

Methods to mitigate supply chain risks related to freeze-dried fruit importation to South Africa

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Abstract (12 font)

Supply chains, especially global supply chains, can be complex and include multiple partners. Owing to the diversity between supply chains, the risks applicable to each may differ. Not enough research has been conducted on businesses using an inter-disciplinary approach when attempting risk management. Therefore, the purpose of this investigation was to explore how the combination of financial and operational risk management methods can be used to assist Carbocraft in mitigating the risks identified and associated with the import of freeze-dried fruit from Germany to their customers in Durban, Cape Town and Johannesburg. Risks were listed and discussed whilst mitigation strategies were suggested.

Risk supply chain mitigations, Freeze dried fruit, Carbocraft, Mitigation strategies

Introduction

Carbocraft is an importer of raw food ingredients, based in Johannesburg, South Africa. The company was founded in 2010 and has since grown to 11 employees. The study was conducted at Carbocraft, primarily focusing on the supply chain risks related to importation of freeze-dried fruits into South Africa. The freeze-dried (FD) fruit is sourced by Carbocraft from Paradise Fruit, a company based in Germany. Paradise Fruit is a company that has emerged as an industry leader in the field of freeze-drying (Paradise Fruits, 2014). Paradise Fruits define their freeze-drying process as:

Freeze-drying is a process where frozen raw materials are placed in a refrigerated vacuum and ice crystals in the product are sublimated into water vapour, while the cell structure of the original product remains.

Carbocraft places purchase orders with Paradise Fruit, for shipping in a food-grade container, from Germany to South Africa. The freeze-dried fruit is non-perishable, sealed in thick plastic bags that are packed in cartons, then palletized. This product can have a production lead-time of 1-3 weeks, as the products are produced according to orders received. Freeze-dried fruit generally has a shelf-life of a year, sometimes a year and a half, thus limiting the inventory the supplier is able to keep available. Shipping from Germany to South Africa takes approximately four weeks. Following which the total lead-time for this product is 4-6 weeks. The shipment is then cleared through customs and delivered to Carbocraft's outsourced warehouses. All shipments from Paradise Fruit are handled ex-works by outsourced freight forwarders. However, the process is not without risks.

The ultimate purpose of risk identification and analysis is to prepare for risk mitigation. This study will review the supply chain, identify and define risks within it and then explore the different methods available for avoiding and possibly counter-acting these risks. In order to identify risks, a definition for 'risk' must be established. Cause and effect over time allows risk to be defined as "the probability of occurrence of disruptive events" Heckmann, et al. (2015).

The definition of risk has endured many modifications and as such the expansion of risk management and development of continuous improvement strategies remains necessary (Gilaninia, et al., 2013). Risk is the effect of uncertainty on objectives, whether positive or negative (ISO Guide 73, 2009).

As imports and exports increase throughout the globe, supply chains are growing more complex and involve more agents, multiple materials-handling points, multiple money movements and information movements throughout the process. Owing to the increase in complexity, supply chains have become more volatile as they are exposed to more

unpredictable risks, such as currency fluctuations, port bottlenecks, weather patterns and terrorist attacks (Heckmann et al., 2015).

Organizations need to predict future challenges to their supply chain, such as exchange rate fluctuations or port congestion causing delays in final deliveries. De Villiers et al. (2008) stated that a supply chain consists of various links/agents, and if any of these links had to stray off the intended path of a planned chain of supply, they could lead the supply chain in a completely new direction. This needs to be avoided, as a shift like this could cause a myriad of undesirable outcomes.

Before a risk can be managed, minimized or obliterated, it needs to first be identified. A supply chain can be vulnerable to multiple different risks, which in turn can be categorized further. It is important that the cause of risks is identified as comprehensively and as clearly as possible. Once these risks have been identified throughout the different sections of the supply chain, an organization will generally evaluate the effect that the risk will have on the supply chain. It would then be possible to plot a supply chain vulnerability map (Figure. 1).

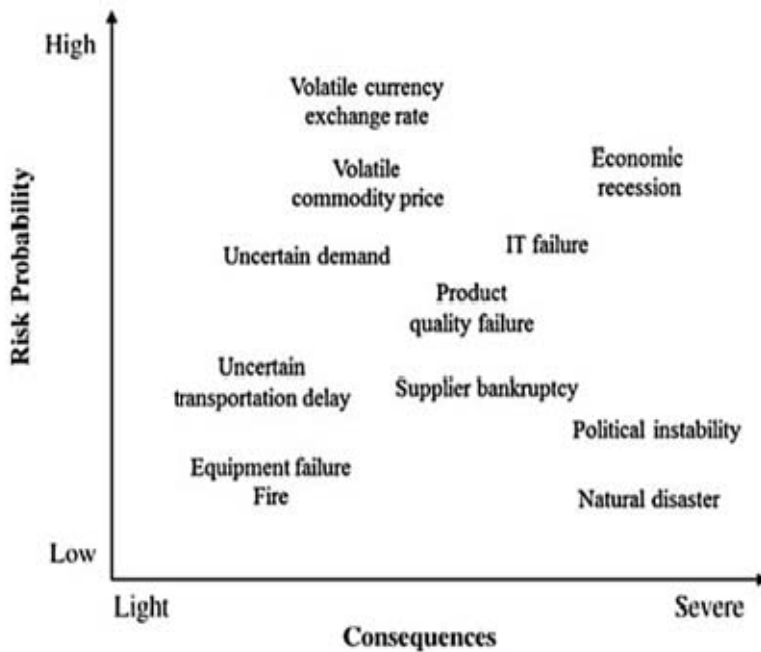


Figure. 1 Supply Chain Vulnerability Map, Source: Kouvelis, (2012).

By compiling a supply chain vulnerability map, an organization could explore the different risks that a supply chain could possibly be exposed to, deciding on whether or not the impact of the occurrence of this risk will have a low or severe impact on an organization's supply chain. Subsequently the organization has to determine the probability that this risk will occur: is it highly probable or fairly unlikely. An organization should identify possible risk factors within the organization, known as internal risk factors. Upon identifying the risks the supply chain is exposed to and mapping them according to probability and impact, Aqlan and Lam (2015) suggested a method called the bow-tie analysis (Figure. 2).

