Developing a performance measurement framework to benchmark the South African wine supply chain with a focus on the packaged export supply chain segment

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Abstract

Over the past few decades, the importance of supply chains and supply chain management has increased significantly. Companies are turning to their supply chains to decrease costs and increase efficiencies. The South African wine industry is currently under financial pressure and the industry will have to focus on its supply chains to stay competitive.

Currently, in the South African wine industry, no supply chain benchmarks exist against which cellars can compare their performance to identify areas for improvement. The need therefore exists to establish these benchmarks. However, before benchmarks can be established, the question of what to benchmark must first be answered.

To address the abovementioned problems, a multi-phased methodology is applied to develop three supply chain measurement frameworks, each using findings from the previous as inputs. The aim of the frameworks is to propose a set of metrics that can be used to measure supply chain performance, thereby answering the question of what to benchmark. Other inputs to the development are a review of the relevant literature, structured and semi-structured interviews with various industry players and findings from other projects which form part of a wine supply chain project hosted by the University of Stellenbosch. The frameworks are each validated by numerous industry players.

This thesis specifically focusses on the packaged export supply chain of natural wine. Seeing that the framework will be used to measure the performance of a supply chain, it can be seen as a decision support tool. Decision support

is focussed on the strategic and managerial levels.

Through the process of developing the frameworks, it is found that the wine industry has low levels of supply chain management maturity. This is confirmed by a quantitative analysis of the first two frameworks: gathering data from a sample of cellars and freight forwarders shows that little supply chain data is being captured. As a result, sample benchmarks are only established for the first framework.

The third framework proposes the final set of metrics, together with methods for collecting data, which cellars can use to measure their supply chain performance. It is recommended that cellars start measuring and tracking their own performance. This will enable cellars to identify areas for improvement. It is then each cellar's responsibility to conduct improvement projects. Once a sufficient number of cellars measure their supply chain performance by implementing the proposed framework, benchmarks can be established.

Opsomming

Gedurende die afgelope dekades het die belangrikheid van voorsieningskettings en voorsieningskettingsbestuur aansienlik toegeneem. Besighede konsentreer tans op hulle voorsieningskettings om kostes te verminder en om doeltreffendheid te verbeter. Die Suid-Afrikaanse wynbedryf is op die oomblik onder finansiële druk en sal moet fokus op voorsieningskettings om mededingend te bly.

In die Suid-Afrikaanse wynbedryf bestaan daar huidig geen voorsieningsketting-maatstawwe waarteen kelders hulle prestasie kan vergelyk om geleenthede vir verbetering te identifiseer nie. Daar bestaan dus 'n behoefte om sodanige maatstawwe op te stel. Voordat maatstawwe egter opgestel kan word, moet daar eers bepaal word watter maatstawwe opgestel moet word.

Om bogenoemde probleme aan te spreek is 'n multi-fase metodologie toegepas om drie voorsieningsketting metingsraamwerke op te stel, waarin die bevindinge van een raamwerk gebruik word as insette vir die volgende raamwerk. Die doel van die raamwerke is om 'n stel metings voor te stel wat gebruik kan word om 'n voorsieningsketting mee te meet en sodoende die vraag oor watter maatstawwe ontwikkel moet word, te beantwoord. Ander insette vir die ontwikkeling van die raamwerke is 'n ondersoek van relevante literatuur, gestruktureerde en semi-gestruktureerde onderhoude met 'n verskeidenheid industrie rolspelers en bevindinge van ander projekte wat deel vorm van 'n wyn-voorsieningsketting projek wat aangebied is deur die Universiteit van Stellenbosch. Elke raamwerk is bekragtig deur rolspelers in die industrie.

Hierdie tesis fokus spesifiek op die verpakte uitvoer voorsieningsketting segment van natuurlike wyn. Sienende dat die raamwerk gebruik gaan word om

prestasie van 'n voorsieningsketting te meet, kan dit ook gebruik word om besluite te ondersteun. Besluitnemingsondersteuning fokus op die strategiese en bestuursvlakke.

Tydens die proses waardeur die raamwerke ontwikkel is, is bevind dat die wynbedryf lae vlakke van voorsieningsketting-volwassenheid het. Dit is bevestig deur 'n kwantitatiewe analise van die eerste twee raamwerke: data wat versamel is vanaf 'n steekproef van kelders en expediteure wys dat min voorsieningsketting-data opgevang word. Gevolglik is steekproefmaatstawwe net opgestel vir die eerste raamwerk.

Die derde raamwerk stel 'n finale lys voor van metings en metodes van hoe data opgevang moet word wat kelders kan gebruik om hulle voorsieningsketting se prestasie mee te meet. Dit word aanbeveel dat kelders begin om hulle eie prestasie te meet. Dit sal die kelders in staat stel om geleenthede vir verbetering te identifiseer. Dit is dan elke kelder se verantwoordelikheid om projekte te implementeer waarin die verbetering gerealiseer word. Wanneer 'n voldoende aantal kelders hulle voorsieningsketting prestasie meet deur die voorgestelde metings te implementeer, kan maatstawwe opgestel word.

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Nomenclature

Superscripts

AG	Agility
AM	Asset Management
BPO	Business Process Orientation
BSC	Balanced Scorecard
CCP	Context, Content, Processes
CO	Costs
FF	Freight forwarder
FOB	Free On Board
GDP	Gross Domestic Product
IDOS	Inventory Days Of Supply
KWV	Ko-operatieve Wijnbouwers Vereniging
OQ	Order Qualifying criteria
OW	Order Winning criteria
PDCA	Plan, Do, Check, Act
POD	Port Of Discharge
RDD	Requested Delivery Date
RL	Reliability
RS	Responsiveness
RSD	Requested Shipping Date

SA	South Africa
SAWIS	South Africa Wine Industry Information and Systems
SCC	Supply Chain Council
SCOR	Supply Chain Operations Reference
SKU	Stock Keeping Unit
SME	Small/Medium Enterprise
WOSA	Wines Of South Africa

CHAPTER 1

Introduction

Contents

This section describes the context of the research. It provides a background of the South African wine industry and discusses the need for a project aimed at improving the supply chains of the wine industry. However, before commencing a supply chain improvement project, certain factors need to be in place. It is the lack of these factors which forms the base of this thesis.

1.1 A short history of South African wine

The South African wine industry is unique in the sense that it is the only wine industry in the world in which the exact date of the industry's origin is known. This is thanks to a diary entry on 2 February 1659 by Jan van Riebeeck, the First Commander of the Cape, in which he wrote: "Today, praise be to God, wine was made for the first time from Cape grapes." This was the start of the today 350 year old South African wine industry (WOSA, 2015a).

Between the late 1600s and the late 1800s the South African wine industry experienced many good and bad times. The good times include the planting of 10 000 vines by Simon van der Stel in 1685, the first export of South African wine by the Constantia estate which won acclaim through Europe in 1761 and in 1822 10% of all wines consumed in Britain were of South African origin. In the same period the phylloxera virus was discovered in vines on the banks of the Liesbeek river, resulting in the uprooting of millions of vines (WOSA, 2015a).

During the early 1900s the wine industry had a problem with overproduction. This resulted in the creation of the Ko-operatieve Wijnbouwers Vereniging, or KWV, in 1918. The purpose of KWV was to regulate the entire wine industry, for example KWV was the sole exporter and importer of surplus alcohol, and determined the minimum prices of all wines. This benefited high yield wine producers, regardless of quality. In 1997 the KWV converted from a co-operative to a company, giving up its role to regulate the entire industry. As a result of this, during the past two decades numerous cellars started to bottle and sell their own wines directly to the public rather than selling bulk wines to other organisations. This is done to benefit from an extended value chain and also to be less dependent on the buyer of grapes, who generally determines the price.

More or less 350 years later, in 2014, South Africa was ranked as number seven in the world in terms of wine production, contributing 4.2% to global wine production. Currently, South Africa has 49 producer cellars, 485 private cellars and 25 wholesalers, resulting in a total of 559 wine cellars which crush grapes (SAWIS, 2015). The wine industry plays an important role in the country's economy, contributing R36.1 billion to South Africa's gross domestic product (GDP), with growth in contribution to GDP being at least 10% per year since 2003. The industry employs about 300 000 people both directly and indirectly (WOSA, 2015b). The wine industry is South Africa's second largest tourist attraction after Cape Town, which leads to further job creation and economic growth in industries outside of the wine industry, such as the leisure industry (South African Tourism, 2014).

1.2 Problem description

The South African wine industry has come a long way since its origin in the mid seventeenth century. Through its long history the industry has fulfilled the art of grape production and winemaking. The markets of the industry have also grown, both locally and internationally, with specifically the export of packaged products playing a significant role in the profits of the industry.

Currently, South African wine producers are under immense financial pressure. Wine producers will have to reduce costs and increase efficiencies within their supply chains in order to survive and stay competitive (Van Eeden, Louw, Van Dyk & Goedhals-Gerber, 2012). According to Laville (2010), who specifically focussed on the French wine industry, the application of supply chain management as a strategic lever is rarely used. Laville (2010) further states that the wine industry is suffering, more than other industries, from a low level of supply chain management maturity, which results in non-cost-efficient operations. According to him, the reason for this is probably a lack of knowledge of supply chain management, not only in terms of the physical flows, but also integrated information and financial flows. Garcia, Marchetta, Camargo, Morel & Forradellas (2012) state that wine companies around the world are realising the importance of supply chains and the impact of the supply chains' performance on the business.

The South African wine industry and the application of supply chain knowledge within the industry were investigated by the University of Stellenbosch, PWC and the CSIR, with the findings being presented at the SAPICS conference in 2012. The investigation confirmed the lack of effective supply chain management within the wine industry by concluding that many cellars are not engaged in the field of supply chain management and are consequently in the very early stages of supply chain maturity (Van Eeden *et al.*, 2012). The study emphasised the need for a project with the aim of improving the industry's supply chains. Extensive research have been conducted with regard to the winemaking process and grape production, but nothing of substance has been conducted with the aim of improving the wine industry's supply chains. This results in an imbalance within wine producing businesses, limiting effective growth.

There has been no project attempted in South Africa to map the country's wine supply chains or to apply supply chain reference models with the aim of improving these supply chains. This clearly shows a gap in the literature and urgent problems which need addressing. Other wine producing countries, such as Argentina, have conducted studies on the application of supply chain management within their wine industries, such as Garcia *et al.* (2012), which provides wine producers in those countries with a competitive advantage over South African wine producers.

There exist many methodologies and frameworks within the literature regarding supply chain management. One of the most well known and widely adopted frameworks is the Supply Chain Operations Reference (SCOR) model which is developed and updated by the Supply Chain Council (SCC). The SCOR model provides, among others, a methodology regarding supply chain improvement projects, namely the SCOR implementation road map, which is shown in Table 1.1.

Table 1.1: SCOR implementation road map

Phase	**Name**	**Deliverable**	**Resolves**
0	Organise	Organisational Support	Who is the sponsor?
I	Discover	• Supply Chain Definition • Supply Chain Priorities • Project Charter	What will the program cover?
II	Analyse	• Scorecard • Benchmark • Competitive requirements	What are the strategic requiements of your supply chain?
III	Material	• Geo Map • Thread Diagram • Disconnect Analysis	Initial analysis - Where are the problems?
IV	Work	• Transaction • Level 3, Level 4 Processes • Best Practice Analysis	Final Analysis - Where are the solutions?
V	Implement	• Opportunity Analysis • Project Definition • Deployment Organisation	How to deploy?

Table 1.1 outlines six phases which can be followed to conduct a supply chain improvement project from planning to implementation. Before commencing a project that follows this methodology, certain factors should be in place, such as benchmarks for the Analyse phase and best practices for the Best Practice analysis in the Work phase. Due to a lack of supply chain maturity within the South African wine industry, no benchmarks exist. In order to create benchmarks, the question of what to benchmark must first be answered through the completion of the Scorecard deliverable in the Analyse phase. The lack of a scorecard and benchmarks creates a gap within the methodology which makes it impossible to complete the Analyse phase. The aim of this thesis is to fill this gap. The Analyse phase is the only phase which cannot be completed. Hence, all six phases can be completed once this gap is filled. Therefore, the successful completion of this thesis will enable the execution of supply chain improvement projects within the South African wine industry.

To sum up the discussion above, there exists a need for a supply chain measurement framework (scorecard) to measure the performance of South African wine supply chains. Once the performance can be measured, the results need to be interpreted. This creates the need for benchmarks.

1.3 Problem statement

The wine industry is currently under financial pressure and a preliminary investigation suggests that the South African wine industry needs to focus on the improvement of its supply chains. However, there exist no supply chain benchmarks against which cellars can compare their performance to identify areas for improvement. Before benchmarks can be established, the question of what to benchmark must first be answered. Hence, there exists a need to develop a supply chain performance measurement framework which can be used to establish benchmarks.

1.4 Scope and objectives

This thesis is part of a three year project, called the wine supply chain project, which ranges from 2014 to 2016 and is conducted by the University of Stellenbosch. This section describes how this thesis fits within the wine supply chain project, after which the scope and objectives for this thesis are discussed.

1.4.1 Wine supply chain project

The aim of the wine supply chain project is to act as a starting point for solving the problems described in Section 1.2. The project is sponsored by Winetech, the Technology and Human Resources for Industry Program (THRIP) and Vinpro. The study is done in collaboration with the CSIR and PwC.

The first two years of the wine supply chain project consisted of three work streams. Work stream 1 ran from April 2014 to September 2014 and consisted of five final year Industrial Engineering students and six Honours in Logistics Management students who were supported by various study leaders. The aim of work stream 1 was to investigate the supply chains of a number of cellars by executing phases 3 and 4 of the SCOR implementation road map. Students conducted an as-is analysis of each cellar, consisting of geo maps, thread diagrams and disconnect analyses. Once this had been completed, students executed best practice analyses and made various suggestions to the cellars.

Work stream 2 ran from April 2014 to October 2015 and consisted of three Masters in Engineering Management students who were supported by study leaders. For work stream 2 the wine supply chain was segmented by classifying wine as either packaged or bulk and customers as either export or local. This generated four supply chain segments, as can be seen in Table 1.2.

Table 1.2: Supply chain segmentation for work stream 2

Wine \ ***Customer***	**Local**	**Export**
Packaged	Packaged Local	Packaged Export
Bulk	Bulk Local	Bulk Export

Work stream 2 had two objectives. The first objective was to develop supply chain measurement frameworks for three of the segments identified in Table 1.2, namely Packaged Local, Packaged Export and Bulk Export. Since wine within the Bulk Local segment eventually ends up in one of the other three segments, no framework was developed for this segment. These frameworks were seen as the Scorecard deliverable in the Analyse phase of the SCOR implementation road map. The second objective of work stream 2 was the establishment of sample benchmarks for each of the three abovementioned segments. This was seen as the Benchmark deliverable in the Analyse phase of the SCOR implementation road map. Hence, the successful completion of work stream 2 would enable the execution of the entire SCOR implementation road map. The aim of this thesis is to complete these two deliverables for the Packaged Export supply chain segment.

Work stream 3 ran from April 2015 to September 2015 and consisted of six final year Industrial Engineering students and four Honours in Logistics Management students, supported by study leaders. The aim of work stream 3 was to investigate various supply chain issues and opportunities for improvement which stemmed from the results of work stream 1 and preliminary findings of work stream 2.

1.4.2 Thesis scope

As explained in the previous section, the aim of this thesis is to develop a supply chain measurement framework, together with sample benchmarks, for the packaged export supply chain segment. The focus of the thesis is natural wine, thereby excluding fortified and sparkling wines. Seeing that the framework will be used to measure the performance of a supply chain, it can be seen as a decision support tool. This section defines the scope of the thesis, firstly in terms of the supply chain, and secondly in terms of decision support.

Supply chain scope

A supply chain includes all the players from the raw material producer to the end customer. Given the lack of supply chain maturity within the wine industry, it is not practical to develop a framework which includes all these players. Seeing that extensive research has been done with regard to the winemaking process, the framework will not include measures which are based on this process. The sourcing side of the supply chain is incorporated to a certain extent, but the section of the supply chain where the biggest opportunities for improvement lie, and which is therefore the focus of this thesis, is from when the winemaking process ends until the wine is delivered to the customer.

Decision support scope

Figure 1.1 illustrates the three management levels within a company, together with certain characteristics of each level.

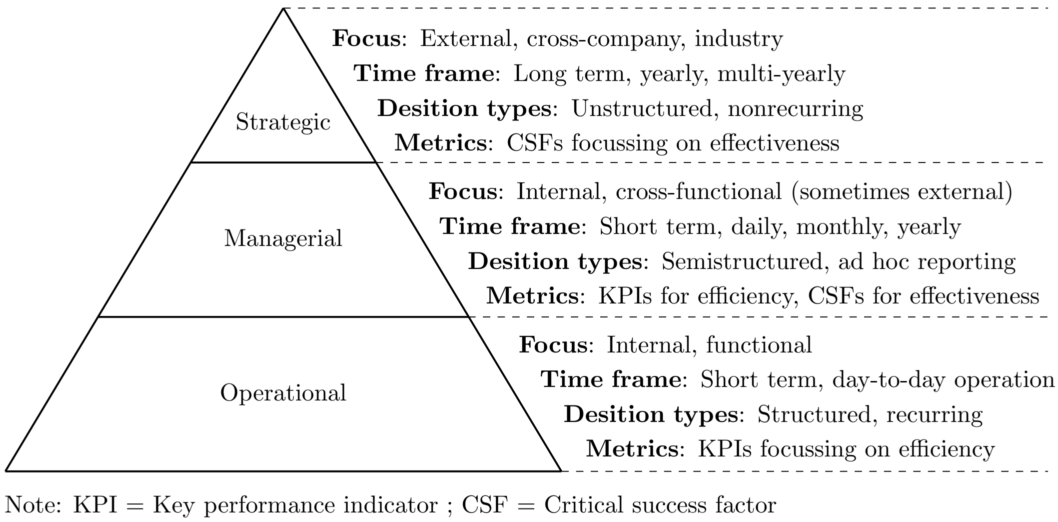


Figure 1.1: Decision support scope (Baltzan, 2012)

Baltzan (2012) defines critical success factors as the crucial steps companies perform to achieve their goals and implement their strategies. He defines key performance indicators as quantifiable metrics which are more specific than critical success factors and are used to evaluate progress towards critical success factors. He further states that efficiency focusses on the extent to which a firm is using its resources in an optimal way, while effectiveness focusses on how well a firm is achieving its goals and objectives. The scope of this thesis is to develop a framework which will aid managers with decisions that fall within the managerial and strategic levels.

1.4.3 Thesis objectives

In order to enable the execution of the Analyse phase in the SCOR implementation road map this thesis has three objectives:

1. To create a supply chain measurement framework for the South African wine industry with a specific focus on the packaged export supply chain segment.

2. To investigate the availability of supply chain data in the industry.

3. To establish sample benchmarks for the metrics identified in the framework using data which is collected from various industry players.

1.5 The South African wine industry

To be able to effectively fulfill the objectives of this thesis, a study of the current state of the South African wine industry needs to be conducted. This section provides an overview of the South African wine industry, both in terms of the industry as a whole and the packaged export segment.

1.5.1 South African wine production

During 2014, 3314 farmers, cultivating 99 463 hectares of vines, harvested 1 519 708 tons of grapes, or 1181.1 million litres, of which 81% was used for wine (WOSA, 2015a). This led to South Africa being the seventh largest wine producing country in the world. South Africa's wine industry can be divided into 26 wine producing districts, which can be consolidated into nine regions. The nine regions are shown in Figure 1.2.

