of big data in hospitals and other care institutions. Based on data gathered from analyzing the results of surgery interventions, data intelligence companies analyze the impacts and effects of surgeries. The findings from such studies can help to improve the quality of surgeries and save lives. What we also have seen is big data used in business planning and forecasting. Companies used big data to better anticipate on online sales on

the basis of a data set of product characteristics. Besides these examples it is used in many other industries and functions, from finance to marketing, and from resource management to machine repair. McAfee and Brynjolfsson concluded that these are not just examples of how big data can be used, but more a fundamental transformation of the economy. The results of the use of big data convinced us that almost no business domain or activity will remain untouched by this movement (McAfee & Brynjolfsson, 2012).

2.4.3 CHALLENGES

The recent developments and current availability of data does not come without difficulties and challenges. Dealing with large availability of data in the most effective way takes a lot effort. The first challenge can be described as filtering the data. As described before everybody is a walking data generator which results in almost infinite raw data. Not all this gathered data is useful; hence much of this data is of no interest and can be filtered. It's a challenge to define how to filter the data in such a way that useful information is retained and not useful data is discard (Labrinidis, 2012).

The enormous load of data that is currently available needs to be stored somewhere. Big data parking is a second challenge that is accompanied with the recent developments. The use of clouds could be a solution, but they also throw up challenges. Using clouds means entrusting valuable data to a distant service provider, a third party. The quick developments of clouds can also cause a bottleneck if data end up parked on several clouds and thus still need to be moved to be shared (Marx, 2013).

Another challenge is the way of dealing with the large quantities of data. The growth in the quantity and diversity of data has led to data sets larger than manageable by the conventional management tools (Waller, 2013). Techniques used in the past, like econometric modelling, are hard to apply on the currently available large datasets. New tools and techniques should be developed to manage these new and potentially invaluable data sets. The next section enlarges upon different forecasting techniques used in business practice before and after the introduction of big data analytics.

2.5 QUANTITATIVE FORECASTING TECHNIQUES

The difference between judgmental and quantitative forecasting is already discussed in section 2.3. Based on academic literature it was concluded that the information processing limitations of the human brain could lead to biases in the forecasts. This resulted in higher error rates for judgmental based forecasting techniques compared to quantitative methods. Since CARU employees mostly rely on their feelings and experience in making decisions and forecasts, the introduction of quantitative forecasting methods could be very beneficial. The most known and widely used quantitative forecasting technique is econometric modelling. Econometric models are statistical models that try to explain the statistical relationship that is believed to hold between various quantities. It is one of the most used techniques to analyze relationships between phenomena. Based on the relationships a forecast could be made. There are many different types of econometric models with all different characteristics. In this section, the pros and cons of some of the most common econometric models are discussed.

2.5.1 EXPONENTIAL SMOOTHING

Probably the most basic quantitative forecasting technique is exponential smoothing. It can be seen as a rule of thumb for smoothing time series data and making forecasts based upon past figures. This way of forecasting is easy to apply for approximately calculating. Smoothing is a statistical process to remove fluctuation out off a data series. In supply forecasting, smoothing is used to remove random variation, noise, from historical supply. This allows us to better identify patterns, like trends and seasonality, in the supply. A simple way of doing this is taking the simple average or moving average from a data series. When using an average, we are applying the same weight to each value in the dataset. The essence of exponential smoothing is that different weights are applied to historical figures and most weight is applied to the most recent period. This is addressed in the following formula:

$$s_t = \alpha x_t + (1-\alpha)s_{t-1},\ t > 0$$

The controlling input of the exponential smoothing calculation is the smoothing factor, this is *a* in the formula. This factor *a* represents the weight applied to the most recent period and should be set between zero and one, based on the circumstances of the case. Based on the

level of the smoothing factor, the weight applied to the periods before decreases exponentially.

An evident pro of this quantitative forecasting technique is the ease of use. When historical data is available it is very easy to apply exponential smoothing with help of excel or another statistics program. The ease of use also has its downside. Because exponential smoothing only uses historical data of the same variable as it tries to forecast, which makes it so easy to apply, it actually has limited forecasting power. Where other quantitative forecasting techniques use explanatory variables to forecast the independent variable, exponential smoothing only uses past data of the independent variable that has to be forecasted.

2.5.2 DISTRIBUTED LAG MODEL

A distributed lag model is a model which is applicable for time series data. “Lag” means delay and indicates that values of earlier periods are used. In a distributed lag model, it is possible to equate a regression to predict current values of a dependent variable based upon both the current values of explanatory variables and the lagged values of these explanatory variables. This makes a distributed lag model a dynamic model in which the effect of an explanatory variable on the dependent variable occurs over time rather than all at once. The lags are used because the value of the independent variable is affected by values of this variable in the past. A regression without lags would fail to account for the relationships trough time and overestimates the relationship between the dependent and independent variables.

The number of historical periods used can differ per model. A distributed lag model can be an infinite distributed lag model or a finite distributed lag model. In an infinite model the dependent variable is assumed to be affected by values of the explanatory variable that go infinitely far in the past. In this case the number of lags is infinite and the model looks like this:

$$y_t = a + w_0 x_t + w_1 x_{t-1} + w_2 x_{t-2} + \ldots + \text{error term}$$

In a finite model only a finite number of lags weight, indicating that there is a maximum lag beyond which values of the independent variable do not affect the dependent. A finite model looks like this:

$$y_t = a + w_0 x_t + w_1 x_{t-1} + w_2 x_{t-2} + \ldots + w_n x_{t-n} + \text{error term}$$

In the two presented models *Yt* is the value of the dependent variable at a certain time period, a is the intercept which has to be estimated and Wi is the lag weight on the value *i* periods previously of the explanatory variable *x*.

A difficulty, which can be seen as a con of this technique, is the choice of lag length. Economic theory rarely gives advice in choosing the lag length which is why this is usually determined empirically. Things to look at in determining the lag length are the statistical significance, information criteria and residual autocorrelation (Pankratz, 2012). Besides choosing the lag length, a distributed lag model is harder to use than exponential smoothing because it uses more than just the historical data of the variable that has to be forecasted. Using this method also requires more data since explanatory variables are used to make the forecast. The use of these explanatory variables also creates a more sophisticated forecast which enlarges the accuracy of this technique and can be seen as an important pro.

2.5.3 AR(I)MA(X) MODELLING

Another quantitative forecasting technique which is used a lot to predict future values in time series is an Autoregressive–moving-average model (ARMA model). This model consists of an autoregressive and a moving average part. The AR part specifies that the output variable depends on its own lagged values and an imperfectly predictable term. Besides this relation the MA part specifies that the independent variable depends linearly on the current and various past values of an imperfectly predictable term. The model is usually referred to as the ARMA(p,q) model. *P* indicates the order of the autoregressive part. This tells us on how many of its own previous values the current value depends. *Q* is the order of the moving average part and tells on how many previous deviations the current deviation from the mean depends. This is addressed in the following formula:

$$X_t = c + \varepsilon_t + \sum_{i=1}^{p} \varphi_i X_{t-i} + \sum_{i=1}^{q} \theta_i \varepsilon_{t-i}.$$

ARMA modelling can be seen as a basic variant of an autoregressive model. Other variants of autoregressive models are ARIMA and ARIMAX modelling. ARIMA stands for autoregressive integrated moving average model. Characteristic of this model is that it combines seasonality with an intervention function to account for the effect of shocks. The other variant, ARIMAX, makes use of an exogenous variable. Rashed et al (2017) made use of these variants to create a short-term forecast of container throughout for the port of Antwerp. With help of

their created models they tried to identify the relationship between economic activity and container throughout (Rashed, 2017).

A difference compared to the distributed lag model is that AR(I)MA(X) models in general cannot be fitted by least squares to find the values of the parameters that minimize the error term.

Pros of these forecasting techniques are that they better understand the time series patterns and have higher predicting power. ARMA is a time series model and least squares a regression model. Time series models specialize more in forecasting whereas regression specialize in understanding a certain relation. The fact that this technique is based on a time series model gives it more predicting power.

A con is that it only captures linear relationships and requires more expertise than previous discussed techniques. Using this technique requires many steps to prepare a model which makes it hard to apply. For example, finding appropriate values of *p* and *q* requires some work in advance (Valipour et al., 2013).

2.5.4 SYSTEM DYNAMICS

Besides the discussed statistical methods there is a different technique called system dynamics. System dynamics is a methodology and mathematical modelling technique used for complex problems. It solves the problem of mutual causation, where some statistical techniques suffer from, by updating all variables in small time increments with feedbacks and time delays. According to (Lyneis, 2000) System dynamics models can provide more reliable forecasts of short- to mid-term trends than statistical models, and thus lead to better decisions. Besides this he concludes that System dynamics models provide a means of understanding industry behavior, and thereby changes in industry structure, as part of an early-warning or on-going learning system.

Following these conclusions from Lyneis one will say to use system dynamics in each situation instead of statistical modelling, but it also has it cons. A System Dynamics model is only capable to run one version of a situation at a time, although it may capture a great deal of variety in the changing values of its variables. When people in an organization see things or situations in a different way it would lead to two whole different outcomes of the model. Apart from the different outcomes, a system dynamics model is very complex and it requires

considerable expertise in modelling, computation and customized software. Because of these requirements, using system dynamics is beyond the scope of this research and will not come back in section 5 where the analysis is done.

2.5.5 FORECASTING TECHNIQUES FOR BIG DATA

The rise of big data is discussed in detail in section 2.4. One of the conclusions made is that based on insights obtained from big data managers can measure more and get to know more about their business environment. Besides this it is concluded that using big data analytics will help to improve planning and forecasting. As mentioned the growth in the quantity and diversity of data has led to data sets larger than manageable by the conventional management tools (Waller, 2013). This development urges researchers to use different statistical and data mining techniques for forecasting. Based on literature it is evident that factor models are the most common and popular tool currently used for big data forecasting (Hassani and Silva, 2015). Besides factor models, Neural Networks and Bayesian models are two other popular techniques used (LaValle et al., 2011). Using these techniques and such large data sets is beyond the scope of this research because of lack of data and expertise.

2.5.6 OVERVIEW OF THE DIFFERENT TECHNIQUES

The following table gives a short overview of the in paragraph 2.5 discussed forecasting techniques.

Forecasting technique	***Characteristic***	***Pro's***	***Con's***
1.Exponential smoothing	Basic forecaster with limited predicting power.	-Easy to use -Little data required	-Basic -Only using historical data of independent variable
2.Distributed lag model	More sophisticated forecaster using explanatory variables and lagged values.	-Higher accuracy -Possibility to adjust the number of lags	-More data required -Choosing lag length can be difficult
3.AR(I)MA(X) modelling	A time series model with an autoregressive and a moving average part. Which could incorporate seasonality and exogenous variables.	-Time series model -High predicting power	-Requires expertise -Only captures linear relationships
4.System dynamics	An extensive mathematical modelling technique which updates all variables in small time increments.	-Variables are continuously updated -Can operate as early warning system	-Requires customized software and much data -One version of a situation at a time -Beyond the scope of this research
5.Big Data techniques	Techniques that can analyze large data sets which will improve planning and forecasting.	-Improves forecasting -Creates more and new insights	-Much data required -Requires expensive software -Beyond the scope of this research

Table 1; Overview of the discussed forecasting techniques

2.6 CONCLUSION

In this first substantive chapter different things about forecasting, from the need and history to the rise of big data, are discussed. The main goal was to answer the first sub-question: *Why forecasting and which techniques could be used?*

The first part of this sub question is addressed in section 2.1, in which the need for forecasting and the developments in history are enlightened. Based on visions from various authors is concluded that forecasting has become a critical organizational capability for both tactical and strategic business planning (Armstrong, 2001). Assumptions about the future and predictions are essential for many business decisions. Managers, but also other employees of firms, can benefit to a large extend from good forecasts. Forecasting is thus used to get insights into the future which could help in making decisions and taking action. Some authors even concluded that the use of forecasts in business, as in most of life, is inevitable (Lyneis, 2000). Section 2.2 focused on different time horizons and explained why a short-term horizon is of most value for CARU. In section 2.3 a start is made with addressing the second part of the first sub question. The difference between judgmental and quantitative forecasting techniques is explained and the main conclusion is that the introduction of quantitative forecasting techniques could be very beneficial for CARU. The introduction of big data is discussed in section 2.4. Possibilities and challenges are reviewed with the result that using big data analytics will help to improve planning and forecasting. Finally, section 2.5 addresses different quantitative forecasting techniques. Exponential smoothing, distributed lag model, ARMA modelling, system dynamics and big data techniques are discussed. After the outline of the second-hand container market is given in the next chapter and the factors that influence the supply of second-hand containers for CARU are enlightened in chapter four, the possibility to create a short-term forecaster is analyzed.

3. THE SECOND-HAND CONTAINER MARKET

In this second substantive chapter an outline of the second-hand container market is given. The players and factors that affect the market are discussed and the role of CARU is enlightened. Section 3.1 gives an overview of the construction of the second-hand container market and focuses on the players that are active in the market and the factors which influence the market. Subsequently section 3.2 shortly describes the demand side of the second-hand container market and section 3.3 covers the role of CARU. Section 3.4 gives a final conclusion with an answer on two sub questions; *"How is the second-hand container market constructed and what is the role of CARU?"* and "*Which factors influence the supply of second-hand containers?"*. An important note that should be made is that the focus will only be on the selling of second-hand containers. CARU is also active in renting and leasing containers but these activities are neglected in this research.

A market or business sector consists of many players and factors that influence the business environment. Sketching a business model is a good tool for companies and analysts to get a clear overview of the ins and outs of their business environment. With help of a business model an overview of the players and factors in the second-hand container market will be created. There are many different definitions of a business model given in scientific literature. Definitions given by (Mayo & Brown, 1999), (Stewart & Zhao, 2000) and (Osterwalder & Pigneur, 2010) focus on different aspects of the business environment. Where the first model has the systems that create a competitive business as focal point, the others focus also on the external processes. In this chapter, the focus will be on the supply side and the demand side of the second-hand container market. For both sides, the actors and factors that play a part are enlightened. Former CARU graduate student, Tim Simons constructed the following mind map which gives a good overview of the different actors and factors that play a part in the second-hand container market. Simons addressed three angels of approach; The supply side, demand side, and market circumstances. In this research, the focus is mainly on the supply side. The actors and factors in figure 4 are critically analyzed later on in this chapter. Besides the by Simons mentioned actors and factors some other variables that came up in expert interviews are enlightened in later chapters.

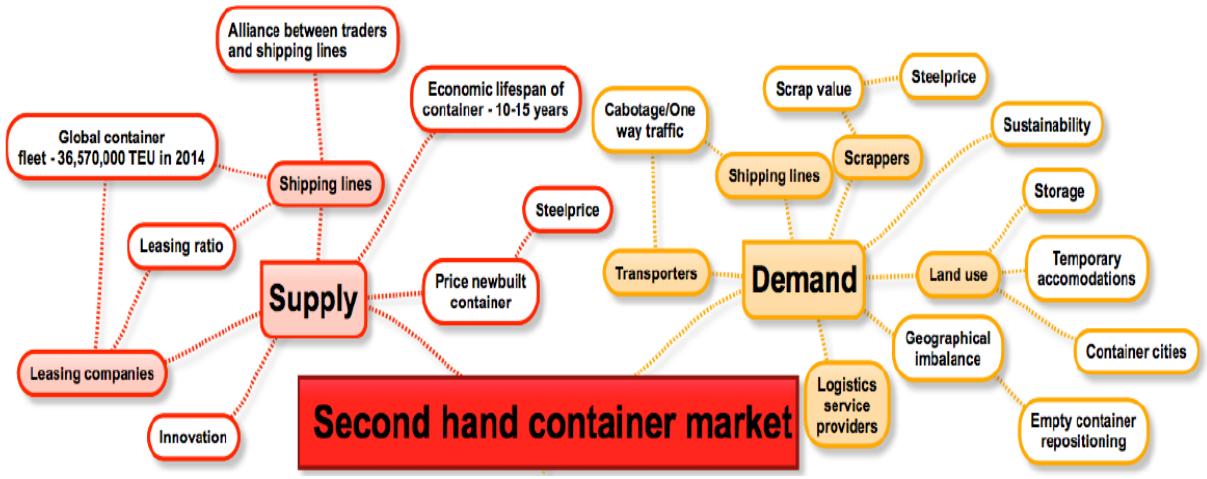

FIGURE 4, MIND MAP OF THE SECONDHAND CONTAINER MARKET, (SIMONS, 2015)

3.1 THE SUPPLY SIDE

The supply of second-hand containers consists of used containers that are resold by different kind of players. Shipping lines and leasing companies are the two main types of players with regard to the volumes. Besides the main actors, different factors have influence on the supply of second-hand containers. The factors that are most tangible, analytical and quantifiable are the leasing ratio, the steel price, the price of new built containers, the economic lifespan and the global container fleet. These factors will be described in the following sections and will be used with forecasting. The alliances between traders and shipping lines is less quantifiable but also discussed.

3.1.2 ACTORS

The supply side basically exists of 2 actors; shipping lines and leasing companies.

3.1.2.1 SHIPPING LINES

Shipping lines are companies that physically use the containerships and thus responsible for a large part of the global economies goods flow. Some shipping lines own all their containers themselves; others own some of their containers and rent the rest. According to Championfreight (2017) the world main shipping lines in terms of market shares are: A.P.

Moller–Maersk Group (16.3%), Mediterranean Shipping Company 14.7%)) and CMA CGM Group (11.1%).

3.1.2.2 LEASING COMPANIES

Leasing companies are providers of containers. Over the past decade or so, container leasing has become more mainstream and apart from a few listed companies, container lessors are owned by private equity investors or pension funds. The leasing companies own all their containers and make them available for, among others, shipping lines. As mentioned before, CARU also has a leasing department, but this research only focusses on the trading of second-hand containers by CARU. According to (Drewry Container Leasing Industry, 2015/2016) the main leasing companies in terms of market share are: Textainer group (17.9%), Triton Container (12.9%) and TAL International (12.3%). The main difference between the two types of players is that leasing companies own containers and shipping lines also lease containers besides owning them. So, in practice the shipping lines are the real users of the containers. Neglecting the small number of containers that is owned by private parties and other companies, the combination of owned and leased containers makes up the global container fleet. This global container fleet consisted of 36.6 million TEU (Twenty-foot equivalent unit) in 2014 and has been growing rapidly (Baker J. , 2015). The exact number of containers worldwide is not monitored by any organization, which makes it hard to measure. According to CARU employees it nearly reached the 40 million TEU. Other parties come up with different figures. Budgetcontainerschipping.com (2016) estimates that there are around 43 million containers (20 and 40 footers) which sums up to a total fleet of over 70 million TEU (www.budgetshippingcontainers.co.uk, 2016).

Difference in supplier type

A shipping liner becomes a player on the supply side of the second-hand container market when it decides to sell containers. This decision is most of the times made when the economic life span of a container has passed (Section 3.1.1.2 deals more extensively with the economic lifespan). Just as the shipping lines, leasing companies become players on the supply side at the moment they decide to sell their containers. When the decision to sell is made by a shipping liner or leasing company, a trader as CARU is going to play a role. At this point, there is also a difference between the two main players, which is of huge importance

for a trader like CARU. Leasing companies are often engaged in trading containers themselves, which is negative for a trader as CARU because their role is ignored in that case. Many leasing companies have their own trading divisions which makes the role of a trader as CARU unnecessary. TAL International, already mentioned as one of the biggest leasing companies worldwide, is an example of such a leasing company. Leasing containers is their core business but they are also active as seller of their old containers. With a dedicated resale division which focusses on disposing their old containers the need for a trader as CARU is unnecessary. Their trading arm gives TAL the possibility to make more money out of their containers without using an intermediate party. Besides selling their own containers from out of their lease fleet, TAL trades containers from third parties which makes them a competitor for CARU. Textainer group, the worlds the biggest leasing company, also has its own resale division. This market structure makes leasing companies less good supply partners for a trading company as CARU is.

In contrast to leasing companies, shipping lines prefer to make use of the services of container traders. They prefer to sell their depreciated containers in big amounts to container traders. In this way, they outsource the trading of second-hand containers to a party as CARU. This resulted in the emergence of alliances between trader and shipping lines in which trading companies take over great shares of retired containers from a shipping line. Like mentioned in earlier sections, CARU is engaged in such an alliance with the second largest shipping line in the world, the Mediterranean Shipping Company (MSC). This alliance is of great value for CARU but also causes a certain degree of dependency on MSC which this research tries to reduce by making a forecaster to forecast the supply of MSC in an earlier stage. Just as the relation between CARU and MSC there are more alliances between traders and shipping lines, for example the alliance between A.P. Moller–Maersk Group and Alconet (Maersk Line, n.d.).

3.1.3 FACTORS

Now the actors have been discussed it is time to define the influence of the already mentioned surrounding factors that influence the supply of second-hand containers for a trader as CARU. As mentioned before the leasing ratio, price of new built containers, steel price, the economic lifespan and the global container fleet will be discussed. Besides these factors which are presented in figure 4, the global maritime trade and the average age of the

world container fleet are enlightened. These are factors that were mentioned by field experts in the conducted interviews. This section describes how these factors could influence the supply of second-hand containers for CARU.

3.1.2.1 GLOBAL CONTAINER FLEET

The market for second-hand containers is completely dependent on the use of new containers. This makes the global container fleet trough supply highly influential on the second-hand market. The strong growth in last years, as already mentioned in section 3.1.2, is of huge importance for CARU as a container trader. Data with information about the global fleet in combination with the economic lifespan, which will be discussed in the next section, could be of great value in forecasting future supply. The global container fleet exists of owned and leased containers, more about this in section 3.1.2.4.

3.1.2.2 THE AVERAGE AGE OF THE GLOBAL CONTAINER FLEET

Based on the advice of Deloitte consultant, mister Salah, the average age of the global container fleet is evaluated. By analyzing the average age of the available containers worldwide, insights for the second-hand container market could be created. A regression of this variable combined with the economic lifespan of a container and the global container fleet can give insights in the future supply of second-hand containers.