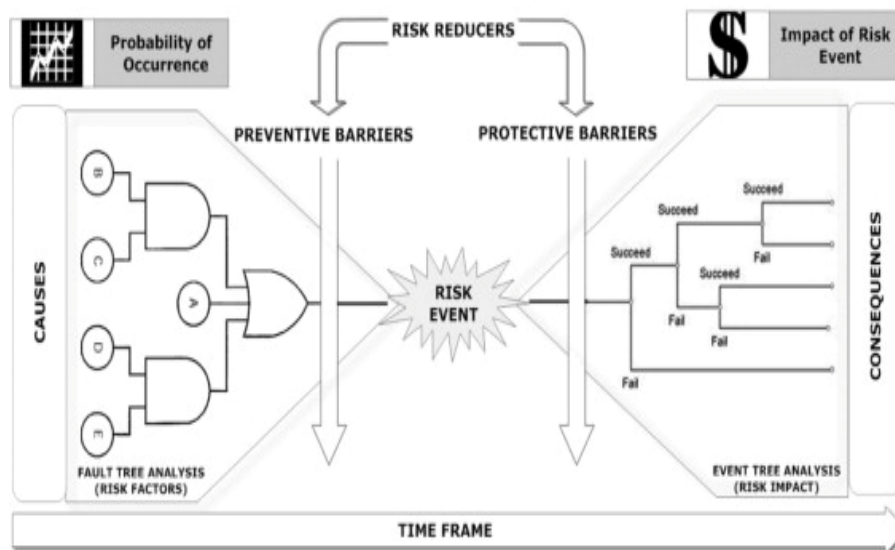


Figure 2: Bow-tie analysis of supply chain risks, Source: Aqlan and Lam (2015)

The bow-tie analysis of supply chain risks is used to estimate the aggregated probability of the risk event based on the estimated probabilities of risk factors associated with the risk. The bow-tie analysis consists of three components, firstly the probability of occurrence, secondly the risk event and, finally the consequences of the risk event occurring (Aqlan and Lam, 2015).

These methods assist in clarifying what risk areas are particularly problematic (high probability and severe effect). These risks are then focused on and plans are formulated to avert the supply chain from the risk, and in the event that this is not possible, to manage the situation strategically. Avoiding these risks is the concept known as risk management (Paulsson, 2004).

Supply chain risk management (SCRM) is defined as the continuous analysis of risks associated with a supply chain and the implementation of strategies to mitigate and/or manage these risks effectively (reference?). The supply chain management objective is to improve the process flow in the supply chain (Si et al., 2007). Furthermore, SCRM attempts to minimize the risks a supply chain is exposed to by effectively predicting possible risks and preparing procedures to be implemented upon exposure to these risks. This management approach decreases the supply chain's vulnerability and prevents possible organizational losses.

According to Kouvelis (2012), not enough research has been conducted on businesses using an inter-disciplinary approach when attempting risk management. As little research has focused on the import of this particular product (freeze-dried fruit), it is possible to investigate the use of financial and operational risk management methods jointly to mitigate risk. Thus, the focus was on determining the best way to avert or manage the most pressing risks related to the importation of freeze-dried fruit.

Literature review

Supply chains have grown considerably owing to globalisation. Global supply chains have therefore become longer and more complex, often including many additional companies in the chain. This in turn increases the vulnerability of the supply chain to risks. As globalisation has grown, firms have been forced to no longer view themselves as single entities, disconnected from others, but rather as part of an integrated chain of stakeholders in an industrial network (Lavastre, 2014). Furthermore, Lavastre, (2014: page number?) described supply chain management (SCM) as "the co-ordination and collaboration of channel partners, such as the suppliers, intermediaries, third-party service providers and customers."

Owing to complex global supply chains consisting of several linked organizations, they are usually slow to respond to changes, which make them even more vulnerable to business disruptions (Tang and Tomlin, 2008). Since the late 1980s research has increasingly focused on supply chain management within organizations. Yet, owing to the diversity of different supply chains, the research conducted on these is fairly diverse, consequently making it difficult to apply the results across supply chains (Mecheli et al., 2014).

- Risk identification and mitigation

The most efficient method in determining a way to mitigate risks that an organization's supply chain is vulnerable to is by applying the risk management process: identify, assess and measure risks (Bogataj and Bogataj, 2007). Risks occur owing to uncertainty about the future; the level of uncertainty depends on the amount of information available to estimate the likelihood of the risk occurring and the possible outcomes thereof (Aqlan and Lam, 2015; Bogataj and Bogataj, 2007). Risk is the "variation in the distribution of possible outcomes, their likelihoods, and their subjective values" (March and Shapira, 1987). Hence, the greater this variation, the greater the unpredictability of the risk would be. Thus, if the identified risk will have a pronounced impact on a supply chain, even if the possibility of this risk occurring is unpredictable, then it is viable for the organization to attempt to reduce the uncertainty associated with the risk (Aqlan and Lam, 2015). Reducing uncertainty improves the accuracy of risk management decisions (Aqlan and Lam, 2015).

Before an organization can start mitigating the risks within its supply chain, all possible risks that it could be vulnerable to should be identified. Any instance within the supply chain, where uncertainty exists, or where there is a possibility of an unpredictable occurrence disrupting the flow of information and/or physical goods along their intended path should be identified and measured. To calculate the risk, Aqlan and Lam (2015) suggested that the probability of this risk occurring should be multiplied with the estimated impact of the risk on the supply chain (low versus severe).

SCRM has been well researched throughout the years, and a number of models and techniques have been developed. These assist companies to better manage and measure supply chain risks (Khan and Zsidisin, 2011).

Although SCRM has been researched thoroughly, the risk of importing freeze-dried fruit within South Africa and possible methods of managing these risks are unknown. This is most likely owing to the fact that Carbocraft is the only company currently importing freeze-dried fruit into South Africa on a regular basis. Therefore, there is limited data available on this unique supply chain and the risks associated with it. Research that has been conducted on the fruit supply chain has focused on perishable fruit and fresh produce (Soto-Silva et al., 2016). The freeze-dried fruit product that Carbocraft imports is neither fresh nor perishable. The product has a shelf life of up to a year, further indicating the need for research into the risks of this particular supply chain.

Further research into similar supply chain risks, may develop theories and provide new methods on how to alleviate supply chain risks related to freeze-dried fruit importation.