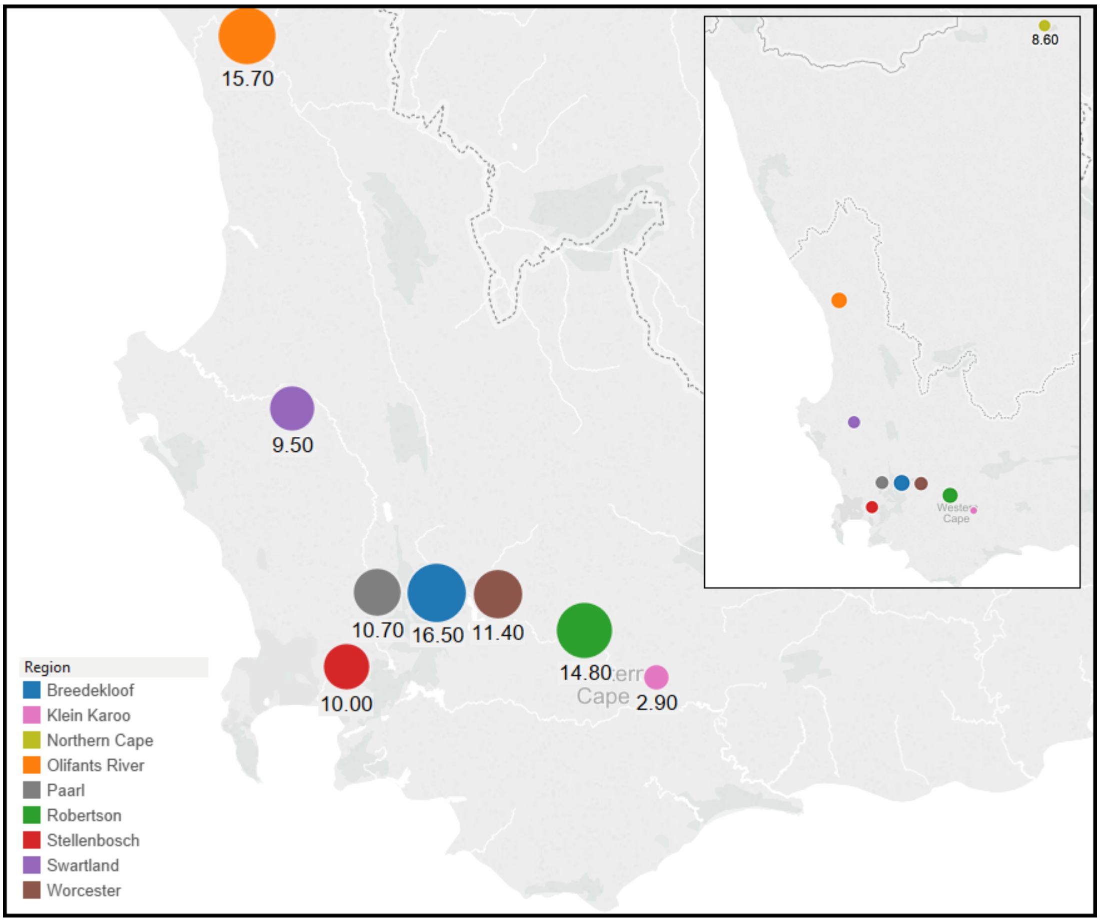


Figure 1.2: Wine producing districts of South Africa according to percentage grape production

Figure 1.2 shows the geographical location of each of the nine districts. The figure also indicates the percentage that each district contributed to the 2014 harvest in terms of grape production. Table 1.3 shows more detailed information of each region.

Table 1.3: Production information per region for 2014 (SAWIS, 2015)

Region	% of total hectares	% of grape production	Average tons per hectare
Stellenbosch	16.12	10.0	7.75
Paarl	15.92	10.7	9.37
Robertson	14.73	14.8	16.16
Swartland	13.66	9.5	9.37
Breedekloof	13.09	16.5	19.57
Olifants River	10.20	15.7	24.51
Worcester	8.91	11.4	18.44
Northern Cape	4.68	8.6	31.52
Klein Karoo	2.67	2.9	17.47

Table 1.3 shows that the percentage of grape production is not directly proportional to the percentage of hectares, as confirmed by the average tons per hectare. This is due to the difference in terrior between the regions. This represents a significant economic advantage for cellars situated in high production regions. However, a region such as Stellenbosch is known for its production of low volume, high quality grapes, whereas a region such as the Olifants River produces large volumes of often lower quality grapes. Therefore, for cellars in the low yielding regions to survive, they need to reap the benefits of the high quality of their grapes. This is done by selling wine under the cellar's own label, hence the large number of private cellars in the Stellenbosch, Paarl and Swartland regions.

South Africa exports about half of its total production. Both total production and total exports experienced positive growth trends during the last seven years. This is shown in Figure 1.3.

Since 2007, growth in production averaged 3.87% per year and exports averaged a growth of 6.92% per year. One of the most significant insights of Figure 1.3 is the difference in variance of the two graphs. The coefficient of variance (standard deviation divided by mean) of the total production is 12%, whereas in the case of total exports,

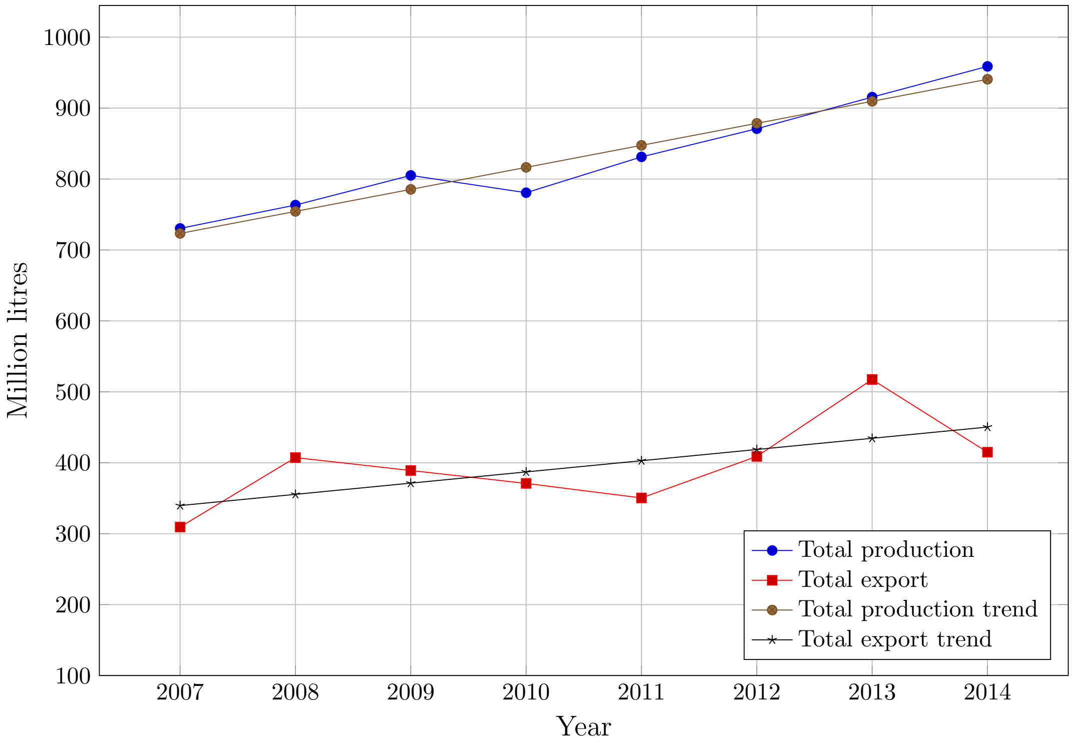


Figure 1.3: SA wine production and export growth (2007-2014) (WOSA, 2015c)

it is 19%. Hence, the total exports fluctuate much more than the total production. The reason for this fluctuation is that the export demand is influenced by many factors. This includes the volumes of other wine producing countries' harvests, the economic state of the countries to which wine is exported, etc. For example, the sudden increase in export volumes in 2013 was due to a bad harvest in northern hemisphere countries. Consequently, to effectively compete in the export segments, a wine cellar's supply chain has to be agile so that it can adapt to the changing demand.

1.5.2 Background of the packaged export segment

According to a survey by PwC (2014) of the South African wine industry, CEOs regard expansion into new international markets as the second highest opportunity for improvement. The survey also pointed out that global supply and demand is the most important factor which influences strategic decisions of wine producers. This emphasises the importance of the export markets for the industry.

Figure 1.4 illustrates the entire wine supply chain, from the raw material producer to the end consumer. It clearly shows the different paths of the export and local supply chains, also illustrating the difference in complexity between the two.

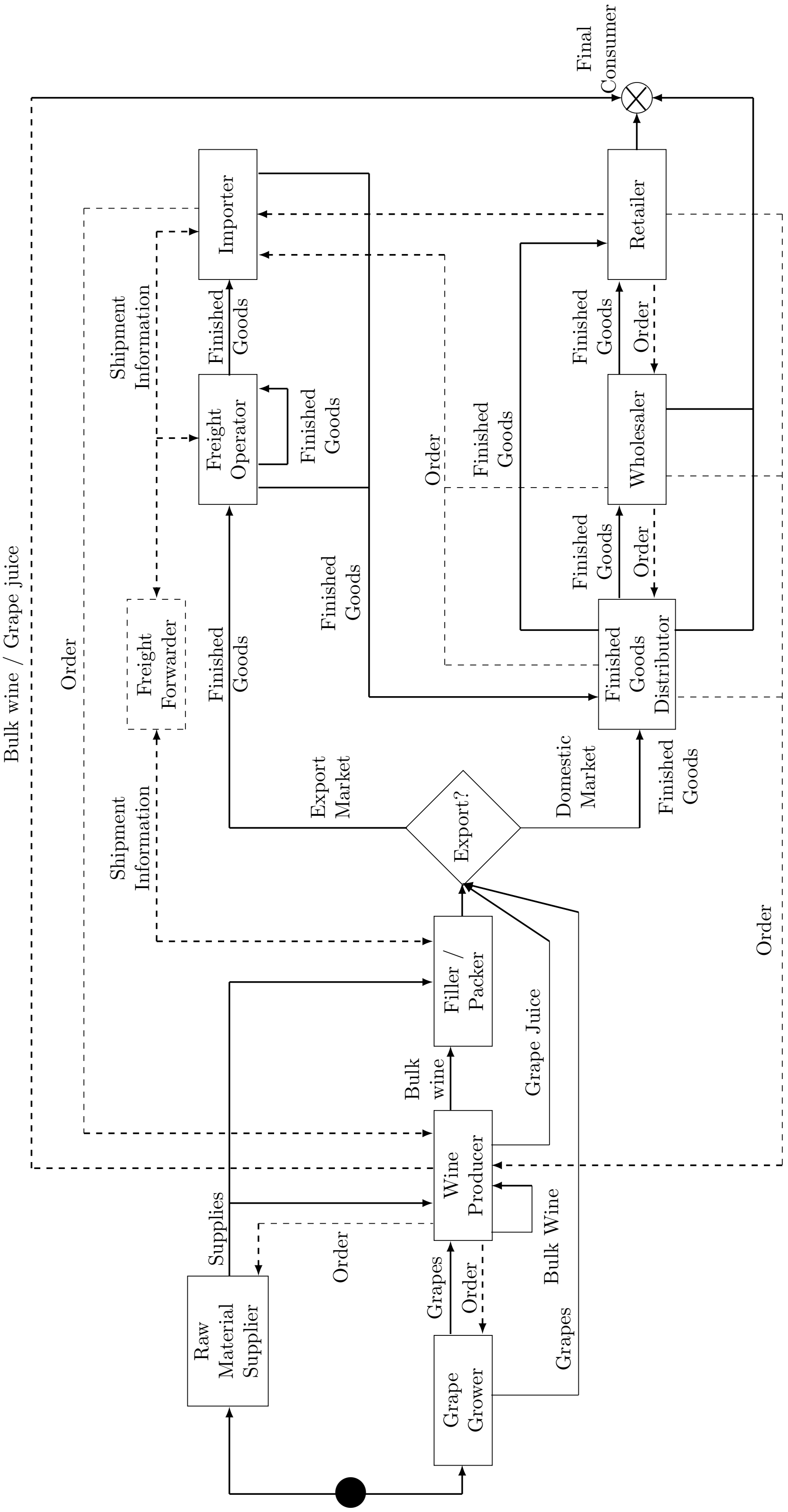


Figure 1.4: Wine supply chain (Garcia *et al.*, 2012)

Figure 1.4 shows that wine is sent directly from the filler/packer to the finished goods distributer for the local market. For the export segment, there are three supply chain players between the filler/packer and the finished goods distributer, namely freight forwarders, freight operators and importers. This, together with extra processes such as customs clearance, adds much more complexity to the export segment compared to the local segment.

Figure 1.5 in conjunction with Table 1.4 illustrate six countries to which packaged wine is exported. These countries where chosen from 25 countries listed by SAWIS (2014) due to volume and growth potential.

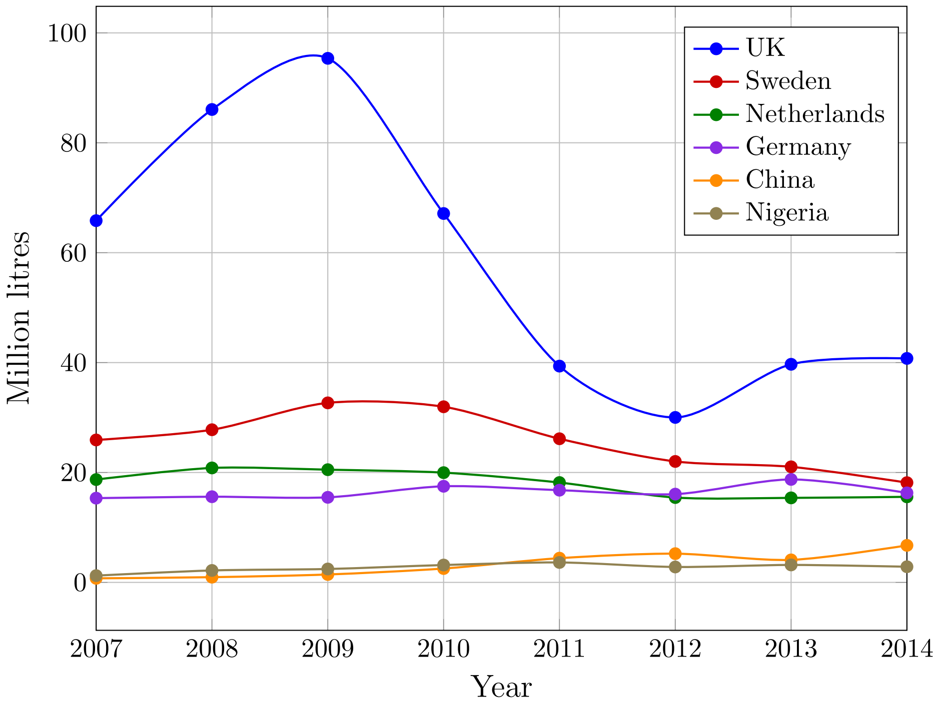


Figure 1.5: Volume of packaged exports per country (SAWIS, 2015)

Table 1.4: Average yearly growth per country: 2007-2014 (SAWIS, 2015)

Country	Average yearly growth
UK	-2.61%
Sweden	-4.22%
Netherlands	-2.29%
Germany	1.32%
China	41.65%
Nigeria	16.18%

Figure 1.5 shows that the United Kingdom is the major export market for South African packaged wine. Sweden is the second largest, with Germany and the Netherlands consuming more or less the same volume over the seven year period. China and Nigeria are the most important markets in terms of growth percentage, as can be seen in Table 1.4.

According to WOSA (2014), wine producers can be divided into three categories:

- Units for the production of estate wine and independent cellars (referred to as private cellars in this in thesis)
- Producer cellars (co-operatives)
- Wholesalers

Figure 1.6 illustrates the contribution in terms of volume of each of these categories to the packaged export segment.

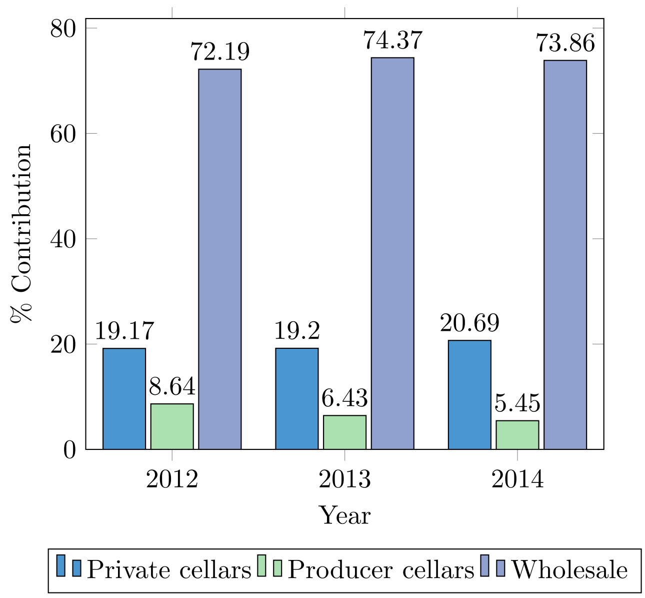


Figure 1.6: Producers within the packaged export segment (SAWIS, 2015)

Figure 1.6 shows that the packaged export segment is dominated by wholesalers, which mainly consist of Distell, KWV and DGB. Producer cellars play a relatively small role in the packaged export segment. The reason being that producer cellars mostly focus on the export of bulk wine.

Figure 1.7 shows the export volume of bulk and packaged wine, together with each segment's average value in terms of Rand per litre. The figure clearly shows a transition from packaged to bulk exports in the last seven years. This may explain the decline in top markets, as illustrated in Table 1.4.

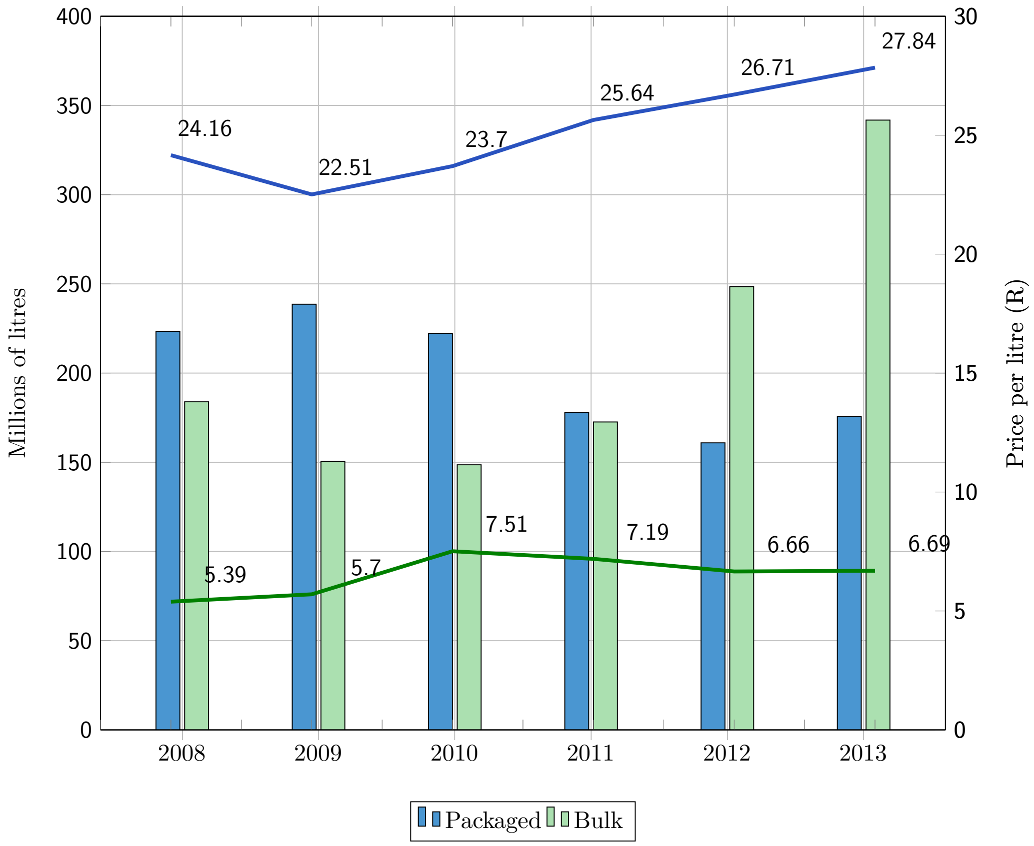


Figure 1.7: Litres and price per litre of packaged and bulk export wines (Analytix, 2014)

As can be seen in Figure 1.7, the packaged export segment experienced a growth in Rand per litre from R24.16 in 2008 to R27.84 in 2013. However, if the 2008 Rand per litre is increased with a 6% inflation rate for 5 years (to 2013) the Rand per litre is R32.33, which is much higher than R27.84. This is also true for bulk wine: taking inflation into account, the Rand per litre for bulk wine in 2013 should have been R7.21. Therefore, the growth in prices of export wines is significantly less than inflation, which may explain the current economic pressures within the wine industry.