3.1.2.3 ECONOMIC LIFE SPAN

All manufactured products have an economic and a physical lifespan. The physical lifespan is the period a product exists and would end when a container is scrapped. For depreciation purposes companies make use of the economic lifespan, the period over which an asset is expected to be usable with regular repairs and maintenance, for the purpose it was acquired. This economic lifespan is usually less than the assets physical life and is a dominant factor in the second-hand container market. At the end of the economic life span a container used/owned by a shipping line or a leasing company will enter the second-hand market. This makes this factor of huge importance for a trader as CARU because it could be used to forecast the future supply of second-hand containers. When the economic lifespan is known and the data of new built containers in the global container fleet is available, it is just an easy add-on. Scientific literature does not give an unambiguously period for the economic lifespan of containers. Off course it differs per container and that's why the averages could be apart. The influence of the container lifespan as a factor that affects the supply of

second-hand containers is clear; the lifespan defines the time when a container enters the second-hand container market, which makes it an important factor in this research.

3.1.2.3 LEASING RATIO

The leasing ratio is a terminology which indicates the percentage containers that is leased in terms of the percentage of owned containers. The classical percentages were around 45% owned by leasing companies and 55% owned by shipping lines (Wu, 2014). Based on these figures it is possible to indicate how many containers are owned by the shipping lines, the practical users of the container. The traditional ratios of 55% and 45% have not been held in the last decade. The number of leased containers started declining since 2007 and reached the 35% because shipping lines increasingly started buying containers themselves instead of leasing them from leasing companies. One of the reasons for the growth of owned containers was due to declining interest rates. The lower interest rates made it for shipping lines easier to attract capital, which made it financially more attractive to buy their containers instead of leasing them. In making the decision to buy or lease a container the financial aspect plays a big part. The declining interest rates provided lower costs when buying a container. Another reason for the shift from leasing to buying finds its origins in the economic recession of 2008 and has to do with the lead time of constructing containers and container vessels. Where it takes about three years to construct a container vessel, the lead time for producing a container is just three months. In the period prior to the economic downfall new ultra large container vessels (ULCV's) were introduced with bigger capacity. Shipping lines ordered many containers to accommodate the expansion of the vessel fleet so they could make use of their larger vessels. After the recession in 2008, the demand for containers overall grew less rapidly. As a result, there was a surplus of containers in the years after the recession which caused a very large decrease in the demand for leased containers. In other words, adjustments of the container ship fleet to market changes are far less rapid than the adjustments of the container fleet to these market changes because of the shorter lead time for producing containers. This mechanism results in a downfall of the leasing ratio when trade has an unexpected downturn.

Since CARU is active in both leasing and selling second-hand containers, the leasing ratio can be viewed in two ways. A higher percentage in leasing will be good for the leasing division and a higher percentage for owning is desirable for the selling division. Since this research only focusses on the selling arm of CARU, it is beneficial for CARU if the percentage of owned

containers rises. The trend that took place last decade should thus be seen as a good trend for CARU, when focusing on the selling of second-hand containers.

3.1.2.4 PRICE OF NEW BUILT CONTAINERS

The second-hand container market is highly influenced by the market for new built containers. This relation is very obvious; just as in for example the market for cars, one of the first decisions you have to make as buyer is if you go for a new one or for an occasion. The price level of new built containers has influence on the supply of second-hand containers because a lower price of new built containers will lead to quicker disposal of second-hand containers by the supplying players (leasing companies and shipping lines). The effect of the prices of new built containers could also be analyzed in several ways from CARU's perspective. Off course a higher market price for new built containers is beneficial for CARU's selling of new built containers. But when looking from this research' perspective, a higher price of new built containers will lead to lower supply of second-hand containers from the main supply players, shipping lines and leasing companies.

3.1.2.5 GLOBAL MARITIME TRADE

Danny de Boer, aftermarket specialist within SeaCube addressed the global maritime world trade as the main driving factor influencing the supply of second-hand containers. The global world trade determines the demand for logistic services and thus indirectly the demand for containers. This total demand for containers will off course have a relation with the supply of second-hand containers. When the global maritime trade is booming, leasing companies will longer hold on their equipment which influences the supply. Section 4.2 deals with further elaboration concerning the usability of this factor.

3.1.2.6 STEEL PRICE

The steel price has an indirect effect on the supply of second-hand containers since the price for new built containers is heavily dependent on the steel price. This is not surprising since the steel costs account represent 70% of the cost for building a new container and 61.8% of the costs when taking in account the sales costs (Wei, 2011). Figure 5 shows the correlation between the steel price and the price of new built containers.

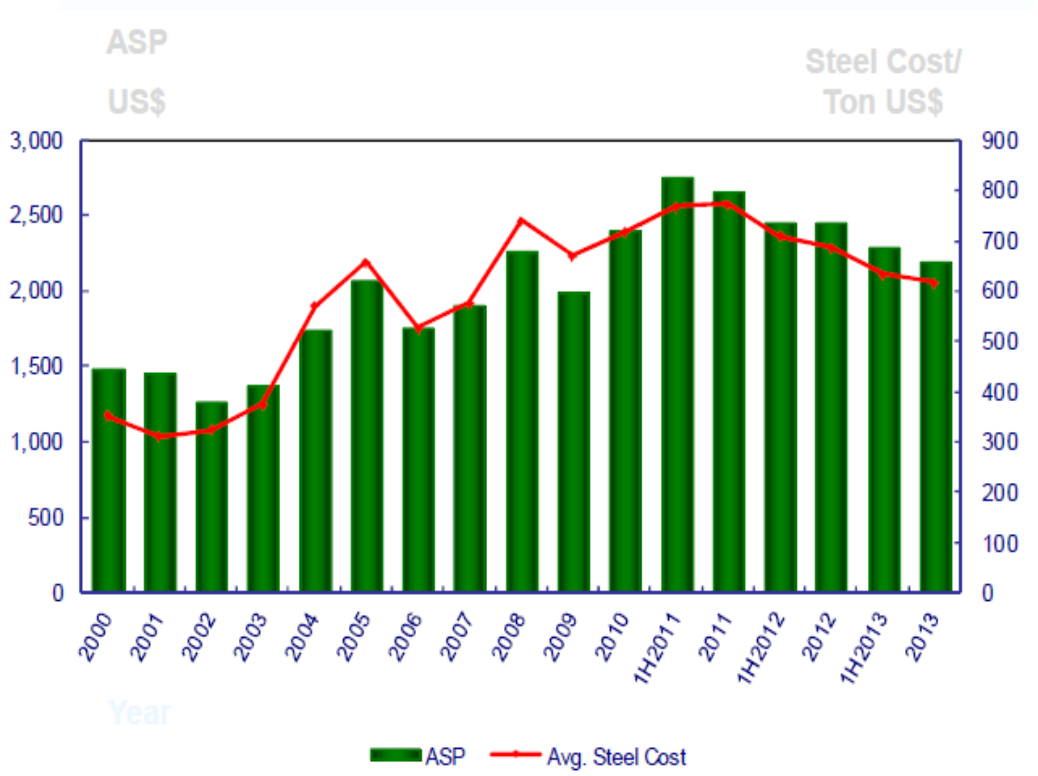

FIGURE 5, CORRELATION BETWEEN AVERAGE SELLING PRICE (ASP) OF CONTAINERS AND THE STEEL COST PER TON (SINGAMAS CONTAINER HOLDINGS LIMITED, 2014)

Figure 5 underlines the high influence of the steel price on the price level of new built containers. The shown correlation creates the indirect effect of the steel price on the supply of second-hand containers via the price of new built containers.

A direct effect of the steel price on second-hand containers seems not to exist. Conversations with CARU management and data showed that there is no relation between the steel prices and the price of second-hand containers. Analyses showed that their price is mainly determined by location, as a result of the imbalance in the world which leads to geographical price differences.

3.2 THE DEMAND SIDE

This section describes the demand side of the second-hand container market after the different main actors are discussed, some factors that influence the demand side are enlightened. The resold containers, mostly used by shipping lines and leasing companies are transferred to demanders of second-hand containers. Sometimes a trader as CARU is used as intermediate party and sometimes not. Since the main focus of this research is on the supply of second-hand containers, the demand side is described less extensive.

3.2.1 ACTORS

Where the supply side of second-hand containers has two main players who are responsible for nearly all the supply, the demand side can be described as the opposite. Fragmented is the correct word to describe the demand side of the market. Second-hand containers can serve a great variety of purposes and this leads to demand by a great variety of players, from big companies to private buyers.

3.2.1.1 SHIPPING LINES, TRANSPORTERS & LOGISTICS SERVICE PROVIDERS

Shipping lines can be seen as actors on both the supply and demand side. As described in section 3.1.2 they become a player on the supply side when their containers reach the economic lifespan and are resold on the second-hand market. On the other hand, they are actors on the demand side when they want to buy big amounts of second-hand containers. Shipping lines and other transporters both use the second-hand containers for regular transportation or one way and one traffic transportation in situations where they prefer an old, cheaper container to a newer, more expensive container. Besides these situations logistics service providers need containers for shipments which they outsource. In these situations, they just facilitate transportation for their customers, most of the time with second-hand containers. These types of actors prefer quick delivery and market conform prices. By accepting the market price and requiring quick delivery they try to keep the transaction costs as low as possible, in which transaction costs are the costs related to making an economic exchange (Besanko & Braetigam, 2010). Since the transportation sector is very competitive with low margins and lots of small companies, time and easiness of ordering is important. In some cases, a trader as intermediate party, like CARU, could be of

value for such parties. Most of the shipping lines have an alliance with their suppliers of containers, just as in the supply side.

The purely logistics services providing companies can be described as a slightly different player on the demand side. They favor quality more compared to the pure transporters because they have to account to their customers on reliability and costs of the operations. This leads to them willing to pay more for extra quality and bother less about the transaction costs in order to obtain the best price-quality ratio.

3.2.1.2 LAND USE

Besides the transport function, containers can be used for storage, warehousing and other land use situations. Following from conversations with CARU employees is concluded that these parties most of the times buy containers in smaller quantities. They care even less about transaction costs compared to logistics services providing companies and use their time to find the best deal.

3.2.1.3 SCRAPPERS

The physical lifespan comes to an end when a party decides to scrap a container. This decision is made when reselling a container is not an option anymore. The value of scrapped parts is then estimated to be higher than the net profit of the reselling process. The benefits of scrapping are easily calculated with help of the steel price. CARU employees consider scrapping not as a viable option on the long term, due to the low selling prices, it is considered as an absolute final resort. They also addressed that the average lifespan of a second-hand container is to diverse to guess.

When analyzing these different demand parties, it can be concluded that even though the purpose of using the container is sometimes the same, the incentives can be far apart.

3.2.2 FACTORS

Just as the supply side, some surrounding factors could be awarded to the demand side. As mentioned before, this research focuses on the supply side. The described factors on the supply side will come back in a later stadium when doing the forecasts. The factors that influence the demand side are shown in figure 4.

3.3 THE ROLE OF CARU CONTAINERS IN THE SECOND-HAND CONTAINER MARKET

As already mentioned this research has its focus on the selling department of CARU and more specified; the selling of second-hand containers. Besides this department CARU has departments active in leasing and hiring both new and second had containers. In the previous sections of this chapter an extensive outline of the second-hand container trading market is given in which actors and factors are discussed. This section will purely focus on the role of CARU as a trader in second-hand containers.

CARU was founded in the year 2000 by the merger of three companies; CATU Rotterdam (founded in 1992), Trade Craft (1984), and Lease Craft (1991). Over the years, CARU has become one of the largest traders of new and used containers in the world. In addition, the increase of the lease fleet which took place over the years led to the entering of CARU to the top 15 worldwide largest leasing companies. Despite the growth of the leasing activities container trading is considered as CARU's core business.

3.3.1 ENTRY BARRIERS

When looking at the market for second-hand container trading, different conclusions can be made. CARU successfully entered the market and has evolved over the years to become a leading player in the market. In 1954 Joe Bain did an extensive research on entry barriers and described them as *"an advantage of established sellers in an industry over potential entrant sellers, which is reflected in the extent to which established sellers can persistently raise their prices above competitive levels without attracting new firms to enter the industry"* (Bain, 1954). Besides Bain, other big economic thinkers wrote about entry barriers and defined many of them. On the one hand the market of container trading can be described as a sector with low entry barriers because relatively little capital funds are required to enter this market and no intellectual property rights strictly necessary. These circumstances provide easiness to enter the market. For example; a 22 years old student like me could start buying old containers with his savings and try to resell them at a premium. As a result of this market structure there are several container trading companies. Examples are Alconet, RCC, ALMAR and many more. Traders buy containers mainly from shipping lines and try to resell the containers at a premium to different type of customers as described in section 3.2. The described barriers to entry, required capital and intellectual property rights, fit all the

common definitions of primary economic barriers to entry. Other examples of barriers like these are tariffs, taxes and restrictive practices.

On the other hand, we can look at the bigger picture and analyze barriers that don't fit all the commonly cited definitions of a barrier to entry. Most of these fit a broader definition of antitrust barriers to entry or ancillary economic barriers to entry. Examples of these kinds of barriers are economies of scale and network effects. When looking at the second-hand container trading market, overcoming these barriers is essential to become a big player like CARU is. Let's take a look at the example of me as 22 years old student again. Without economies of scale and a big network of potential suppliers and demanders it would be an impossible mission to compete with a player as CARU. CARU benefits from economies of scale because they have the possibility to buy big parties of second-hand containers which results in discounted prices. For me as a 22 years old student this is not possible since my savings will not allow this and I don't have a gold uncle. Even when I had a rich uncle it would still be a big, and very likely impossible challenge, to compete with CARU without any network effects. CARU benefits from the much-debated relationship they have with MSC on the supply side of second-hand container market and from its broad network of clients on the demand side of the market. For me as student without connections in the market it would be very difficult to fight against players as CARU.

3.3.2 CARU AND ITS MAIN SUPPLIER MSC

Section 3.1.2 covered the difference in supplier types. Market research has shown that most leasing companies are active in reselling their written off containers from their selves, by making use of a trading arm which gives them the possibility to make more money out of their containers without using an intermediate party. In contrast to leasing companies, shipping lines are open for collaboration with intermediate parties as container traders like CARU. Shipping lines most of the time make use of the services of a container trader.

As stated in the first chapter of this research; the main purpose is to find out where CARU's supply of second-hand containers depends on. CARU is engaged in an alliance with the second biggest shipping line of the world, the Mediterranean Shipping Company (MSC). Since MSC is by far the biggest supplier of second-hand containers for CARU, their influence is of great importance in this research. The fact that MSC is not able to provide CARU from supply information on the short-term forms the basis of the dependency as explained in

section 2.1. MSC sells shares of their superfluous containers to CARU and the amounts of these containers differ per region and period. From conversations with CARU employees was concluded that the amount of MSC left overs depends on their own needs and orders and that MSC does not care about forecasting or planning this amount. They basically just sell their leftovers and they are not triggered to forecast this amount for CARU (Ijzerman, 2017). Based on these finding was concluded that the need for a forecasting tool to provide CARU employees of the needed supply information is desirable. In chapter four the development of this forecast tool is described. Another conclusion that was made at this point is to shift the main focus from MSC as the main supplier to the complete second-hand container market with regard to the forecasting model. Creating the forecasting model and locking in on MSC as main supplier would make it harder to get the required data. That is why the decision is made to use the complete supply side when creating the model.

3.4 CONCLUSION

In the second substantive chapter of this research the second-hand container market is described extensively. The main goal of this chapter was to answer two of the five formulated sub questions:

- How is the second-hand container market constructed and what is the role of CARU?
- Which factors influence the supply of second-hand containers?

The choice was made to describe the market by dividing the whole market in the supply side and the demand side. For both sides, the actors and factors are reviewed. Section 3.1 reveals about the supply side and section 3.2 covers the demand side. Since the emphasis of this research is on the supply side, this side is described more extensively. In section 3.3 is the role of CARU explained. A crucial conclusion made in this section is that the total supply side will be analyzed while constructing the model instead of locking in on MSC. This decision is made to get the required data easier. Based on the findings when looking at the complete supply side of the market, conclusions concerning the MSC dependency can be made more easily. The crucial factors that appear to influence the supply of second-hand containers are listed again below:

- *Alliances between traders and shipping lines*
- *Average age of the global container fleet*
- *Economic lifespan of a container*

- *Leasing ratio*
- *Price of new built containers,*
- *Steel price*
- *The global container fleet.*
- *The global maritime trade*

The factors that are most tangible, analytical and quantifiable are: the average age, the leasing ratio, the steel price, the price of new built containers, the economic lifespan, the global container fleet and the global maritime trade. These factors will be reviewed in the next chapter where an econometric model to forecast the supply of second-hand containers will be built.

4. A GUIDELINE FOR THE NEAR FUTURE

As stated in the introductory chapters, CARU's main problem is the dependency on MSC and this research tries to create a guideline for sales employee to deal with this dependency. In this chapter, the possibility to create a short-term predictor is analyzed.

In section 4.1 a conducted interview with Deloitte consultant Abdelmoula Salah is discussed to describe what kind of forecasting model is needed. The lack of available data and data tools is one of the explanations for the use of judgmental forecasting techniques by CARU employees. Before starting with digging into the data the vision of a field expert is taken in consideration and his advice has been used well. Section 4.2 reports the available data that could be used by analyzing the necessity, availability and applicability. The data is presented in section 4.3 and in section 4.4 the different forecasting options are discussed and compared. Section 4.5 gives the main conclusion of this chapter.

4.1 THE VISION OF AN EXPERT

The way of looking from consulting expert, Manager - M&A Transaction Services within Deloitte, is discussed in this section. During the time this research is written, four Deloitte consultants conducted a comprehensive research for CARU. The goal of their research was to underline CARU's strengths and weaknesses by doing data research and conducting interviews with employees. In some way, it could be seen as comparable to this research, but way more comprehensive and done by field experts. The interview with Salah confirmed that one of CARU's weaknesses, and a possible threat, is the dependency on MSC. His findings in creating an econometric model to forecast the supply of second-hand containers are well considered and applied in this research. The complete interview can be seen in Appendix F.

Salah's main advice was that the model should be easy to use and understandable for the sales employee within CARU, because they are the assets that will make use of the created model to deal with the dependency on MSC. A comprehensive econometric model might be impressive but in the end, it won't be used a lot and the intended users will fall back to their own judgement. Besides this his advice was to only use accessible data since big data tools are not used within CARU's way of working and this is unlikely to change in the near future. Another substantiation to make use of accessible data is that the model must remain

applicable after the construction of it. Using much data from all kind of different sources will make it hard to keep the model up and running. Besides this the feelings of and knowledge from the market of sales employees are CARU's main asset. Salah suggested creating the model in such a way that it could be used as extra help in making purchase and sales decisions. The created model should be a guideline for support and not a replacement for CARU's main asset.

4.2 AVAILABLE AND USABLE DATA

Following Salah's advice, the main factors influencing the supply side of the second-hand container market are analyzed in this section. These factors that influence the supply of the second-hand containers, which is the independent variable, have already been discussed extensively in section 3.1 and are listed again below. The decision to focus on the listed factors is mainly based on the fact that these are the most tangible and quantifiable variables. Using factors like the development of new built containers and shifting alliances was not recommended by Salah since it is hard to make these variables quantifiable. The listed factors are evaluated in this section with the main goal to conclude if they should be incorporated in the forecasting model. To make this conclusion they are analyzed with regard to their necessity, availability and applicability when creating an econometric model. The necessity deals with the question: Will the use of this variable be necessary in forecasting the supply of second-hand containers? The availability deals with the question: Is the necessary data available within CARU's resources? And the applicability deals with the question: Will using this variable contribute to creating a model that will be easily used by CARU's sales employee?

- *Average age of containers owned by shipping lines and leasing companies*
- *Economic lifespan of a container*
- *The global container fleet.*
- *Leasing ratio*
- *Price of new built containers,*
- *Steel price*
- *The world economy*

4.2.1 AVERAGE AGE OF CONTAINERS OWNED BY SHIPPING LINES AND LEASING COMPANIES

Based on Salah's advice the average age of the global container fleet is evaluated. The input of this variable could help in creating the forecasting model. The average age of containers can be calculated using the following formula:

$$\overline{x} = \frac{\sum_{1}^{n} x}{n}$$

In which the upper part of the equitation is the sum of all observations (container X age) and the lower part is the number of observations. This is the arithmetic mean. A simple regression of this variable combined with the economic lifespan of a container and the global container fleet can give insights in the future supply of second-hand containers. This makes the need of use for this variable sufficient. When looking at the availability, it should be concluded that it is possible to collect data that gives insights in the average age of the current container fleet. For example; access to the data sources of a website like Drewry Shipping Consultants (Drewry Container Leasing Industry, 2015/2016) can provide the required data. However, the applicability of this variable is doubtful. Forecasting the short-term supply of second-hand containers would require the average age in months or quarters. With Salah's advice in mind, problems are foreseen with regard to the applicability. The model should be easy to use and understandable for the end users. At first it takes a lot of time to keep constantly track on the average age of the container fleet since containers are produced on a daily basis. To keep this variable accurate either an employee should track the data on a daily basis or an expensive data tool is required. Since the goal of the model is that it should be a guideline which is easy to use as guideline for sales employee, problems are foreseen. The use of the average age of containers would probably make it to difficult, which will lead to neglecting the model. Adopting this variable is too much time-consuming and too expensive since subscriptions on websites like Drewry are high-priced. Constructing a model with this variable will definitely reduce the applicability, which makes the use of this variable doubtful. However, using assumptions the average age of the container fleet could be approached.