By identifying the risks, all factors that may influence the supply chain can be determined, and by analysing the risks, a comprehension of the probability of it occurring and the degree of risk can be established. This paired with an evaluation of the risk, can result in an attempt to understand it better (Jüttner and Christopher, 2003).

Risks in supply chains arise from both external and internal factors as illustrated in Figure 3.

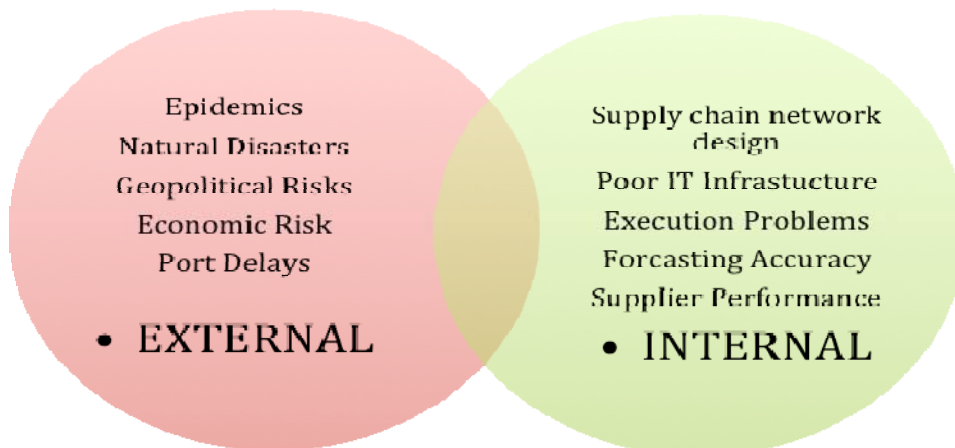


Figure 3: Internal and External Risks, Source: (Igboanugo: 2014).

The external supply chain risks include environmental factors that can affect the direct and indirect flow of the supply chain (Kleindorfer and Saad, 2005). Internal supply chain risks can be described as the chain of actions within a company that assists with providing a product to the customer (Basnet, 2012). Deloitte (2012, cited by Robinson, 2016) has identified four distinct categories of supply chain risk (Figure. 4).

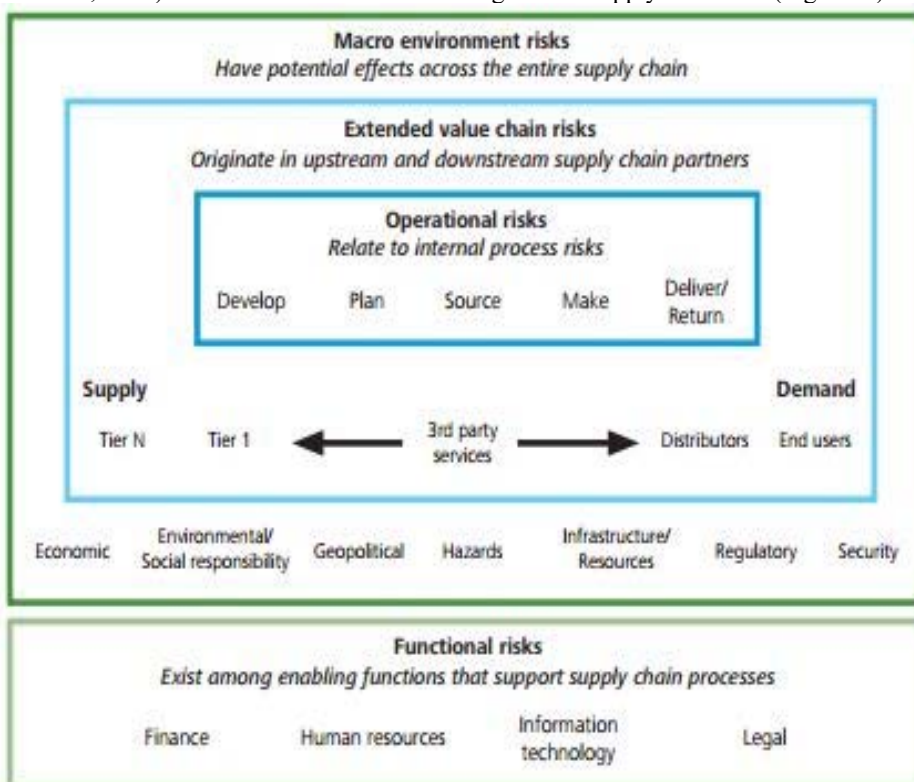


Figure. 4 Supply Chain Risks, Source: (Deloitte, 2012).

Macro environmental risk refers to forces outside the control of an organization that have the potential to disrupt the entire supply chain. To identify the external forces that could have an impact on an organization, the political, economic, sociocultural, technological, environmental, and legal factors (PESTEL factors) should be reviewed (Carpenter, 2011).

This kind of analysis would be pertinent to SCM for imports. Owing to imports being paid in a foreign currency, exchange-rate fluctuations have a major impact on the rand-value price of freeze-dried fruits. This economic risk corresponds with political risk, as was witnessed on 9 December 2015 in South Africa. President Jacob Zuma appointed the relatively unknown David van Rooyen to succeed Nhlanhla Nene as Minister of Finance, sending the rand plummeting by more than 5 percent (Reuters, 2015). This had serious implications for Carbocraft and its customers.

Extended value chain risks are those risks associated with an organization's upstream and downstream supply chain partners (Deloitte, 2012, cited by Robinson, 2016). For example, outsourcing certain functions to third parties increases the complexity of a supply chain and therefore increases risks.

Carbocraft outsources all its logistics services to multiple logistics providers, such as warehousing, transport and customs clearing. This adds multiple points of exposure to risks within the supply chain.

Operational risks are those introduced through an organisation's internal product development, manufacturing, and distribution operations (Deloitte, 2012, cited by Robinson, 2016). Efficiency measures, such as lean manufacturing and just-in-time inventory reduce an organization's margin for error and have the potential to exaggerate the effects of supply disruptions or natural disasters.

Paradise Fruits manufactures most of their produce on receipt of a purchase order from a customer. This contributes to the extended lead times on some freeze-dried fruit. Carbocraft keeps limited stock in their warehouses, owing to the shelf-life of the product being fairly short. Carbocraft prides itself on just-in-time (JIT) deliveries, yet relies on their appointed logistics provider to ensure that deliveries happen.