CHAPTER 2

Literature review

Contents

This chapter describes and discusses the most important findings of the literature review. The choice to review the literature with regard to the six sections stated above stems from the rationale behind the project, as described in Chapter 1, which can be divided into three parts. Section 2.1 is associated with the first part, namely the need for supply chain improvements within the wine industry. Sections 2.2, 2.3 and 2.4 are associated with the second part, namely the need for the creation of a scorecard (supply chain measurement framework). Sections 2.5 and 2.6 are associated with the third part, namely the need for benchmarks.

2.1 Background of supply chain management

This section gives an overview of the concepts of supply chains and supply chain management. This includes the history and definition of each concept.

2.1.1 History and definition of the supply chain concept

Organisations can no longer compete in isolation of their suppliers and customers due to the trends in global sourcing, an emphasis on time and quality-based competition and greater environmental uncertainty. Hence, during the 1980s the interest in the concept of supply chain management was steadily on the increase (Lummus & Vokurka (1999) and Mentzer, DeWitt, Keebler, Min, Nix, Smith & Zacharia (2001)). In order to discuss supply chain management, the concept of a supply chain must first be defined.

Mentzer *et al.* (2001) conducted a study in which one of the goals was to review, classify and synthesize some of the widely-used definitions for *supply chain* and *supply chain management* and then to develop one comprehensive definition for each. They defined *supply chain* as:

> *A set of three or more entities (organisations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer.*

Within this definition, Mentzer *et al.* (2001) identifies three degrees of supply chain complexity, shown in Figure 2.1, namely

- *Direct supply chain*
  Consists of a company, a supplier and a customer involved in the upstream and/or downstream flows of products, services, finances, and/or information.

- *Extended supply chain*
  Includes suppliers of the immediate supplier and customers of the immediate customer, all involved in the upstream and/or downstream flows of products, services, finances, and/or information.

- *Ultimate supply chain*
  Includes all the organisations involved in all the upstream and/or downstream flows of products, services, finances, and/or information from the ultimate supplier to the ultimate customer.

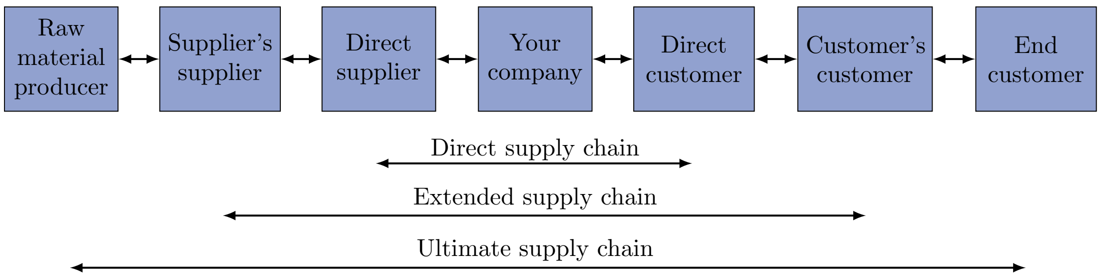


Figure 2.1: Degrees of supply chain complexity

Figure 2.1 illustrates only a small portion of a typical company's supply chain. This is because a company usually has more than one supplier and customer, who in turn have more than one supplier (the company's supplier's supplier) and customer (the company's customer's customer). Barber (2008) states that a supply chain is indeed a complex area and not just a single chain of one or more business entities but rather an interrelated network of multiple members and complex relationships.

It is important to realise that a company does not only have one supply chain. Rather the number of supply chains within a company depends on the number of products it produces and the number of customers it serves. This concept is explained using Table 2.1.

Table 2.1: Supply chain definition matrix

	Customer 1	Customer 2	Customer 3
Product 1	X		X
Product 2			X
Product 3	X	X	

Table 2.1 shows the supply chain definition of a company which produces three types of products and serves three customers. A specific product which is sold to a specific customer represents a supply chain (illustrated by the "X"). Hence, Product 1 which is sold to Customer 1 is a unique supply chain and the company has five supply chains in total.

Seeing that a supply chain reflects the behaviour of a complex system, it is important to always keep the overall system in mind and to avoid the adoption of a silo view. This type of thinking is called systems thinking. Holmberg (2000) states that the rationale of using systems thinking is because it provides a method for describing, analysing and planning complex systems. Systems thinking offers a way of understanding problems and communicating this understanding to others, both upstream and downstream in the supply chain. Furthermore, a systemic view helps in understanding the emergent principles of a system, namely those characteristics of a system which are more than the sum of its individual parts. An example of an emergent principle is the ability of an aircraft to fly, which is not a possibility of any individual part, nor simply the sum of its parts, but is dependent on the specific makeup of the entire system. An example of an emergent principle in a supply chain context is the delivery of products from a raw material producer to the end customer: no individual player in the supply chain can fulfill this action, only the system as a whole.

Midgley (2003) defines a system as: "A set of objects together with relationships between the objects and between their attributes." Midgley (2003) then defines an *object* as a part or component of a system, an *attribute* as a property of an object and a *relationship* as that type of relationship that ties the system together. All systems operate within a given *environment*, which Midgley (2003) defines as follows: "For a given system, the environment is the set of all objects, a change in whose attributes affect the system and also those objects whose attributes are changed by the behaviour of the system."

The importance of viewing the supply chain as a single system is further emphasised by Huang, Sheoran & Wang (2004), who state that, in order to be successful in a highly dynamic marketplace, businesses can no longer afford to compete as individual entities. Rather they need to compete as networks or chains of trading partners. According to Estampe, Lamouri, Paris & Brahim-Djelloul (2013), smooth collaboration between logistics and other corporate functions is no longer sufficient, considering that a company is actually performing well. A much more expansive range of areas comes into play nowadays, calling on a variety of additional parties who might be called business partners, ranging from suppliers' suppliers to customers' customers.

Lockamy & McCormack (2004b) state that, during the twenty-first century, supply chains continue to replace individual businesses as the economic engine for creating value. Consequently, companies are focussing on the improvement of inter-company processes. According to Lockamy & McCormack (2004a), businesses are increasingly viewing processes as strategic assets, requiring investment and development as they mature. This has had a major impact on how businesses are operating. Van Hoek (1998) states that the supply chain concept fundamentally changes the nature of organisations, since control is no longer based on direct ownership, but rather on integration across interfaces between functions and companies. However, managing entire supply chains can become difficult due to their inherent complexity. Holmberg (2000) explains that, within supply chains, effects of actions are separated from their cause both in time and place. This, together with the functional division of responsibilities, increase the complexity of supply chains. This led to the development of the concept of supply chain management.

2.1.2 History and definition of supply chain management

The concept of an assembly line was first introduced by Henry Ford in the early 1900s. Since then many theories have been developed with the goal of optimising the assembly line, both in terms of cost and production. However, due to the reasons stated in Section 2.1.1, such as increased globalisation and customer demands, a business can no longer compete as an individual entity. An organisation's performance is dependent on the performance of other players within the same supply chain. Consequently, organisations began applying the same theories used to optimise their internal performance to the entire supply chain.

An example of this shift in focus from internal processes to supply chain processes can be seen in the push and pull production theories. Traditionally an assembly line was operated using the push system, in which products are produced according to a forecast and finished goods are kept in a storage facility. In this system the most important objective is to be as productive as possible in every aspect of the manufacturing process. The result of this is a large quantity of inventory and little flexibility. This system also gives rise to problems such as the bullwhip effect, where small variability in end customer demand amplifies the demand for upstream organisations. A solution for these problems is to base production on actual customer sales data rather than on a forecast. This led to the design of the pull system. In the pull system, the organisation's customer pulls products through the manufacturing process. By this it is meant that the customer dictates what is being produced and production is not based on a forecast which often leads to overproduction or stock-outs. However, making a business more efficient by implementing the pull system is futile if, for example, the business's suppliers cannot deliver the required products on time. As a result of this, organisations in the same supply chain began shifting the focus from local efficiency (efficiency within a single business) to supply chain efficiency. This can be done by applying the pull methodology of an assembly line to the entire supply chain: rather than a customer, such as a retailer, pulling products through a production process, the end customer pulls products through the entire supply chain. Morgan (2004) suggests that the whole supply chain must have access to end customer sales data so that it can become possible for each organisation within the chain to synchronise the velocity of inventory. Thus the entire supply chain is seen as one synchronised system which satisfies the end customer's needs. Optimally managing these supply chain operations has become critical to a business's ability to effectively compete in a global market (Stewart, 1997).

In 1958, Jay Forrester proposed that, after a period of research and development in terms of basic analytical techniques, "there will come general recognition of the advantages enjoyed by the pioneering management who have been the first to improve their understanding of the interrelationships between separate company functions and between the company and its markets, its industry and the national economy." Although this was stated more than fifty years ago, it seems that Forrester identified key management concepts and dynamics of factors associated with the phenomenon referred to in contemporary business literature as supply chain management (Mentzer *et al.*, 2001).

According to Mentzer *et al.* (2001), despite the popularity of the term *supply chain management*, both in academia and in practice, there remains confusion as to its precise meaning. Authors have even conceptualised the concept differently within the same article, namely as a combined system between vertical integration and separate identities on the one hand, and as a management philosophy on the other hand. Mentzer *et al.* (2001) reviewed a number of definitions for supply chain management and concluded that the definitions can be classified into three categories: a management philosophy, implementation of a management philosophy, and a set of management processes. This indicates that there exists confusion about the exact meaning of the term. The reason for this confusion, according to Mentzer *et al.* (2001) is that the literature is trying to define two different concepts with one term, namely supply chain management. The idea of viewing the supply chain from a systems perspective, which has been called supply chain management as a management philosophy, is better described as *supply chain orientation*. The implementation of this orientation is more appropriately called supply chain management. In other words, supply chain orientation is a management philosophy, and supply chain management is the sum of all the management actions needed to realise this philosophy. Therefore supply chain orientation is a prerequisite for supply chain management. This perspective lead Mentzer *et al.* (2001) to define supply chain orientation as:

> *The recognition by an organisation of the systemic, strategic implications of the tactical activities involved in managing the various flows in a supply chain.*

and supply chain management as:

> *The systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole.*

According to Morgan (2004), the greatest contribution which the concept of supply chain management has made is to encourage managers to think outside the organisational box, to recognise the interdependencies both within and between organisations and to recognise the financial and logistical inter-company and international trading. Gunasekaran, Patel & McGaughey (2004) state that firms have taken bold steps to break down both inter- and intra-firm barriers to form alliances. Their aim is to reduce uncertainty and enhance control of the distribution channels. This is done to increase the financial and operational performance of each member in the chain through a reduction in costs and inventories. Consequently, the popularity and importance of supply chain management increased over the past two decades. Lockamy & McCormack (2004b) state that understanding the relationship between supply chain management and supply chain performance becomes increasingly important. These concepts were common knowledge ten years ago, and are already applied in most industries as the supply chain management world evolved. However, as discussed in Chapter 1, the SA wine industry has not yet reacted and therefore these basic supply chain management concepts first need to be understood.

A supply chain can be managed according to various strategies. Perez (2013) lists four elements of supply chain strategy:

- Industry framework
  Industry framework refers to the interaction of suppliers, customers, technological developments and economic factors that affect competition in any industrial sector. Within the framework there are four main drivers which affect supply chain design:

1. *Demand variation, or demand profile*
   This affects the stability and consistency of the manufacturing assets' workload and consequently is a main driver of production efficiency and product cost.
2. *Market mediation costs*
   Costs associated with the imbalance of demand and supply. These types of costs reflect the unstable and fragile balance between lost sales and product obsolescence and arise from the consequences of the degree of demand predictability. Examples are product price markdowns to compensate for excess supply and lost sales when demand exceeds supply.
3. *Product life cycle*
   The life cycle of a product affects the predictability of demand and the market mediation costs. Life cycles are constantly becoming shorter in response to the speed of change in technology, fashion and consumer product trends.
4. *Relevance of the cost of assets to total cost*
   This element becomes critical in businesses where profits are highly correlated with the utilisation rate of assets. Businesses fitting this profile must assure high utilisation rates, often negatively affecting working capital and service levels. Businesses which can afford low utilisation rates often focus on responsiveness, therefore increasing customer satisfaction and reducing market mediation costs.

- Unique value proposal
  This element requires a clear understanding of the business's competitive positioning in terms of its supply chain. A good approach to understand this positioning is the concept of order winners and order qualifiers, which is explained in Section 2.6.

- Managerial focus
  The managerial focus within a business acts as the link between the business's competitive positioning and its supply chain processes, and to ensure alignment between the two. This element should encourage businesses to focus on eliminating local efficiencies which may conflict with their unique value proposal to customers, thus reducing misalignment between the supply chain and business strategy.

- Internal processes
  This element provides an orientation that ensures a proper connection and combi-

nation within the supply chain activities which fall under the categories of source, make and deliver. This includes many factors, the most important of which are asset utilization and the location of the decoupling point. There exists a high degree of interdependence between these two factors, and they in turn govern other factors, as can be seen in Figure 2.2.

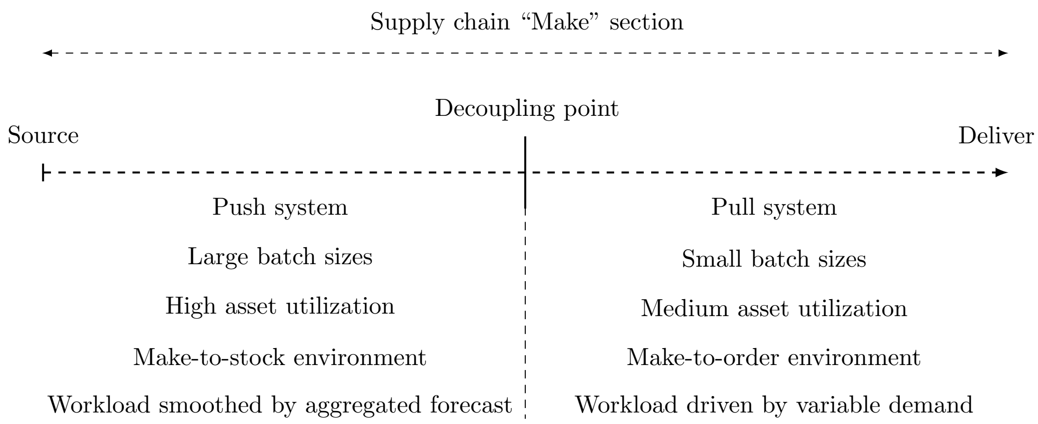


Figure 2.2: Internal processes according to the location of the decoupling point (adapted from Perez (2013))

Another model which, among others, describes supply chain strategy is the Supply Chain Operations Reference (SCOR) model. This model is described in Section 2.4. The strategy section of the SCOR model is described in Chapter 4.

Effective supply chain management has numerous advantages. Morgan (2004) states that the supply chain is possibly one of the final structural areas of business in which significant savings are to be made. However, since supply chain management is focussed on the entire supply chain, the potential advantages exceed that of simply reducing costs. This is confirmed by University Alliance (2014) who states that through supply chain management, Wal-Mart has realised several sustainable advantages, including lower product costs, reduced inventory costs, improved in-store variety and highly competitive pricing for the customer. In an article by Bolstorff (2008), it is stated that after the implementation of the SCOR model by a certain company, the company was able to cut US \$ 2.6 million in costs while increasing perfect order fulfillment from 50% to 87.5% and decreasing suppliers' order fulfillment cycle time from 30 days to 15 days.

According to Stewart (1997), maintaining a competitive advantage forces constant redirection and enhancement of product features, cost, quality, options and services. Therefore supply chain management has joined product quality and time-to-market as a key competitive differentiator. This was stated in 1997 and is already outdated in many industries. Mentzer *et al.* (2001) confirm this by stating that delivering a defect-free product faster and more reliably than the business's competition is no longer viewed as a competitive advantage; it is simply a prerequisite to stay in the market. Supply chain management within the global wine industry is however in its very early stages, as discussed in Chapter 1.

2.2 Background of supply chain performance measurement

Starting a project with the broad aim of "improving a supply chain" is futile due to the vast number of potential areas for improvement. In order to effectively improve a supply chain, different performance parameters of the supply chain must first be measured to be able to determine where exactly improvement is most required. This is the purpose of the Scorecard deliverable in the Analyse phase of the SCOR implementation road map, illustrated in Figure 1.1. However, there exist numerous performance metrics, each with various ways in which it can be measured. Therefore, it is important to first define performance measurement and the process of implementing it through the use of performance measurement frameworks.

2.2.1 Defining performance measurement

Morgan (2004) states that *performance* implies predetermined parameters, and *measurement* implies the ability to monitor events and activities in a meaningful way. According to Neely, Gregory & Platts (2005), there exist two main aspects which can be measured, namely the effectiveness and efficiency of actions or processes. Effectiveness refers to the extent to which all customer requirements are met, while efficiency is a measure of how economical a business's resources are utilised when providing a certain level of customer satisfaction. A business's performance is therefore a function of its effectiveness and efficiency. Neely *et al.* (2005) then defines the following concepts:

- Performance measurement is the process of quantifying the effectiveness and efficiency of actions.

- A performance measurement is a metric used to quantify the effectiveness and/or efficiency of an action.
- A performance measurement system is a set of metrics which is used to quantify both the effectiveness and efficiency of actions.

Even though there exist many definitions of performance, Lebas (1995) believes that performance per se may not be definable in the absolute. It is contextual both in terms of users and in terms of purpose. This is further discussed later in this chapter.

In the early 1990s, Eccles (1991) stated that during the few years leading up to the 1990s, academics and practitioners have started to demonstrate that accrual-based performance measures are at best obsolete, and more often harmful. The existing performance evaluation models, which were largely financial, often undercut a company's strategy when the strategy is for example focussed on customer satisfaction. Barber (2008) agrees with this by stating that by the 1970s and 1980s a general expression of dissatisfaction within the traditional backward looking financial metrics was widespread. Kaplan & Cooper (1997) state the need for performance measurement to drive performance improvement and to move away from the passive administrative tradition. Information must be used in a continuous feed-forward approach, instead of a feed-back approach which financial measurements tend to give. Chan (2003) emphasises the need for performance measurement to go beyond the mere quantification of actions and accounting based measures. It is supposed to contribute much more to business management and performance improvement. Only using financial measurements has been described as driving a car by looking in the rear view mirror (Morgan, 2004). Discontent turns into rebellion when people see an alternative worth fighting for. During the 1980s, managers found such an alternative in the quality movement which encouraged measures such as defect rates, response time, and delivery commitments.

According to Eccles (1991), what quality was for the 1980s, customer satisfaction was for the 1990s. He argued that customer satisfaction is the next logical step in the development of quality measures. During the 2000s, the focus on sustainability increased. This can be seen in the development of, for example, Green SCOR (LMI, 2003). These types of measures are classified as non-financial measures. Ittner & Larcker (2003) state that non-financial measures enable managers to get a glimpse of a business's progress well before a financial verdict is pronounced.

2.2.2 Systems thinking within supply chain performance measurement

Due to the importance of systems thinking within supply chain management, it should also be kept in mind when designing a performance measurement system. Cuthbertson & Piotrowicz (2011) developed a framework for the analysis of supply chain performance measurement systems in which they applied such a view. They used the context, content, process (CCP) principle and modified it for the analysis of supply chain performance measurement systems. They defined the principle as follows:

1. *Context (under what conditions does measurement take place?)*
   Factors that impact supply chain performance were divided into two sections:
   - organisational context - inter-organisational factors
   - supply chain context - factors specific within the supply chain environment
2. *Content (what is measured?)*
   Includes metrics, their levels, categories and dimensions.
3. *Process (how is the performance measurement carried out?)*
   This includes tools, methods and frameworks to measure the performance of supply chains; the methods through which data is captured, presented and used; and the development of the performance measurement system.