4.2.2 ECONOMIC LIFESPAN OF A CONTAINER

The use of the economic lifespan of a container seems to be necessary in creating a forecasting model. With regard to the need there is no doubt using this variable. In all conducted interviews, it comes up as a necessary variable when forecasting the short-term supply of second-hand containers (see the appendix). Based on the economic lifespan and the average age of the container fleet or the number of containers that nearly reach the age of the economic lifespan forecasts can be made. When looking at the availability also no problems are foreseen. Even though the opinions of market experts are sometimes different (see the interviews in the appendix), with some assumptions a market average of the economic lifespan can easily be calculated by summing up the different opinions and dividing the outcome by the number of observations. At last, the application of the model will be easy when incorporating this variable. There are no external data sources required and the economic lifespan can be adjusted easily when this is necessary due to changing market circumstances. Using the economic lifespan of a container as input variable will certainly be of value for the to be created model.

4.2.3 THE GLOBAL CONTAINER FLEET

This variable cannot be led out when creating the model. The need to use this variable speaks for itself, using the total number of available containers worldwide is a must when creating a model to forecast the supply of second-hand containers. This because based on the total number of containers, in combination with other variables, the share of second-hand containers can be approached more accurate. Concerning the availability there might be some problems since it seems that nobody knows the exact number of containers worldwide. However, with some assumptions it should be workable. The applicability will also be fine when the right assumptions are made. This will probably influence the accuracy of the final result but it is the only way to construct a model which approaches the goal.

4.2.4 THE LEASING RATIO

As explained in section 3.1.2.3 the leasing ratio indicates the percentage containers that are leased in terms of the percentage of owned containers. The leasing ration is highly correlated with the market interest rates. It is also discussed that a higher percentage for

owning is desirable for the selling division of CARU. The leasing ratio will in all likelihood influence the supply of second-hand containers either direct or indirect and that is why the use of this variable will be helpful in creating the model. Concerning the availability there will neither be big problems. Different websites and databases provide insights in the number of owned and leased containers. However, with regard to the applicability and in some way the availability there will be problems with making the leasing ratio applicable in the required way. Since goal is to forecast the short-term supply, a leasing ratio that will be adjusted on monthly or quarterly basis would be desirable. This brings us back to kind of the same problem as described in section 4.2.1 where the applicability of the variable "Average age of containers owned by shipping lines and leasing companies" discussed. Adopting the leasing ratio to use it on monthly or quarterly basis will also be time-consuming when an employee should do it his self or to expensive when a forecasting tool will be used. This makes the use of the leasing ratio as variable to forecast the short-term supply of second-hand containers doubtful.

4.2.5 PRICE OF NEW BUILT CONTAINERS

The relation between the price of new built containers and the supply of second-hand containers is shortly addressed in section 3.1.2.4. When looking at the need to use this variable it could be kept short. It is clear that there is a relationship between the variable and independent variable, if this is a causal relation should be analyzed. Regarding the availability there are neither concerns. The market price of new built containers is transparent and even set by CARU's own selling division. Incorporating this and adjusting it to changing market conditions won't cause problems for CARU employees. This also underlines that there are no problems concerning the applicability of this variable. The use of this variable won't be too time consuming or expensive for CARU employees so it could be concluded that this variable should be used when constructing the model.

4.2.6 STEEL PRICE

It is clear that the steel price will have an indirect effect on the independent variable if there is a causal effect with the new built price. The causality between the steel price and the price of new built containers is already described in section 3.1.2.5. The necessarily of this variable is a little bit doubtful since the relation between it and the independent is maybe far-

fetched. However, using it in creating the model is always an option and when the outcome shows no significance it could be left out again. In regard to the availability and applicability there are no problems. The steel price is transparent and easy to adjust when necessary. Using it as variable will thus not lead to problems for the end users of the model.

4.2.7 THE GLOBAL MARITIME/CONTAINERIZED TRADE

As addressed by Danny de Boer, the global maritime trade determines the demand for logistic services to a large extend. The Necessity of using this variable to create the forecaster is very important in his eyes. Using this variable could indicate if there is a causal relationship with the independent factor. Concerning the availability of data about the global maritime trade there are not much problems foreseen since making use of the worldwide GDP growth could be a good indication of this variable. Research about forecasting methods assuming a relation between GDP and port throughput have been done a lot in previous years. Almost all of them showed a stable relationship between the two (Meersman, 2002). In practice however, this relationship is changing due to changes in production, trade patterns, and other circumstances (Rashed, 2017).

Another, and maybe better option, is using the global containerized trade. The United Nations publish a report about trade development every year with data about the containerized trade, see figure 6 (UNCTAD, 2017).

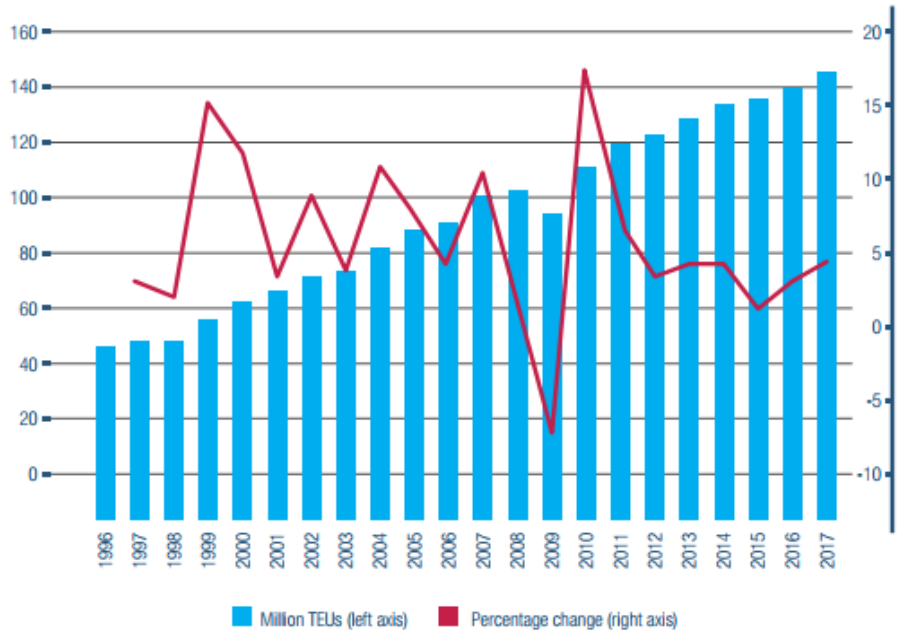

FIGURE 6, GLOBAL CONTAINERIZED TRADE, 1996-2017 (UNCTAD, 2017)

Even though there are two possible data measures to adopt the global maritime/containerized trade in the model there might be problems since the main goal is to forecast the short-term supply. The effects of a growing world economy will not directly increase or decrease the supply of second-hand containers. Therefore it should be used as lag variable and this might make the model to complicate. For the containerized trade the same applies. Besides this the data comes available on a yearly basis which makes it hard to apply in a short-term predictor.

4.2.8 OVERVIEW OF THE VARIABLES

Variable	***Necessity***	***Availability***	***Applicability***	***Adopting?***
1.Average age	Using it will probably give good insights.	Available, but time consuming and expensive to keep it up to date.	Due to the facts described in the availability Colom hard to applicate.	Doubtful, assumptions needed.
2.Economic lifespan	Necessary since this variable indicates when containers will come available on the second-hand market.	Available by combining expert's visions on the economic lifespan	Easy to applicate and to be adjusted when circumstance chance	Yes.
3.Global container fleet	Necessary since the total number of containers will influence the amount of second-hand containers.	Not fully available but approachable using assumptions.	Applicable but not very accurate.	Yes.
4. Leasing ratio	Using it could probably give good insights, maybe not necessary.	Not readily available. Assumptions needed.	Will probably make the model complicated.	Doubtful, assumptions needed.
5. New built price.	Using it will probably give good insights.	Easy available since CARU has influence on it.	Easy applicable and possible to adopt.	Yes.
6.Steel price	Not necessary but could be used.	Easy to obtain.	Using could make the model to extensive.	Doubtful, only if causal relation.
7.Global maritime trade	Necessary following de Boer's advice.	Available using the world GDP/ Containerized trade	Problems might occur regarding the complexity.	Doubtful, only when easy to use.

Table 2; Overview of the discussed variables

4.3 DATA STANDARDS AND OUTPUT

The usability of the different variables is analyzed in the previous section. In this section, the standards per variable are described and the way in calculating/defining the output is addressed.

4.3.1 AVERAGE AGE

As described in section 4.2 the usability of this variable is doubtful since it is hard to get clear data about the average age of the containers. Data gathering would be time consuming and expensive since yearly fees should be paid to get access to data sources. More specific figures on monthly or quarter basis are a utopia. Using this variable is only possible by making assumptions. Therefor the assumption is made that the average age of the containers worldwide will be between 8 and 12 years old.

4.3.2 ECONOMIC LIFESPAN

The economic lifespan is a variable that should be adopted in the model without any doubt as addressed in section 4.2.2. Since the expert's visions are divergent and scientific researchers also come up with different figures, the choice is made to take the average of the different visions and use this average as the economic lifespan.

Based on conversations with CARU employees, the market experts and three of the most cited articles about container lifespan this research will work with an average lifespan of 13 years.

- 10 - 15 (Rodrigue & Slack, 2013)
- 12 - 15 (Brewer, 2014)
- 12 (Theofanis & Boile, 2008)
- 10 -12 (Danny de Boer, Aftermarket specialist Sea Cube)
- 13 -14 (Arshad Hossain, Resale Director North America Textainer)
- 18 (Paul Erik Andersen, General Manager Maersk)

4.3.3 GLOBAL CONTAINER FLEET

As addressed already in previous sections, the global container fleet is constantly growing. The exact number of containers worldwide is not monitored by any organization, which makes it hard to measure. Even well-known databases like Drewry do not present the exact number of containers. By working with proxies of the container fleet this variable can be adopted in the to be created model. According to CARU employees it nearly reached the 40 million TEU. Some other researchers come up with different figures around the 40 million and they also address that the amount of containers worldwide is still growing. Based on this information there will be worked with proxies between the 40 and 45 million

4.3.4 LEASING RATIO

Like described in section 4.2.4 the adopting of the leasing ratio is doubtful. Using it as an explanatory variable is not as necessary as the other variables and the applicability could make the model to complicate. Off course working with assumptions is an option but to keep the model easy to use for CARU employees, the choice is made to not incorporate this variable.

4.3.5 NEW BUILT PRICE

As addressed before, the new built price of containers is transparent. For this research, the prices set by CARU itself, will be used as the base. The prices today, 31-01-2018, are €2300, - for a 20ft sea container and €3700, - for a 40ft sea container (https://shop.carucontainers.com/nl/). Since the focus of this research is on normal sea containers, reefers, tank containers and other container type variants are neglected, the average of the day prices of the 20ft and 40ft equivalents will be used as the current day new built price. The “new built price” on 31-01-2018 is thus (2300+3700)/2 = €3000, -

4.3.6 STEEL PRICE

The steel price is highly correlated with the new built price and that’s why an indirect effect on the independent variable is expected. The steel price is transparent and easy to adjust when necessary. Because there are many different steel types and different suppliers the choice is made to work with the “plaatstaal” prices of Douma Staal BV, one of the main steel

suppliers in The Netherlands, since this is the type of steel used for sea containers (http://www.doumastaal.nl/11_prijzen).

4.3.7 GLOBAL MARITIME/CONTAINERIZED TRADE

As described in section 4.2.7, adopting the maritime/containerized could be done by using the world GDP or the containerized trade. Since the focus of this research is on the second-hand container market, it is decided to use the containerized trade since it focusses purely on trade with containers. The review of maritime transport by the United Nations is used to gather the required data.

4.3.8 OVERVIEW OF THE POSSIBLE DEPENDENT VARIABLES

Variable	***Method of approach***	***Quantity***
1.Average age	Proxy	8-12 years
2.Economic lifespan	Average of the different expert visions	13 years
3.Global container fleet	Assumptions based on different sources	40 million – 45 million
4. Leasing ratio	Too hard to approach	X
5. New built price.	Average day price 20ft and 40ft	Daily price in € on CARU web shop
6.Steel price	"Plaatstaal" price of "Douma staal BV"	Price in € on Douma webshop
7.Global maritime trade	Using Global containerized trade	Yearly figures from UNCTAD

Table 3; Overview of the discussed variables

4.4 CREATING A QUANTITATIVE GENERAL FORECASTER

This research started with an extensive literature review about forecasting. Section 2.3 dealt with the difference between judgmental and quantitative forecasting techniques. One of the main conclusions made in chapter two was that the introduction of quantitative forecasting techniques could be very beneficial for CARU. Subsequently in section 2.5 an overview of different quantitative forecasting techniques is given. In this section, the overviewed forecasting techniques are discussed again and in combination with the found data is concluded that creating a general forecaster is not possible.

4.4.1 EXPONENTIAL SMOOTHING

The first, and most easy to use, technique is the exponential smoothing model. As described in section 2.5.1 this technique only requires historical data of the independent variable. Since the supply of second-hand containers is the independent variable, a regression could be made easily by looking for historical data concerning the number of available second-hand containers for CARU. The easiness of this technique has its downfall since such a simple regression is very likely not of much value for CARU's employees.

4.4.2 DISTRIBUTED LAG MODEL

Where the exponential smoothing technique only makes use of the independent variable, the distributed lag model also incorporates dependent variables. The use of this technique makes it possible to incorporate the analyzed possible dependent variables. For example, the economic lifespan, the global container fleet and the new built price could be used as explanatory variable. The main advantage of this technique is that it is possible to equate a regression to predict current values of a dependent variable based upon both the current values of explanatory variables and the lagged values of these explanatory variables. As addressed before in this research, the effect of the global maritime trade will in all likelihood not directly influence the supply of second-hand containers, which makes a distributed lag model a possible solution to incorporate this variable in the most optimal way. However, regarding the dataset it is very doubtful that the outcomes will be of value for CARU employees.

4.4.3 AR(I)MA(X) MODELLING

The third discussed forecasting technique in chapter two are the different Autoregressive-moving-average models. The use of an autoregressive part and a moving average part could be a good fit regarding the available dependent variables. Based on the interviews with field experts could be concluded that the independent variable, the supply of second-hand containers, depends on its own lagged values. Especially when the time horizon is short. Since the main goal of this research is to forecast the short-term supply of second-hand containers there will be a short time horizon. Because not all available second-hand containers will be sold within one time horizon, the independent variable will partly depend on its own lagged value. The AR part will control for this phenomena with an imperfectly predictable term. Besides the AR part the (I)MA(X) parts make it possible to analyze the effect of the usable dependent variables in different ways. Integrating the (I) in the model makes it possible to incorporate and control for seasonality. This could be very usable since the expert interviews underlined the possible seasonal fluctuations in the independent variable. The (X) part makes it possible to incorporate exogenous variables, the dependent variables, to analyze the effects of them.

This type of modelling will with all probability forecast the supply of second-hand containers in the most optimal way. However, regarding the available data, applying this technique to forecast the global supply of second-hand containers will be a utopia. The available data is to general to create a model with significant predictions.

4.4.4 SYSTEM DYNAMICS

As concluded in section 2.5.4, the system dynamics technique is a technique that requires a lot of expertise. It solves the problem of mutual causation, where some statistical techniques suffer from, by updating all variables in small time increments with feedbacks and time delays. In section 2.5.4 is also stated that system dynamics models can provide more reliable forecasts of short- to mid-term trends than statistical models, and thus lead to better decisions according to (Lyneis, 2000). Besides this he concluded in his article that system dynamics models provide a means of understanding industry behavior, and thereby changes in industry structure, as part of an early-warning or on-going learning system. These characteristics perfectly fit the needs for CARU regarding the problem of the current

situation in which they depend to a large extend on MSC. Constructing a system dynamics model could be the most optimal way to getter insights in the short-term future of the supply of second-hand containers. However, to use this technique, specific customized software is required to create an applicable model. Implementing system dynamics in CARU's way of doing business will be problematic at this time based upon two reasons. The first reason to discourage implementing System Dynamics is its ease of use. Currently, within CARU a project is started to implement Sales Force. Sales Force is a cloud based CRM software solution which supports account managers with their sales activities. Many companies are working with Sales Force. It is known as a tool that makes working much easier and usually benefits the results achieved (Anderson, 1984). However, one of the first practical findings in working with Sales Force is that the implementation is a time consuming and costly process. CARU's employees are used to the current way of handling their accounts and, as with many things in life, the unlearning of habits is a hard thing. Interviews, training sessions and, most of all, time is required to successful complete his project. The implementing of Sales Force is expected to boast the sales results but if it really does within CARU will become clear later. When comparing system dynamics to Sales Force in terms of its ease of use, it is concluded that system dynamics is way less user-friendly which makes implementing it anything but easy. The second reason is the required amount of data to construct a system dynamics model. In a system dynamics model all variables are updated in mall time increments with feedbacks and time delays. The available data for CARU was presented in the previous section. Based on the relatively low availability of data my advice is that incorporating this technique is not a suitable option.

To conclude; even though system dynamics could be the perfect forecasting technique for CARU to deal with their dependency on MSC, it is not recommended to incorporate its use at this moment. The difficulty that comes with using it combined with the sales force experiences, the costs and the lack of data are the main substations for this conclusion. Despite this conclusion, system dynamics could be an option for CARU to implement in a later stadium. The hiring of a data analyst and subscription to external databases might help to deal with the current downsides of this advanced forecasting technique.

4.4.5 FORECASTING TECHNIQUES FOR BIG DATA

The rise of big data is discussed in detail in section 2.4 and the forecasting techniques for big data sets are shortly addressed in section 2.5.5. The conclusions made in these sections are that based on insights obtained from big data, managers can measure more and get to know more about their business environment. Besides this it is concluded that using big data analytics will help to improve planning and forecasting. However, to apply these techniques, a big data set is required. Within CARU's way of doing business more and more data is gathered in the last two years (see the case study). However, when only using the internal collected data, there is not sufficient data to make use of big data techniques. Just as concluded for the use of system dynamics, the use of Big Data forecasting techniques is not an option for CARU's current way of doing business. However, the implementation of Sales Force possibly contributes to a change of this conclusion in the near future. Sales Force is a tool which helps collecting data, it obliges account managers to register more data and offers many possibilities to create data reports. Besides the use of Sales Force, the hiring of a data analyst and subscription to external databases will also contribute to create bigger data sets. These are things for CARU's management to consider.

To conclude; the rise of big data is expected to provide new opportunities for CARU. However, at this stadium, incorporating big data techniques to forecast the supply of second-hand containers on the short-term, is not a suitable option. The current lack of available data leads to this conclusion. Despite this conclusion, big data techniques, could be an option for CARU to implement in a later stadium. The hiring of a data analyst and subscription to external databases are the main recommendations to gather more data which makes using this technique a suitable option.

4.4.6 OVERVIEW OF THE DIFFERENT FORECASTING TECHNIQUES

The following table gives a short overview of the in paragraph 2.5 discussed forecasting techniques.

Forecasting technique	***Characteristic***	***Incorporate as general predictor?***
1.Exponential smoothing	Basic forecaster with limited predicting power.	No, to basic to be of value for CARU employees
2.Distributed lag model	More sophisticated forecaster using explanatory variables and lagged values.	No, no significance results expected regarding the data set
3.AR(I)MA(X) modelling	A time series model with an autoregressive and a moving average part. Which could incorporate seasonality and exogenous variables.	No, perfect fit regarding the characteristics but a utopia regarding the available data.
4.System dynamics	An extensive mathematical modelling technique which updates all variables in small time increments.	No, based on the ease of use, the current business situation and the lack of data, incorporating this technique is not recommended at this stadium.
5.Big Data techniques	Techniques that can analyse large data sets which will improve planning and forecasting.	No, based on the available data is concluded that incorporating "Big data techniques" is not suitable for CARU at this stadium.

Table 4; Overview of the discussed forecasting techniques

4.5 CONCLUSION

The main goal of this chapter was to analyze the possibility to create a general short-term predictor for the global second-hand container market. Based on the possible dependent variables and forecasting techniques, is concluded that it is not possible to create a model that could help CARU employees with getting general insides in the global supply of second hand containers. In chapter five, a case study is done to analyze the possibilities on a specific geographical market.

5. CASE STUDY 1: A CLOSER LOOK AT THE USA MARKET

In the first chapter of this research the difference between quantitative and judgmental forecasting is underlined. The three following chapters discussed the second-hand container market, the role of CARU and the question if it is possible to predict the global supply of second-hand containers, using quantitative methods, to deal with the MSC-dependency. In chapter four is concluded that it is not suitable for CARU to use quantitative forecasting techniques to forecast the short-term supply of second-hand containers on a global level. The different interviews with field experts made clear that one of the main problems in forecasting the short-term supply of second-hand containers are the geographical differences in supply and demand. To tackle that problem, this chapter contains a case study in which the focus is shift to a smaller geographical level. Section 5.1 describes why the USA market is an interesting market to look at in analyzing geographical differences. Section 5.2 describes the differences in geographical markets more in detail. Section 5.3 focuses on the role of CARU in the USA. The possibility to use quantitative forecasting techniques is discussed in section 5.4. and section 5.5 gives the conclusion.

5.1 THE USA MARKET

The USA has been an economical giant for ages. As CARU is a worldwide oriented container trader, it is not strange that a big share of their earnings come from the USA market. In general, the USA can be seen as an import oriented country, as the total import of goods tranced the exports (Santos-Paulino, 2004). Figure 7 shows the trade balance of the USA for 2017. The most obvious explanation for the USA trade balance is their position in the world economy. Especially when only focusing on the trade of goods, the USA imports more than it exports because the production of goods is cheaper in overseas countries like China.

2017 : U.S. trade in goods with World, Seasonally Adjusted

NOTE: All figures are in millions of U.S. dollars on a nominal basis, not seasonally adjusted unless otherwise specified. Details may not equal totals due to rounding. Table reflects only those months for which there was trade.