Functional risks relate to the various business functions of an organization. These are the activities that the organization relies on to support the supply chain entity, such as information technology (IT) development and human resources (Deloitte, 2012, cited by Robinson, 2016).

If supply chain risk is not managed effectively and efficiently it can have serious consequences for the organization. These consequences include not only financial losses, but also interruption of operations, reduction in product quality, as well as ruined customer and supplier relationships and damaged reputation (Mecheli et al., 2014). Problems in one link of the supply chain can cause total disaster to another link, resulting in substantial financial and non-financial losses.

Supply chain risk can be broken down into two types of risk, namely operational risk and disruption risk. Operational risk can be explained as the risks associated with the lack of co-ordination between people, processes and systems (Chen et al., 2013). Disruption risks are risks associated with the occurrence of man-made or natural disasters. Operational risks can be controlled while disruption risks are uncontrollable and can only be dealt with through calculated procedures and processes.

Furthermore, Chen et al. (2013) classified operational risks into three categories: supply risk, demand risk and process risk. This classification is researched extensively, Tang and Tomlin (2008). The supply chain of freeze-dried fruit faces multiple risks related to every section and link in the chain. Owing to the fact that this specific supply chain is a global one, with various participants from different sectors and industries, various risks are relevant at the different stages of the chain.

- Freeze-dried fruit supply chain

The first link in the freeze-dried fruit supply chain would be the supplier of the raw materials (farmers). Potential supply risks that are exposed to the chain at this stage include risks that can be classified as 'supply risks', such as issues relating to the quality of the raw materials supplied and the consistency with which they are supplied (Chen et al., 2013). Other risks include 'disruption risks', such as weather patterns or political instability. The lack of the use of advanced technology among farmers can pose threats to the supply chain and therefore lead to risks such as supply interruptions (Duan, 2016).

Once the fresh produce is sourced from the supplier, they are moved through the chain to the factory, where the fruit is processed into the freeze-dried fruit product ready for consumption. Possible risks at this stage would be the transportation of the raw material to the factory. Whilst the raw materials are in transit several risks are relevant,

such as damage to cargo or delays in delivery. As fresh fruit is a perishable product, the transport thereof would require a refrigerated vehicle to prevent decay.

The final product is then packaged, sealed and warehoused, where it is stored for sale. Risks introduced to the chain at this stage include possible damage during the consolidation process of products for shipment, the consideration of shelf life, all risks associated with the storage of inventory (fire, damage and theft). The lack of communication between supply chain partners can lead to double orders or inconsistencies between delivered quantities and actual quantities received, which is known as 'demand risks'.

Demand risks are all risks associated with the differences between forecasted demand and actual demand. Kumar et al. (2010) and Kouvelis, (2012) referred to this as a mis-match risk, when the supply and demand for a product do not match, leading to shortages or excess stock. Fawcett et al. (2014) suggested that the more information moves away from the final customer through the chain, the more uncertainties and inefficiencies arise, known as the bullwhip effect (Fawcett et al., 2014). Owing to a lack of communication and inaccurate forecasts being prepared, unexpected variations in demand occur. This risk can lead to differences between the amounts of stock that is actually required and the amounts of stock that is ordered. If the risks, or the cause of this vulnerability in the supply chain, can be identified by an organization, such as Carbocraft, then this risk can be managed effectively.

The product is then transported by truck from the warehouse to the relevant port for shipping to the customer. Risks at this stage would include weather patterns, transport risks, incorrect packages shipped and potential damage to products during transport. All of which have been discussed above. Once the ship carrying the product arrives and docks at the destination port, risks include errors in paperwork, inspectors discovering low quality, late arrival of the shipment, and other 'demand risks' associated with a mismatch in demand and delivered supply. The shipment then needs to clear through South African customs, exposing the supply chain to the risk of bribery and corruption.

After the shipment is cleared, generally in Durban, the container will be transported to a Carbocraft outsourced warehouse, unpacked and assessed for damages. The stock is then sent to Johannesburg, Cape Town or kept in Durban, depending on where the customers for the consolidated shipment are based and where they require the stock to be stored. The stock is vulnerable to damages during transport and warehousing and to theft.

- Conclusion

Once risks have been identified and assessed, an organization should attempt to develop strategies to manage these risks. An organization can plot the identified risks on a supply chain vulnerability map, in order to measure each risk by the probability of it occurring and its consequence. Two strategies are proposed: firstly, reduce the possibility of the risk occurring and secondly, attempt to reduce the negative implications of the undesirable event on the supply chain flow (Tang and Tomlin, 2008).

To reduce the probability of the risk occurring, risk avoidance strategies can be implemented, such as using technological advances or total quality management (TQM) (Tang and Tomlin, 2008). In order to reduce the consequential burdens, Tang and Tomlin (2008) introduced a theory by Dr Hau Lee called the 'Triple A' principles. Unfortunately, there is limited access to the original source, but Tang and Tomlin provided a clear explanation of Lee's theory of alignment, adaptability and agility.

Firstly, an organization should ensure that the interests of all the members within a supply chain align. This in turn will increase the efficiency at which these interests are achieved. Secondly, an organization should adapt to ever-changing market dynamics, thus reducing the impact of economic and political factors. Lastly, an organization should enhance their supply chain in such a way that its agility is heightened to reduce the impact of short-term risks, such as over/under stocking (Tang and Tomlin, 2008).

It follows that the supply chain relating to the importation of freeze-dried fruit into South Africa is possibly vulnerable to a number of supply chain risks, many of which should be managed in order to prevent any physical or financial losses. This study will attempt to identify the main risks facing this supply chain and then suggest strategies that Carbocraft can apply to mitigate/manage these major risks.

Research Problem Statement

Supply chains, especially global supply chains, can be incredibly complex and can include multiple partners. Unfortunately, owing to the diversity between different supply chains, it cannot be assumed that the same risks are associated with each supply chain. Kouvelis (2012) highlighted that not enough research has been conducted on businesses using an inter-disciplinary approach when attempting risk management. Therefore, the purpose of this investigation is to explore how the combination of financial and operational risk management methods can be used to assist Carbocraft in mitigating the risks identified and associated with the import of freeze-dried fruit, from the source in Germany to their customers in Durban, Cape Town and/or Johannesburg.

Research Question

What are the risk mitigation methods available to Carbocraft when importing freeze-dried fruit into South Africa to efficiently manage or eliminate risks at their origin?