The framework considers not only metrics, tools and methods, but also contextual aspects with regard to performance measurement in supply chains. The framework helps to point out the differences and similarities among different performance measurement systems and also aids the development of performance measurement systems. Cuthbertson & Piotrowicz (2011) state that, in the literature which they reviewed, there is little discussion about how the context in which the supply chain operates influences the selection of suitable methods and metrics. This framework is later used to assess the measurement framework developed in this thesis.

Another reason to keep the systems view in mind is to guard against the measurement of sub-optimisation. According to the Theory of Constraints, it is more often than not the case that certain sub-processes should not perform optimally in order to realise optimal performance for the overall process. This highlights the need to first define the required overall performance and then measure the actual performance accordingly. Holmberg (2000) states that a lack of systems thinking also influences how firms approach the design of their performance measurement systems. He states that measuring local productivity and local costs increases the risk of sub-optimisation within the supply chain.

The concept of emergent principles was explained in Section 2.1. For a performance measurement system to operate effectively it must not only measure the performance of the individual parts of the system, but also that of the emergent principles of the system. If, for example, a supply chain consists of five organisations, each with an overall average reliability of 90%, the reliability of the supply chain is 0.90^5. This means that the reliability of delivering products to the end customer, which is one of the emergent principles of the system, is only 59%. For practical reasons, as discussed in the scope of this thesis in Chapter 1, the framework developed for this thesis will not measure any emergent principle.

Holmberg (2000) proposed a framework aimed at positioning measurement problems and initiatives based on systems thinking. The framework identifies three levels of explanations to phenomena which firms use, each describing a different degree of how well firms have adopted the systems view:

- Level 1
  This level consists of firms that do not recognise the relationships between phenomena and the context in which they operate. Such firms turn to event explanations, therefore constantly reacting on single events and always finding themselves victims of circumstances. These circumstances are viewed as external factors which cannot be controlled. Due to these reasons, firms tend to develop a self-centered, inward-looking attitude which leads to fragmented and isolated performance measurement.

- Level 2
  Firms at this level are concerned with describing behavioural patterns, for example seasonal variations and the effect it has on demand fluctuations within the supply chain. Hence, firms recognise certain relationships between phenomena and do not consider them as independent events. However, they do not always know how to prevent them from happening seeing that they do not understand the drivers of change.

- Level 3
  This is considered the most developed level, where firms realise how structure determines behaviour. This understanding is crucial to the restructuring of supply

chain measurement systems, with the aim of developing predictive and desired outcomes by implementing, for example, continuous information sharing.

The framework developed in this thesis strives to incorporate the characteristics of level 3 systems thinking as much as possible. However, there exists a balance between the degree of complexity of the developed framework and the practicality of the framework given the current state of supply chain management maturity within the South African wine industry. This is further discussed in the development of the framework in Chapter 6.

2.2.3 Necessary functioning of a performance measurement system

In order to effectively plan a project, the purpose of the project must first be defined. Gunasekaran & Kobu (2007) list the following as the purposes of a performance measurement system:

- Identifying success
- Identifying whether customer needs are met
- Better understanding of processes
- Identifying bottlenecks, waste, problems and improvement opportunities
- Providing factual data to make decisions
- Enabling progress
- Tracking progress
- Facilitating more open and transparent communication and cooperation

Morgan (2004) argues that a good performance measurement system should support an organisation in its current activities in both a consistent and reliable manner, retain validity as time passes, supply balanced information which is relevant to activities and strategies and enable management to use the information in both a proactive and reactive way. He further states that a performance measurement system should keep strategic aspects on competitive, or market, targets and operational aspects on strategic targets. Bititci, Carrie & McDevitt (1997) state that, for a performance measurement system to be effective in achieving its objectives, the system should take into account the strategic and environmental factors relating to the organisation, as well as considering the structure of the organisation, its processes, functions and their relationships.

Many articles with the aim of describing effective performance measurement systems have been published (Tangen (2005), Gunasekaran, Patel & Tirtiroglu (2001), Beamon (1999), etc.). In one such article, Akyuz & Erkan (2010) conducted a review of the supply chain management literature. They reviewed twenty-four articles published in sixteen different journals. From these articles they summarised twenty-two criteria to which new era performance measurement metrics should adhere. The criteria includes:

- Truly capture the essence of organisational performance
- Be based on company strategy and objectives
- Be comparable to other performance measures used by similar organisations
- Relate to strategic, tactical and operational levels of decision making and control
- Clearly define the purpose, data collection and calculation methods, update and monitoring mechanisms and related procedures
- Allow for setting targets, aggregation and disaggregation
- Be able to handle complex overhead structures
- Be simple and easy to use, preferably in the form of ratios rather than absolute numbers
- Be specific and non-financial, rather than aggregate and financial, to be more actionable
- Adopt a proactive approach, enabling fast feedback and continuous improvement
- Be determined through discussion with all the parties involved and serve the needs of the people from all levels (not only upper management)
- Be able to measure collaboration, partnership, agility and flexibility.

Akyuz & Erkan (2010) state that, due to the twenty-two requirements, establishing a performance measurement system is a challenging task. This challenge is further emphasized by the increased pressures of measuring partnership, collaboration, agility and business excellence requirements.

It is often difficult to decide exactly what to measure in a supply chain in order to determine the performance of the supply chain. Beamon (1999) states that the process of selecting appropriate supply chain performance measures is difficult due to the complexity of supply chains. It is important not to measure only one or a few parameters. According to Beamon (1999), a supply chain performance measurement system that consists of a single performance measure is generally inadequate since it is not inclusive, ignores the interactions among important supply chain characteristics and ignores critical aspects of organisational strategic goals. Beamon (1999) suggests that, for a performance measurement system to operate effectively, the system must include three types of performance measures: resource measures, output measures and flexibility measures. Resource measures include inventory levels, costs, etc. Output measures include responsiveness to customer orders, quality, etc. Flexibility measures include volume flexibility, delivery flexibility, etc. According to Barber (2008), one shortfall of this model is that it does not include the measurement of predictive powers, such as forecast accuracy. The importance of predictive powers is highlighted by Barber (2008), who states that findings show that best in class global supply chains met customer commitments while reducing inventory levels. This was achieved by sharing three key areas of information, enabling effective predictions, namely inventory levels, demand forecasts and real-time sales activity.

In my view, an important criterion which is not listed by Akyuz & Erkan (2010) or Beamon (1999) is the need for sufficient information quality. If a performance measurement system satisfies all criteria, but the quality of the information gathered for the metrics is not up to standard, the system will not be able to aid management decision making. Baltzan (2012) lists five common characteristics of high quality information, which are shown in Table 2.2.

Table 2.2: Characteristics of high quality information (Baltzan, 2012)

Characteristic	Description
Accurate	All values within the information must be correct
Complete	No values should be missing within the information
Consistent	Aggregated information should be in agreement with detailed information
Unique	Each event must be represented only once within the system
Timely	Information must be current with respect to business needs

Information adhering to these requirements does not guarantee that correct decisions will be made, as decisions rely on the interpretations of people. It does however ensure that the foundation for making decisions is accurate (Baltzan, 2012).

One major step in the evolution of performance measurement systems was the realisation that financial-based metrics alone cannot reflect the true state of a business. This led to the development of various non-financial metrics, as discussed in the beginning of this section. However, Ittner & Larcker (2003) argue that simply measuring non-financial metrics will not necessarily benefit an organisation. The reasons being firstly that companies do not measure the right non-financial metrics (those which will advance their strategies) and secondly that companies often fail to demonstrate a clear connection between improvements in non-financial activities and financial performance. The result is misdirected investments and unfulfilled strategies. In order to address this problem, Lebas (1995) proposes the use of a causal model, also called value-driver maps by Ittner & Larcker (2003), which lay out the possible cause-and-effect relationship between the drivers of strategic success and actual outcomes. Lebas (1995) compares a causal model to a tree consisting of four levels of metrics, namely fruit, leaves and branches, a stem and roots. This model is explained as follows:

1. Fruit
   The fruit of the tree represents the profit of the business, namely the difference between income and costs. This is the level at which most financial measurements are carried out.

2. Leaves and branches
   This level represents the variables which have a direct impact on the profit, namely customer satisfaction, quality, flexibility, etc.

3. Stem
   The variables associated with the leaves and branches are a result of the processes within the business, which are represented by the stem. For example, the delivery process of products to customers has a direct impact on customer satisfaction and flexibility.

4. Roots
   Lastly, the roots of the model represent the variables which "feed" the stem, therefore variables impacting on the effectiveness of the business processes. These variables include employee satisfaction and training, knowledge of markets, management style, supplier relations, etc.

Lebas (1995) discusses this model by stating that if the levels which are defective are identified, appropriate corrective action can be taken. However, if only the final, most aggregated level is measured, namely the fruit, no appropriate corrective action can be identified. For example, knowing whether customers are satisfied is already better than only observing the changes in profit, but it is not early enough to guide a manager in the choice of corrective action. It is therefore necessary to anticipate the causes of performance by placing measures further upstream of the desired outcome, namely in the stem and roots of the business. By understanding the process of performance generation, it is not only easier to identify corrective action, but it also helps with the deployment of strategy at all levels of responsibility. After the discussion of the causal model, Lebas (1995) proposes a definition for performance:

> *Performance is about deploying and managing well the components of the causal model that lead to the timely attainment of stated objectives within constraints specific to the firm and to the situation. Performance is therefore case specific and decision-maker specific.*

In Chapter 5 this reasoning is used to explain the use of the framework developed in this thesis. The framework cannot be used to define good or bad performance, but is rather a tool to be used by managers to evaluate their cellar according to their unique definition of performance.

Berrah & Clivill (2007) state that a overall objective is generally broken down into elementary ones along organisational levels (strategic, tactical and operational) while the elementary performance expressions can be aggregated to provide information about the satisfaction of the overall one. One way to implement this is through the use of a causal model. However, according to Berrah & Clivill (2007), the question of overall performance resulting from process performances is rarely approached. They demonstrate this using the SCOR model: performance indicators are associated with each process of SCOR, but these performances are independently defined, as each process is evaluated separately from the others. This partitioned vision makes it difficult to consider the supply chain as a whole, which makes it difficult to control it. In this regard, the indicators must be enriched by the knowledge of the links between them. This requirement is incorporated in the framework developed in this thesis by displaying all the metrics on a single dashboard, making visible the links between them.

Bititci *et al.* (1997) believe that the objective of performance measurement is to provide a proactive system which gives feedback according to the closed-loop control system design. Corporate and functional strategies are deployed to all business processes, activities, tasks and personnel, and feedback is obtained through the performance measurement system to enable effective management decisions. Berrah & Clivill (2007) agree with this by stating that new strategies for driving continuous improvement generally include the following steps: identifying key areas, as-is situation analysis, planning and implementing changes, monitoring the results and developing a closed-loop control system. The design of such a closed-loop system is illustrated in Figure 2.3.

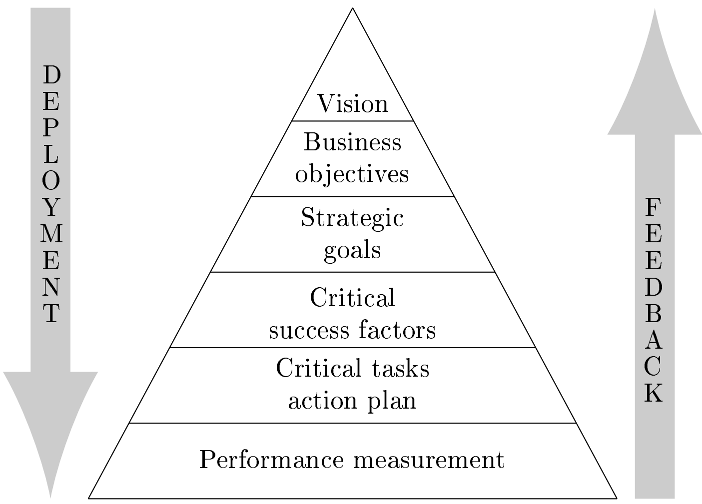


Figure 2.3: Closed loop deployment of a performance measurement sytem (Bititci *et al.*, 1997)

It is worth noting that a performance measurement system for a small and medium enterprise (SME) should be structured differently than a performance measurement system for a large organisation. This is important for this thesis since most of the wineries within the packaged export segment are private cellars (refer to Figure 1.6), which are SMEs. Hudson, Smart & Bourne (2001) state a number of points that differentiate SMEs from large organisations. Firstly, due to resource constraints within SMEs, dimensions of quality and time are critical in order to reduce waste, and to ensure that a high level of productivity is realised. Secondly, the reliance on only a small number of customers means that customer satisfaction must be kept at a high level and that the organisation must be flexible to respond to market changes. Thirdly, even though financial performance is important to both large organisations and SMEs, it is of special importance to SMEs due to the lack of a monetary safety net to absorb short term fluctuations. Lastly, due to the flatter structure of SMEs, employees usually have more responsibility and a greater number of job roles. Thakkar, Kanda & Deshmukh (2009) suggest that due to such differences, a performance measurement system for a SME should adhere to the following three criteria:

1. Measures should be strategically aligned and should provide explicit feedback to operations; and the performance measurement system should provide input directly into the strategy formulation process.

2. Measures should be clearly defined, have an explicit purpose, be relevant, easy to maintain and easy to understand.

3. A well-trained and motivated workforce is paramount and necessitates effective monitoring of human resources.

Amaratunga & Baldry (2002) state that measurement itself is not an end, but a tool to facilitate more effective management. The results of measurement only indicate what happened, but not why it happened, or what to do about it. It is therefore always necessary to keep in mind that in order for an organisation to make effective use of a performance measurement system, it must be able to make the transition from performance measurement to performance management. Procurement Executives' Association (1999) defines performance management as:

> *The use of performance measurement information to effect positive change in organisational culture, systems and processes, by helping to set agreed-upon performance goals, allocating and prioritising resources, informing managers to either confirm or*

change current policy or program directions to meet those goals, and sharing results of performance in pursuing those goals.

Amaratunga & Baldry (2002) argues that organisations must be able to anticipate the changes needed in strategic direction and have a methodology in place for effecting the strategic change. This forms the foundation of good performance management. They state that performance management systems enable organisations to modify strategies in order to reflect real-time learning and the implementation of performance management systems gives organisations the capacity for strategic learning. They believe that, for an organisation to effectively move from performance measurement to performance management, two key components need to be in place:

1. The right organisational structure which facilitates the effective use of performance measurement results.
2. The ability to use performance measurement results to bring about change in the organisation.

Lebas (1995) suggests that performance measurement and performance management form a loop and follows one another in an iterative way. This concept is illustrated in Figure 2.4.

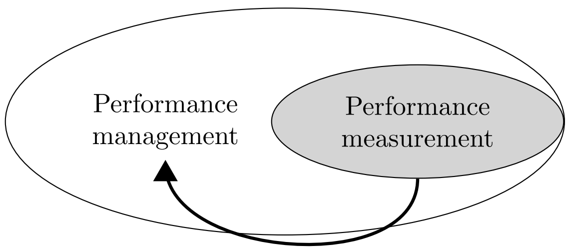


Figure 2.4: Performance management and performance measurement are closely connected (Lebas, 1995)

Figure 2.4 shows that performance management both precedes and follows performance measurement. The two concepts form a spiral with performance management creating the context for performance measurement, which in turn changes the nature of performance management. Chan (2003) also suggests an iterative loop between performance measurement and management by stating that performance measurements identify the potential and success of management strategies, direct management attention and revise company goals, which will in turn modify the performance measurements. Amaratunga & Baldry (2002) concludes by stating that one of the main purposes of performance management is to create a learning organisational culture. A learning organisation possesses an improved ability to react to, adapt to and capitalise on changes within its internal and external environment.

2.2.4 Typical pitfalls of performance measurement

Holmberg (2000), Gunasekaran & Kobu (2007) and Ittner & Larcker (2003) propose the following common errors which should be kept in mind when designing a measurement system.

1. *Strategy and measurements are not connected*
   All measurements should be derived from the organisation's strategy. Not deriving measurements from the strategy leads to misalignment between measurements and the strategy, resulting in inadequate information.

2. *A biased focus on financial metrics*
   Relying too heavily on financial measurements leads to insufficient information as financial measurements are better at indicating the performance of past actions rather than the performance of future actions. Proactive measurements, such as the agility of a supply chain must be included in a measurement framework so that the framework will represent a balanced view of performance. Companies often do not create a causal model for linking non-financial drivers and financial performance. Not all companies which do develop a causal model validate the assumptions behind these links, for example *how* do satisfied employees increase customer satisfaction?

3. *Too many isolated and incompatible measures*
   Because measurements which are used by an organisation are rarely removed, the measurements soon become obsolete due to the changing nature of strategies. This results in too many measurements, requiring unnecessary resources, and making it difficult to identify the critical few among the trivial many.

4. *Measuring incorrectly*
   Measuring incorrectly in terms of validity and reliability. Validity refers to the

extent to which a metric succeeds in capturing what it is supposed to capture. Reliability refers to the extent to which measurement techniques reveal actual performance and do not introduce errors of their own.

5. *Problems in a supply chain context*
   The four problems stated above are mostly those encountered within one organisation. The same problems can however occur in the supply chain due mainly to the lack of systems thinking and being too much inward looking.

Even though all of the abovementioned research, and much more, have been done regarding performance measurement, new research constantly expands the knowledge. Furthermore, consensus over what exactly to measure and how to measure it is never fully reached. Lebas (1995) argues that measuring means transforming a complex reality into a series of limited symbols that can be communicated and, to a certain extent, reproduced under similar circumstances. Therefore, the measured performance will more often than not be a compromise to the true performance.

All the elements discussed in this chapter need to be consolidated into a performance measurement framework. The degree of complexity associated with the development of such a framework makes it difficult to develop one generic framework which can be used effectively in all scenarios. Eccles (1991) argues that uniformity can be carried too far: different organisations with different strategies require different information for decision making and performance measurement. Estampe *et al.* (2013) confirm this by stating that in today's performance evaluation processes, companies tend to refer to several models that will differ in terms of corporate organisation, the distribution of responsibilities and supply chain maturity.

2.3 Supply chain management maturity

Lockamy & McCormack (2004a) state that the concept of process maturity proposes that a process has a lifecycle which is assessed by the extent to which the process is defined, managed, measured and controlled. As the concepts of supply chains and supply chain management become increasingly important and organisations adopt the process view, process maturity also increases in importance. According to Estampe *et al.* (2013), a firm which benefits from an integrated or extended organisation will clearly not rely on the same performance evaluation model as one whose organisation has a functional nature. Where the latter will focus on separate function-specific indicators, the former will combine indicators to obtain a more global vision. The reason for this is that the choice of a performance evaluation model depends mostly on a company's level of supply chain maturity. Consequently, when measuring supply chain performance, it is important to situate a company according to its maturity level given the variations, at different maturity levels, between the strategies which will be adopted, organisational implementation and the approaches used to measure performance.

Lockamy & McCormack (2004a) constructed a supply chain management maturity model. The model is based on the five stages of the business process orientation (BPO) maturity model and customised for the supply chain management environment. BPO suggests that overall performance of an organisation can be improved if the process view of the organisation is adopted. Lockamy & McCormack (2004a) suggest that building an infrastructure and culture which support BPO methods, practices and procedures, enables process maturity to endure long after those who have created it. BPO consists of the following key elements:

- *Process management and measurement*
  Measures which include characteristics of the process, such as output quality, cycle time, process cost and variability, as opposed to the traditional accounting measures.
- *Process jobs*
  Jobs which are focussed on prosesses as opposed to functions, and has cross-functional responsibility.
- *Process view*
  The horizontal and cross-functional view of an organisation which includes elements of structure, measurement, focus, ownership and customers.

McCormack & Johnson (2000), cited by Lockamy & McCormack (2004a), also statistically showed that BPO is critical in supporting greater connectedness and reducing conflict within an organisation and also increasing performance. The supply chain management maturity model, which is based on the BPO concept, can be seen in Table 2.3.