Month	Exports	Imports	Balance
January 2017	126,643.4	194,803.8	-68,160.5
February 2017	126,950.7	191,285.0	-64,334.3
March 2017	126,525.6	191,388.7	-64,863.1
April 2017	126,185.9	193,232.8	-67,046.9
May 2017	126,322.7	192,544.0	-66,221.2
June 2017	128,466.6	192,345.9	-63,879.3
July 2017	128,105.7	191,867.3	-63,761.6
August 2017	127,767.2	191,438.3	-63,671.2
September 2017	129,932.7	193,896.7	-63,964.1
October 2017	129,245.7	197,438.4	-68,192.8
November 2017	133,611.5	203,407.9	-69,796.4
December 2017	137,004.0	209,262.5	-72,258.5
TOTAL 2017	**1,546,761.6**	**2,342,911.3**	**-796,149.7**

FIGURE 7, TRADING BALANCE USA, (WWW.CENSUS.GOV, 2017)

As already stated in previous chapters, the container is the most used “packaging product” to transfer goods. The main advantage of containers is the possibility to use it for intermodal transport. Intermodal transport is defined as unified loads that are transferred from one mode to another. So, a transport system where at least two different modes are used in an integrated manner in order to complete a door-to-door transport sequence (Panayides, 2002). Based on the trade balance of the USA you would expect that the USA is also an import oriented market regarding worldwide container flows. An extensive report presented by MARAD data statistics confirms this (Marad, 2016). In this report, the import and export flows for the USA market in TEU are presented for the period 2000-2015. In total, the import flows measured in TEU are almost twice as much as the exports in TEU for this period. This confirms the expected hypothesis that the USA is also an import oriented location regarding container flows.

Besides the interesting characteristics of the USA market, Aad Storm, Marketing Director of CARU, underlined the importance of the USA market for CARU and shared a report with CARU-MSC specific data of the USA market. The importance of this market in the global economic world combined with its characteristics and importance for CARU makes this market the perfect choice for a case study.

5.2 GEOGRAPHICAL DIFFERENCES IN THE SECOND-HAND CONTAINER MARKET

One of the first things that becomes clear when analyzing the second-hand container market are the geographical differences, which come forward in all the market facets. The fact that these geographical differences are underlined by all the field experts interviewed in this research is not a surprise. Salah mentioned that the geographical differences in the container market are enormous which makes it difficult to create a general forecasting model. De Boer and Hossain underlined this and explained it in dept. The container flows follow the import and export patterns. An import oriented location, in general, has a surplus in empty containers. This is explained by the fact that more containers are shipped to that specific region as a consequence of the importing good flows which exaggerate the outgoing good flows. When the goods reached their final destination, containers are shipped back or stored at a port/depot for other goals like storage, leasing and selling. Looking at the USA market, it could be concluded that this market will be characterized by a surplus of empty containers. However, as already stated, the USA is one of the global leading markets. This means that within the USA there are also geographical differences per location. One port in the USA could be an import oriented port and another port could be an export oriented port. Looking at the port of Boston it could be concluded that this is an import oriented port; the total imports in Boston for the period 2000-2015 are almost twice as big as the exports for the same period (Marad, 2016). Another example is the port of New Orleans, for this port it is the other way around. The total exports in TEU for the period 2000-2015 are twice as big as the total imports in TEU for this period (Marad, 2016). So, what can be concluded is that a specific market could be seen different when the geographical level is changed.

5.3 CARU'S ROLE IN THE USA SECOND-HAND CONTAINER MARKET

The main purpose of this research is to deal with CARU's dependency on MSC. As addressed in section 3.3, CARU has become one of the largest traders of new and used containers in the world since its establishment in 2000. CARU's success is for a big share based on the cooperation with MSC. The fact that MSC is not able to provide CARU from supply information on the short-term forms the basis of the dependency as explained in section 2.1. MSC sells shares of their superfluous containers to CARU and the amounts of these containers differ per region and period. The interviews with CARU employees showed that

MSC does not care about forecasting or planning this amount. They basically just sell their leftovers (Ijzerman, 2017).

Where the first chapters focused on the worldwide market, the scope is reduced to a smaller geographical market in this chapter. The conducted interview with (Langhuizen, 2017) made clear that in his market the focus of CARU is on selling the received MSC "boxes" via local agents. CARU is thus a clear intermediary party in this market focusing on selling as much containers. To sell as much containers as possible it depends on the supply of MSC. This brings us to the following section.

5.4 SCOPING TO A MORE LOCAL LEVEL

In this section, basically the same analysis will be done as in the entire research. The only difference is the change of the geographical level, which will be narrowed. Where the first four chapters focused on quantitative techniques as regression models to analyze the entire market, this chapter looks at more location specific data and more practical applicable solutions.

5.4.1 ANALYZING THE USA MARKET CASH FLOWS FOR CARU

Deloitte consultant Salah advised to track the cash flows and other market variables when optimizing CARU's way of doing business. When analyzing a market of second-hand products, it is important to look at two crucial factors according to (Vorasayan, 2006). The two crucial factors mentioned by them are quantity (Q) and price (P). When addressing these insights on the second-hand container market from CARU's perspective, the number of available containers to resell is (Q) and the price of a second-hand container is (P). The main goal of this research is the dependency on MSC. From CARU's perspective, MSC is responsible for Q, the number of containers to sell. CARU is able to set their own prices when reselling containers and basically just wants to have better insights in the number of available containers to resell. Based on this given fact, the focus in this case study will be on analyzing the Q from CARU's perspective in the USA market.

5.4.2 USABLE DATA AND DEFINITIONS

The available report containing the MSC-CARU specific data focuses on CARU's capture rate. To better understand this case study some definitions are listed below:

- Capture rate: the share of available MSC containers that are bought by CARU to resell
- Deficit areas: Locations where MSC's export transcends their imports
- Open locations: Locations where CARU wants to receive MSC containers
- Closed locations: Locations where CARU does not want to receive MSC containers

The goal of the meeting with MSC's local agents was to improve the cooperation to create a win-win solution. Win-win thinking is one of the basic principles when doing business (Covey, 2013). The usable data from the report is showed in figure 8, 9, 10 and 11.

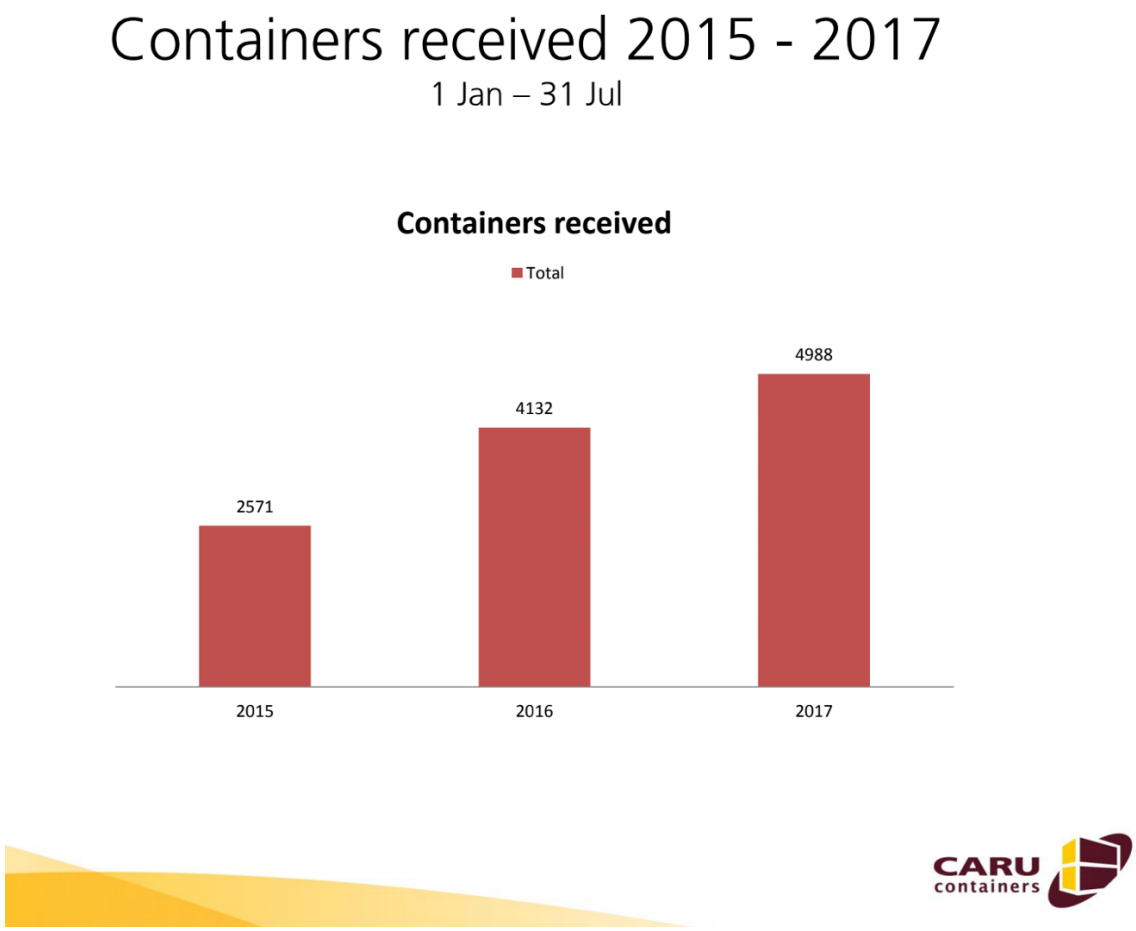

FIGURE 8, MSC CONTAINERS RECEIVED IN THE USA MARKET OVER THE YEARS

Figure 8 shows a very significant increase in terms of total received containers by CARU. This underlines the already addressed importance of the USA market and its potential for the coming years.

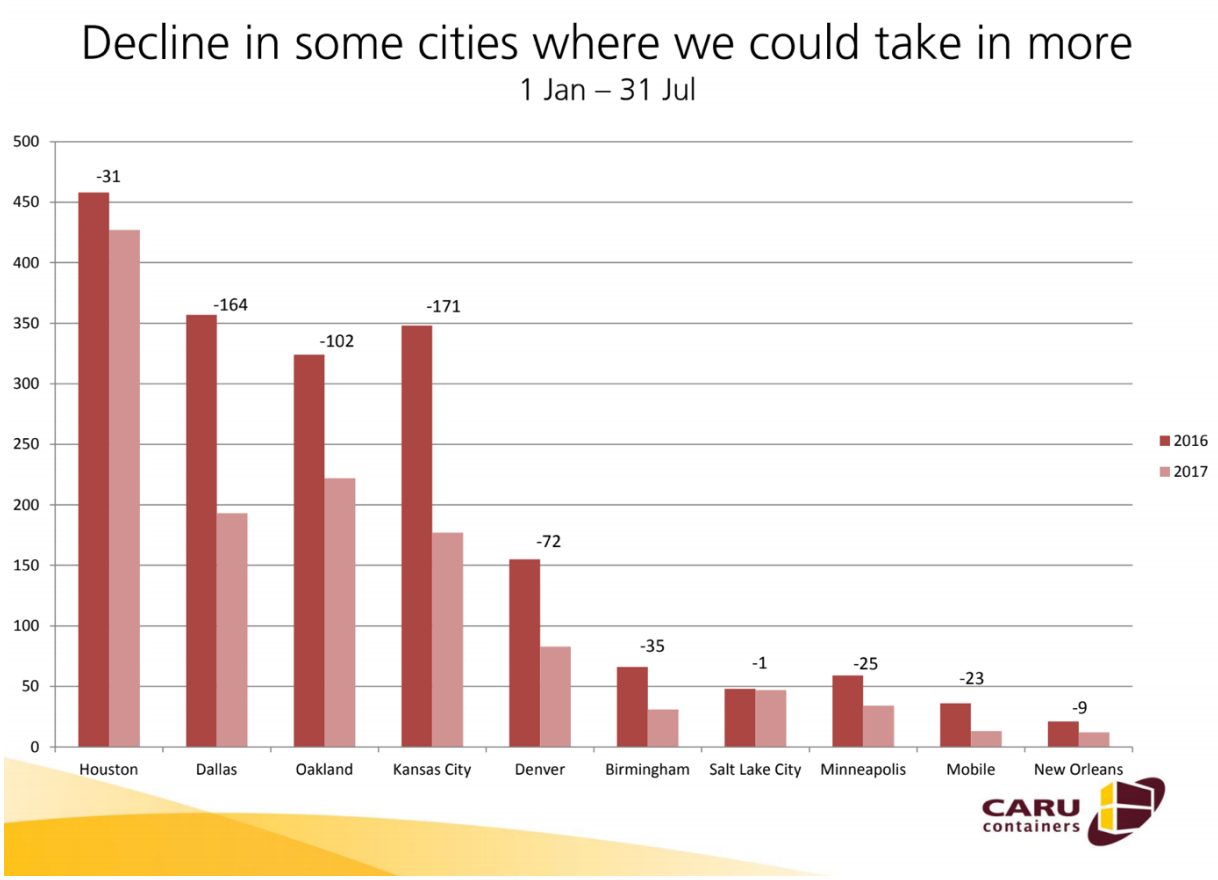

FIGURE 9, CRUCIAL LOCATIONS

Where figure 8 shows data concerning the total USA market, figure 9 focusses on specific cities. The geographical scope is narrowed down to a location specific level. Dallas, Oakland and Kansas City are locations that need extra attention. Figure 9 clearly shows a huge decline in received containers for these cities. The decline in received containers has impact on the capture rate for these cities.

Figure 10 shows the capture rate per city. A capture rate of 1 means that all the available MSC containers are bought by CARU. The green indicated cities are locations that need extra attention. The capture rate for those areas has declined while the selling possibilities are high in these areas. For CARU it is thus crucial to take in more MSC containers since there are good business opportunities.

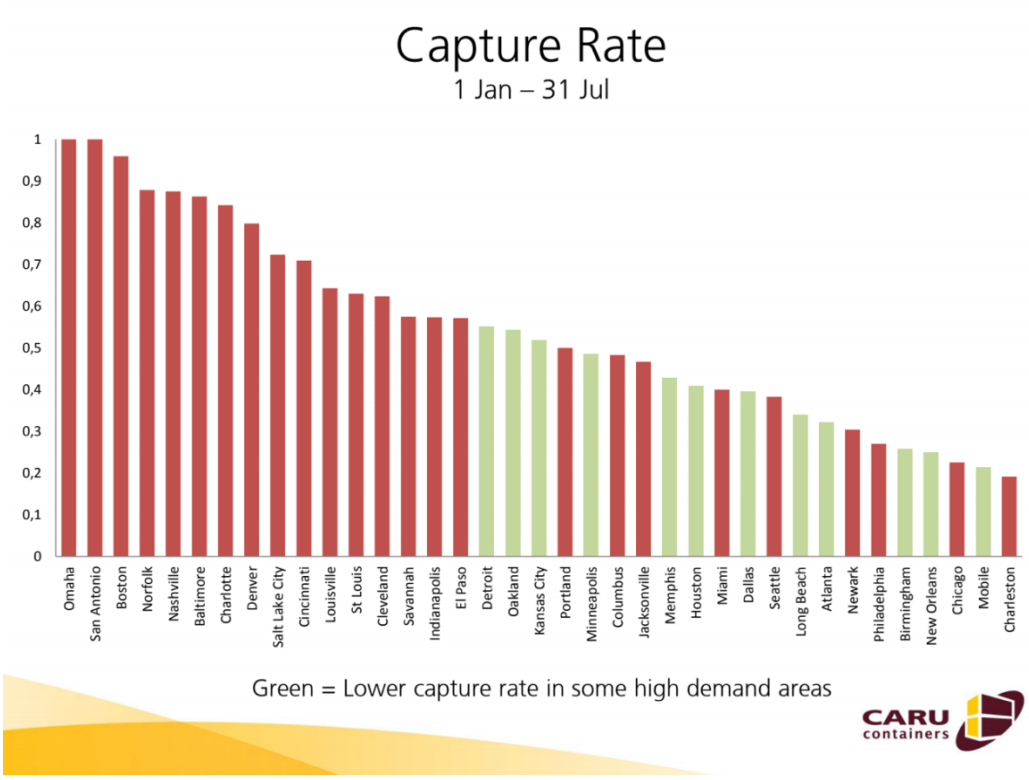

FIGURE 10, CAPTURE RATE PER CITY

The capture rate is simply calculated by the following formula:

$$\frac{MSC\ Containers\ bought\ by\ \ CARU}{Total\ available\ MSC\ containers}$$

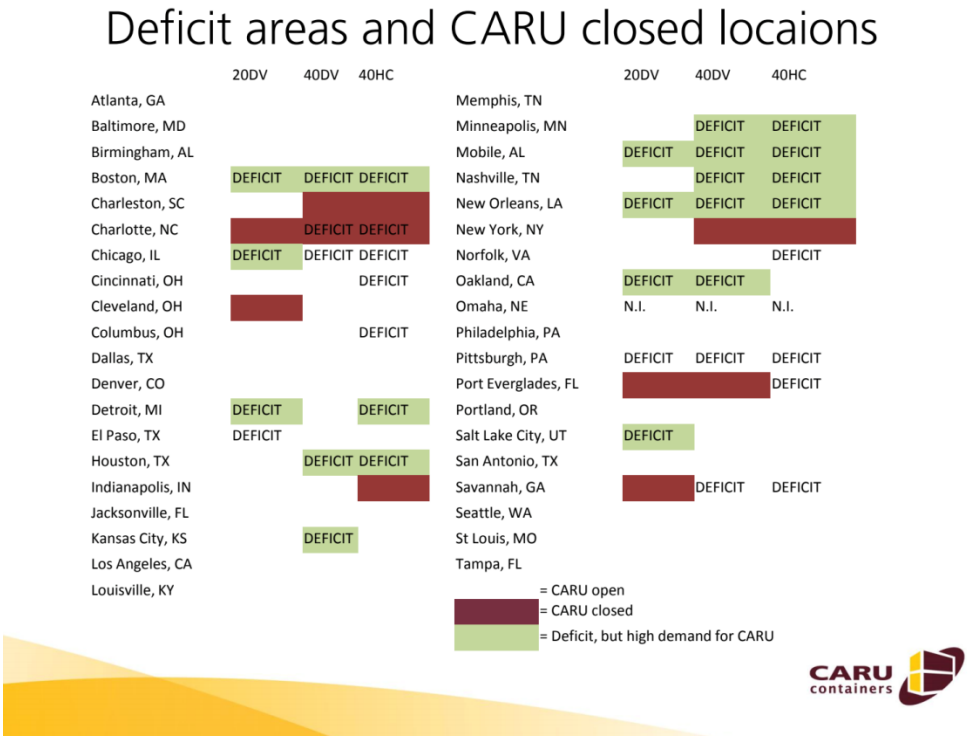

FIGURE 11, OVERVIEW PER LOCATION

Figure 11 shows CARU's 'list'. Per city is indicated if it is a 'open' 'closed' or/and 'deficit' area.

Besides the data presented in figure 9-11, the MARAD report could be used. As described before, this report contains the import and export flows for the USA market in TEU are presented for the period 2000-2015. In total, the import flows measured in TEU are almost twice as much as the exports in TEU for this period.

5.4.3 QUANTITATIVE VERSUS JUDGMENTAL FORECASTING

One of the topics described in the literature review about forecasting is the difference between quantitative and judgmental forecasting. The main conclusion made regarding these two different approaches is that the introduction of quantitative forecasting techniques could be very beneficial for CARU. The first chapters is made clear that it is hard to use the quantitative techniques because of the lack of data and required expertise to use the described forecasting techniques. As addressed in the previous sections, this case-study makes a shift to a more local market. The shift in geographical scope led to more precise and applicable data. The following section analyzes if the availability of more practical data changes the main conclusion made in the first four chapters. If this is the case, quantitative forecasting techniques could probably get the upper hand instead of sales employee's experience and feeling for the market, which could be addressed as judgmental forecasting techniques.

5.5 ANALYZING POSSIBLE QUANTITATIVE RELATIONS

In chapter two, the different quantitative forecasting techniques are extensively described. The lack of usable data about the global second-hand container market led to the conclusion that it is not possible to use the analyzed techniques to forecast the global supply. With help of the data presented in section 5.4.2 the conclusion will be different when analyzing the USA market. Where chapter two described both simple and comprehensive techniques to create forecasting models, here just correlations are analyzed. Per relation is concluded if there is a possible significant relationship. Relations between variables can help with constructing economic and econometric models. The difference between an economic and an econometric model can be described with help of the following example (Haaren, 2016).

Economic model:

Supply location Y = f (Trade Balance Location X, Price New container)

Econometric model

*Supply location Y = β0 + β1*Trade Balance Location X + β2* Price New container + U*

Economic models basically make clear that a certain phenomenon Y is influenced by some variables X. Econometric models try to explain relationships by looking for significant and causal links between variables. Another difference is that econometric models allow for uncertainty by incorporating *"U",* the unobserved error term. Econometric models can also be derived from a deterministic economic model by allowing for uncertainty, or from an economic model which itself is stochastic (Woolridge, 2013).

A significant relation is not necessarily a causal one. Causality is the natural agency or efficacy that connects one process (the cause) with another process or state (the effect), where the first is partly responsible for the second, and the second is partly dependent on the first. You could say that it tries to answer the "Chicken or the egg question". However, there are different forms of causality; the following example will explain this.

X > Y

- *Causal effect.*
- *USA Trade Balance > Supply of second-hand containers.*
- *The USA Trade Balance significantly influences the supply of second-hand containers.*

Not X< >Y

- *Bi-causal relationship (simultaneity).*
- *USA Trade Balance < > Supply of second-hand containers.*
- *They both influence each other and it's not clear in which way.*

Not X < Y

- *Reverse causality.*
- *USA Trade Balance < Supply of second-hand containers.*
- *The USA trade balance is significantly influenced by the supply of second-hand containers.*

Not X > Y, because Z > X and Z > Y

- *Price new built container > USA trade balance + Price new built container > Supply of second-hand containers.*
- *A neglected variable causes the effect.*
- *Omitted variable bias.*

What also should be mentioned is that there exists no easy test to evaluate causality. To address a hypothesis concerning a causality problem, three questions should be evaluated according to (Haaren, 2016). Does the relation make sense form a theoretical perspective? Are enough other variables held constant? And; does the analysis approximate an ideal experiment to establish causality? The use of econometric models is recommended when looking for causal relations. Linear regression models like Ordinary Least Squares can be seen as one of the basic techniques to use when constructing econometric models, but there are many different techniques (Woolridge, 2013).