- Sub research questions
 - To which risks is freeze-dried fruit exposed to during transportation from its source in Germany (Paradise Fruits) to delivery at Carbocraft's customers in South Africa?
 - Where in the freeze-dried fruit supply chain do these risks occur?
 - Which risks are most prominent with regard to their severity of impact on the freeze-dried fruit supply chain and the probability of them occurring?
 - What strategies can Carbocraft implement to mitigate different types of risks?
- Primary Research Objective
 - To investigate the most effective way of preventing and managing the most persistent risks related to the importation of freeze-dried fruit to South Africa.
 - Secondary objectives
 - To determine all the risks that the global supply chain of freeze-dried products are exposed to, during the transportation and importation from Germany to South Africa.
 - To demarcate at what section/link the freeze-dried fruit supply chain is exposed to risk.
 - To ascertain which risks have the highest impact/disruption and probability of occurrence within the supply chain of freeze-dried fruit.
 - To establish strategies that Carbocraft can implement to mitigate the different risks.

Research Purpose

Exploratory research design enables researchers to ask open questions to discover what is happening and gain insights into a topic (Saunders et al., 2016). According to Sreejesh et al. (2014) exploratory studies are conducted to analyse a problem, evaluate alternatives, and identify new ideas. This is ideal for this research, as the purpose is to gain insight into the risks within a supply chain in order to analyse these and identify methods for mitigating these.

Descriptive research design allows researchers to gain an accurate profile of events or situations (Saunders et al., 2016). Descriptive research often goes hand in hand with exploratory research. As the objective within this research project is to accurately analyse the event of a risk occurring in the supply chain and what causes this risk, both exploratory and descriptive research methods will be used.

Research Philosophy

The research philosophy most appropriate to this project is pragmatism. For a pragmatist, research starts with a problem, and aims to contribute practical solutions that inform future practice (Saunders et al., 2016). Pragmatism enables researchers to use a range of methods (mixed, qualitative, and quantitative) when conducting research. By combining qualitative and quantitative questions, pragmatism permits a more comprehensive approach to a research question (Creswell, 2013). In order for this research to encompass the intricate analysis into the freeze-dried fruit supply chain and to effectively suggest solutions to the identified risks, the pragmatic philosophy combined with explorative and descriptive research methods would yield the most detailed and resourceful results

Methodological Choice

Owing to the exploratory and descriptive nature of the research objectives, a quantitative research method was used to conduct this research. There is a need to identify the risks within the freeze-dried fruit supply chain and to rate the risks according to impact and severity. Data can be acquired through quantitative methods. Unfortunately, the successfulness of the implementation of mitigation methods is not easily measurable. The self-completed questionnaire utilizes rating questions, as these are appropriate in identifying which risks have the highest impact and frequency of occurrence in the various sections of the supply chain. Open-ended questions ascertain what

strategies respondents use to mitigate these risks. By requiring respondents to specify what division they work for (ocean freight, warehousing, customs clearance, transport, procurement/sourcing, or other) the researchers are able to identify which risks occur most frequently at the various links in the supply chain.

Research Strategy

A questionnaire was used to identify the risks in the supply chain, while open-ended questions in the questionnaire were used to propose mitigation strategies. The open-ended questions are important as they provide insight into best-practice mitigation strategies used in the different supply chain links. Once data were gathered, a supply chain vulnerability map was constructed, in order to clearly identify the most prominent risks. This could assist in proposing mitigation strategies for the most threatening risks in the supply chain.

Data Collection and Data Analysis

The unit(s) of analysis within this study would be the risks within the supply chain, along with studying which risk mitigation strategy would be best suited to manage a particular risk. Using a purposive non-probability sampling technique, this study will approach a sample population consisting of freight forwarders operating in Cape Town, Johannesburg and Durban, as well as the employees of both Paradise Fruit and Carbocraft. The sampling frame for this research has been identified as persons that have been involved in and/or are currently involved in the export of freeze-dried fruit from Germany and the import thereof into South Africa or staff that are involved in logistical and/or managerial functions relevant to the importation of products into South Africa. The number of possible respondents was therefore very limited. Furthermore heterogeneous purpose sampling was used to access a variety of expertise throughout the supply chain to answer the questions that are related to the study (Creswell, 2013). The sample size for this study consists of 25 respondents.

The quantitative data for this study were collected by means of a structured questionnaire. The questions were mostly structured using a matrix structure, with a few open-ended questions. The e-mail link to the online questionnaire was sent to the selected respondents. The questionnaire was completed through the use of web-based platforms, such as Google Forms. Open-ended questions were used to gain knowledge of how individuals manage risk on a daily basis.

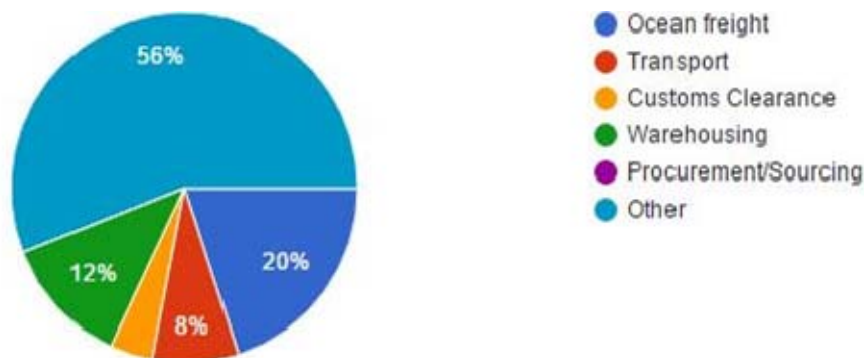
The population consisted of 60 professionals with 32 respondents, who are a reliable source of information, as they have first-hand knowledge and experience in their field. The internal validity of the questionnaire was tested by means of a pilot test to ensure that the questions are understood; internal validity was confirmed by researchers basing their questionnaire on the previously discussed "Vulnerability Map". The questions focused on identifying risk and attempting to measure their possible frequency and level of disruption on the supply chain.

The quantitative data were captured using Google forms. The data were exported into an Excel worksheet for further analysis and representation. The data collected by open-ended questions were used to identify the risk mitigation strategies used by professionals in each industry. The idea was to identify the best possible risk mitigation strategies for the most prominent risks in the supply chain.