Table 2.3: Five levels of supply chain maturity (Lockamy & McCormack, 2004a)

Maturity level	Description / Characteristics
Extended	Competition is based on a multi-firm supply chain. Collaboration is routine, to such an extent that responsibility is transferred without legal ownership. Organisational culture is based on horizontal, customer focussed processes. Performance of the extended system is measured and joint investments are made to improve the system.
Integrated	Cooperation is taken to the process level by the company, vendors and suppliers. Traditional functions begin to disappear, as organisational structures are based on supply chain management procedures. Advanced practices, such as CPFR, are implemented with customers and suppliers. Performance is very predictable and targets are achieved reliably. Management costs are significantly reduced and customer satisfaction becomes a competitive advantage.
Linked	The breakthrough level. Supply chain management is applied strategically. There is cooperation between intra-company functions, vendors and customers, who share common measures and goals. Performance is more predictable and targets more regularly achieved. Management costs decrease. Improvement efforts increase customer satisfaction.
Defined	Basic supply chain processes are defined. Organisational structure remains traditional. Performance is more predictable. Targets are defined, but often missed. Management costs remain high. Customer satisfaction improves, but is still low.
Ad hoc	Supply chain processes and practices are ill-defined and unstructured. Organisational structure not based on the horizontal supply chain. Unpredictable performance. Targets not defined, and when defined, often missed. Management costs are high. Customer satisfaction and functional cooperation low.

Table 2.3 shows the five levels in the supply chain management maturity model, developed by Lockamy & McCormack (2004a), with *Ad Hoc* being the lowest level of maturity and *Extended* the highest. The levels describe the progression of activities

towards effective supply chain management and process maturity. Levels should not be skipped, as this would be counter-productive, since each level forms the foundation for the next level (Lockamy & McCormack, 2004a).

Reyes & Giachetti (2010) conducted a study with the aim of constructing a supply chain management maturity model so that Mexican firms can evaluate their current supply chain management operations and develop an improvement road map. Implementing the Delphi method with eighty supply chain experts, they also developed five levels of supply chain maturity, namely *Undefined*, *Defined*, *Manageable*, *Collaborative*, and *Leading*. The description of each level shows a clear resemblance to the five maturity levels developed by Lockamy & McCormack (2004a), therefore confirming the model by Lockamy & McCormack (2004a).

According to Hammer (1996), cited by Lockamy & McCormack (2004a), as process maturity increases, institutionalisation takes place via policies, standards and organisational structures. A maturity level represents a transition point, which when reached, will institutionalise the necessary systems view to achieve a set of process goals (Dorfman & Thayer (1997) cited by Lockamy & McCormack (2004a)). The higher the process maturity, the higher the level of process capability, and the more the process moves from an internal perspective to an external one, as can be seen in Figure 2.5. Process capability is defined as (Lockamy & McCormack, 2004a):

- *Control*
  The difference between targets and actual results, also noting the variation around the targets.

- *Predictability*
  The variability in achieving performance objectives.

- *Effectiveness*
  The achievement of targets and the ability to raise targets.

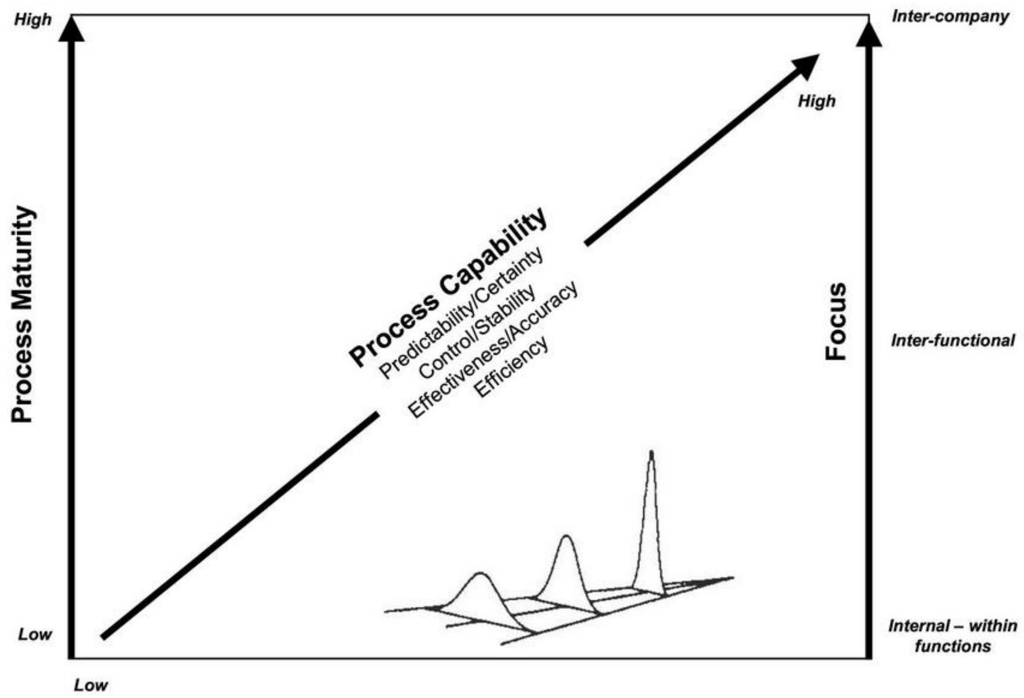


Figure 2.5: Relationship between process maturity and process capability (Lockamy & McCormack, 2004a)

Lockamy & McCormack (2004a) conducted a statistical analysis with the aim of determining the extent to which process maturity governs process performance. They used a sample of 523 key informants representing 90 firms. Participants were asked to rate the performance of different processes, which were based on the SCOR model's *plan*, *source*, *make* and *deliver* processes and on comparisons with major competitors. Next, a supply chain management maturity measurement instrument was developed to collect data from the respondents used to analyse the relationship between process maturity and rated performance. A regression analysis of supply chain management maturity versus performance indicated that the level of direct process performance, such as cycle time and inventory levels, is related to the maturity of supply chain management.

In a study by Soderberg & Bengtsson (2010) it is stated that the basic idea behind supply chain management maturity models is that increased maturity will lead to improved supply chain performance, which will then lead to improved financial performance. However, there exists little evidence about the relationship between supply chain maturity and financial performance, specifically in SMEs. Consequently the study proposed two hypotheses:

- H1: Higher levels of supply chain management maturity lead to better supply chain performance.
- H2: Higher levels of supply chain management maturity lead to better financial performance.

In order to test these hypotheses, Soderberg & Bengtsson (2010) used more or less the same methodology as Lockamy & McCormack (2004a). They found that there exists a strong positive correlation between supply chain management maturity and performance of measures such as delivery performance and productivity. This is the same as the conclusion made by Lockamy & McCormack (2004a). However, the outcome for logistics costs and asset management showed a negative correlation. Since almost all of the parts of supply chain management maturity strongly correlated to overall supply chain performance, Soderberg & Bengtsson (2010) did not reject hypothesis 1. In terms of hypothesis 2, the only metric which showed a significant correlation to supply chain management maturity was profitability. Other metrics, such as cash flow, inventory turns, operating margin and costs of goods sold did not show a significant correlation. Soderberg & Bengtsson (2010) concluded that the study does not provide full support for hypothesis 2.

Soderberg & Bengtsson (2010) argued that the reason why logistics costs do not positively correlate to supply chain management maturity is an open question. In my own view, a possible explanation for this is that, for example, an *extended* supply chain might perform worse in terms of costs and asset management than, for example, a *linked* supply chain. This may be due to strategic decisions such as a policy to implement small batch sizes in order to reduce lead time. The extended supply chain will then perform better in terms of responsiveness, reliability or agility. This will equip the extended supply chain with order winning criteria, which will lead to more sales, increasing profitability. This confirms the finding of hypothesis 2, namely that there exists a significant correlation between supply chain management maturity and profitability. In my own view, this is a confirmation that mature organisations implement systems thinking, in the sense that they realise that certain processes have to perform sub-optimal for the overall process, namely the generation of profit, to perform optimal. It is therefore important to measure the appropriate metrics, or choose the appropriate supply chain measurement framework, in conjunction with an organisation's supply chain management maturity.

2.4 An analysis of supply chain measurement frameworks

It has been proven that a management framework, or a reference model, assists in identifying problems associated with supply chains, enabling leverage of capital investment, aligning business processes and creating a strategic road map (Hudson, 2004). According to Stewart (1997), process reference models are the next logical step following the concept of business process re-engineering, which was created in the late 1980s.

The Supply Chain Operations Reference (SCOR) model, developed by the Supply Chain Council (SCC), provides a framework for characterising supply chain management practices and processes that result in best-in-class performance. According to the SCC (2012), the SCOR model integrates the well-known concepts of business process re-engineering, process measurement and benchmarking into a cross-functional framework. The scope of the SCOR model is illustrated in Figure 2.6. As can be seen in Figure 2.6, the SCOR model covers the extended supply chain. The model consists of six generic supply chain processes, namely plan, source, make, deliver, return and enable.

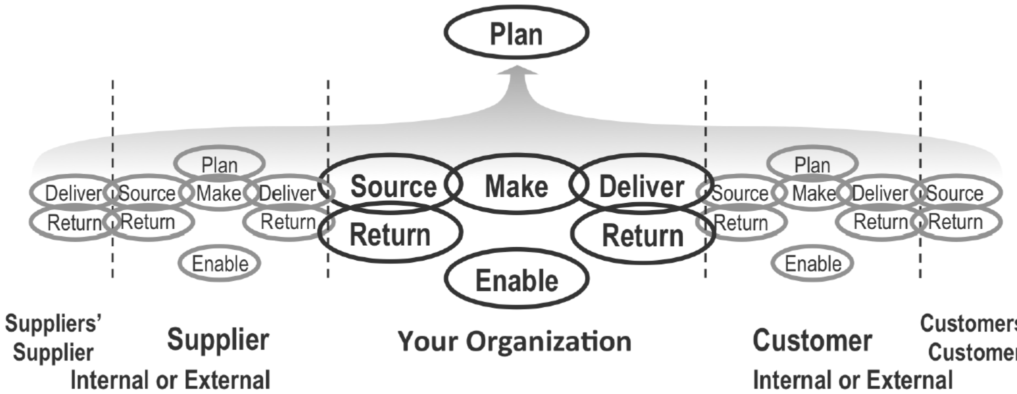


Figure 2.6: Scope of the SCOR model (SCC, 2012)

Table 2.4 defines five performance attributes used within the SCOR model. A performance attribute represents a grouping of metrics and is used to express a strategy (SCC, 2012). The five performance attributes are trade-offs of each other.

Table 2.4: The SCOR performance attributes (SCC, 2012)

Performance attribute	Definition
Reliability	The ability to perform tasks as expected. Reliability focuses on the predictability of the outcome of a process. Typical metrics for the reliability attribute include: On-time, the right quantity, the right quality.
Responsiveness	The speed at which tasks are performed. The speed at which a supply chain provides products to the customer. Examples include cycle-time metrics.
Agility	The ability to respond to external influences, the ability to respond to marketplace changes to gain or maintain competitive advantage. SCOR Agility metrics include Flexibility and Adaptability.
Costs	The cost of operating the supply chain processes. This includes labor costs, material costs, management and transportation costs. A typical cost metric is Cost of Goods Sold.
Assets Management Efficiency	The ability to efficiently utilize assets. Asset management strategies in a supply chain include inventory reduction and in-sourcing vs. outsourcing. Metrics include: Inventory days of supply and capacity utilization.

When measuring performance, it is important not to only focus on metrics, but to also incorporate the links between them, as stated in Section 2.2. There exists a relationship between the SCOR attributes and what Beamon (1999) suggests should be included in a performance measurement system: reliability and responsiveness can be classified as output measures, agility as flexibility measures and costs and assets as resource measures. The SCOR model, however, fails to state that at least one of the measurements in each of the three categories suggested by Beamon (1999) should be included in a measurement system. When analysing the definitions of effectiveness and efficiency by Neely *et al.* (2005), stated in Section 2.2.1, it is clear that effectiveness is an external, or customer facing, measure while efficiency is an internal measure. One aspect of performance measurement which is not included in these definitions is the ability of an organisation to adapt to external changes, such as a sudden increase in demand. The SCOR model calls these types of measures Agility measures, as can be seen in Table

2.4. The remaining four attributes can be classified as either effectiveness measures, namely Reliability and Responsiveness, or efficiency measures, namely Cost and Asset Management Efficiency.

The five attributes listed above each consist of metrics which are divided into three levels. Level 1 metrics are diagnostics of the overall health of the supply chain. These metrics can be described as strategic metrics and key performance indicators. Therefore level 1 metrics can be used to create a high level business strategy. By benchmarking level 1 metrics, realistic targets can then be set in accordance to strategic objectives. The SCOR model also defines level 2 and level 3 metrics, each serving as the diagnostic for the higher level, with level 1 being the highest. The diagnostic relationship helps in the identification of performance gaps within higher levels (SCC, 2012). Therefore the SCOR model can also be seen as a causal model and reap all the benefits associated with such a model as described in Section 2.1.

The SCOR model makes it possible for businesses to determine and compare the performance of their supply chain and related operations against other businesses (SCC, 2012). Huang *et al.* (2004) state that the major objective of SCOR is to improve the alignment between the marketplace and the strategic response of a business's supply chain, on the basis that better alignment will lead to an improved bottom-line performance. Huang *et al.* (2004) also state that by providing a set of performance metrics, industry best practices and enabling systems, the SCOR model allows businesses to perform very thorough fact-based analyses of all aspects of their supply chains. Theeranuphattana & Tang (2008) suggest that, since the SCOR model offers standardised definitions for performance metrics, it is easier for managers to identify relevant measures. According to Akyuz & Erkan (2010), the SCOR model contributes to the development of supply chain performance measurement systems and maturity models by:

- Providing a standardised way of viewing the supply chain (cross-industry standard).
- Offering a consistent "scorecard" framework for the development of performance measurement systems.
- Emphasising process orientation and de-emphasising functional orientation.
- Enabling cross-industry benchmarks.

According to the SCC (2012), the SCOR model is the world's most widely accepted framework for evaluating and comparing supply chain activities and their performance. The SCC (2012) also provides a comprehensive list of the organisational benefits of adopting SCOR, but states no shortcomings of the SCOR model. In their research, Huang *et al.* (2004) discuss the weaknesses of the SCOR model. This includes a lack of change management and difficulties in network optimisation when using the SCOR performance metrics. Cirtita (2012) point out another shortfall of the SCOR model, namely that performance metrics are only used for internal performance measurement and there exist no external performance metrics which can be used to measure the performance of inter-firm operations and coordination. When modelling a supply chain, the SCOR model has a shortcoming in the sense that SCOR only models static operations, while there also exists a need to study dynamic effects, such as changes in production rate (Persson & Araldi, 2009). One very important aspect of supply chain management is the sharing of information throughout the entire chain by using, for example, electronic data interchange (EDI). Consequently, Chan (2003) proposes the measurement of information visibility by implementing time and accuracy based measures. Even though the SCOR model proposes best practices in this regard, it does not include metrics for measuring it.

In 2010 a study was conducted by Laville (2010) with the aim of improving the supply chain of Alliance Loire, a company specialising in the marketing, sales and distribution of wines which are produced by nine co-operatives in the Loire Valley in France. Even though the SCOR model has certain weaknesses, Alliance Loire implemented the SCOR model. The company chose the SCOR model since it describes the business activities associated with all phases of meeting customer demands within the supply chain and since the model uses universal building blocks (plan, source, make, deliver, return, enable) which can be used to model any type of supply chain. Both the CEO and quality- and processes manager of Alliance Loire concluded that the SCOR model was extremely useful in delivering the expected financial returns and in growing their business.

Another well-known performance measurement system is the balanced scorecard (BSC), developed by Robert S. Kaplan and David P. Norton in 1992. According to Thakkar *et al.* (2009), the BSC framework relates the different classes of business performance, namely financial and non-financial, internal and external. These four classes are measured using the metrics *financial*, *learning and growth*, *internal business processes* and *customer*, respectively (Kaplan & Norton, 2001). Thakkar *et al.* (2009) compared the BSC with the SCOR model:

- The BSC does not provide a mechanism for maintaining the relevance of measures, whereas the SCOR model uses a building block approach which offers complete traceability.
- The BSC fails to integrate strategic measures with operational measures which potentially makes execution of a strategy problematic, whereas the SCOR model defines types of processes (planning, execution, etc.) and configures them to suit supply chain requirements.
- The BSC fails to stipulate a user-centered development process, whereas a detailed study in terms of the SCOR model generated enough information to even develop a tailor-made software system.

Garcia *et al.* (2012) conducted a study with the aim of developing a logistics benchmarking framework for the Argentinean wine industry. They considered the performance attributes of the SCOR model, but chose to use four other attributes instead, which are similar to the SCOR attributes, but focus primarily on the logistical side of a supply chain. The following four performance attributes related to logistical processes were used in their research:

- Quality
- Timeliness
- Logistics cost
- Productivity and capacity

Quality is related to both process and product quality. Timeliness is related to the response time of the supply chain. Logistics cost is related specifically to the financial performance of the business's logistics. Productivity and capacity is related to the efficiency with which resources are utilized.

Estampe *et al.* (2013) analysed sixteen supply chain performance measurement models, developed between 1983 and 2010. They evaluated the models according to two sets of criteria. Firstly, they developed five essential characteristics which were used to understand each model and to highlight the dissimilarities between the models: (1) the model's origin; (2) the type of analysis involved; (3) implementation conditions and constraints; (4) the degree of conceptualisation; (5) the quantitative or qualitative indicators being used. They state that this evaluation illustrates the difficulty of understanding the different models' roles and uses, whether in terms of the perspectives characterising particular decision-making levels (strategic, tactical or operational), the typology of flows and processes in question or the area of activity under study. From the comparisons between the models, two advantages of the SCOR model can be derived, namely that the SCOR model enables both internal and external benchmarking and that it can be implemented regardless of the organisation's maturity level. This is mainly due to the fact that the SCOR model uses a standardised common language for different actors in the chain, supplies definitions of basic concepts, processes, management modes, etc. and explains indicators using calculation modes.

Secondly, Estampe *et al.* (2013) constructed a performance evaluation matrix in which they compared the relevancy of each of the sixteen models. The matrix considered eight levels of criteria which are independent and enable an identification of each model's characteristics. The matrix with a selection of models is shown in Table 2.5.

Table 2.5: Matrix of performance evaluation models

	ABC	**BSC**	**SCOR**	**WCL**
Decision level				
Tactical	✓	✓	✓	✓
Operational	✓		✓	✓
Type of flows				
Physical flow			✓	✓
Information flow		✓	✓	✓
Financial flow	✓	✓	✓	✓
Level of supply chain maturity				
Intra-organisational	✓	✓	✓	✓
Inter-organisational	✓		✓	✓
Extended inter-organisational			✓	
Multi-chain			✓	
Societal		✓	✓	
Type of benchmarking				
Internal	✓	✓	✓	✓
External			✓	✓
Conceptualisation				
SME				
Retailer				
Industry				
Service				
All sectors	✓	✓	✓	✓
Quality factors			✓	
Human capital		✓	✓	✓
Sustainability		✓	✓	✓

ABC: Activity based costing
BSC: Balanced scorecard
WCL: World class logistics model

The SCOR model is the only model which satisfies all the maturity criteria used by Estampe *et al.* (2013). The SCOR model is in fact the only model of all sixteen analysed which satisfies all the criteria. This means that the SCOR model is the most relevant of the sixteen models in any given scenario.

Estampe *et al.* (2013) concludes by stating that their overall comparison has led to a distinction between two main categories of models: firstly, models aimed at measuring the internal performance of each actor in the chain, such as activity based costing. This category applies mainly to firms which have achieved level 1 or level 2 maturity. Secondly, models aimed at measuring the performance of all the actors in the chain, such as the SCOR model. This category applies mainly to firms which have achieved level 3, 4 or 5 maturity.