To conclude, this case-study is part of this research to analyze if a shift in geographical level changes the conclusion made that quantitative techniques are not applicable for CARU. This section therefore makes a start in analyzing possible relations. Hereby the focus will be on 'more basic' correlation analyses. Correlation can be described as a statistical measure (expressed as a number) that describes the size and direction of the relationship between some variables. The question if that relationship is causal or not is not answered.

5.5.1 CONTAINERS RECEIVED X USA TRADE BALANCE

The relation between the received containers from MSC and the USA trade balance is analyzed in this section. Finding a relationship between these variables could be of value for CARU to forecast the future supply from MSC. Figure 8 shows a huge increase in the number of received containers for CARU from MSC in the USA market. Where CARU received 2571 containers in the first seven months of 2015, they received almost double two years later. On the other hand, the USA trade balance regarding goods for 2017 is presented in figure 7. The negative trade balance for 2017 confirms that the USA should be seen as an import oriented country.

To relate the huge increase in received containers for CARU with the USA trade balance, the trade balances for 2015 and 2016 are also retrieved (www.census.gov, 2017). To test the correlation in the most optimal way the assumption is made that the number of received containers by CARU is evenly distributed over the first 7 months each year. The result of correlation test is presented in figure 12 and calculated based on Pearson's correlation coefficient, the most used and accepted method to calculate the correlation between two

variables X and Y (Woolridge, 2013). After entering the available data in STATA and recognizing the low availability, the decisions was made to calculate the Pearson's correlation coefficient by using Microsoft excel.

Period	Containers received	USA Trade-Balance in milions
2015-01	367	$ (62,786)
2015-02	367	$ (57,431)
2015-03	367	$ (70,193)
2015-04	367	$ (61,293)
2015-05	367	$ (60,364)
2015-06	367	$ (63,231)
2015-07	367	$ (60,581)
2016-01	590	$ (62,907)
2016-02	590	$ (64,275)
2016-03	590	$ (56,653)
2016-04	590	$ (57,846)
2016-05	590	$ (60,796)
2016-06	590	$ (63,705)
2016-07	590	$ (61,114)
2017-01	713	$ (68,161)
2017-02	713	$ (64,334)
2017-03	713	$ (64,863)
2017-04	713	$ (67,047)
2017-05	713	$ (66,221)
2017-06	713	$ (63,879)
2017-07	713	$ (63,762)
	Correlation Coefficient:	-0.31821429

FIGURE 12 CALCULATION OF CORRELATION COEFFICIENT BETWEEN CONTAINERS RECEIVED AND USA TRADE

The calculated correlation coefficient of -0.318 tells us that there is no direct significant relation between the two variables on a 5% significance level. This is no surprising result since it is clear that the USA trade-balance is not the only variable influencing the number of received containers for CARU. The fact that the correlation is negative indicates that a further decrease of USA trade balance will increase the number of received containers for CARU, or vice versa. Since this is just a correlation coefficient no statement can be made regarding the causality. Further analyzes could be done in which control variables are used to create a more extensive econometric model to analyze possible causality. A more obvious explanation for the increase in received containers, and at the same time a compliment for CARU, could be the effort putted in by CARU employees.

5.5.2 DECLARING THE DEFICIT AREAS

CARU has to deal with deficit areas. As described in section 5.4.2 a deficit area is a location where MSC's exports transcends their imports. Such a 'positive' trade balance of MSC results in higher container needs for MSC because they have to use their containers to meet the export demand. The chances for MSC to sell containers, as a consequence of a surplus or

lack of storage space, are lower in these areas, which is negative for CARU. Such areas could also be described as 'hard areas' for CARU to operate because in these areas the supply from MSC is doubtful. In these areas CARU should try to improve their capture rate to outperform their competitors. A rise in capture rate means a bigger share of the MSC supply for CARU. Having a bigger part of the pie, compared to competing resellers of second-hand containers, provides more profit opportunities.

In this section, the trade balance following the MARAD report will be analyzed on a city-level to analyze the correlation between the trade balance and deficit areas. Figure 11 showed CARU's 'list' with an overview per location where CARU is active. Deficit areas that are also included in the MARAD report are: Boston, Houston, New Orleans, Oakland, Port Everglades and Savannah. Figure 13 presents a table in which the trade balance (measured in TEU) per deficit area for a 15 years' time period is shown.

Analysis of the Deficit Areas	Boston	Houston	New Orleans	Oakland	Port E.	Savannah
Total Exports in TEU 2000-2015	806,246	11,135,732	2,739,685	10,664,709	5,244,430	6,783,946
Total Imports in TEU 2000-2015	1,306,124	9,059,050	1,373,718	10,831,248	4,029,834	14,692,184
Trade Balance 2000-2015	(499,878)	2,076,682	1,365,967	(166,539)	1,214,596	(7,908,238)

FIGURE 13, ANALYSIS OF DEFICIT AREAS

What immediately stands out is that some of CARU's deficit areas have a positive trade balance and some have a negative trade balance. Solely based on this finding could be concluded that there is no significant correlation between 'MSC's trade balance' and the USA trade balance measured in TEU. To make better or more complete statements about the relation between, the by CARU identified, deficit areas and the USA trade balance an econometric logit or probit-model could be created. Logit and probit-models are regression models in which the dependent variable can take only two values (Woolridge, 2013). In this case the, a location being a deficit area or not, is the dependent variable which makes a logit or probit model a good fit.

5.5.3 A CLOSER LOOK AT TWO "DECLINE CITIES"

In this section, the geographical scope is narrowed down to a city specific level. Figure 9 focusses on specific cities. The decline from 2015 to 2016 and 2016 to 2017 is presented for the "decline cities". As the name tells, the "decline cities" are locations where the supply for CARU has decreased in recent years. Out of the top three decline cities, Houston and Oakland are both included in the data set from the MARAD report. This makes it interesting to analyze those two locations.

5.5.3.1HOUSTON, WE HAVE GOT A SMALL PROBLEM

As can be seen in figure 9, the number of received containers from MSC in Houston declined with 31 TEU. This 7% decrease is, as the title of this section indicates, a small problem for CARU. In figure 11 is already made clear that Boston is a deficit area and figure 13 showed a positive trade balance for Houston over the years 2000-2015. Since it is just an absolute decline of 31 containers there will not be very serious consequences for CARU. However, as described in the previous section, it is of importance for CARU to increase their capture rate to outperform their competitors in deficit areas. This is why a location as Houston deservers some extra notice and why it is marked green in figure 10. The positive trade balance for Houston regarding the total USA good flows in TEU could be an explanation for Houston being a deficit area. However, to get better insights and track possible causal relations, more data is required.

5.5.3.2 OAKLAND, WE HAVE GOT A SERIOUS PROBLEM

Just as Houston, Oakland is market as deficit area in figure 11 and market green in figure 10. Figure 9 shows a decrease that might deserve more attention compared to Houston. The number of received containers from MSC in Oakland declined with 102 TEU, which is a decrease of more than 30%. The absolute decline of 102 TEU deserves more attention since it seriously affects the capture rate for this location. Also, worth mentioning is the given fact that, in contrast to Houston, Figure 13 shows a negative trade balance for Oakland over the years 2000-2015.

5.5.3.3 DECLINE CITIES X TRADE BALANCE

What could be concluded with certainty is that one of the decline cities, Houston, has a positive trade balance regarding the total good flows in TEU following the MARAD report. The other decline city, Oakland, has a relative small but negative trade balance. When only looking at these two locations and these variables, one would say that there is no correlation between the trade balance and decline. However, just as noticed in the other analyzed relations, an econometric model should be created to analyze possible significant causal relations. Also, worth mentioning is that the focus is on a specific geographical market in this analysis and very little data is used. A small change in market circumstances, like the replacement of an MSC agent, could already be the explanation for the decrease measured in just one year. Historical data regarding the by CARU received containers in the years 2000-2015 would be of great value to expand the current used data-set and make more extensive analyses.

5.6 CONCLUSION

In this case study, the geographical scope has been narrowed down to the USA market. The USA market is an import oriented market with interesting characteristics and huge potential, which makes it an interesting market for CARU. The more local scope, to neglect the geographical differences, led to more specific data related to cities and ports. Based on the more extensive data more telling useable relations could be analyzed. The general goal of this research is to deal with de MSC-dependency. This case-study has brought to light that cooperating with MSC and scoping down on specific locations is the key, when dealing with the independency. Cooperating could lead to win-win solutions in which CARU can try to improve their capture rate in deficit areas, their main goal. Scoping down to a city level in the second part of this case study showed that more specific data is required to analyze significant causal relations.

Overall could be concluded that this case study showed that quantitative forecasting techniques might be beneficial for CARU when the focus is on specific locations and there is enough data available. Improving the communication with MSC local agents could help by gathering the required usable data. The next chapter presents a case study that goes deeper to the core of the relation with MSC.

6. CASE STUDY 2: A CLOSER LOOK AT THE MAVERICS OF THE MEDITERRANEAN

The first case study focused on the effects of narrowing the geographical scope and focussed on the USA market. The main conclusion made is that scoping down on a specific location is associated with more applicable data based upon which possible relations could be analyzed. However, to analyze significant causal relations, there is more data required. A suggestion made in the case study is that better cooperating with MSC could help in obtaining more data. But; *does better cooperation with MSC decrease or increase the dependency on CARU's main partner?*

This case study focusses on the relationship between CARU and MSC and describes possible scenarios that could occur in the market outside CARU's circle of influence. Section 6.1 describes the history and characteristics of MSC as a company. Section 6.2 describes four possible scenarios for the long-term future and section 6.3 gives the implications of these scenarios for CARU. In section 6.4 recommendations for CARU and an answer on the question formulated above are given.

6.1 THE MEDITERRANEAN SHIPPING COMPANY

As presented on their own website, MSC is a world leader in global container shipping and a company offering global service with local knowledge. The relationship between CARU and MSC is already discussed in section 3.1.3. MSC sells shares of their superfluous containers to CARU via local agents at places all over the world. The fact that MSC is the second largest shipping line in the world in terms of market share according to Championfreight (2017), makes cooperation with them of great value for CARU. This section tries to describe MSC's business vision by looking at their history, their decisions made over the years, their future and a comparison with their competitor and partner; Moller–Maersk Group, the largest shipping line in the world in terms of market share.

6.1.1 MSC'S HISTORY & MSC NETHERLANDS

MSC was founded in Naples in 1970 as a private company by the Italian Gianluigi Aponte and started as a shipping line operating between the Mediterranean and Somalia. In the late 70's MSC expanded quickly by purchasing second-hand cargo ships and expanding their geographical boundaries to northern Europe, Africa and the Indian Ocean. Their growth continued in the 80's by entering new geographical markets; North America and Australia. In the 90's, MSC entered a different 'product market' by purchasing cruise ship operator Lauro Lines and renaming it to "MSC Cruises". The main focus of MSC is still in the cargo handling and that is also where this research focuses on.

As of October 2014, the second generation of this 'family owned company' took over when Diego Aponte, son of founder Gianluigi, was named president and CEO of MSC. Gianluigi remained active within the company as group executive chairman to support his son in shaping the future of MSC. The Italians would name him the consigliere in his new role.

Today, MSC is one of world's leading container shipping lines and their headquarters is located in Geneva, Switzerland. MSC operates worldwide with almost 500 offices across 150 countries, 490 vessels, employing over 24000 employees and sailing more than 200 trade routes using over 500 ports. Antwerp is MSC's most important port but its neighbor Rotterdam is also used a lot (www.msc.com).

6.1.1.1 MSC NETHERLANDS

MSC Netherlands operates from the Delta Marine Terminal. The main office of MSC Netherlands is located in Rotterdam and managing director in Holland is Theo van Ravensteyn. MSC Netherlands focusses on exporting machinery and equipment, chemicals, fuels and foodstuffs. Regarding the import, the most common products are comparable however; clothing is also one of the main products imported by MSC Netherlands. Concerning the geographical markets; MSC Netherlands focusses on Germany (26,5%), Belgium (13.7%) and France (8.8%) regarding the export. When looking at the import; economical giants as China (12%), Russia (6.4%) and USA (6.1%) are important markets (www.msc.com). This difference in geographical markets is probably caused by the function of the Netherlands in the world economy. When looking at the port cluster of Rotterdam and its hinterland one could say that Rotterdam functions as hatch for the Europe

consuming market (de Langen, 2004) (Van Klink, 1998). A Port cluster could be defined as a geographical area nearby a port with organizations that mutually benefit from the geographical location. Actually, it is like a population of geographically concentrated and mutually related business units, associations and public and private organizations centered on a distinctive economic specialization (de Jong, 2016). In the context of Rotterdam as a port cluster functioning as hatch for the European consuming market, it is not surprising that Hollands neighbor countries are the main destinations regarding MSC's export. The importance of economical giant China regarding the import for MSC is as well easily explained in this light since it is a leading producing economy. This substation also applies to MSC Netherlands other main location, the port cluster Amsterdam.

6.1.2 THE MAVERICKS OF THE MEDITARREAN?

When looking at the organizational structure of MSC, one of the striking things to mention is that it is a family owned company. The main consequences of the fact that MSC is registered at the chamber of commerce as a private company, what is in Dutch called BV, is that it is not obligated to publish their financial reports. This in combination with its Italian roots, the characteristics of the container industry and Somalia as their first geographical market, can lead to association with a typical maverick approach of being independent and different from other carriers. MSC dominates worldwide 'legal product markets'. The fact that they are the second biggest shipping line in the world makes it easier to say that MSC is a successful company.

6.1.2.1 CHARACTERISTICS

In this section, the main characteristics of MSC are discussed by analyzing their business vision by decisions made in the past. The discussed characteristics are compared to MSC's biggest concurrent but also partner, Maersk shipping line. The cooperation between these two European shipping lines is called 2M and plays a major role in this case study.

Family owned company

As already mentioned, MSC is a private company with less duties compared to limited companies. One of the consequences of this given fact is that a private company has no obligation to publish annual reports certified by independent parties and as a consequence of this, the data MSC releases about itself is not verifiable. Another consequence of being a

private company is that there is, in general, less hierarchy and faster decision-making. Where a limited company has several different stake holders which are obliged by law, a private company does not have to comply with these rules. When MSC for example wants to buy 10 new ULCV's, there is no one with a veto-right or other instrument to block this decision and it is "Don Aponte" who makes the final call. Compared to private companies, limited companies are obliged to have different parties in the decision-making process like a supervisory board and shareholder meeting. Consultation between the different organs of limited companies could delay the decision-making process. The other way around, having more parties that evaluate a certain investment opportunity could lead to a better decision (Lokin, 2015). Every medal has two sides.

Product driven?

As described before, MSC is not only active in shipping cargo containers. It has a separated 'product' which is the cruising line industry. By purchasing cruise ship operator Lauro Lines they entered a new product market. Does this make MSC a product driven company? A product driven company could be described as a company that focusses on selling their product in as many markets as possible while focusing on their product by optimizing it. Such a company looks at its offerings and strives to improve them continually. There is a constant drive to make the product or service better, and the strategy of the business revolves around differentiation tied to product superiority (Cravens, 2003).

When looking at shipping containers as a 'product' one could argue that MSC is a product driven company since it constantly tries to optimize their product for their customers all over the world. Being a 'product' driven company could be described as being internally focused. Such companies identify improvements from the inside out by analyzing possibilities to improve their way of doing business within their own possibilities. The improvements are identified by looking at customer desires. When looking at choices made by MSC in the past, a good example is the purchase of eleven 22,000-TEU vessels last year. The purchase of eleven new container ships has been an important decision with great consequences for the future. It was not only the largest order in MSC's history but also one of the biggest ever in the containership industry (Knowler, 2017). One could argue that this decision confirms MSC's product driven focus since it has as goal to improve the shipping qualities to meet the

customer's desires. Having more and bigger ships helps MSC to meet possible increasing demand in future years.

Market driven?

In comparison to a product driven company, a market driven company could be described as externally focused. A market driven company looks outside the company and analyzes their markets to make strategic and tactical decisions. Market focus means understanding your customer's behavior. It also means knowing your competitors and anticipate based on their strategy or tactic. When looking at the previous used example about MSC's purchase of eleven 22,000-TEU vessels, which was addressed as a product driven strategy, one could also argue that this should be seen as a market driven strategy. Some of the Asian competitors also made huge orders regarding new vessels in the years before MSC decided to order theirs. A list of the biggest vessels that are currently used is presented in figure 14.

15 largest container ship classes, listed by TEU capacity

Built	Name	Class size	Maximum TEU
2017	*OOCL Hong Kong*	6	21,413
2018	*CMA CGM Antoine de Saint Exupery*	3	20,776
2017	*Madrid Mærsk*	11	20,568
2017	*MOL Truth*	2	20,182
2017	*MOL Triumph*	4	20,170
2018	*COSCO Shipping Taurus*	5	20,119
2015	*Barzan*	6	19,870
2016	*MSC Diana*	6	19,462
2016	*MSC Reef*	6	19,437
2016	*MSC Anna*	2	19,368
2018	*COSCO Shipping Aries*	6	19,237
2015	*MSC Oscar*	6	19,224
2014	*CSCL Globe*	5	18,982
2013	*Mærsk Mc-Kinney Møller*	20	18,270
2015	*CMA CGM Vasco de Gama*	3	17,859

FIGURE 14; LIST OF LARGEST CONTAINER VESSELS (RETREIVED FROM WIKIPEDIA, DATA FROM WWW.MARINETRAFFIC.COM)

Another example that substantiates the market driven approach of MSC is the Alliance with Maersk, which will be addressed more in detail later in this case study. Midoro et all. (2005), addressed that cooperation has always characterized the liner sector in which strategic alliances, mergers and acquisitions have generated synergy and win-win situations. The alliance with Maersk has been very important for MSC. Especially last decade, with the explosion of the Asian market, MSC and Maersk have to cooperate to maintain their positions. The cooperation between the two European leaders could be perfectly seen as a market driven strategy. Since the shipping liner industry is characterized by alliances, cooperating with another European party is the perfect tactic to fight competitors established in other geographical markets (Midoro, 2005).

Data driven?

The alliance with Maersk is called 2M. By cooperating, MSC and Maersk line try to remain in control in their positions as leader in the shipping line industry. An example of how they work together is the vessel share agreement (VSA) 2M. This agreement made between the two European giants is seen as a reaction on the decision of China's Ministry of Commerce to refuse the P3 alliance, in which the France CMA CGM would also be a participating party. As the name says, a VSA is an agreement to share vessels and trade routes. 2M includes almost 200 vessels which sums up to a capacity over 2 million TEU. Figure 15 shows an overview of the existing alliances in the market in 2017 (Maersk, 2017).

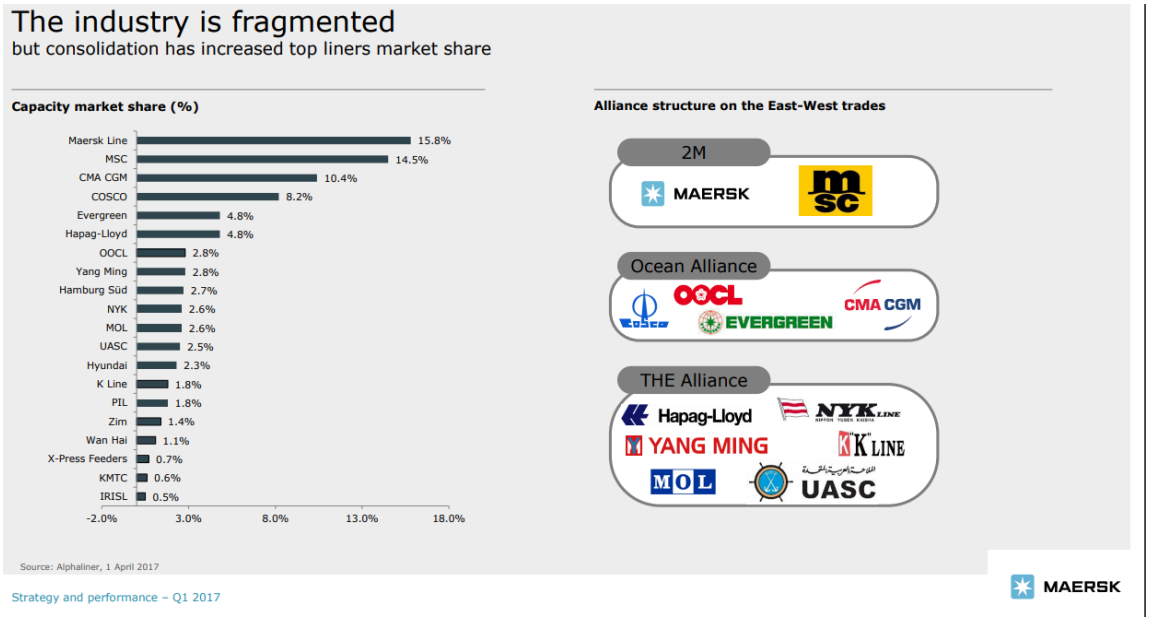

FIGURE 15; OVERVIEW OF THE ALLIANCES (MAERSK, 2017)

When comparing the business culture of MSC with its 2M partner Maersk, the main difference is its degree of proactivity. As addressed before, MSC could be seen as both a product driven and market driven company. In contrary, Maersk can be considered as a data driven company. The publicly presented report in which their strategy and performance is presented underlines this. Their position as market leader in the shipping line industry is due to its proactive attitude. By making high R&D expenses, they try to remain market leader with a progressive and innovative vision. A good example is the current block chain development that is going on. Maersk is proactively trying to remain market leader by keeping up with technological developments in 'other markets'. A partnership with IBM to develop block chain opportunities underlines this (Linnet, 2018). Another example that

underlines the difference in Maersk's vision compared to MSC's is the decision made by them to become a global integrator. Besides their ocean activities they want to become a complete logistic service provider (Baker, J., 2018).