A limitation of this study is that the sampling population was fairly small, and this could in turn result in less accurate data. In addition, the risk mitigation strategies that were suggested are not proven and are recommended and based on opinion, previous research and the experiences of others.

Findings

The respondents for this study ranged from the administrative clerk for the dispatch of freeze-dried fruit in Germany to the receipt of good in warehouses in South Africa. The range of respondents allows for a detailed understanding of the various links and possible risks per link within the freeze-dried fruit supply chain. Figure 5 illustrates the distribution of the respondents from the imported freeze-dried fruit supply chain.



These respondents were able to provide insight, not only into the risks that are prominent in their industry, but also the risks that they believe freeze-dried fruit would be exposed to. When asked to indicate which company division respondents work in, 20 percent of respondents indicated ocean freight, 8 percent indicated transport, 4 percent indicated customs clearance, 12 percent indicated warehousing, and 56 percent of respondents indicated ‘other’ as their company division. According to the few respondents that answered the question ascertaining their designation within a company, it seems that the “other” section consisted of sales consultants for the freeze-dried fruit, directors of freight companies and directors of Carbo Craft.

The study focused primarily on 15 potential risks: 1) Currency exchange risks (fluctuations in currency due to the exchange rate), 2) Regulatory risks (regulatory risks from new local/international government laws), 3) Economic risks (risks related to the local or world economy), 4) Financial risks (related to liquidity of a buyer or supplier), 5) Supply risks (i.e. under-stocking or overstocking locally, supplier shipping "old" stock), 6) Demand risks (over-demand situation for the product or service), 7) Quality risks (risks related to quality issues within the supply chain), 8) Environmental or geographic risks (risks related to environment, floods, hurricanes), 9) Customer risks (risks related to losing your customer), 10) Supplier performance risks (risks relating to the ability of the supplier to perform), 11) Raw materials risks (risks of lack of supply at a reasonable price), 12) Shipping or port risks (unreliable vessel bookings, shipment delays due to bad weather or labor delays, damages during ocean freight leg of journey), 13) Transport risk (delay in pick up, unreliable transporters, careless handling), 14) Customs risk (delays in processing customs clearance, delays in clearing due to port health and plant inspections, bottlenecks at customs) and 15) Risk of damage or loss (owing to transport by truck or rail, pilferage)

These were identified as the main headings of possible risks a supply chain could be exposed to. The respondents were asked to choose a minimum of three of these listed risks to determine which risks would be applicable to the freeze-dried fruit supply chain; the results are summarized in Figure 6.

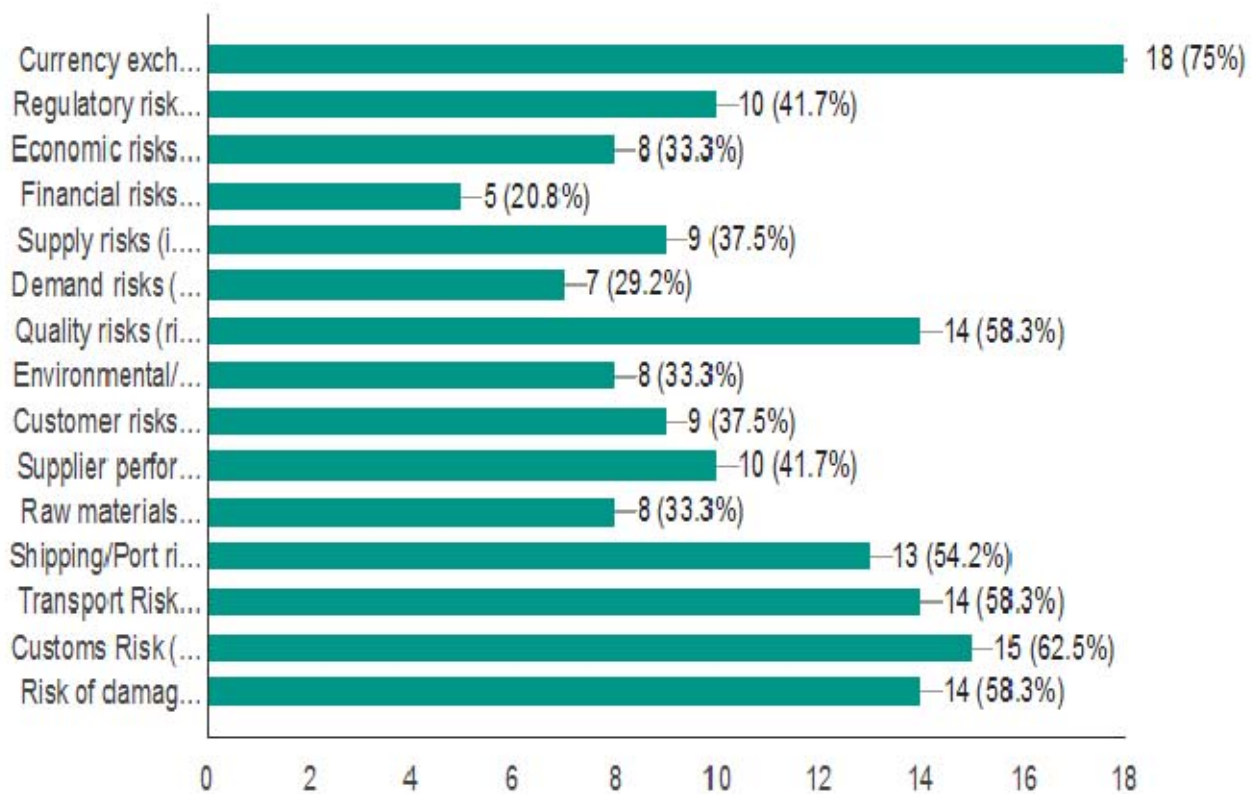


Figure 6: Risks the freeze-dried supply chain is exposed to during importation into South Africa from Germany

These results show that: 75% of the respondents believe currency exchange risk to be a risk in the freeze-dried fruit supply chain, 62.2% identify customs risk as a probable risk and 58.3% find transport and quality risk and the risk of damaging to be applicable to the freeze-dried fruit supply chain, and 54% identified shipping/port risk as a relevant risk.

It became apparent during the analysis of the data, that the identification of where the risks occur in the supply chain cannot be answered accurately.

In order to construct a supply chain vulnerability map by plotting the probability of a risk occurring against its impact on the supply chain, respondents were asked to rank the risks according to these two characteristics (Figure 7).