In my own view more emphasis should be placed on the SCOR model when developing a supply chain measurement framework for the South African wine industry. The reasons being that the SCOR model utilises universal processes and is already implemented in numerous industries. This will facilitate the linking of the wine producers' supply chain processes with that of their suppliers and customers. Kasi (2005) agrees by stating that the core strength of the SCOR model lies in its ability to define standard metrics and measurements which enables the SCOR model to identify and apply best practices to different supply chains. Berrah & Clivill (2007) confirm this by stating that the set of processes and sub-processes within the SCOR model enables it to represent different types of manufacturing organisations, so it is easier for the decision-makers to consider the whole supply chain, which is a necessary condition to consider the consequences of their decisions. Hence, the SCOR model is well suited for the need highlighted by Gunasekaran *et al.* (2004), namely that all participants in the supply chain partake in the development of a supply chain-wide performance measurement initiative. In Chapter 5 it is explained that, even though the SCOR model is mainly applicable to organisations at level 3, 4 and 5 maturity, it can be used to develop a framework for the South African wine industry, which is mainly at level 1 or 2 maturity, by selecting only a few applicable metrics. The advantage of basing the framework on the SCOR model is that the framework will be scalable in terms of maturity, since the SCOR model is applicable even for organisations with level 5 maturity.

This section described various supply chain measurement frameworks, each with their own advantages and shortcomings. Using these frameworks to measure performance will however not be sufficient: benchmarks are required to which the measurements can be compared to be able to truly assess and interpret the measurements.

2.5 Benchmarking supply chain performance

In the beginning of Section 2.2 it was stated that in order to improve a supply chain, the performance of the chain must first be measured so that the most significant improvement areas can be identified. This may prove difficult if there is no means of gauging the calculated performance. The solution to this problem is to conduct a benchmarking analysis, which is the second deliverable in the Analyse phase of the SCOR implementation road map.

2.5.1 Benchmarking background

According to Bhutta & Huq (1999), the essence of benchmarking is the process of identifying the highest standards of excellence for products, services, or processes, and then making the necessary improvements to reach those standards. These improvements are commonly called best practices. They state that 70% of Fortune 500 companies use benchmarking on a regular basis. Furthermore, they carried out a benchmarking study which consisted of two case studies, namely Xerox and Kodak. They state that the benefits derived by both companies are innumerable and that in terms of cost savings and customer satisfaction the companies have saved millions. Therefore they believe that benchmarking has played a significant role in the industry leadership stature of both companies.

(Hong, Hong, Roh & Park, 2012) carried out a study of benchmarking literature, including articles from journals such as Benchmarking: An International Journal, which were published between 2001 and 2010. They reviewed a number of different definitions for benchmarking and concluded that the common themes relevant to benchmarking are measurement, comparison, improvement, continuity and learning in order to achieve new and superior performance standards and competitive advantage. Figure 2.7 illustrates the relationship between these universal themes, which form a sustainable benchmarking cycle.

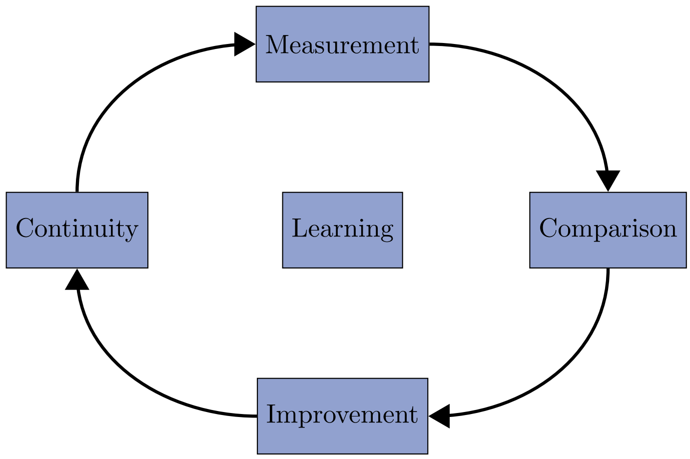


Figure 2.7: Sustainable benchmarking cycle (Hong *et al.*, 2012)

Watson (1993), cited by Evans, Tisak & Williamson (2012), proposes that benchmarking can be divided into five generations based on its history and future:

1. First generation: reverse engineering. A basic form of benchmarking which kept track of the technical aspects of a competitor's improvements on its products.

2. Second generation: competitive benchmarking. The same form as the first generation, the only difference being a changeover form product-oriented benchmarking to process-oriented benchmarking.

3. Third generation: process benchmarking. This generation overlaps with the second generation. The difference is that this generation also focusses on companies outside of their line of business to benchmark processes rather than only benchmarking processes against competitive companies. More information can be shared between companies, since they are not competing, which leads to more effective benchmarking.

4. Fourth generation: strategic benchmarking. The same as the previous generation, except that this generation involves a more detailed analysis and stronger commitment between the sharing organisations. Watson (1993) defines this generation as "a systematic process for evaluating alternatives, implementing strategies, and

improving performance by understanding and adapting successful strategies from external partners who participate in an ongoing business alliance".

5. Fifth generation: global benchmarking. In this generation, benchmarking evolved to global markets of trade, culture and business.

Evans *et al.* (2012) reviewed 46 master theses and 154 doctoral dissertations which were conducted between 2003 and 2010. They state that not one of these academic works suggest a new generational category. The aim of this thesis in terms of benchmarking is to create sample benchmarks by implementing competitive benchmarking, i.e. the second generation of benchmarking. Once the wine industry has benchmarked itself it can expand benchmarking into other industries, thereby evolving to higher generations of benchmarking.

2.5.2 Types of benchmarking

Morgan (2004) states that benchmarking within a supply chain context is a non-trivial undertaking due to the number of different benchmarking techniques. Benchmarking can be done on a product level, functional level, process level, organisational level or strategical level. Hence there exists different types of benchmarking. The type of benchmarking depends on what is being compared and what the comparison is made against (Bhutta & Huq, 1999). The different types of benchmarking, together with the definition of each, are shown in Table 2.6. Table 2.7 indicates the connections between these types of benchmarking.

Table 2.6: Types of benchmarking (Bhutta & Huq, 1999)

Types	**Definitions**
Performance benchmarking	Comparing performance measures in order to gauge the performance of one company against another
Process benchmarking	Comparing methods and processes with the aim of improvement in the company carrying out the benchmarking study
Strategic benchmarking	Comparing strategic direction with the company's competition in order to redirect the company's strategy
Internal benchmarking	Comparisons are being made between departments or function within the same company
Competitive benchmarking	Comparing performance and results against the best competition
Functional benchmarking	Comparing technology or processes within the same industry or technological area, the purpose of which is to become the best in that technology or process
Generic benchmarking	Comparing processes against the best operators regardless of industry

Table 2.7: Benchmarking relevance matrix (Bhutta & Huq, 1999)

	Internal benchmarking	Competitive benchmarking	Functional benchmarking	Generic benchmarking
Performance benchmarking	Medium	High	Medium	Low
Process benchmarking	Medium	Low	High	High
Strategic benchmarking	Low	High	Low	Low

According to Eccles (1991), competitive benchmarking gives managers a methodology which can be applied to any measure, financial or non-financial, but emphasises non-financial metrics. Secondly, it has a transforming effect on managerial mindsets and perspectives. The external oriented approach makes people aware of improvements which are orders of magnitude beyond what they would have thought possible. In contrast to this, internal benchmarks that measure current performance in relation to past performance, current budgets, or results from other functions within the same company rarely have such an eye-opening effect. Furthermore, internally focussed comparisons have the danger of leading to both complacency through a false sense of security and counter productivity due to internal rivalry. For this thesis, performance benchmarking is used. Arguably competitive benchmarking is also used, but seeing that no benchmarks currently exist within the wine industry, it is not possible to determine who the best competition is. Consequently, the sample of cellars used for each measurement phase may or may not include the best competition. According to Table 2.7, there exists a high degree of relevance between performance benchmarking and competitive benchmarking and thus a natural progression from performance benchmarking to competitive benchmarking can follow.

2.5.3 The benchmarking process

Gryna, Chua & DeFoe (2007) define a benchmark as a reference point that is used as a standard of comparison for actual performance. Gryna *et al.* (2007) list ten steps which compose the benchmarking process:

1. Identify the benchmark subjects
2. Identify organisations which will serve as benchmarks
3. Determine the data collection method and collect the data
4. Determine the gap between the organisation's performance and the benchmark
5. Project the future performance of the industry and the organisation
6. Communicate the results
7. Establish functional goals
8. Develop action plans
9. Implement plans and monitor results

10. Recalibrate the benchmarks by repeating the benchmarking process

In 1950, Dr. W. Edwards Deming proposed a continuous improvement theory called the PDCA (Plan, Do, Check, Act) cycle which is illustrated in Figure 2.8. The ten steps in the above benchmarking process can be allocated to the four phases within the PDCA cycle: the first two steps can be seen as "Plan", step three as "Do", steps four and five as "Check" and steps six to nine as "Act". Step ten illustrates the iterative nature of benchmarking and can be seen as the arrow between the "Act" and "Plan" phases in Figure 2.8. Since the benchmarking process can be fitted to the PDCA cycle, benchmarking can be seen as a continuous improvement process.

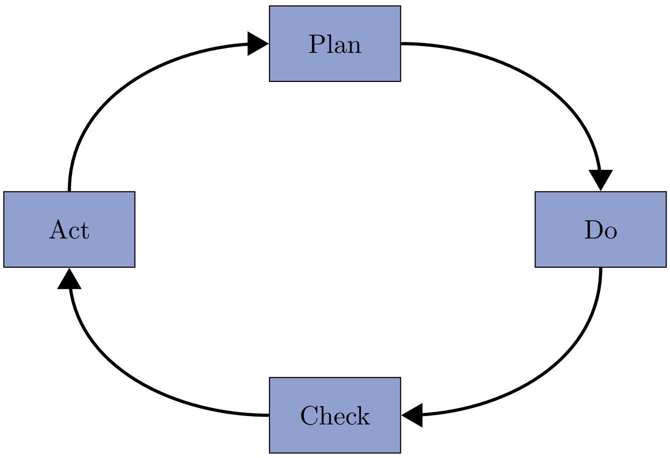


Figure 2.8: Plan, Do, Check, Act cycle

The 10 steps suggested by Gryna *et al.* (2007) can be applied to most benchmarking studies. However, included in the SCOR model is a benchmarking process which is specifically focussed on supply chains, called the SCORmark process. According to APICS Supply Chain Council (n.d.), SCORmark combines the SCOR metric hierarchy, PwC's PMG historical data of over 1000 companies and 2000 supply chains and a 20 year history of collaboration. The SCORmark process consists of seven generic steps:

1. Supply chain definition

2. Supply chain prioritisation

3. Supply chain strategy
4. Selecting metrics
5. Sourcing data
6. Creating a balanced SCORcard
7. Performing benchmark

Due to its proven track record, and seeing that the SCOR model is chosen as the framework on which to base the framework developed in this thesis, the SCORmark process will be used as the methodology for this thesis. This is discussed in more depth in Chapter 3.

The identification of the proper measures to be benchmarked is of critical importance. Carpinetti & de Melo (2002) proposes five steps for defining the object of study of benchmarking:

1. *Step 1: Product and market analysis*
   Collect information regarding product characteristics, target customers and markets, business strategies, competitive priorities and general areas of improvement.
2. *Step 2: Critical dimensions*
   Collect information regarding customer expectations and perceived quality for different categories of customers and products and rank importance of requisites of main customers. Collect information regarding performance against competitors in attaining customer expectations.
3. *Step 3: Critical processes*
   Map all processes and activities relating to the value chain and understand their relationship with the dimensions most in need of improvement. An optional addition to this step is to construct a matrix relating processes to dimensions in order to focus the attention on the processes and activities which most impact performance on the prioritised competitive dimensions.
4. *Step 4: Performance assessment*
   Execute a qualitative or quantitative evaluation of the critical processes and activities. It is important to conduct a diagnosis of the current situation in order to identify weak points which need to be addressed.

5. *Step 5: Improvement priorities*
   After performing steps one to four, the most significant areas of improvement become evident. From this point onwards, the benchmarking study can start for those areas for which a benchmarking application is considered to be adequate.

These five steps facilitate the identification of the areas most critical to overall business success and which therefore should be improved through a benchmarking analysis. What Carpinetti & de Melo (2002) fail to take into account is the trade-offs between different areas which will most likely be affected if the performance of one of the areas within the trade-off is altered. For example, if an organisation, after the completion of the five steps, determine that the reduction of lead-time is their top priority and they execute a benchmarking study with the aim of reducing lead-time, certain costs will most likely increase. Hence, even though costs were not identified as an area in need of improvement, the reduction in lead-time may cause certain costs to increase to an unacceptable level. Therefore, organisations should not blindly improve the identified areas, but also take various trade-offs into account.

Bhutta & Huq (1999) state that benchmarking cannot be carried out in isolation, but has to match and contribute to the overall business objectives to be of any benefit. Bhutta & Huq (1999) and Hong *et al.* (2012) list a few misconceptions and limitations of benchmarking:

- Benchmarking on its own does not indicate what the customer wants. If a product is obsolete, no amount of improvements will make it competitive.
- Not involving employees during a benchmarking process. Since the employees will ultimately need the information, they should be included in the process.
- Companies do not want to benchmark because it exposes their weaknesses and gives too much information to competitors.
- Companies have difficulties treating benchmarking as an ongoing process.
- Benchmarking can become too expensive.
- By only adopting another firm's best practices, a firm stays behind and will not necessarily exceed the performance of the other firm.

According to Hong *et al.* (2012) there is an increasing need for benchmarking studies of complex business practices. As customer demand and market requirements become ever more complex, so does the research of benchmarking increasingly focus on intertwined business practices. In their study they analysed 156 articles relating to various types of benchmarking. From the analysis they found that the majority of articles deal with benchmarking on a micro-level, with only 3 out of the 156 articles dealing with conceptual benchmarking studies on a macro-level (mostly industry level). However, they also found that macro-level analyses are slowly gaining more research attention. The wine supply chain project contributes to benchmarking both as a conceptual and empirical study on the macro-level.

2.6 Supply chain segmentation

When conducting a benchmarking analysis, it is important that the objects being compared are on the same level so that a fair comparison can be made. For example, the reliability associated with innovative products will most likely be lower than that associated with commodity products, or the lead-time associated with different customers may vary according to the geographical location of the customer. Therefore the nature of the supply chain, in terms of product and customer characteristics, must be taken into account when comparing performance measurements. The nature of the supply chain can be integrated with measurements by implementing supply chain segmentation.

Fisher (1997) suggests the need for supply chain segmentation by stating that a company should not respond to all types of demand using the same kind of supply chain. Managers should construct a supply chain according to the demand characteristics of the customer. In terms of product characteristics, Fisher (1997) segmented the supply chain according to functional or innovative products. Seeing that these two types of supply chains have different goals, namely efficiency and responsiveness, their performance metrics should have different emphasis. Ideally, each supply chain identified in the supply chain definition, illustrated in Table 2.1, should have its own strategy and performance targets. However, since some of these supply chains are managed more or less the same, they can be grouped together. This reduces the number of supply chains within a company, simplifying the task of managing them. The question now exists of exactly when supply chains can be grouped together and when not.

Lovell, Saw & Stimson (2005) carried out a study with the aim of identifying the importance of supply chain segmentation. They state that there are numerous factors which can affect the segmentation of a supply chain. They agree with the above discussion by arguing that at one extreme, these factors would provide a unique supply chain for each product in each market, which would be extremely expensive, unmanageable and inefficient. The other extreme is to assign all products to the same supply chain, which will not be able to accommodate different strategies for different products. The optimal solution therefore lies between these extremes. According to Lovell *et al.* (2005) there are four main factors which may influence the segmentation of a supply chain:

1. *Product factors*
   These include issues such as life cycle, variety and product type (which can be either innovative or commodity). For example, products with a short life cycle should be delivered reliably, while innovative products should be linked to a responsive and agile supply chain. Another product factor is the physical characteristics of the product: products with a short shelf life should be allocated to supply chains which carry low levels of inventory and focus on responsiveness. Other product factors include handling characteristics, product value, etc.

2. *Market factors*
   These include issues such as demand variability and service expectation. These factors can also be linked to product features, for example an innovative product generally has a higher demand variability, which requires a more responsive and agile supply chain.

3. *Source factors*
   These factors include whether a product is supplied with a given lead time or made to order, economies of scale and limitations on raw material availability.

4. *Geographical and commercial environment*
   Geographical issues may include the level of infrastructure development, legislation, etc. The factors affecting the commercial environment include corporate income tax rates, barriers to trade and currency exchange rates.

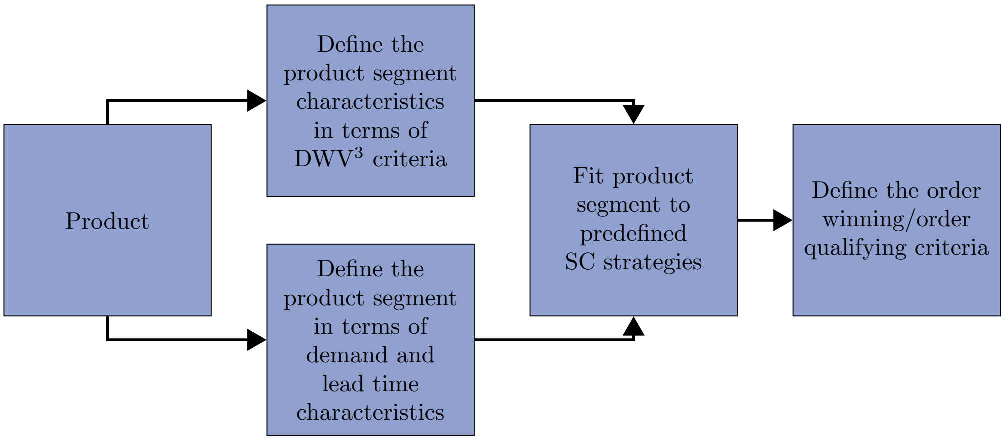
Lovell *et al.* (2005) state that there exist five main cost drivers for each product, namely, throughput level and variability, product size and weight, product value and demand variability/service factor. Product size and weight can be combined with product value to create product value density (PVD). The resulting three cost drivers can be used to allocate a specific supply chain design to a specific product, taking into account the product's lead time and demand characteristics. This was done by Sony and enabled the company to conduct cost trade-off analyses within their supply chains. Lovell *et al.*

(2005) concluded that the supply chain redesign at Sony reduced costs with 48% and increased sales by 100%, which is an endorsement of an effective supply chain segmentation strategy.

Before further discussing supply chain segmentation, the concept of order winners and order qualifiers (OW/OQ) must first be defined. Order qualifiers are defined as those factors that are required to compete in a particular market (threshold criteria) and order winners are the factors which win orders. Once suitable market segments have been identified, the segments can be described in terms of the order winning/order qualifying criteria. The relevant criteria can then be used to drive product and manufacturing strategies (Godsell, Diefenbach, Clemmow, Towill & Christopher, 2011). For example, the order winning criteria of a commodity product is generally cost, therefore the strategy of the specific segment should be focussed on costs and asset utilisation, whereas for a fashion product, the order winning criteria is generally "first-to-market" and thus the strategy should be focussed on responsiveness and agility. Christopher & Towill (2001) takes the concept of order winners/order qualifiers further by stating that:

> *We can borrow from these important ideas to develop a wider supply chain oriented concept of "market qualifiers" and "market winners". The notion here is that to be truly competitive requires not just the appropriate manufacturing strategy, but rather an appropriate holistic supply chain strategy.*

Godsell *et al.* (2011) conducted a study in which they enabled supply chain segmentation through demand profiling. The aim of the study was to set out an approach to demand profiling which offers a means for considering both product and market characteristics to enable the construction of a segmented supply chain strategy. The first approach they used to enable the development of supply chain strategies is product driven. This approach is illustrated in Figure 2.9.



Note: DWV^3 = Duration of life cycle, time window for delivery, volume, variety and variability

Figure 2.9: Product driven supply chain segmentation (Godsell *et al.*, 2011)

Figure 2.9 shows that products should be allocated to two product segments, namely DWV^3 criteria and demand and lead time characteristics. Depending on the nature of the product segment, the segment is fitted to a predefined strategy. Once products are allocated to product segments, each with an associated strategy, the OW/OQ criteria are identified for each product/supply chain strategy combination.