MSC on the other hand operates more reactive and conservative. As addressed earlier in this research they were not able to share data with CARU, a serious partner, which leads to the conclusion that they do not gather a lot of data. MSC basically analyzes their products and markets, when chances occur they hit directly without having long consolation procedures and data analyses. The purchase order of the eleven MSC vessels can be mentioned again to underline this. Where MSC followed competitors by buying huge vessels, Maersk waited to see which way the wind blows. The bankruptcy of Hanjin more or less confirmed Maersk's 'wait and see attitude' since Hanjin went partly down on overcapacity, which raised questions about the development of the use of ULCV's.

Concerning the use of data in doing business MSC is not comparable to its partner and competitor Maersk. However, it should be kept in mind that MSC is a private company with fewer obligations to present their way of doing business to the outside world.

6.1.3 CONCLUSION MSC

As second shipping line in terms of market share, cooperating with the number one, MSC's future looks bright. However, with current market developments, every leader should watch his back and look forward. The Vikings of Norway and the Mavericks of the Mediterranean are currently dominating the worldwide shipping line industry but modern day's developments as the block chain technology can cause revolutions. The relation with MSC is a big asset for CARU. However, the characteristics of MSC as described in this section can be a cause for concern. MSC could be seen as a reactive company that acts abruptly with a more short-term thinking vision compared to its partner Maersk. MSC's short-term thinking in combination with their abrupt acting is something to keep in mind for Caru's management. The relation with MSC must be cherished for as long as it could but with regard to their short-term thinking and product/market driven approach, Caru should not follow their strategy. A data driven and proactive approach, like Maersk, is a better strategy and could help in reduce the dependency on MSC. In the next section four possible scenarios are described for coming decade.

6.2 POSSIBLE SCENARIOS

In this section, four scenarios are presented about MSC's long term future. The implications of these scenarios for CARU are discussed in section 6.3. The scenarios are based on two crucial factors that will influence MSC and Caru's future. The first factor is the *technology development*. The horizontal axis in the matrix represents this factor. The two scenarios on the right side of the matrix are scenarios in which the technology has made big progress. The scenarios on the left side are characterized by lacking technology development. For example, the implementation of the block chain technology could cause a lot of change in the market. *Alliance structure* is the second crucial factor in constructing the four scenarios. As described in the previous section, the 2M alliance is dominating the market at the moment. Previous years have shown that these alliances are not solid since they have shifted over the years. In the two scenarios at the top of the matrix, the alliances are shifted and the partnership between MSC and Maersk has ended. In the scenarios at the bottom of the matrix the alliances remained intact.

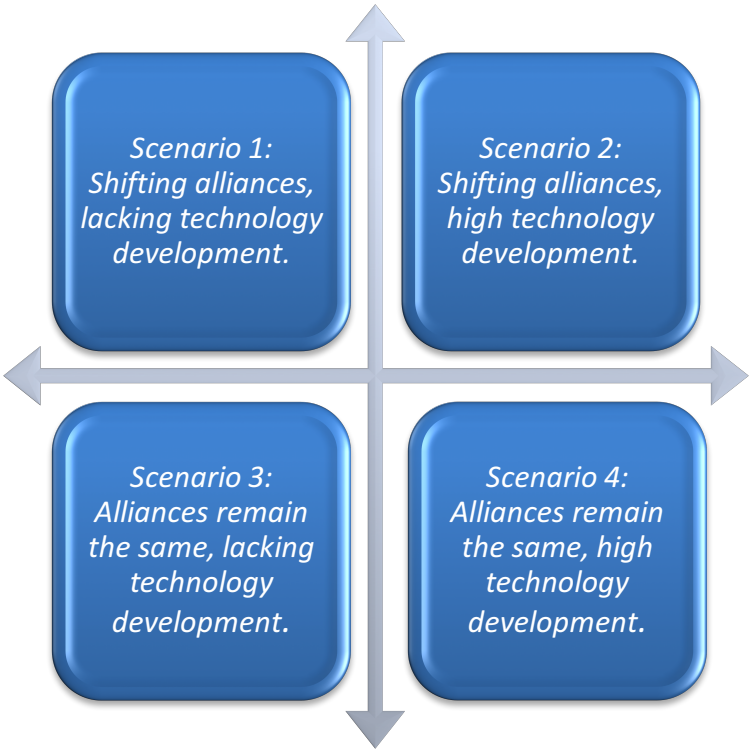

FIGURE 16, MATRIX OF THE SCENARIOS. THE HORIZONTAL AXIS REPRESENTS THE TECHNOLOGY DEVELOPMENT, THE VERTICAL AXIS REPRESENTS THE ALLIANCE STRUCTURE.

6.2.1 SCENARIO 1: *THE MEDITERRANEAN MAVERICKS OF THE WORLD*

MSC is the big winner in this scenario. In this scenario, the alliances shift and the technology developments stay behind. Maersk already made clear to the entire market that they want to become a global integrator. The use of block chain plays a big role in their plans but in this scenario the technology stays behind and the application of block chain fails. Maersk focused too much on R&D and implementing the block chain technology which appeared to be the wrong course to sail. This shift in vision will lead to a shift of focus for Maersk. In this scenario, MSC sees this as an opportunity to take over a great share of Maersk's shipping routes. The change of vision by Maersk could be seen as a temporary weakness for its shipping operations because it takes a lot effort and focus to become a global integrator. MSC's aggressive attitude regarding market opportunities as described in section 6.1.2.1 makes Don Aponte choose for an attack on its partner Maersk. The M2 alliance will come to an end with MSC as the big winner on the seas. MSC will win the battle due to its sole focus on the shipping activities. The victory over Maersk will be seen as a sign of power to the entire market and will lead to new alliances in which MSC will strengthen its position.

6.2.2 SCENARIO 2: *THE VIKINGS CONQUER THE WORLD*

The current alliance with Maersk, 2M, exudes a lot of confidence to the whole market. By working together with Maersk, MSC could remain one of the main shipping lines in the world. Especially in good times it is seductive to take it easy for a while. Pride comes for the fall, and when Maersk sees a chance to enlarge their market share at the cost of MSC, they will probably take their chance. In this scenario, the 2M alliance will come to an end with Maersk as the big winner. The technology has made big progress and Maersk used the technology to outperform MSC. MSC lose the battle due to a lack of vision for the future. Maersk, The Vikings, already made clear to the entire market that they want to become a global integrator. This means that they will focus on the whole container transport and logistics and not only on shipping activities. With this strategy, they will try to become the FedEx of the oceans. Maersk wants their customers to be able to ship their freight to the desired destination by just dealing with Maersk as logistic service provider. They promise their customers to take care of everything that is necessary for the shipment of their goods including the inland service, custom house brokerage, insurance and any services one could

think of. Block chain will be the main tool and the big culprit for MSC regarding this change of course made by their partner Maersk. Due to high technology developments, the new strategy of Maersk will lead to a situation in which they don't need to cooperate with MSC anymore. The disappearance of Maersk's support makes MSC weaker. While Don Aponte will look for a scapegoat, the Asian and American competitors who also incorporated block chain will smell blood and take over MSC areas. In the 21st century society in which we are living one should always be proactive while analyzing his business environment. Shipping lines are big companies that are active in places all over the world, working with distant contracts. The revolutionary block chain technology, which Maersk will incorporate in the coming years, will be decisive because of the possibility to use smart contracts.

6.2.3 SCENARIO 3: *THE VIKINGS AND THE MEDITERRANEAN MAVERICKS REMAIN IN CONTROL*

This scenario could be seen as the status quo. In this scenario, the alliances remain the same and 2M stays in control the coming decade by cooperating to remain shared market leaders. Besides this the technology development is lacking and the block chain protocol cannot fulfill its potential. MSC more or less benefits from the lacking technology development since they focus less on R&D. Even though Maersk will follow a different path based on data driven technologies, MSC manages to remain in control by using their feeling for the market. 2M is strong enough to remain in control. Especially in the coming years MSC will profit from the new route chosen by Maersk. The decision made by Maersk to focus on becoming an integrator that also takes care of the inland logistic services, provides opportunities for MSC to take over some of their shipping activities. Trust in each other is of high importance for 2M to survive in the coming years since the decision made by Maersk could be seen as a sign of weakness in the eyes of the Asian and American competitors.

6.2.4 SCENARIO 4: *MSC BECOMES A REACTIVE FOLLOWER*

In the last scenario, the alliances remain in control and the technology has made big progress. Maersk successfully implemented the block chain technology and succeeded in becoming a global integrator. The shift of focus made by Maersk created opportunities for MSC and they will take over some of Maersk share. In this scenario 2M remains in control and Maersk will keep dominating the market. However, this seems all good for MSC, their

lack of vision for the future and reactive approach remains a pitfall. MSC becomes a reactive follower lifting on Maersk dominance. By using the new options offered by the technology of the future, other liners will try to take over MSC's second position in the market. The Asian and American competitors will smell blood. MSC' reactive approach and lack of use of data will cause problems in this scenario.

6.3 IMPLICATION OF THE SCENARIOS FOR CARU

In this section, the implications and effects of the four described scenarios for CARU are analyzed. The next section gives a final conclusion of this case-study.

6.3.1 IMPLICATIONS OF SCENARIO 1

Scenario one becoming reality implicates a partnership with the world's leading shipping line from a CARU perspective. As described in the other scenarios; MSC gaining market share could be interpreted in two ways. A pro is that it creates possibilities to cooperate in more geographical markets. A con is that it will have a negative impact on the surplus of containers for MSC and thus the general supply for CARU. This scenario will lead to new alliances in the shipping line industry which creates uncertainty for CARU. However, MSC being the winner of the 'war' with Maersk is favorable for CARU compared to scenario two in which Maersk is the big winner.

Even though it could be beneficial when MSC enlarges their market share, it will create uncertainty in the market and change the alliances. As described before, certainty about the market circumstances is desirable since this is the most optimal situation for CARU to choose its own path to deal with the MSC dependency.

6.3.2 IMPLICATIONS OF SCENARIO 2

The fall of the 2M alliance, with MSC as the big loser, could be seen in two ways from a CARU perspective. On the one hand, a big defeat for CARU's main partner MSC is also a big loss for CARU, which makes this the worst-case scenario. Looking from this perspective MSC loses market share to the other big shipping lines which will probably lead to the withdrawal of MSC at multiple locations. MSC withdrawing from geographical locations implicates fewer opportunities for CARU to do business in these areas by cooperating with MSC's local agents.

On the other hand, this scenario could be seen as a big win for CARU. The loss of market share for MSC will lead to a surplus of containers for MSC which will probably lead to high supply of second hand containers for CARU at several locations. In general, MSC losing the fight with Maersk is no desirable situation for CARU. Even though it could be beneficial on the short term regarding the surplus of containers coming available, the disappearance of possibilities to cooperate with MSC on the long-term weighs heavier.

6.3.3 IMPLICATIONS OF SCENARIO 3

The third described scenario is the status quo. In this scenario, not that much will change concerning the alliances and 2M will stay in charge. This scenario could be described as desirable from a CARU perspective. The different path chosen by Maersk will create opportunities for MSC to increase their market share at sea while Maersk focusses on inland logistics. The increase of market share by MSC could lead to a situation in which MSC becomes active at more geographical markets which means more locations for CARU to do business with local agents working for MSC. On the other hand, the increase of market share for MSC will have a negative impact on the surplus of containers for MSC. MSC having fewer surpluses implicates less supply for CARU.

In general, the status quo scenario is favorable for CARU. The market alliances have a big influence in the container branch. Knowing that the alliances remain intact gives CARU the opportunity to choose its own path.

6.3.4 IMPLICATIONS OF SCENARIO 4

In the last scenario MSC becomes a reactive follower due to the technology developments. From a CARU perspective this scenario is not desirable when MSC loses market share to other liners. If MSC manages to take over a piece of Maerks's share CARU could benefit. Like in scenario three, the increase of market share by MSC could lead to a situation in which MSC becomes active at more geographical markets which means more locations for CARU to do business with local agents working for MSC. CARU must try to anticipate on this by hiring more local agents and focusing on data and R&D to get insights in these possibilities.

6.4 CONCLUSION & RECOMMENDATION FOR CARU

In this case-study a more in-depth research has been conducted into MSC as a company. Section 6.1.3 concluded that MSC could be seen as a more reactive company that acts abruptly with a more short-term thinking vision compared to its partner Maersk. One of the main differences between the two European shipping lines is the use of data. With regard to the use of data, it should be concluded that MSC lags behind. In earlier chapters was already concluded that CARU lacks data to perform proper quantitative analyses to create short-term forecasters. Better cooperating with MSC could be an option to get more useful data but does this reduce the dependency on them?

Four possible scenarios are described concerning the alliances and possible future changes in these alliances. Scenario three, the status quo scenario regarding 2M, is addressed as desirable since knowing that the alliances remain intact gives CARU the opportunity to choose its own path. The best option for CARU to deal with the dependency on MSC is following their main partner Maersk in terms of its data driven approach. Currently CARU could, just as MSC, be described as a reactive company that follows the market and takes chances when they occur. Increasing the data supply could help CARU to become more proactive by creating possibilities to improve the future insights in the secondhand container supply. The first and crucial step to increase the data supply is already taken by CARU. Currently a project team within CARU focusses on the implementation of Salesforce, a CRM platform which helps to become more data driven.

7. FINAL CONCLUSION

Based on all the information gathered, ordered and given in the previous chapters, in this Chapter, the final conclusion is given and answer on the research question is formulated. Besides the final conclusion, the limitations of this research and possibilities for follow-up research are given.

7.1 ANSWER ON THE RESEARCH QUESTION

CARU has to deal with the dependency on their main supplier of second-hand containers, MSC. To tackle the problem sales employees, deal with, the main purpose of this research was to find out where the supply of second-hand containers depends on and to analyze the possibility of using quantitative forecasting methods to forecast the short-term supply. The Formulated research question was as follows:

"Is it possible to forecast the short-term supply of second-hand containers using quantitative forecasting techniques?"

An extensive literature review analyzed the different forecasting techniques and the difference between judgmental and quantitative forecasting techniques. The conclusion that quantitative techniques could be useful for CARU prompted to further analyze the possibilities. After an outline of the second-hand container market was given and CARU's role in this market was described the main factors that influence the supply of second-second hand containers were discussed. Based on the described possible dependent variables and forecasting techniques, it was concluded that it is not possible to create a model that could help CARU employees with getting general insides in the global supply of second hand containers. The requirement that the constructed model should be easy to use and update by employees, contributed to this conclusion. Subsequently, a case study on the USA market showed that the above formulated conclusion might be different when the geographical scope is reduced to local markets. Shifting the focus to a smaller geographical market led to more practical data which made it possible to analyze relations based upon which an easy applicable forecasting model could possibly be created. Dealing with the dependency on MSC is further analyzed in the second case-study. The conclusion made in this case-study is that MSC could be seen as a market and product driven company which

makes them reactive. Their main partner in the 2M alliance, Maersk is addressed to be a data driven company, which makes them more proactive. The recommendation made for CARU is that they should take example of Maersk and become more data driven to deal with the dependency on MSC.

To conclude an answer on the research question could be formulated as follows:

Forecasting the supply of second-hand containers on a global level, using quantitative techniques, is not possible, under given limitations. The geographical differences worldwide and the lack of applicable data make it impossible to create a quantitative short-term forecaster. CARU employees currently rely more on their feelings for the market and prefer judgmental forecasting techniques when analyzing selling opportunities.
However, this research showed that reducing the geographical scope to local markets makes it possible to analyze correlations which could help CARU in forecasting the supply on specific locations. In the second case study is concluded that MSC is a more reactive company compared to its partner Maersk. Improving the cooperation with MSC would make CARU reactive too. Becoming more data driven, like Maersk, is a better option to deal with the dependency.

Figure 17 gives a visual overview of this research.

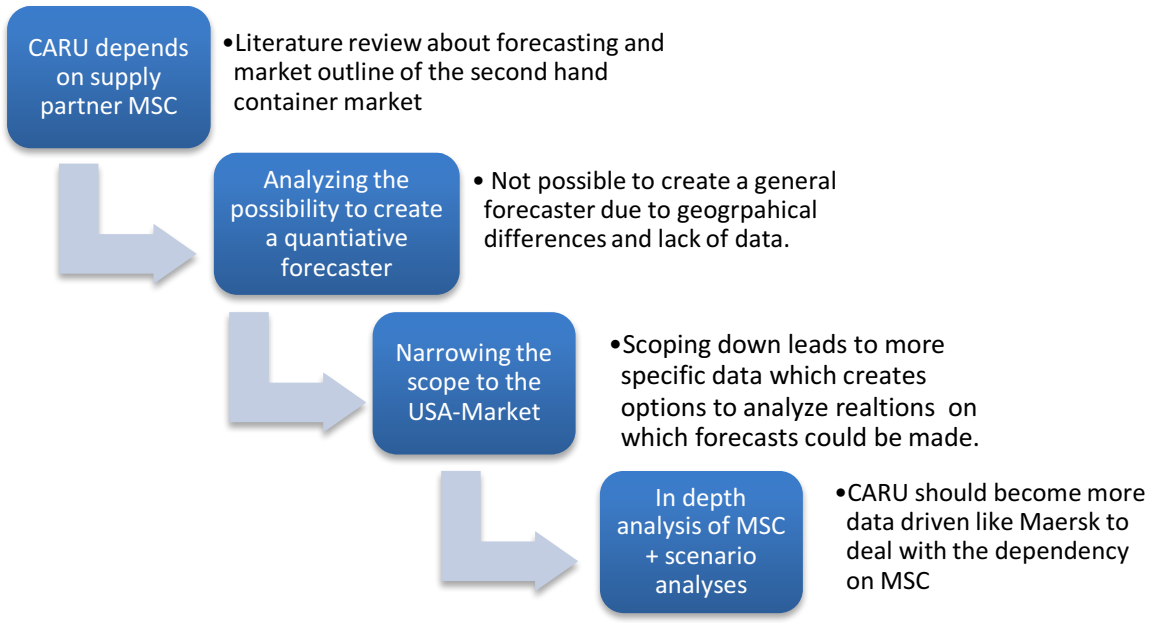

FIGURE 17 VISUAL OVERVIEW

7.2 LIMITATIONS

One of the main limitations of this research is the used data for the first four chapters. The conclusion made that quantitative forecasting techniques cannot be used to forecast the general supply of second-hand containers rests on incomplete data. Access to extensive data sets would increase the possibilities which might chance the conclusion made. With the current possibilities regarding big data analyzing and techniques as system dynamics, it might be possible to come to a different conclusion.
Besides this there are many more quantitative forecasting techniques than the methods analyzed. More econometric knowledge might increase the possibilities.

When looking at the first case study it should be mentioned that the analyzed case is based upon data from CARU. Off course this research is done for them, but this results in degradation of the external validity. Finally, the conclusion made that scoping to a more local level will make the use of quantitative techniques applicable rests only on a single case. It could be that the extensive data about import export statistics, as available for the USA ports, are not available for less developed countries. However, this is also an opportunity to do further research, which brings us to the next section.

7.3 RECOMMENDATION FOR FURTHER RESEARCH

This research provided an extensive literature research about forecasting, which concluded that quantitative techniques to forecast the supply would be useful for a company as CARU. Based upon this conclusion many other company specific researches could be done for companies where data is not used yet to forecast market circumstances.
Another obvious follow-up study for CARU is analyzing other geographic locations. Locations where the dependency on MSC is high, are interesting locations to look at. Looking for location-specific data to analyze possible relations which might help to forecast the supply of second-hand containers will help CARU employees.
Besides looking at other locations it is also possible to look at other markets. This research focusses on the second-hand container market. However, CARU is operating in way more

markets with different business units. For example, the focus could be shifted to the lease market or markets for specific sorts of containers like reefers.

With no doubt, the best recommendation for further research is an extensive completion of the first case study in which the possible relations are tested using more data and extensive econometric models. By using the described quantitative forecasting techniques, the possibility to create a location specific short-term forecaster for the supply of second-hand containers could then be analyzed in the most complete way. Access to comprehensive data bases to get more complete data is recommended when doing such a research.

7.4 IMPLIACTION FOR CARU

The implications and value for CARU containers of this research hopefully has become clear in the presented case studies. The use of quantitative techniques might improve the way of doing business if there is applicable data. However, it should be taken in account that the way of working differs per account manager. Employee interviews made clear that the one is more open for new techniques than the other. The degree of experience and feeling for the market plays a big role in here.

Creating a short-term forecaster to forecast the global supply of second-hand containers seems to be a utopia. Looking at location specific data is the best option to get insights which might improve the way of doing business for CARU. Closer cooperating with MSC might lead to better information and data to help CARU's sales employees. Hiring somebody to control the MSC accounts could be an option. Training the current location specific account managers to improve their cooperation with MSC is an alternative option. On the other hand, closer cooperation with MSC could enlarge the dependency on them as addressed in the second case study. Another recommendation or option for CARU to reduce the dependency on MSC, is trying to get more beneficial partnerships with other shipping lines. The partnership with MSC is based on pure win-win thinking and their might be more big parties that are open for such cooperation.

Further steps that could be taken by CARU based upon more extensive data analyzes could be to withdrawal from specific locations which are deficit areas. The withdrawal in certain areas enables account managers to focus more on the high potential areas. However, these

are very rigorous actions that probably should be based on both quantitative and judgmental considerations.

An option to generate more in-house data which enlarges the possibilities to get value out of data and follow the course of Maersk is hiring a full-time data-analytics. This in combination with licenses on external databases like Drewry and a successful implementation of sales force could enlarge the possibilities for CARU to become a more proactive data driven company.

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9. APPENDIX

A. INTERVIEW BAS VEENHOF, MANAGEMENT TRAINEE, (01-05-2017)

This Interview was conducted to get insights in the processes within CARU with the main goal to find a research problem

Wat gebeurt er allemaal bij de afdeling Operationeel?