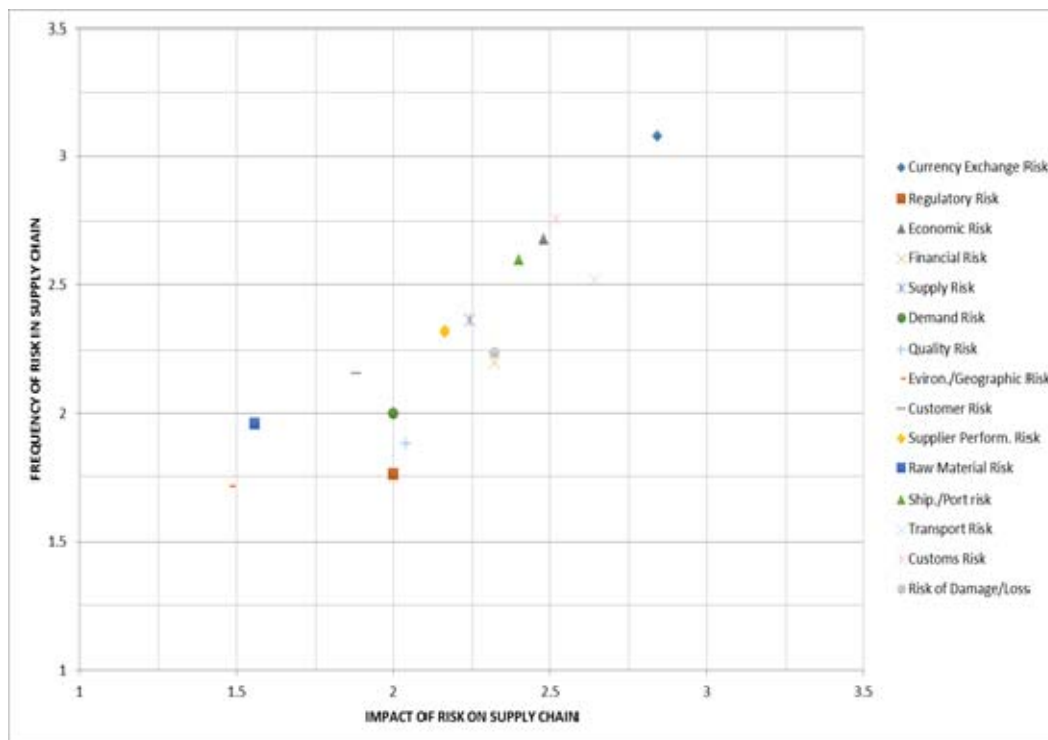
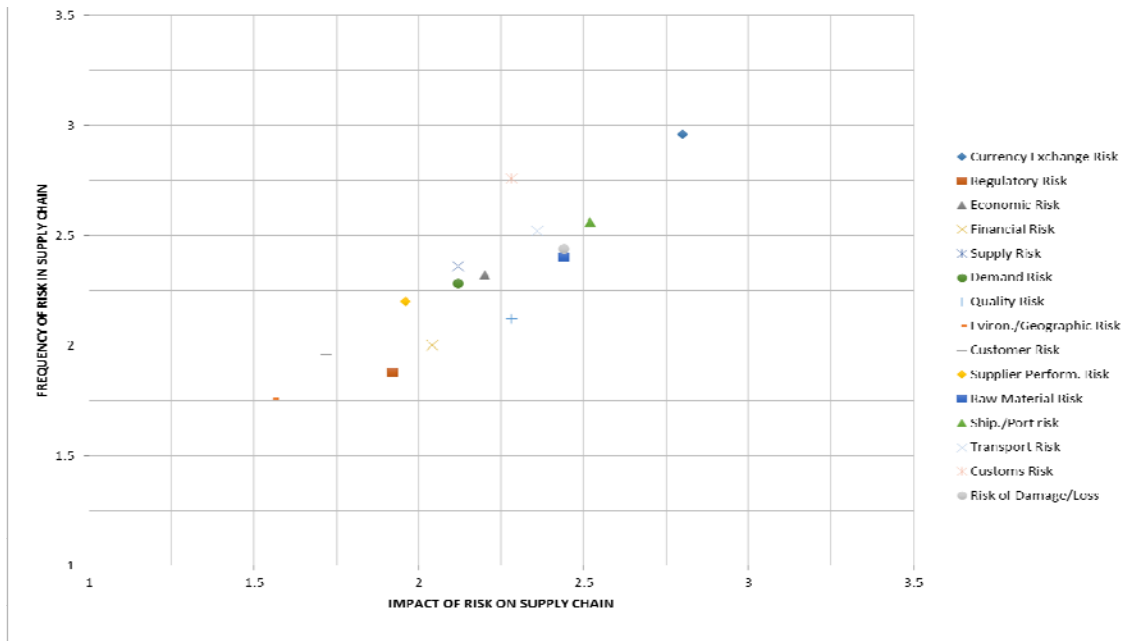


Figure 7: Industry related impact and frequency of risks

Any risks plotted in the top right-hand quadrant are identified as high impact-high probability risks. This means that mitigation strategies for these risks must be in place to prevent disruptions in the supply chain. From Figure 7 examples would include currency exchange, customs, economic and shipping/port risk. Risks that are plotted in the bottom left-hand quadrant are low probability-low impact risks in the supply chain. These risks can be managed as and when they occur and include customer, demand, and quality, environmental, regulatory and raw material risk.

Furthermore, risks that occur in the bottom right-hand quadrant and top left-hand quadrant are high impact-low probability (Supplier performance and supply risk) and low probability-high impact risks (Risk of damage/loss and financial risk), respectively.

The respondents were then asked to repeat the exercise and rank the same risks, with regards to the freeze dried fruit supply chain; the results are illustrated in Figure 8.



From the results, the risks are slightly different for each quadrant. The high impact-high frequency risks are currency exchange, customs, shipping, and demand and transport risks. Furthermore, the high impact-low frequency risk identified is financial risk and low impact-high probability risks are supply and supplier performance risks. Lastly, low impact-low probability risks include customer, demand, and raw material, regulatory, quality and environmental/geographic risks.

The risks are categorized into quadrants in Figure 9.