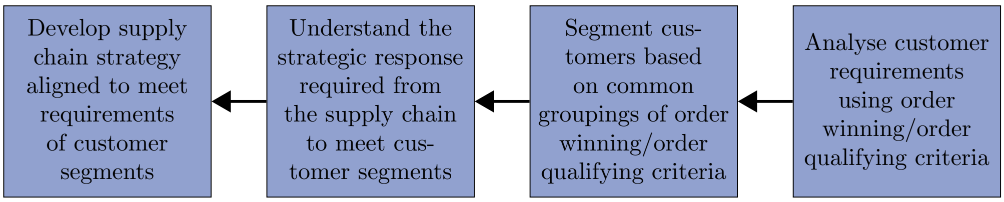


Figure 2.10: Customer driven supply chain segmentation (Godsell *et al.*, 2011)

The second approach to supply chain segmentation is illustrated in Figure 2.10. This approach is customer driven and strategies are derived by going back up the supply chain from the customer to the organisation. In contrast to the product driven approach, the identification of OW/OQ criteria is the first step in this approach. Customers are grouped according to their OW/OQ criteria, seeing that common OW/OQ criteria will require the same strategic response and therefore the same supply chain strategy. Supply chains are then designed to fulfill the requirements of each customer segment. The supply chain segmentation for this thesis related to the packaged export segment of the South African wine industry is discussed in Chapters 5 and 6.

2.7 Conclusions

This chapter presented the findings of the literature review, which was conducted with regard to three main sections, namely supply chain management, supply chain performance measurement and benchmarking. Firstly, a short history was given in terms of supply chains and supply chain management, after which each concept was defined. Secondly, the evolution and definition of performance measurement were discussed. An analysis of supply chain performance measurement frameworks followed, with the SCOR model being selected as the most appropriate model on which to base the framework developed in this thesis. Furthermore, the impact which supply chain management maturity has on the performance measurement was highlighted. Thirdly, an investigation of different types of benchmarks, together with the process of implementing a benchmarking study was conducted. This was followed by a review of supply chain segmentation in which both the factors influencing segmentation and the process of segmentation were discussed.

CHAPTER 3

Thesis methodology

Contents

3.1 Methodological background

In Chapter 1 the SCOR road map was presented as a methodology which can be applied when conducting a supply chain improvement project. In the context of the South African wine industry, there exists a gap in this methodology, as explained in Chapter 1. In order to remove this gap, the methodology of this thesis is based on the SCORmark process, due to its proven track record (refer to Section 2.5.3) and seeing that the framework developed in this thesis is highly influenced by the metrics framework of the SCOR model. The SCORmark process was applied to develop three measurement frameworks, as illustrated in Table 3.1.

In Table 3.1, a “X” denotes that a SCORmark step was executed for the development of the applicable framework. Steps 1 to 6 of the SCORmark process were executed to develop a phase 1 framework in Chapter 4, with the completion of step 7 being each cellar’s own responsibility. The purpose of the phase 1 framework was to act as a starting point for the development of the phase 2 framework and to gain knowledge of the industry. Steps 4 to 6 were then reiterated to develop the phase 2 framework in Chapter 5.

Table 3.1: Framework development methodology

SCORmark steps	Phase 1	Phase 2	Ideal
1. Supply chain definition	X		
2. Supply chain prioritisation	X		
3. Supply chain strategy	X		
4. Selecting metrics	X	X	X
5. Sourcing data	X	X	
6. Creating a balanced SCORcard	X	X	
7. Performing benchmark			

For the phase 2 framework, steps 1 to 3 were not reiterated, seeing that the only purpose of these steps was to understand the supply chain strategies in the packaged export segment so that the framework can be developed in accordance to the strategies. Once the strategies were known, it was not necessary to conduct steps 1 to 3 again. Lastly step 4 was reiterated for the development of an ideal framework in Chapter 6. The purpose of the ideal framework was to specify what should ideally be measured to determine the performance of a packaged export supply chain, regardless of data availability. Steps 5 and 6 were not reiterated for the ideal framework, since much of the required data for the ideal framework is not currently available within the wine industry as a result of low levels of supply chain management maturity.

In order to create the benchmarks required for the completion of step 6, a benchmarking technique proposed by the SCC (2012) was used. This technique allocates three benchmarks to each metric in a measurement framework, namely parity, advantage and superior. These benchmarks are defined as follows:

- Superior: Top 10%
- Advantage: Top 30%
- Parity: Top 50%

An example of a measurement framework, or a scorecard, together with the three benchmarks for each metric is illustrated in Figure 3.1. The framework in Figure 3.1 can be used as a decision support tool: the second column from the left is the strategy of a cellar for each attribute and the figure then uses illustrative data to show how the target gap is identified, which then highlights areas of improvement. The same design was used for the frameworks developed in this thesis. The three benchmarks were established through the collection of data from various industry players. The successful creation of a scorecard with benchmarks, as illustrated in Figure 3.1, will remove the gap in the SCOR implementation road map, which is the objective of this thesis.

Attribute	S/A/P	Metric	You	P	A	S	Target gap
Reliability	S	Perfect order fulfillment	97%	92%	95%	98%	1%
Responsiveness	A	Order fulfill-ment cycle time	14 days	8 days	6 days	4 days	8 days
Agility	P	Upside supply chain flexibility	95 days	80 days	60 days	40 days	15 days
Cost	P	Supply chain man-agement cost	12.5%	11%	10.4%	10.1 %	1.5 %
Assets	A	Cash-to-cash cycle time	22 days	45 days	30 days	15 days	-8 days

Note: P = Parity ; A = Advantage ; S = Superior

Figure 3.1: Supply chain measurement framework (scorecard) with illustrative benchmarks

3.2 Thesis methodology

A flow diagram of the thesis methodology, together with the research design for the development of each framework, is presented in Figure 3.2. The ideal measurement framework for the packaged export supply chain segment was developed using a multi-phased mixed method exploratory approach. A phase 1 and phase 2 framework were developed and the findings of each used to create the ideal framework. Qualitative data collection is the primary form of data collection in an exploratory study, thus it is presented in a bigger block than quantitative data collection in Figure 3.2 to denote its importance. A review of relevant literature, together with various semi-structured and unstructured interviews and workshops with industry players, were conducted as ongoing processes, the findings of which were also used in the development of the three frameworks. Lastly, the findings of work streams 1 and 3, which were explained in Chapter 1, were used in the development of the phase 2 framework and ideal framework respectively.

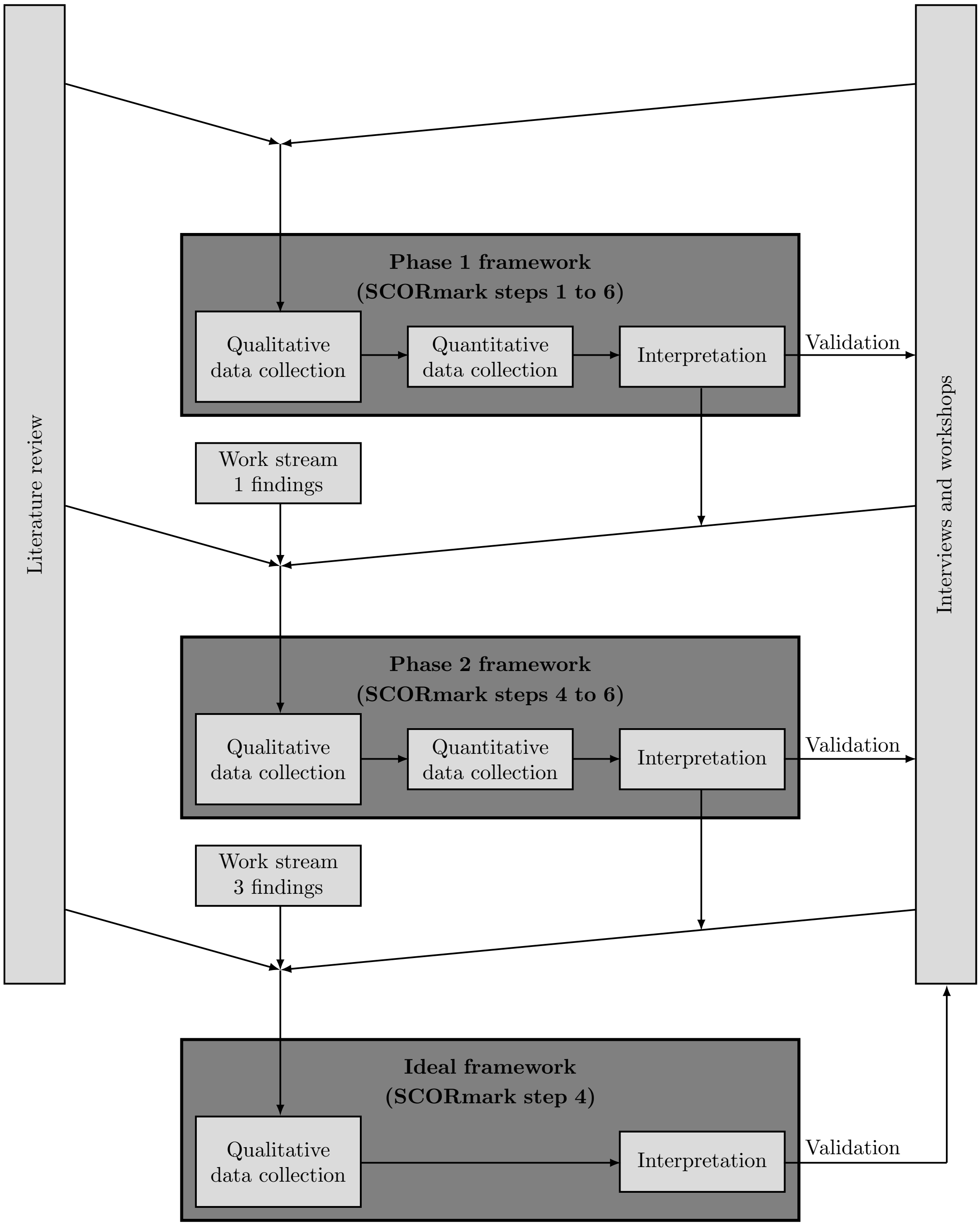


Figure 3.2: Flow diagram of thesis methodology

3.2.1 Methodology for developing the phase 1 framework

In order to develop the phase 1 framework, qualitative data was collected through a literature review together with interviews and workshops with a sample of 16 cellars and various other industry players. The sample consisted of 15 producer cellars and one private cellar. The cellars within the sample were selected in such a manner that the sample would provide a reasonable representation of the entire SA wine industry based on product volume. The industry representation according to product volume is illustrated in Figure 3.3. Other factors which were also taken into account for the selection of cellars were organisational structure (for example own vs outsourced bottling, storage and delivery) and the geographical location of the cellar.

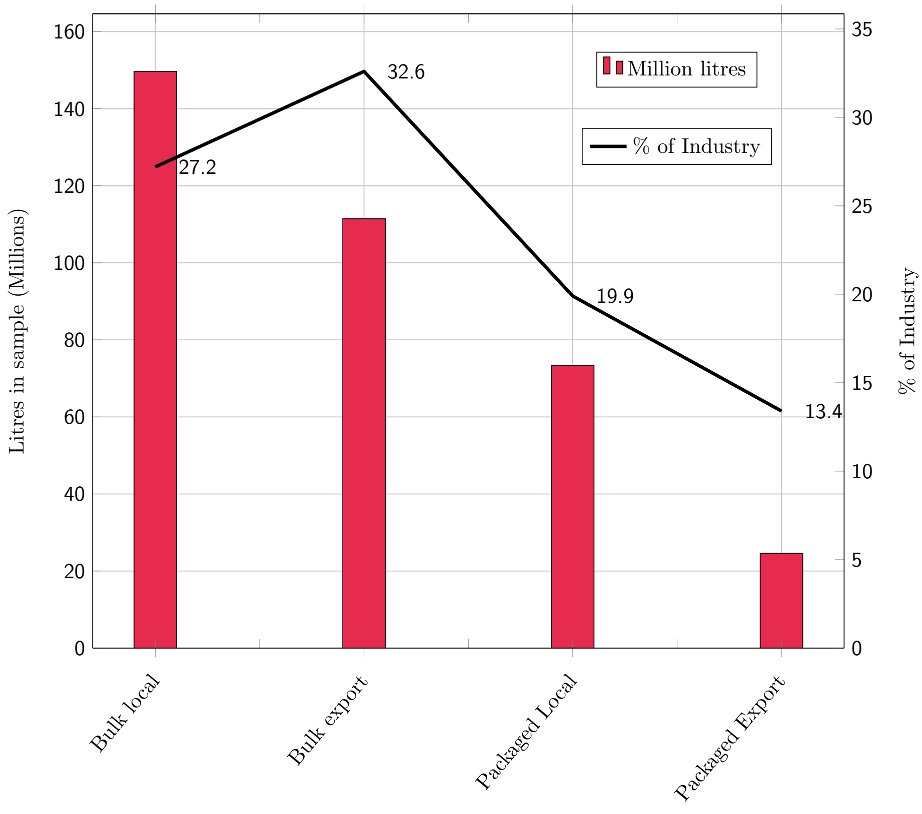


Figure 3.3: Representation of the industry for the phase 1 framework

Figure 3.3 shows that the two bulk segments were best represented by the sample, with only 13.4% of the packaged export segment being represented. This can be explained by Figure 1.6 which shows that private cellars contribute more to the packaged export segment than producer cellars, which made up the majority of the sample.

All wine in the bulk local segment would eventually have been converted into one or more of the other three segments. If all of the 16 participating cellars had sold all of their bulk local wine to other participating cellars, the sample would have represented 23% of the South African wine industry. If no bulk local wine had been sold between participating cellars, the sample would have represented 40% of the industry. Therefore the representativeness of the sample lay between 23% and 40% of the total population according to wine volume (Van Eeden, 2014b).

Once sufficient qualitative data had been collected to enable the development of the phase 1 framework, the framework was developed using Microsoft Excel and sent to the 16 cellars via email. This enabled the collection of quantitative data for the first quarter of 2014. Cellars were asked to supply data for at least two of the four supply chain segments (refer to Table 1.2). The quantitative results were used to analyse the framework in the sense that it indicated both the practicality of the framework and the readiness of the industry to measure the specified metrics. It was also used to establish sample benchmarks. Furthermore, the framework was evaluated and validated in a qualitative sense through interviews and workshops.

3.2.2 Methodology for developing the phase 2 framework

The phase 2 framework was developed following the same methodology as the phase 1 framework. However, the qualitative data collection was expanded to incorporate the findings of both work stream 1 and the phase 1 framework, which included various suggestions by industry players. The quantitative results of the phase 1 framework were also used as qualitative data for the phase 2 framework in the sense that the results portrayed the data availability in the industry, which influenced the selection of metrics for the phase 2 framework. Furthermore, the sample was expanded to include four medium sized private cellars. This was done to increase the representativeness of the sample, especially for the packaged export segment, not only in terms of volume, but also in terms of different business sizes. More cellars could have been included, but it was decided to rather focus on data quality than quantity, hence only four private cellars were added to the sample.

Quantitative data was collected from two types of industry players. Firstly, data was collected from the sample of cellars using Surveymonkey. Cellars were again asked to supply data for at least two supply chain segments. Secondly, order data was collected from various freight forwarders. This was done to reduce the inputs needed by cellars and it was assumed that freight forwarders' data adhere better to the data requirements listed in Table 2.2. Table 3.2 shows the volume representation of each freight forwarder that took part in the project. As with the phase 1 framework, the results were used to determine the availability of data within the industry. The framework was also evaluated and validated qualitatively through further interviews and workshops.

Table 3.2: Freight forwarder volume representation (Van Zyl, 2015)

Freight Forwarder	Volume representativeness (%)
JF Hillebrand	40-50
Intersped	20-30
Giorgio Gori	5-10
Outsource Logistics	< 2

Table 3.2 lists the four freight forwarders who supplied order data. The freight forwarders represent a significant portion of the entire population. It is important to note that this representation is not the representation of the quantitative data collection for the phase 2 framework, as the freight forwarders only supplied data of the cellars that were taking part in the study. The representation is however relevant to qualitative data that was collected from freight forwarders through interviews.

3.2.3 Methodology for developing the ideal framework

Qualitative data for the development of the ideal framework was collected in the same way as for the phase 2 framework, with the findings of work stream 3 also contributing to the data collection. As explained earlier in this chapter, no quantitative data collection was done for the ideal framework and no restrictions due to a lack of available data was incorporated into the design of the framework, hence the name ideal framework. As with the previous two frameworks, the ideal framework was validated through interviews and workshops. The multi-phased methodology also acted as validation for the ideal framework.

CHAPTER 4

Phase 1 framework

Contents

This chapter describes the phase 1 framework. The framework was developed by following steps 1 to 4 of the SCORmark process, which is listed in Section 2.5. Once the framework had been developed, data was gathered from a sample of 16 cellars. The data was used to establish sample benchmarks. Finally, the results of both the measurements and the framework design are discussed.

4.1 Background of the phase 1 measurements

A project kickoff meeting was held at each cellar in which the background of the project, together with the project's expectations, were discussed. Since four supply chain segments where already identified for the study, the supply chain definition, refer to Table 2.1, for each cellar was only discussed and not explicitly constructed. For the second step in the SCOR benchmarking process, namely supply chain prioritisation, managers at each cellar were asked to complete a supply chain prioritisation matrix, Table 4.1, to be able to prioritise the four supply chain segments according to the criteria in each column. Managers had to complete the "rank" columns by assigning a value to each supply chain segment for the corresponding criteria (4 = most important and 1 = least important). The relative weights of the criteria could also be adjusted according to the cellar's strategy. The "result" column is the product of the rank and relative weight. The "overall" column is the sum of the results, with the highest overall score being the highest prioritised supply chain. Managers were able to prioritise their cellar's supply chain segments without the use of Table 4.1, but it was unclear on exactly which criteria their decisions were based. Table 4.1 was therefore used as a tool to aid the managers to rank all four supply chains according to a numeric value (the overall column), while taking into account all five criteria.

The completion of Table 4.1 had a second goal, namely to encourage the managers to adopt a segmented view of their supply chains. It was found through various discussions that managers treat all products and customers more or less the same using a single "average" supply chain. This confirmed the conclusions by Van Eeden *et al.* (2012), namely that most cellars do not have accurate quantitative supply chain information available for each separate supply chain. The need to segment supply chains and to manage each segment according to its characteristics was described in Section 2.6.

Table 4.1: Supply chain priority matrix

Company's supply chains	Criteria	Revenue		Gross margin		Number of SKUs		Unit volume		Strategic value	
	Weight	20%		20%		20%		20%		20%	
	Overall	Ra	Re	Ra	Re	Ra	Re	Ra	Re	Ra	Re
Bulk local											
Bulk export											
Packaged local											
Packaged export											

Note: Ra = Rank ; Re = Result

Once Table 4.1 was complete, managers were asked which of the five SCOR attributes are the most important for each of the four supply chain segments. They could allocate either superior, advantage or parity, which were defined in Chapter 3, to each attribute. For example, if a manager allocated "superior" to responsiveness within the bulk local segment, the strategy of the cellar would be to perform better than 90% of the South African industry in terms of responsiveness in the bulk local segment. Since the five attributes influence each other, for example if responsiveness increases, costs would increase, and a single supply chain would rarely, if ever, be able to perform superior in all five attributes, managers could only select one attribute to be superior, one or two to be advantage and the rest to be parity, as recommended by the SCC (2012). Managers were asked to do this exercise for at least the supply chain which received the highest rank in Table 4.1. The results of the 16 cellars are summarised in Table 4.2.