Bij operationeel is "Persoon A" verantwoordelijk voor het onderhoud en beheer van de containers. Hij inspecteert alles wat binnenkomt en beoordeeld de staat van de containers en wat ermee moet gebeuren om weer verkoopbaar te maken. Daarnaast is "Persoon B" verantwoordelijk voor S&R, dit is ons eigen container programma waarin de gegevens bijgehouden en waarin de containers gevolgd worden. De overige 4 medewerkers houden zich bezig met het analyseren van de containerstromen en houden dit bij is S&R. "Persoon C" is verantwoordelijk voor de inkoop van nieuwbouw containers en "Persoon D" is de leidinggevende en verantwoordelijk voor het managen van het team.

Zelf denk ik dat ik mijn onderzoek beter kan richten op de verkoopafdelingen, denk jij ook niet?

De marktontwikkelingen zijn inderdaad interessanter bij de verkoopafdeling. De ontwikkelingen in de markt zullen weinig invloed hebben op de werkzaamheden binnen operations.

Wanneer verwacht jij de toestroom van de containers die massaal gebouwd werden tijdens de opkomst van de ULCV's op de 2e handsmarkt?

De toestroom 2^{e} handscontainers van ULCV-bouw duurt nog wel even denk ik. De meeste shipping lines hebben de containers nu zelf nodig. De schommelingen zijn groot en dit maakt het moeilijk om dat op korte termijn te onderzoeken.

Een trend die nu speelt is de nieuw soort verf, denk jij dat dit een goed onderwerp is om te onderzoeken?

Ook dit is erg onzeker. Rederijen doen nu gemiddeld 13 jaar met containers en dan kopen wij ze op en verkopen ze weer door. Met de nieuwe verf veracht men dat de economische levensduur van een container zal afnemen, dit is echter moeilijk te onderzoeken

Voor CARU zou dit een gunstige ontwikkeling zijn aangezien jullie dan eerder en meer ingeschakeld gaan worden als tussen partij, toch?

Dit zou inderdaad gunstig uit kunnen pakken omdat er sneller 2e handscontainers op de markt komen maar aan de andere kant zou het goed kunnen dat de vraag naar en prijs van 2e handscontainers erdoor beïnvloed gaat worden.

Denk jij dat het mogelijk is om een korte termijn voorspeller te maken die inzicht geeft in het aanbod van 2e handscontainers voor CARU?

De prijzen zijn laatste maanden heel erg aan het stijgen en dit heeft invloed op het aanbod. De onderliggende oorzaken hiervan zijn de onzekerheid van het verfsysteem, de val van Hanjin en de hervormingen in de allianties. Zelf denk ik dat het moeilijk wordt om een korte termijnvoorspeller te maken maar je kan het zeker proberen.

B. INTERVIEW ALLARD LANGHUIZEN, SALES AGENT LATIN AMERICA, (01-05-2017)

The main goal of this interview was to get insights in the work approach of sales employees.

Hoe bepaal jij je prijzen van 2e handscontainers en welke data gebruik jij hierbij?

Ten eerste kijk ik naar onze eigen voorraad en wat er op korte termijn binnen gaat komen. Is deze hoog, dan verkoop ik sneller en houd ik de prijzen wat lager om te voorkomen dat wij met voorraad overschotten gaan kampen. Als er weinig aanbod is dan probeer ik wat we hebben voor een zo hoog mogelijke prijs te verkopen.

Wat je hebt bepaald de prijs en je kijkt om je heen wat andere doen, op een beurs spreek je met concurrenten en deel je marktinformatie. Je ijkt het ook, klanten komen met feedback en je proeft hoe serieus dat is.

Pas je de prijs wekelijks aan?

Nee, eigenlijk zit er geen structuur in, ik probeer constant te eiken. Momenteel gaat de prijs snel omhoog. Iin Peru zat ik wat laag en dat heb ik verhoogd en een week later voor een 2e badge weer verhoogd. Dit kan soms voor verwarring zorgen bij de klanten, daarom probeer ik het wat geleidelijke te doen. De richtlijn die we hanteren is een marge van 20% marge of meer.

Welke marktinformatie is er beschikbaar en maak je gebruik van?

De marktinformatie die ik momenteel gebruik zijn de prijzen die ik hoor van de concurrenten. Hiernaast is een belangrijk beginpunt onze inkoopprijs bij MSC en hun aanbod, aangezien dit leidend is met oog op de 20% marge. Maar het blijft natuurlijk een marktspelletje dus moet ik ook gewoon kijken naar de wetten van vraag en aanbod. Een luxe die wij hierin hebben is dat we de supply op stop kunnen zetten door tegen MSC te zeggen dat we tijdelijk geen containers af willen nemen. Als de markt zo slecht is zetten we het gewoon stil.

Hoe werkt dat nu?

Wekelijks geef ik mijn voorkeuren door aan operations (open/dicht). Dit houdt in of ik op een bepaalde plek wel of geen containers van MSC wil ontvangen. Bijvoorbeeld Peru zet ik open en dan dag erna krijg ik van operations een lijst met nummers hoeveel MSC heeft aangemeld voor terug levering. Als het nummer hoog is weet ik of er veel supply is. Dus ik krijg elke week eigenlijk feedback en ongeveer 2 weken later komen de containers dan binnen, dit wil nog weleens verschillen per locatie.

Het probleem is dat de lokale agent van MSC bepaald hoeveel er terug geleverd worden aan CARU. Als ze zelf de containers nodig hebben dan krijgen wij niks. De lijst is dus een indicatie en zegt niet alles. Hierom moet ik verwachtingsmanagement toepassen.

Welke informatie/ontwikkelingen zou je willen weten om gebruik van te kunnen maken?

Het zou voor mij extreem waardevol zijn als ik in een vroeger stadium inzicht kan krijgen in het overschot bij MSC. Aan de hand daarvan kan ik dan beter in schatten hoeveel containers er voor ons beschikbaar gaan komen en mijn verkopen hier vervolgens op afstemmen.

Wat zou je anders doen als je deze informatie tot je beschikking had?

Als ik zie dat aanbod lager gaat worden en wegzakt, dan kan ik huidige stock vasthouden en over 2 weken voor hogere prijs verkopen. De storage kosten worden dan wat hoger maar de hogere verkoopprijs zal dit dan compenseren. In Peru had ik de afgelopen periode meer kunnen verdienen als ik de containers langer vast had gehouden.

Hoe heb jij de val van Hanjin ervaren in je werkzaamheden?

In Mexico zijn de tarieven achtergebleven. Mexico is een boevenland, ze maakte de kosten om containers terug te krijgen zo hoog dat leasemaatschappijen zeiden laat maar staan dan. Hierdoor hadden ze gratis containers die ze voor lage prijzen verkochten. Dit had je niet kunnen weten. Stel je had t geweten had je de containers snel terug moeten claimen.

Als ik dit zo hoor denk ik dat het voor jou erg waardevol kan zijn om eerder inzicht te hebben in het aanbod van MSC, klopt dit?

Ja, zeker!

C. INTERVIEW PAUL AFMAN, SALES AGENT MIDDLE-EAST & CANADA, (01-05-2017)

The main goal of this interview was to gauge how Paul thinks about a short-term predictor to get insights in the supply of MSC and finding possible other research problems.

Welke marktinformatie is er beschikbaar en maak je gebruik van?

De marktinformatie die ik momenteel gebruik zijn de prijzen die ik hoor van de concurrenten. Ook maak ik veel gebruik van de data die ik genereer door middel van gesprekken met klanten aan te gaan. Op basis van die gesprekken probeer ik inzichten te krijgen en onze prijszetting te verbeteren. Daarnaast maak ik gebruik van de voorraad rapporten van concurrenten en hun prijzen.

Wanneer verwacht jij de toestroom van de containers die massaal gebouwd werden tijdens de opkomst van de ULCV's op de 2e handsmarkt?

Ik verwacht dat deze toestroom wel mee zal vallen. De prijs van nieuwbouw containers ligt momenteel vrij hoog waardoor shipping lines ervoor kiezen om containers langer vast te houden. Daarnaast wordt het huren en leasen van containers ook duurder. Dit draagt ook bij aan het uitstellen van containers beschikbaar stellen op de tweedehandsmarkt. De meeste shipping lines hebben de containers nu zelf nodig. Tevens zijn de schommelingen vaak erg groot en dit maakt het moeilijk om dat op korte termijn te onderzoeken.

Kan jij marktinformatie bedenken wat jou werk makkelijker zou maken indien dit beschikbaar komt?

Ten eerste kan de voorziening van de marktinformatie die nu beschikbaar is geoptimaliseerd worden. Dan heb ik het over de voorraadrapporten van concurrenten en prijzen van concurrenten. Ik kan zelf niet wekelijks gaan bellen en vragen naar hoe zij ervoor staan. Als er extern voor wordt gezorgd dat ik hier inzicht in krijg, zou dit erg waardevol zijn. Hiernaast vind ik dat we erg afhankelijk zijn van MSC. Wij zijn push gedreven ten opzichte van MSC en opereren heel reactief. In Canada kunnen we bijvoorbeeld vele malen meer verkopen maar daar komen nauwelijks MSC-containers binnen. Wat betreft de communicatie binnen CARU zie ik ook ruimte voor verbeteringen. Minder afhankelijk handelen en meer communicatie

tussen CARU-medewerkers wereldwijd kan bijdragen aan het verkleinen van de afhankelijkheid. Als we de containers daar brengen waar ze goed verkocht kunnen worden zal dit het eindresultaat ten goede komen.

Denk jij dat een korte termijn voorspeller van het aanbod aan 2e handscontainers de afhankelijkheid van MSC kan verkleinen?

Ik denk dat dit zeker kan helpen en bij kan dragen aan het verkleinen van de afhankelijkheid van MSC. We zullen in feiten altijd reactief blijven omdat we afhankelijk zijn van de containers die MSC aan ons beschikbaar stelt. Eerder inzicht in dit aanbod kan er echter voor zorgen dat wij onze verkopen hierop aan kunnen passen. Dit zou het bijvoorbeeld mogelijk maken om meer forward contracten af te sluiten. Hierdoor zouden we in een vroeger stadium al deals kunnen closen omdat we weten wat er vanuit MSC beschikbaar gesteld gaat worden.

Kan jij variabele bedenken waarvan je denkt dat ze invloed hebben op het aanbod aan tweedehandscontainers?

Het creëren van een model om dit in kaart te brengen gaat geen makkelijke klus worden. Variabele die ik zeker mee zou nemen zijn:

- De groei van de Chinese export
- Prijs van nieuwbouw containers
- Economische levensduur van containers
- De wereld containervloot

D. INTERVIEW MARCO VAN VUGT, SALES AGENT DOMESTIC (03-05-2017)

The main goal of this interview was to gauge how Marco thinks about a short-term predictor to get insights in the supply of MSC and finding possible other research problems.

Welke marktinformatie is er beschikbaar en maak je gebruik van?

De marktinformatie die ik momenteel gebruik zijn de prijzen die ik hoor van de concurrenten, de plekken waar zij inkopen en hun voorraden. Hiernaast probeer ik te kijken naar of zij ook een beleid hebben voor nieuwbouw containers. Op basis van deze data en natuurlijk de inkoopprijs zet ik mijn prijzen en probeer ik zo goed mogelijk te verkopen.

Kan jij marktinformatie bedenken wat jou werk makkelijker zou maken indien dit beschikbaar komt?

Eerder inzicht krijgen in het aanbod dat er voor ons beschikbaar is van MSC zou zeer wenselijk zijn. De informatie is er wel maar vaak pas in een laat stadium. Op het moment krijgen we nauwelijks containers van MSC. Als we inzicht krijgen in wanneer dit om gaat slaan zou dat voor ons heel erg handig zijn.

Daarnaast zou ik wel willen weten hoe onze concurrenten te werk gaan. Zitten ze puur op de prijs of geven ze net als wij ook toegevoegde waarde aan klanten, bijvoorbeeld in de vorm van betalingsregelingen.

Wat zou jij anders doen indien je op een vroeger stadium op de hoogte wordt gesteld van het aanbod MSC-containers?

Eerder inzicht krijgen in het aanbod dat er voor ons beschikbaar is van MSC zou zeer wenselijk zijn. Als ik die informatie verkrijg kan ik mijn pricing daarop aansturen waardoor je snellere doorloop hebt van je voorraden. Momenteel handelen we veel op gevoel. De prijzen zijn onlangs verhoogd naar boven de marktprijs en zijn er nu weer iets onder omdat we een grote voorraad hebben die in beweging moet komen. De meeste traden hebben zowel nieuwbouw containers als gebruikte containers. Historisch gezien zien we dat er op nieuwbouw containers hogere marges kunnen maken, voornamelijk omdat je de pricing daar meer in de hand hebt.

Wat denk jij dat interessanter is om te onderzoeken, de nieuwbouwmarkt of de tweedehandsmarkt?

Ik denk dat de markt van gebruikte containers interessanter is omdat we het proces in de nieuwbouw markt zo goed als volledig in eigen handen hebben. We bepalen de productie zelf en hebben zelf meer invloed op de prijzen. In de markt van tweehandscontainer is dit een ander verhaal. Daar hebben marktfactoren een grotere invloed.

Met oog op de val van Hanjin, zou jij anders gehandeld hebben wanneer je de val aan had zien komen?

Misschien had ik meer voorraad ingekocht als ik het aan had zien komen. Maar op zo een manier inspelen op marktontwikkelingen kan enkel als we de mogelijkheid en middelen daarvoor hebben.

E. INTERVIEW WIM DE BOS, SALES MANAGER (03-05-2017)

The main goal of this interview was to gauge how Wim thinks about a short-term predictor to get insights in the supply of MSC and finding possible other research problems.

Welke marktinformatie is er beschikbaar en maak je gebruik van?

De marktfactoren die ik momenteel gebruik bij het verkopen van tweedehandscontainers zijn de inkoopprijzen bij MSC, de prijzen die concurrenten hanteren en de feedback die ik ontvang van klanten.

Kan jij marktinformatie bedenken wat jou werk makkelijker zou maken indien dit beschikbaar komt?

Eigenlijk heb ik niet echt extra middelen nodig. Ik handel voornamelijk op basis van mijn gevoel en kennis van de markt. Dit heb ik door de jaren heen ervaren als methode om mijn werk het best uit te voeren.

Wat verwacht je van het aanbod van MSC in de komende maanden?

MSC heeft de afgelopen maanden veel nieuwbouw gekocht. Hierom denk ik dat het met de supply van tweedehandscontainers wel goed zit. De hervorming van de allianties brengt meer scheepsruimte waardoor er straks meer containers deze kant op komen.

Een trend die nu speelt is de nieuw soort verf, denk jij dat dit een goed onderwerp is om te onderzoeken?

Eerlijk gezegd zou ik dat niet weten, het is net nieuw en ik heb geen idee wat het teweeg gaat brengen. Ik wacht in spanning af....

F. INTERVIEW REMCO IJZERMAN, OPERATIONAL INTERNATIONAL (03-05-2017)

The main goal of this interview was to get insights in the degree of cooperation between MSC and CARU.

Heb jij weleens contact gehad met MSC over het delen van marktinformatie?

Vorig jaar heb ik veel contact gehad met MSC. De huidige situatie is heel apart, we krijgen nauwelijks containers van ze binnen. In Amerika sturen ze elke dag een lijst door en daar gaven ze aan (veranderde meestal per 3 a 4 weken) in welke gebieden ze tekort hebben, en dus zelf de containers nodig hebben en wij geen containers gekregen. Die gegevens heb ik toen uitgewerkt en lijsten met data gemaakt. Deze heb ik vervolgens aan de MSC-agenten laten zien en het volgende aan de agenten gevraagd: "De afgelopen jaren hadden jullie een tekort op deze plekken van deze types op tijdstip X, kan ik ervan uitgaan dat dit volgend jaar weer zo zal zijn dan kunnen we de tijden hiervoor op inkopen?" Het antwoord wat ik toen van de MSC-agenten kreeg is dat zij zelf niet zover gaan in het voorruit kijken.
Voor MSC is het lastig om dat vooruit te plannen, zij zitten met eigen boekingen en wij pakken gewoon de restjes op. Als ze het zelf nodig hebben dan hebben wij pech.

Zijn er wat afzet van MSC betreft grote verschillen per locatie?

Ja, dit hangt erg af van wat voor soort land het is en dan doel ik op of het een import of export georiënteerd land is. Voor Import georiënteerde landen geldt dat er vaak meer aanbod is van MSC-containers voor ons. Dit is als volgt te verklaren: import georiënteerde landen halen veel producten naar hun land toe wat zorgt voor een overschot aan lege containers. Export georiënteerde landen daarentegen, verkopen vele producten. Dit zorgt ervoor dat de vraag naar lege containers hier hoog is. Wat weer tot gevolg heeft dat MSC als shipping line veel lege containers nodig heeft om te voldoen aan de export wensen van hun klanten.

Als MSC dit heeft, hoe zit dit dan met andere rederijen?

Ik denk dat die hetzelfde tewerk gaan aangezien ze allemaal uit hetzelfde klantenbestand vissen. Hierom zou ik me als ik jou was niet enkel op MSC richten maar meer op de gehele tweedehandscontainermarkt.

Wat denk jij dat interessanter is om te onderzoeken, de Wholesale markt of de markt waarin eindgebruikers bediend worden?

De Wholesale markt omdat de effecten daar vele malen groter zullen zijn dan in de markt voor eindgebruikers. Neem MSC als voorbeeld, als zij niet leveren aan ons zullen de effecten in de Wholesale markt groter zijn omdat het hier om veel grotere hoeveelheden containers gaat. Ik zou me specifiek richten op de Wholesale markt als ik jou was.

G. INTERVIEW ABDELMOULA SALAH, MANAGER M&A TRANSACTION SERVICES DELOITTE (19-10-2017)

The main goal of this interview was to get insights in the way field experts work when constructing a forecasting model

Hoe gaan jullie als consultants te werk wanneer een bedrijf als CARU jullie inschakelt?

Om te beginnen starten wij met het kijken naar de cijfers. Onze opdracht bestaat uit het in kaart brengen van de sterke en zwakke punten binnen CARU's bedrijfsvoering. Hierbij starten wij meestal met het analyseren van de geldstromen. Voorbeelden van punten die wij analyseren zijn:

- Hoe wordt de omzet gegenereerd?
- Welke kosten posten zijn er allemaal?
- Welke divisie is het meest winstgevend?
- Waar kan de meeste vooruitgang geboekt worden?
- Welke klanten zijn het meest winstgevend?
- Wat zijn belangrijke partners?
- Wat zijn waardevolle assets?

Bij het analyseren van deze vragen kijken wij naar de drijfveren die deze financials beïnvloeden, Q (hoeveelheid) en P (Inkoopprijs-verkoopprijs) zijn de voornaamste drijfveren binnen de organisatie van CARU. De fluctuaties van deze financials proberen wij in kaart te brengen om deze vervolgens te optimaliseren. Aan de hand van deze financials kunnen we de eerdergenoemde vragen beantwoorden.

Wat kwam er, bij het analyseren van de verschillende divisies, in jullie analyse naar voren met betrekking tot de verkoopdivisie van CARU?

Bij het analyseren van de verschillende divisies kijken we voornamelijk naar de omzet stromen en kostenposten. De voornaamste kosten die CARU heeft zijn de personeelskosten, de lonen van de werknemers. Dit is niet zo gek aangezien zij ook de meest waardevolle asset voor CARU zijn. CARU is een organisatie die zich, binnen de verkoopdivisie, vooral richt op het inkopen en verkopen van (tweedehands)containers. De verkoopmedewerkers voegen waarde toe door de containers voor een premium te verkopen.

Wat wij vervolgens hebben gedaan is kijken naar de verschillende klanten en partners. Hierbij hebben we onderscheid gemaakt tussen winstgevende en minder winstgevende klanten. Op basis van deze analyse zouden we CARU kunnen adviseren om bepaalde klanten te laten vallen omdat ze niet rendabel genoeg zijn. Echter, het gaat niet altijd om de winstgevendheid. Sommige klanten kunnen, ondanks dat ze niet winstgevend zijn, van waarde zijn omdat zij er bijvoorbeeld zorgen voor een zekere afzet van containers waardoor CARU zijn marktaandeel kan behouden.

Kijkend naar de partners van CARU, hoe zien jullie de rol van MSC?

Uit de analyses kwam duidelijk naar voren dat de relatie met MSC van groot belang is voor CARU. De inkoop van tweedehandscontainers vindt voor het overgrote deel plaats bij MSC. In het lijstje met top leveranciers stond MSC dan ook stijf bovenaan. De relatie met MSC moet dan ook gekoesterd worden maar verdiend ook extra aandacht. Het gevaar zit hem in het feit dat CARU te afhankelijk van MSC is. Het wegvallen van de relatie zou van grote invloed zijn op de resultaten.

Kan het creëren van een model, wat tracht vroegere inzichten te geven in het korte termijn aanbod van tweedehandscontainers, de afhankelijkheid van MSC verkleinen?

De directe afhankelijkheid van MSC zal altijd aanwezig blijven, tenzij CARU een andere partner weet te vinden die in staat is dusdanige getalen tweedehandscontainers beschikbaar te stellen voor CARU. Het creëren van een model dat inzicht weet te geven in de te verwachtte partijen tweedehandscontainers zou wel goed bij kunnen dragen aan het verkoopproces. Ik denk dat de verkoopmedewerkers veel baat hebben bij het verkrijgen van vroegere inzichten in het aanbod aan containers wat zij kunnen gaan verkopen op de tweedehandsmarkt. Inzichten vanuit het model kunnen de indirecte afhankelijkheid van MSC wel verkleinen. Vroegere inzichten in het aanbod geven de verkoopmedewerkers de mogelijkheid om hun verkopen beter te sturen.

Wat zijn dingen om rekening mee te houden bij het creëren van een econometrisch voorspel model voor dit vraagstuk?

Bij het creëren van een model dat door andere gebruikt gaat worden dien je altijd rekening te houden met de wensen en capaciteiten van de gebruikers. De verkoopmedewerkers van

CARU zullen de finale gebruikers worden. Hierom is het belangrijk dat het model voor hun bruikbaar en begrijpelijk is. Als al aangegeven zijn zij de mensen die de meeste waarde creëren voor CARU en dit doen zij momenteel op hun eigen manier. Zij handelen op basis van hun gevoel en kennis van de markt, dit zullen zij waarschijnlijk ook blijven doen. Het creëren van het model moet niet als doel hebben deze capaciteiten van de medewerkers te ondermijnen, dit zal overigens ook erg lastig worden. Wat het model wel moet doen is ondersteuning bieden en op die manier zorgen voor een meerwaarde.