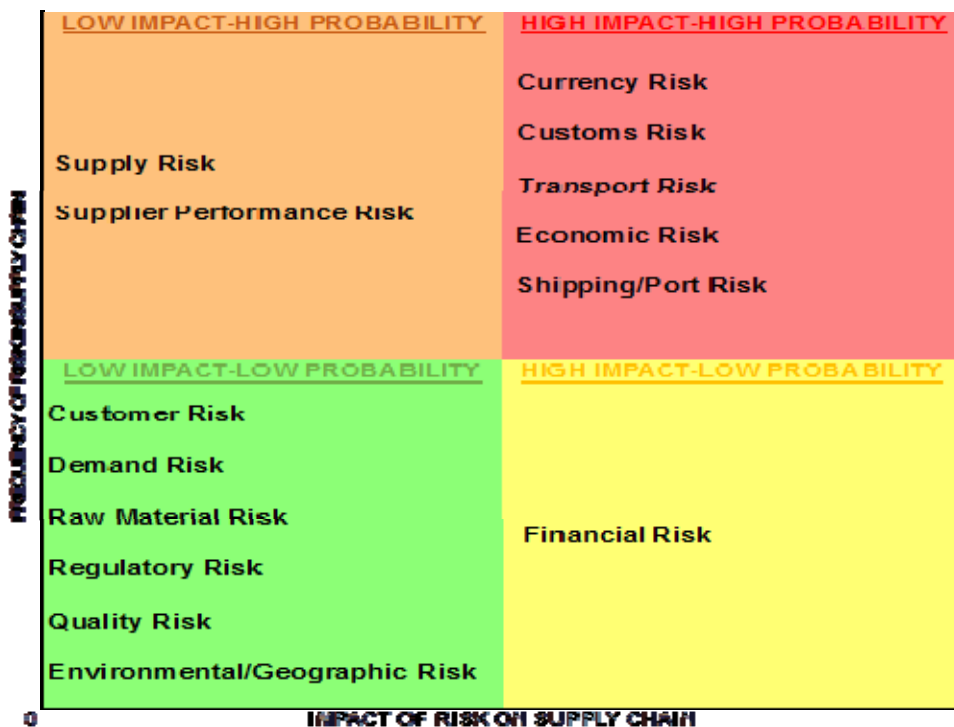


Figure 9: Freeze-dried fruit related impact and frequency of risks (simplified)

Conclusion

Risks that are listed in the top-right quadrant are high impact-high probability risks and therefore require constant monitoring and stringent mitigation strategies. High impact-low probability risks require management strategies or company procedures to be in place for the possibility of such an event. Risks that are identified as low impact-high probability risks (top left) are every-day risks that would require monitoring to ensure that they do not move into the top right quadrant. Lastly, risks that fall in the bottom-left zone are low impact-low probability risks. These would require regular monitoring, but general company policies and procedures should assist in managing these with a certain degree of ease during day-to-day business.

There are numerous mitigation strategies and procedures that Carbocraft can implement in order to make sure their freeze-dried fruit supply chain remains uninterrupted. Carbocraft can design a model to identify and measure supply chain risk, following which they can identify the procedures that should be implemented in order to prevent these risks from occurring. This would provide all employees with an excellent framework and checklist for mitigating possible supply chain risks.

To prevent currency fluctuation risks from affecting profit margins in the business, Carbocraft can ensure forward cover on shipment. By booking forward cover in advance you have the certainty that for a specific period, the currency is fixed. Hedging exchange rates with their bank prior to shipping and/or building in a currency exchange buffer into customer price negotiations are other options to manage currency fluctuations.

When importing freeze-dried fruit, Carbocraft should ensure 100 percent commitment from the customer, such as an official purchase order, to protect the company in the case that the customer goes bankrupt or decides that they no longer want the good after they have been shipped. Carbocraft should insist on payment for goods prior to shipping, for those customers that do not have an approved credit application with the company. They can further protect themselves by arranging debtors insurance.

Carbocraft should ensure that they have a blanket stock insurance policy in place to cover costs for damages or losses. Risk of damage or loss and transport risk have been plotted in the top-right zone. Damages during transport can be managed by ensuring the product is packaged in good quality cartons and sealed bags, furthermore that it is palletised and shrink-wrapped. This will limit damages when the product is being handled. It is also generally preferred to ship this kind of product in a full-container load than an LCL. Regardless of which method is chosen, freight forwarders should receive instructions on how to handle and pack this product, such as food-grade material. Further to this, Carbocraft can implement a 3-strike policy with third party logistics providers (3PLs); if the service provider defaults three times, they are automatically replaced.

It is not always possible to prevent delays with shipping or customs, but it is important that Carbocraft builds in time contingencies into their lead-times. In case there are delays, the customer's expected delivery date is not affected. When shipping LCL, sometimes freighters "over-book" container space and will then post-pone shipping of a consignment because of it. When shipping from Germany, this will usually add an additional week, as vessels destined for South Africa leave weekly. It is also important that the freight forwarder is provided with enough time by Carbocraft to coordinate pick-up and vessel booking.

Once the shipment reaches South African shores, Carbocraft needs to ensure that their clearing agent has all the necessary documentation in order to clear the product through South African customs. This would include documents such as certificate of origin, commercial invoice, packing lists, certificate of analysis and a clearing instruction. The clearing agent should pre-clear the product prior to it being taken off the vessel. Port Health and Plant Inspections are typical for this type of product and should be booked as soon as possible to prevent delays in delivering the shipment to the warehouse. It would be prudent to ship this type of consignment with the same clearing agent, as they would most likely build up a relationship with customs officials, which would ensure hassle-free clearing of these shipments.

Recommendations

It would be advisable that Carbocraft have a team dedicated to evaluating the supply chain, identifying the risks facing the supply chain and brainstorming ways to mitigate the identified risks. By categorising the risks, according to frequency of occurrence and impact on the supply chain, Carbocraft could have a better understanding of the

strategies needed to resolve or manage the risks identified. Implementing some of the strategies mentioned above should ensure a smooth flow of freeze-dried fruit from Germany to South Africa, while ensuring continuous customer satisfaction. This study is limited as it cannot measure the exact impact of the risks on the supply chain.

Further studies could be conducted on the successfulness of implementing the suggested strategies in this supply chain. A detailed supply chain analysis could be prepared and compared to internationally recognized supply chain best practices for supply chain solutions that cover a broader base than just risks.

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