Hiernaast moet er goed gekeken worden naar de te gebruiken data. De data vormt de basis van het model. Naast het feit dat het model begrijpelijk en toepasbaar moet zijn voor de medewerkers, is het van groot belang dat het model gemakkelijk door andere hergebruikt kan worden en nagemaakt moet worden. Kijkend naar de data input is het hierom van belang dat de data toegankelijk is en ververst kan worden.

Overigens denk ik dat het haast onmogelijk wordt om een model te creëren wat de zeer korte termijn in beeld brengt. Inzicht geven op maandelijkse basis is in mijn ogen een utopie wanneer je een model als beschreven (begrijpelijk en toepasbaar) creëert. Je zult eerder moeten denken aan een model wat de schommelingen in per kwartaal of jaar in beeld kan brengen.

Wat ik je ook nog mee wil geven is dat de geografische verschillen binnen de containermarkt heel groot kunnen zijn. Een model creëren wat rekening houdt met de verschillen per locatie is erg moeilijk. Mocht je de geografische verschillen toch mee willen nemen zou ik dit doen in een eventuele casestudy waar je het over had. De laatste tip die ik je graag wil geven is dat je het model smart moet maken door goed te kijken naar welke variabelen er toepasbaar en beschikbaar zijn.

Welke variabelen zouden jullie meenemen in het model om tot de gewenste output te komen?

Variabelen waar je zeker naar moet kijken zijn de totale wereld container vloot. Wat ook heel waardevol zou zijn is de gemiddelde leeftijd van de containervloot van MSC en andere rederijen, al zal dit lastig te achterhalen zijn. De containervloot koppelen met de gemiddelde

economische levensduur van een container kan al veel inzicht geven. Deze data koppelen maakt het mogelijk om deels in kaart te brengen wanneer er partijen tweedehandscontainers op de markt gaan komen. Aan de hand van al beschikbare data kan je dan gaan back casten om te bepalen welk model de waarheid het best benaderd.

H. INTERVIEW PAUL ERIK ANDERSEN, GENERAL MANAGER MAERSK (29-11-2017)

The main goal of this interview was to get insights in the way field experts work and obtaining information about the variables that will be used.

What are you doing at your Job?

I am based in Hong Kong and I am constantly sourcing other people's containers out of the factories in China and then use it to export cargo to everywhere in the world. The reason we do that is to balance our own float because we are always short of equipment in Asia and that's why we use other people's containers and save some money.

How do you think the short-term supply of second-hand containers could be forecasted in the best way? What kind of variables would you use?

I would definitely look at the new built price of containers because there are a lot of companies trading in new containers. The price of the new built containers is correlated with the price of second hand containers. What is also important is what the containers are used for, the second-hand market is more for domestic users. Those are not much used for transport but more by end-users.

What do you think about the economic lifespan of containers? Is this a good variable to use in forecasting the supply of second hand containers?

Yes, it could be used. We within in Maersk do not have a strict time boundary in which we have to use our containers. If a container is damaged and cannot be used anymore we drop them off. Our goal is to use them for 18 years but is just dependent on the time needed to repair a container and this differs per container. So, what we do is just use it for 18 years if this is possible and then we sell it. Off course there are exceptions but our goal is using it for 18 years.

What is the number of containers in Maersk current fleet and the average age?

At the moment, I guess we have 3.5 million TEU. The average age is hard to say because we constantly get in new containers which makes is hard to estimate but I think it is around 12

to 13 years. Every year we will probably end up with 300.000 containers to sell. We do not have moment that we sell it just depends per location.

Is it possible to foresee me from data regarding the amount of second hand container sales per location?

I would love to give it to you but I do not have access to that kind of information. Within Maersk we have a special division that is responsible for the sales of our used containers. That division has a list with those figures, they are based in Copenhagen with people all over the world and they sell the containers in the local market using agents.

The location of the containers has the most influence in the price of the container because we use the containers as long as we can and we will not use empty containers around to sell them for a higher price. So, in general we sell the containers after 18 years on the location where it is at that moment.

I. INTERVIEW ARSHAD HOSSAIN, RESALE DIRECTOR NORTH AMERICA TEXTAINER (30-11-2017)

The main goal of this interview was to get insights in the way field experts work and obtaining information about the variables that will be used.

What are you doing at your Job?

Within my job I am responsible for the resale group in the whole US, Canada and Mexico.

Can you think of variables I should look at when forecasting the short-term supply of second hand containers?

I think this will be very complex. The supply comes from the leasing companies and shipping lines. Last year the shipping lines were struggling a lot. It depends to a large extend on the geography since the lines sell where they have surpluses. But, in general our forecast is that the supply will be tight in the coming months because the shipping lines will hold on to the boxes. At the moment, the new built prices are high and also the leasing rates are rising. To counter that, the lines hold on their equipment because this is cheaper. Since everybody is expecting a shortage they might be a little worried about having to low equipment when they need it. In general, the supply is going to remain tight.

Looking at your fleet, how much TEU do you own and what do you think about the economic lifespan of a container?

Honestly, I cannot disclose all the data but in general we make that decisions based on the lease potential, the location of the box, the age of the box, the damages on the box and the sales price on that location. We have a model that evaluates these factors. The priority is always to lease the box but if the selling price goes up it might be attractive to sell the box, but this is the second priority since leasing is our core activity. So, what I can say, in general it is all about the geographical location and this is very hard to forecast for a student as you are haha.

Haha, and what about a case study? Can you give an example where the location makes a big impact in your decisions?

For example, Chicago is a bad market globally, it is as surplus market. We expect more in Chicago than a depend market as Los Angeles or Oakland. It is because there is no export there so the shipping lines take back their box and off hire the leasing box.

Going back to the average lifespan and you're the average age of your fleet, can you tell me something about that?

Concerning the economic lifespan, I think it is being pushed further now like I mentioned. On average, I would say 13 or 14 years at the moment. Concerning our current fleet, it is very hard to tell you something about our current age. I honestly do not know that.

J. INTERVIEW DANNY DE BOER, AFTERMARKET SPECIALIST SEA CUBE (30-11-2017)

The main goal of this interview was to get insights in the way field experts work and obtaining information about the variables that will be used.

Wat doe jij precies binnen Sea Cube?

Sea Cube is een leasemaatschappij en binnen SeaCube ben ik verantwoordelijk voor de after-market. Wij financieren equipment voor shipping lines en leasen containers. Gemiddeld na 10 tot 12 jaar komen de containers bij ons terug, want het blijven onze assets, en ik ben verantwoordelijk voor wat er dan met de containers gebeurd. Ik verkoop ze dus en wij coveren Europa, het Midden-Oosten en Afrika. Daar waar de shipping lines de containers terugbrengen, proberen wij ze zo snel en goed mogelijk te verkopen.

Kijkend naar jullie vloot, hoelang gaan de containers gemiddeld bij jullie mee?

Bij ons is dat 10 tot 12 jaar. Maar ik weet dat dat verscheelt per bedrijf. Wij denken hierbij aan de branding. We willen goede kwaliteit bakken leveren daarom hanteren wij 10 tot 12 jaar. Hij kan wel 20 tot 25 jaar meegaan maar op een gegeven moment maken wij de afweging met betrekking tot de kwaliteit van de containers.

Welke variabelen kunnen volgens jou een goed beeld geven over het aanbod aan tweedehands containers?

Ik denk dat het voornamelijk afhangt van de wereldeconomie en de wereldhandel maar dat is heel moeilijk te betrekken op de korte termijn. We zien nu dat er heel veel vraag is naar lease containers doordat de economie aantrekt. Hierdoor worden containers langer vastgehouden wat ervoor zorgt dat er minder aanbod is van containers op de tweedehandsmarkt. Dit was vorig jaar heel anders. Kijk dus goed naar de wereldeconomie en de wereldhandel. Wij hebben een tijd geleden bijvoorbeeld gekeken naar een onderzoek over het wereldwijde voedseltekort. Door dit tekort verwachtte wij toen dat de vraag naar reefers toe zou gaan nemen omdat deze gebruikt worden om voedsel te vervoeren. Dit is uiteindelijk ook uitgekomen.

Hebben de marktontwikkelingen invloed op de door jullie gehanteerde 10 tot 12 jaar?

Wij zijn niet de grootste leasemaatschappij maar willen wel de beste zijn. We willen goede containers leveren en marktconform zijn qua prijs. Hierbij focussen we ons op reefercontainers, we hebben het grootste percentage aan reefers en staan bekend om de goede kwaliteit, ook in de after-market. Wij verkopen de containers vaak in een as-is conditie. Dit houdt in dat we ze verkopen zonder ze eerst te repareren. Omdat we onze kwaliteit altijd waarborgen hebben onze as-is containers vaak minder sleutelwerk nodig waardoor we een hogere prijs kunnen vragen, zeker voor de reefers.

Doen jullie veel zaken met CARU?

Wij zien CARU als partner, niet als concurrent. Waar we elkaar kunnen helpen proberen we dit dan ook te doen.

Hoe zou jij een voorspel model om het korte termijn aanbod van tweedehandscontainers te voorspellen maken?

Ik denk eerlijk gezegd dat dit heel moeilijk wordt. Zoals gezegd denk ik dat je alleen naar de wereldhandel en wereldeconomie kan kijken. Daarnaast spelen de geografische verschillen een hele grote rol maar deze zijn heel moeilijk mee te nemen. Zeker wanneer je je richt op de korte termijn wordt het moeilijk om een accuraat model te bouwen. De marktkennis en het gevoel van jullie accountmanagers heeft hierin denk ik meer toegevoegde waarde.

K. DATA SET MARAD

U.S. Department of Transportation
Maritime Administration
U.S. Waterborne Foreign Container Trade by U.S. Customs Ports (2000 - 2015)
Imports in Twenty-Foot Equivalent Units (TEUs) - Loaded Containers Only

U.S. Custom Ports	Coast	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total Import	Total export	Balance
Aberdeen, WA	P	0	0	0	0	0	1	0	0	0	2	0	2	75	64	7	0		633,89	-633,9
Anacortes, WA	P	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1,04	181,79	-180,8
Anchorage, AK	AK	0	0	0	350	2.631	513	129	78	57	109	34	217	299	465	995	1.528	7.404,97	338.584,94	-331.180,0
Baltimore, MD	A	172.564	177.638	202.686	191.945	236.094	244.069	256.621	234.494	262.201	228.555	280.093	304.501	319.662	334.414	349.344	387.313	4.202.193,90	2.472.085,21	1.730.188,7
Baton Rouge, LA	G	2	0	75	4	1	15	152	0	0	67	390	145	3	97	4	2	955,24	1.332,61	-377,4
Beaufort-Morehead City, NC	A	0	38	124	60	19	27	2	41	21	0	26	36	8	0	74	0	476,73	55,07	421,7
Beaumont, TX	G	169	41	128	2	43	0	117	296	288	382	472	387	1.100	134	9	2	3.570,80	3.610,61	-39,8
Boston, MA	A	54.222	50.736	55.522	58.285	72.653	74.084	80.237	94.333	92.759	83.728	79.872	97.357	95.243	96.954	105.306	114.834	1.306.123,81	806.245,89	499.877,9
Brunswick, GA	A	0	0	2	7	2	14	10	23	2	6	84	116	55	72	311	380	1.084,57	4.280,25	-3.195,7
Camden, NJ	A	298	339	257	356	524	141	1.151	961	1.062	1.823	51	55	36	0	168	0	7.222,60	90.824,01	-83.601,4
Charleston, SC	A	618.461	612.163	676.109	720.639	837.582	901.107	889.377	768.829	693.699	499.558	548.276	601.879	649.377	665.972	742.906	831.750	11.257.683,48	9.445.854,44	1.811.829,0
Chester, PA	A	31.959	31.466	35.491	44.301	48.670	55.597	51.576	52.045	49.650	34.658	43.768	46.904	27.588	41.901	58.050	65.219	720.841,02	557.502,66	163.338,4
Corpus Christi, TX	G	0	20	48	25	46	0	380	595	243	195	241	380	1.051	7	0	92	3.322,62	443,10	2.879,5
Everett, WA	P	927	412	203	0	131	0	1.231	273	1.538	2.729	2.610	4.312	677	1.824	1.507	3.915	22.287,83	27.134,77	-4.846,9
Fernandina Beach, FL	A	8.782	7.057	5.961	4.617	4.337	7.221	7.854	3.913	1.233	769	683	711	307	344	461	155	54.403,03	137.736,85	-83.333,8
Fort Pierce, FL	A	14	2	2	56	252	840	1.192	2.380	3.717	4.248	3.062	3.582	2.150	39	1	0	21.535,64	50.256,39	-28.720,8
Freeport, TX	G	23.829	19.442	29.269	27.639	26.784	27.809	26.657	31.326	31.114	35.370	31.601	29.609	34.235	46.986	35.702	32.897	490.268,35	409.866,71	80.401,6
Galveston, TX	G	1.999	6.031	12.459	4.816	6.248	3.607	6.333	3.982	5.047	6.016	8.037	11.427	8.517	13.999	14.149	17.487	130.155,42	48.773,51	81.381,9
Gloucester City, NJ	A	19	507	23	109	35	0	541	3.136	2.573	854	5.249	6.242	3.426	10.473	24.219	30.719	88.124,84	42.384,92	45.739,9
Gramercy, LA	G	2	5.924	392	6.303	1.062	784	1.097	933	761	475	656	494	251	1	0	0	19.133,24	7.114,43	12.018,8
Gulfport, MS	G	81.495	85.480	92.878	109.807	119.934	108.930	97.230	104.009	106.901	100.172	104.850	107.875	103.030	96.999	87.420	65.945	1.572.954,35	1.172.166,34	400.788,0
Honolulu, HI	HI	13.078	13.827	15.534	18.545	21.372	23.626	25.279	23.333	22.299	17.941	18.624	17.467	18.155	20.243	23.313	22.094	314.130,07	325.284,59	-11.154,5
Houston, TX	G	366.821	381.308	420.361	449.697	532.288	625.933	662.271	616.439	574.348	481.703	519.247	559.316	618.891	654.790	752.897	842.740	9.059.050,11	11.135.731,86	-2.076.681,8
Jacksonville, FL	A	30.914	24.520	35.733	41.654	41.627	45.352	48.100	41.113	49.623	76.410	92.617	117.009	127.403	240.450	262.829	270.325	1.545.678,95	2.873.031,82	-1.327.352,9
Kodiak, AK	AK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	6.319,27	-6.319,3
Lake Charles, LA	G	0	0	929	240	38	71	7	276	23	152	542	665	672	8	2	4	3.628,91	17.794,04	-14.165,1
Long Beach, CA	P	2.401.300	2.376.417	2.466.756	2.367.612	2.951.439	3.374.091	3.747.342	3.672.384	3.132.228	2.499.561	3.050.893	3.023.922	3.046.363	3.444.680	3.538.195	3.620.577	48.713.760,11	18.099.996,55	30.613.763,6
Longview, WA	P	0	0	0	0	0	3	0	98	745	97	233	41	17	3	0	0	1.237,22	5.164,82	-3.927,6
Los Angeles, CA	P	2.428.794	2.613.777	3.193.804	3.641.579	3.845.539	3.865.546	4.426.542	4.327.486	4.048.462	3.506.696	3.880.572	4.057.419	4.068.235	3.924.612	4.189.035	3.980.832	59.998.928,74	21.860.717,35	38.138.211,4
Mayaguez, PR	PR	9.738	10.510	11.863	12.059	12.120	14.230	15.014	16.310	12.098	5.581	6.163	4.745	4.561	3.024	1.004	0	139.019,84	108.666,57	30.353,3
Miami, FL	A	335.294	346.939	402.726	427.679	465.052	443.972	429.938	345.214	313.019	287.083	308.156	345.972	354.702	351.724	344.066	408.253	5.909.408,80	5.599.878,67	309.530,2
Mobile, AL	G	5.514	6.346	6.240	6.031	9.232	14.005	26.615	35.121	38.194	34.838	35.152	54.558	59.743	68.721	70.087	81.912	552.309,48	695.143,01	-142.833,5
New Orleans, LA	G	91.384	85.647	89.498	97.840	99.855	70.004	70.475	78.612	82.527	74.843	78.433	86.693	80.052	81.004	92.826	114.024	1.373.717,97	2.739.684,62	-1.365.966,7
New York, NY	A	1.511.579	1.587.675	1.879.455	1.964.759	2.238.763	2.438.367	2.601.327	2.641.667	2.567.409	2.288.443	2.623.861	2.722.781	2.777.360	2.787.511	2.922.714	3.190.552	38.744.224,36	18.502.556,17	20.241.668,2
Newport News, VA	A	40.057	23.988	36.795	47.890	57.920	61.236	44.255	28.622	13.217	77	21	81	213	494	1.201	1.951	358.018,09	261.237,43	96.780,7
Norfolk, VA	A	437.523	454.216	551.168	633.455	717.346	780.918	834.198	857.703	811.382	677.798	721.369	726.910	817.486	900.292	981.189	1.042.138	11.945.090,80	10.661.768,87	1.283.321,9
Oakland, CA	P	418.924	419.010	482.485	516.558	613.296	761.971	815.837	796.738	726.051	640.796	739.323	740.123	748.807	771.921	824.441	814.967	10.831.247,98	10.664.709,13	166.538,9
Panama City, FL	G	7	0	0	11	0	7.184	26.315	21.491	18.815	16.306	14.556	19.260	18.699	17.686	16.282	14.765	191.376,00	167.841,89	23.534,1
Pensacola, FL	G	0	90	0	1	0	20	6	0	231	0	0	0	0	53	24	1	430,21	765,12	-334,9
Pensauken, NJ	A	6	5	2	18	22	27	43	0	0	0	158	0	0	15.216	13.890	19.415	48.801,69	122.864,91	-74.063,2
Philadelphia, PA	A	65.915	71.138	78.254	94.577	113.385	139.031	153.895	161.634	159.885	143.752	143.603	157.077	185.695	186.504	189.732	207.311	2.251.389,04	675.938,27	1.575.450,8
Ponce, PR	PR	32.380	30.171	21.995	5.576	1.764	129	60	27	18	27	5	0	72	138	2	0	92.362,62	22.614,69	69.747,9
Port Angeles, WA	P	0	76	0	0	0	0	2	0	0	0	6	0	2	15	12	11	123,76	258,48	-134,7
Port Arthur, TX	G	7	0	1	13	9	23	53	49	33	303	189	70	312	69	206	0	1.337,19	246,01	1.091,2
Port Canaveral, FL	A	172	168	280	22	510	1.513	256	248	250	139	176	694	481	125	11	120	5.165,70	622,30	4.543,4
Port Everglades, FL	A	175.131	170.710	157.096	186.930	232.473	276.865	296.892	305.582	281.707	220.057	242.345	253.885	266.278	308.955	334.608	320.322	4.029.834,09	5.244.430,31	-1.214.596,2
Port Hueneme, CA	P	9.302	8.674	8.236	10.043	10.731	15.036	15.713	17.535	16.364	15.926	18.272	17.590	47.686	49.361	47.291	44.020	351.779,64	57.031,49	294.748,2
Port Manatee, FL	G	0	0	0	525	4.785	3.310	4.684	4.126	4.662	13.649	11.707	6.105	7.992	6.388	8.908	17.149	93.988,52	32.582,70	61.405,8
Port Townsend, WA	P	0	0	0	0	3	3	0	29	0	2	0	1	0	0	0	10	48,86	8.914,98	-8.870,1
Portland, ME	A	1.075	1.452	1.861	1.671	1.215	1.513	935	405	6	0	0	343	206	2.998	5.218	0	18.897,66	1.553.337,38	-1.534.439,7
Portland, OR	P	38.050	46.646	46.696	63.428	70.180	60.096	87.166	106.287	96.844	68.807	68.806	74.134	62.644	72.854	73.889	7.365	1.043.892,83	142,78	1.043.750,1
Portsmouth, NH	A	0	0	0	0	4	0	0	1	5	9	28	16	90	39	2	0	193,91	36.381,00	-36.187,1
San Diego, CA	P	10	4	1.413	43.817	45.692	45.204	48.509	48.137	46.281	47.943	49.931	49.574	51.861	48.438	53.060	57.267	637.142,73	40.610,57	596.532,2
San Francisco, CA	P	23.857	15.749	11.027	7.687	17.635	370	286	24	35	9	19	168	461	93	4	6	77.429,92	662.213,11	-584.783,2
San Juan, PR	PR	105.835	108.207	117.117	146.677	155.598	165.476	156.277	148.017	155.795	153.130	153.248	156.029	159.610	162.381	151.494	166.137	2.361.029,25	13.956.760,04	-11.595.730,8
Savannah, GA	A	382.070	430.806	561.278	595.051	664.969	804.639	869.166	1.079.002	1.088.446	913.237	1.055.072	1.073.115	1.076.005	1.145.521	1.346.024	1.607.783	14.692.183,90	6.783.946,09	7.908.237,8
Seattle, WA	P	588.419	499.584	511.521	483.943	680.780	874.774	793.637	784.981	658.653	622.044	888.103	772.656	726.430	544.964	424.359	474.495	10.331.543,86	6.203.063,81	4.128.480,1
Tacoma, WA	P	391.491	356.385	490.789	594.039	601.187	794.332	735.962	722.378	651.244	457.963	495.600	519.955	649.104	733.072	817.697	829.353	9.840.551,43	128.861,48	9.711.690,0
Tampa, FL	G	1.858	812	158	2.338	7.495	6.222	10.247	18.867	19.600	19.016	23.082	17.581	18.587	19.871	24.051	28.055	217.837,46	3.292,22	214.545,2
Vancouver, WA	P	303	736	65	123	2.484	373	172	316	12	101	569	307	181	779	1.160	1.836	9.518,99	1.697.039,07	-1.687.520,1