Table 4.2: Strategies per supply chain segment

Attribute	Bulk local		Bulk export		Packaged local		Packaged export	
	Sup	Adv	Sup	Adv	Sup	Adv	Sup	Adv
Reliability	1	4	7	1	2	4	1	3
Responsiveness	2	2	1	6	1	4	4	2
Agility	1	3	0	4	0	2	0	1
Cost	2	2	0	4	3	2	1	2
Assets	1	3	0	0	1	2	0	3
Total	7		8		7		6	

Note: Sup = Superior ; Adv = Advantage

In Table 4.2 the "Total" row is an indication of the number of cellars which completed the exercise for the corresponding supply chain segment, since "superior" could only be selected once per segment. Both export segments appear to have a clear preferred attribute: 87,5% of respondents selected reliability to be superior for the bulk export segment and 66,67% selected responsiveness to be superior in the packaged export segment. These strategies reflect the nature of the two export segments. Customer orders within the bulk export segment are more often placed in advance compared to the packaged export segment, therefore it is more important to deliver reliably than to be able to respond quickly to orders. Responsiveness is however still important since not all orders are placed in advance, therefore six of the respondents selected it to be "advantage". Responsiveness within the packaged export segment is more important than reliability, since customers place orders more on an ad hoc basis. Orders are generally smaller and placed more frequently than in the bulk segment.

The two local segments have a much more even distribution of preferred attributes, both in terms of which attributes are "superior" and which are "advantage". The only small distinction is the selection of cost as the most important attribute by three cellars within the packaged local segment. The lack of a clear supply chain strategy for the local segments can be the result of two factors, namely that all the cellars do not agree on the order winning criteria for the segments and therefore implement different strategies, or that further supply chain segmentation is required within the local segments.

In general it is clear that the export segments place more emphasis on the customer facing attributes and the local segments on the internal attributes. There are two factors which give rise to this, namely the value of the wine and the characteristics of the market. Since exported wine is generally more expensive than wine sold locally, costs and asset management efficiency plays a less significant role in profitability. It is more important to win an order through superior customer facing attributes than to save costs by focussing on internal attributes. In terms of market characteristics, the export market is generally more volatile than the local market. In the local market, customers often supply a cellar with an order forecast which allows cellars to shift their focus to internal attributes. Consequently, costs and asset management become the prioritised attributes.

4.2 Phase 1 framework design

For the phase 1 framework it was decided to measure mainly level 1 SCOR metrics. There are two reasons for this: firstly, seeing that the necessary knowledge of exactly what to measure was not yet attained, the level 1 metrics acted as convenient starting points from which more in-depth analyses could be done for the phase 2 and ideal frameworks. Secondly, measurements were kept simple, since all the level 1 metrics are easy to understand and only measure high-level performance. Level 2 and 3 metrics were only measured when it was deemed necessary. The framework was further simplified by measuring the same metrics for all four segments. The reason for this being that cellar managers are often not sure whether, for example, bulk wine will be sold to the local or export market or whether it will be sold as packaged wine. The same point is valid in the packaged segments, namely that managers are not always certain whether buffer stock will be sold to the local or export market. Therefore, although metrics were measured per segment, the fact that all the metrics were the same helped simplify the measuring process. The phase 1 framework can be seen in Table 4.3.

Table 4.3: Phase 1 framework

Attribute	Metric	Metric number	Unit
Reliability	Perfect Order Fulfillment	RL.1.1	%
Responsiveness	Order Fulfillment Cycle Time	RS.1.1	Days
Agility	Upside Supply Chain Flexibility	AG.1.1	Days
	Upside flexibility (Source)	AG.2.1	Days
	Upside flexibility (Make)	AG.2.2	Days
	Upside flexibility (Deliver)	AG.2.3	Days
Cost	Storage Cost	Not in SCOR	R/bottle or R/litre
	Transportation Cost	CO.3.022	R/bottle or R/litre
Assets	Inventory Days of Supply (IDOS)	AM.2.2	Days

As explained in Chapter 2, measurements should always be linked to strategy. Since measurements were kept the same for all four segments, and all of the SCOR attributes were selected at least once by cellars to be superior, the phase 1 framework included metrics from all five attributes. Reliability and responsiveness were measured using both attributes' single level 1 metric. These two metrics are calculated using order data. For reliability, this metric is *Perfect Order Fulfillment*, which is defined as (SCC, 2012):

> *The percentage of orders meeting delivery performance with complete and accurate documentation and no delivery damage. Components include all items and quantities on-time using the customer's definition of on-time, and documentation - packing slips, bills of lading, invoices, etc.*

For responsiveness, this metric is *Order Fulfillment Cycle Time*, which is defined as (SCC, 2012):

> *The average actual cycle time consistently achieved to fulfill customer orders. For each individual order, this cycle time starts from the order receipt and ends with customer acceptance of the order.*

According to the scope of this project, which was described in Chapter 1, only the direct supply chain is being measured. All the cellars in the sample used the Free On Board (FOB) Incoterm, which stipulates that the seller bears both costs and risk until the order is on board the ship. Therefore, the direct customer was seen as delivery according to the FOB Incoterm. Hence, responsiveness and reliability were measured from the date of order receipt to the date of delivery according to the FOB Incoterm.

It was decided to measure agility using the the level 1 metric *Upside Supply Chain Flexibility*. The reason being that this metric is arguably the agility metric which is the easiest to understand. The metric is defined as: "The number of days required to achieve an unplanned sustainable 20% increase in quantities delivered." Since this is a rather abstract calculation, it was decided to break the calculation down into three sub-calculations (level 2 metrics), namely *Upside flexibility (Source)*, *Upside flexibility (Make)* and *Upside flexibility (Deliver)*. Upside Supply Chain Flexibility is the sum of these three level 2 metrics. Seeing that the segments compete for the same resources, the agility metrics were not measured per segment, but for the cellar as a whole.

Seeing that level 1 and 2 cost metrics are aggregated financial metrics which require significant input to be calculated, it was decided to rather include metrics which are already being measured by most cellars. *Storage cost* and *Transportation cost* were selected, as both are common metrics applicable to bulk and packaged wine.

Inventory management is one of the most important differentiating factors within the wine industry and it was highlighted as an area needing improvement (De Waal (2014), Heckroodt (2014a)). It is also one of the areas with the most opportunities for improvement. Therefore, the level 2 metric *Inventory Days of Supply* was used as the measurement for the asset management attribute. The SCOR model provides the following equation to calculate inventory days of supply:

$$\frac{Average\ value\ of\ inventory}{Average\ cost\ of\ goods\ sold} \times 365 \tag{4.1}$$

The phase 1 framework was sent to each cellar via email in the form of a Microsoft Excel document. The document included explanations for all metrics, together with highlighted cells where managers had to supply their data. Managers were asked to supply data for the previous three months, namely the second quarter of 2014. Once the managers completed the document, it was returned via email.

Fifteen of the sixteen cellars completed Table 4.1 for their top two prioritised segments. One of the cellars, which produces 97% of its wine within a single segment, completed Table 4.1 for only that specific segment. Managers were asked to complete the survey for at least their top two prioritised segments. Therefore, if all the required data was supplied both correctly and completely, it was expected that data for a total of 31 segments would be collected for the phase 1 measurements. The data completeness per segment is shown in Table 4.4.

Table 4.4: Data completeness per segment

	Bulk local	Bulk export	Packaged local	Packaged export	Total
Expected replies	7	9	6	9	31
Received replies	6	6	4	5	21
Completeness (%)	85.7	66.7	66.7	55.6	67.7

Table 4.4 shows that a total of only 21 replies were received. The packaged export segment had the lowest completeness percentage with 55.6%, with the packaged local segment receiving the fewest replies. The completeness percentage for all the segments was 67.7%, however, since each segment's reply consisted of nine individual replies (for each of the nine metrics listed in Table 4.3) the actual completeness of the received data was less, seeing that certain cellars did not supply data for all nine metrics. This is illustrated in Table 4.5.

Table 4.5: Data completeness per metric per segment

	Bulk local		Bulk export		Packaged local		Packaged export		Total	
	Exp	Rec	Exp	Rec	Exp	Rec	Exp	Rec	Exp	Rec
RL.1.1	7	5	9	6	6	3	9	5	31	19
RS.1.1	7	4	9	4	6	2	9	5	31	15
AG.1.1	7	5	9	5	6	4	9	4	31	18
Storage cost	7	5	9	2	6	2	9	3	31	12
CO.3.022	7	5	9	6	6	3	9	3	31	17
AM.2.2	7	4	9	4	6	4	9	4	31	16
% Complete	66.7		50.0		50.0		44.4		52.2	

Note: Exp = Expected ; Rec = Received

The three level 2 agility measurements are not included in Table 4.5, since AG.1.1 is the sum of the level 2 measurements and it was always the case that when data for AG.1.1 was received, all the level 2 measurements were completed. Table 4.5 shows that the completeness of the received data for the phase 1 measurements was 52.2%.

4.3 Results and analysis of the phase 1 framework

To enable managers to quickly gauge overall supply chain performance, a performance measurement system should be able to display the overall performance using only a few metrics, as stated in the third criterion in Section 2.2.4. It is however difficult to evaluate overall supply chain performance using only a few aggregated measures. If, for example, the average performance of level 1 metrics of each attribute within the SCOR model is used as a single aggregated measure, the overall performance will portray the performance of an average supply chain. Using this measure, a cellar which is performing on parity in all five attributes will probably receive a higher average than a cellar which is performing superiorly in one attribute, is on advantage in another and below parity in the rest. This leads to a false image of true performance, since a supply chain should be customised to fit its strategy and context, as explained in Chapter 2. One way to incorporate this rationale into a single aggregated measure is to take the trade-offs between the attributes into account. Models such as the multi attractiveness categorical based evaluation technique (MACBETH) have been developed in this regard. These types of models take both the values of metrics and the interactions between them into account to evaluate overall performance using a single aggregated measure. However, even though trade-offs are taken into account, the drawback of using a single measure is that the trade-offs are not visible. The proposed solution to this problem is to display all five attributes on a single dashboard. By doing this, managers are able to see the trade-offs between attributes while also being able to gauge overall performance in a single glance. This is illustrated in Figure 4.1, which shows the results for the packaged export segment. Each circle represents a cellar's measurement of the metric.

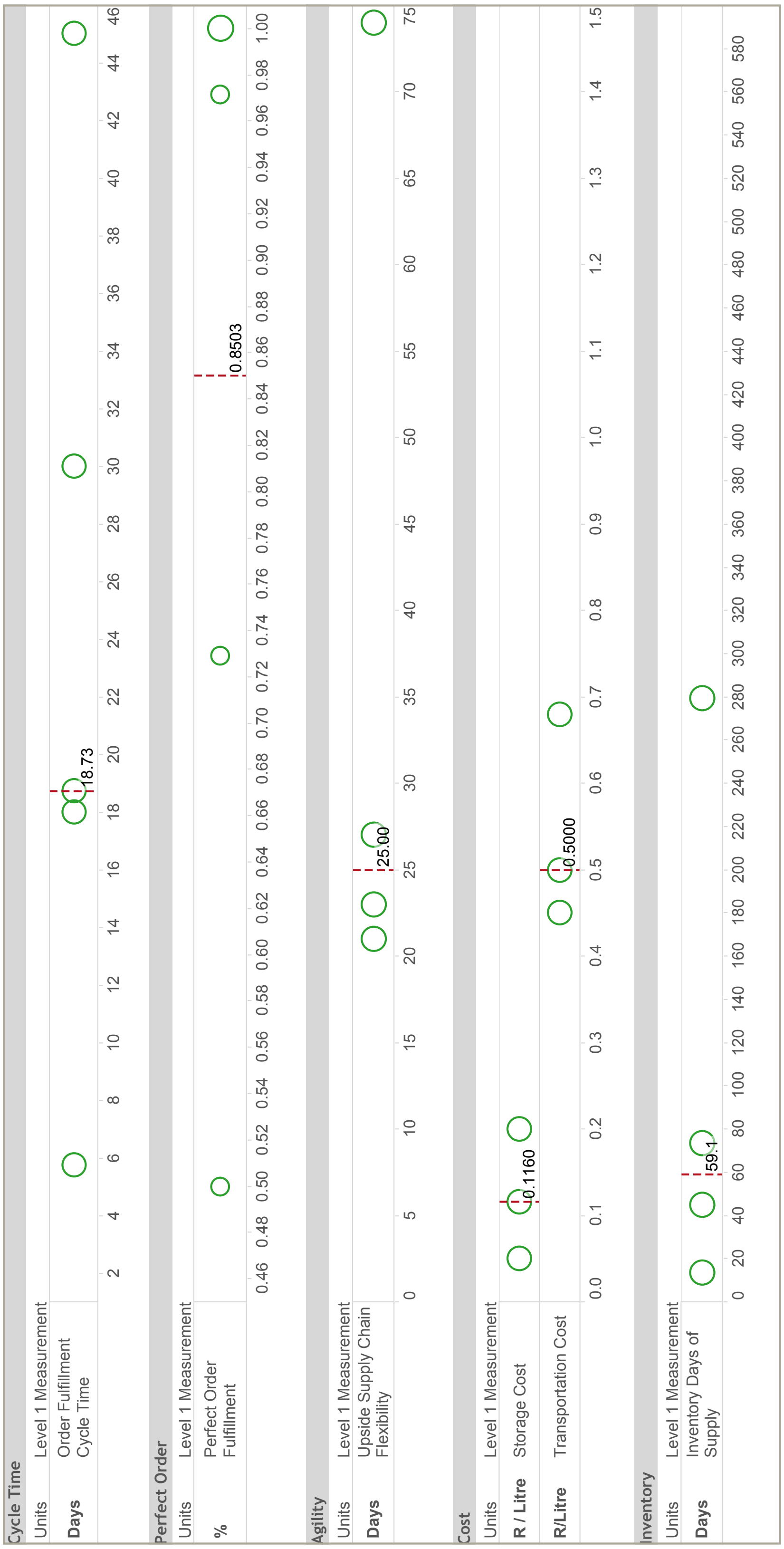


Figure 4.1: Phase 1 results for the packaged export segment

The combined results of all four segments can be seen in Appendix A. These results were not colour coded when feedback was given to the cellars. The idea behind this was to let managers realise that unfair comparisons are being made. It is clear that cycle times for export orders are longer than that of local orders, and perfect order fulfillment is lower for export orders compared to local orders. A clear distinction can also be made between bulk and packaged wine for IDOS. Therefore, segmentation was done according to the four identified supply chains.

Table 4.6 lists the sample benchmarks which were derived from the phase 1 measures. It is important to keep in mind that these benchmarks represent a very small portion of the entire packaged export segment: each benchmark was calculated using data from only 3 to 5 cellars, and some of the data was lacking in terms of the requirements listed in Table 2.2.

Table 4.6: Sample benchmarks of phase 1 framework

Metric	**Packaged export**			**Combined segments**		
	P	**A**	**S**	**P**	**A**	**S**
Order fulfillment cycle time (days)	18.7	18.14	10.62	8	3.17	2
Perfect order fulfillment	97%	99.4%	100%	100%	100%	100%
Upside supply chain flexibility (days)	21		1.4		0	
Transportation cost (R/litre)	0.5	0.48	0.46	0.32	0.04	0
Storage cost (R/litre)	0.12	0.092	0.06	0.06	0.04	0.01
Inventory days of supply (days)	59	41.9	23.3	191.1	65.1	12.7

Note: P = Parity ; A = Advantage ; S = Superior

The phase 1 results will now be analysed. The analysis is done in two parts. Firstly, the results of the actual measurements are discussed and, secondly, the results of the framework design are discussed.

4.3.1 Measurement results

The average packaged export cycle time per cellar varied from 5,7 days to 45 days with a median of 18,7 days. All three cycle time benchmarks are significantly longer than that of the combined segments. The main reason being that the packaged export segment has a much more extensive order fulfillment process than the other three segments in terms of documentation, possible consolidation, etc.

The three sample benchmarks for perfect order fulfillment are better than expected. One reason for this can be that the cellars do not capture reliability data and therefore concluded that all, or most, of their orders were perfect. Another reason can be that the period of measurement, namely from 1 April 2014 to 30 June 2014, is too short to gather representative data. For example, if a cellar only exported three orders during this period and every one was perfect, the cellar's reliability is 100%, whereas if the measurements where taken over a period of one year, the chances are that not all orders will be perfect, and reliability will be less than 100%. Note that Figure 4.1 indicates that for the perfect order fulfillment metric the circle at 100% is twice as large as the other circles in the same metric. The reason is that this circle represents two cellars.

The upside supply chain flexibility ranged from 21 to 74 days. The advantage and superior benchmarks are both very low, which is the result of the bulk segments. The reason for the low benchmarks (high agility) is the fact that a cellar has to be agile in terms of its capacity to be able to handle the yearly fluctuations of harvests. Consequently, the only significant process which can decrease the agility of a cellar in terms of bulk wine is the delivery process. Since the delivery process can more often than not be easily scaled up, the upside supply chain flexibility of bulk wine cellars is very high. For packaged wine there is potential scaling problems within the source, make and deliver processes and therefore the parity of upside supply chain flexibility is 21 days.

In terms of costs, both the transportation cost and the storage cost of the combined segments are lower than that of the packaged export segment, the reason being the low cost associated with the transportation and storage of bulk wine. Other factors which can have an influence on these costs are whether a cellar has its own storage facilities and does its own transportation, or whether it uses outsourced storage and transportation, the size of the cellar, which will have an influence on its economies of scale, etc.

IDOS for the packaged export segment resulted in a wider than expected range, namely from 14 days to 280 days, with a median of 59,1 days. The parity benchmark for the combined segments, namely 191.1 days, is very high compared to the packaged export segment. This is because the measurements for the phase 1 framework were taken from April to June, with harvesting normally ending in April. As a result, cellars had a lot of bulk wine in stock.

4.3.2 Framework results

Both order fulfillment cycle time and perfect order fulfillment represent a wider than expected range. Through discussion with various industry players (Heckroodt (2014b); Van Eeden (2014a)) it was found that the reason for this is insufficient segmentation, resulting in orders which have different contexts being compared with each other. For example, in the phase 1 framework there is no distinction between whether an order is fulfilled according to a make-to-stock or a make-to-order inventory policy. Other factors which should be taken into account is whether the order was consolidated with orders from other cellars, the amount of SKUs per cellar and whether there was dwell time within the order fulfillment process. Each of these factors are discussed in the development of the phase 2 framework in Chapter 5.

Responsiveness and reliability are both calculated using order data. It was found that cellars often had difficulty collecting the required order data. Possible reasons are that cellars do not capture the data or that the data is not captured in a software system through which it can be dragged into a single report, but is captured in the form of hard copies. This results in too much time having to be spent searching for the data. Seeing that freight forwarders capture the required order data, it was decided to collect this data from the freight forwarders for the phase 2 framework.

The upside supply chain flexibility metric had three shortfalls. Firstly, the framework did not take into account the type of production to be scaled up, namely whether it is bulk or packaged wine, but focussed on the cellar as a whole. For packaged wine, equipment such as a bottling line had to be taken into account, which is not necessary for bulk wine. Therefore, the value of the metric will be different for bulk and packaged wine. Secondly, even though it was stated clearly that the metric concerns a sustainable upscale in production, certain managers calculated the metric using overtime work, emergency procedures, etc., and the measurement is therefore subjective. Consequently, a clear definition of what is seen as sustainable needs to be developed, which may not be practical, given the extent of areas which will have to be included in such a definition. Thirdly, and probably the biggest issue of the metric, is that the metric is based solely on guesswork. Even though the overall metric was simplified by breaking it down into three other metrics, namely source, make and deliver metrics, it was found that due to the large amount of variables and possible scenarios, managers had trouble making a calculated guess. An example of this is that managers were not always certain what effect a 20% upscale in production would have on outsourced facilities. The need therefore exists to include a different agility metric in the phase 2 and ideal frameworks.

In terms of the cost metrics, managers had trouble calculating both storage cost and transportation cost, since clear definitions of how to measure each (what to include and what to exclude) were not included in the framework. However, certain managers supplied their cost measurements which were calculated according to their own definitions. In some cases it was found that managers indicated their storage cost to be R0.00. The rationale behind this was that if a storage facility had been paid off, the storage does not cost anything. This of course is not the case due to costs such as material handling, electricity, opportunity costs of the invested capital, etc. Another drawback of the two cost metrics was that neither metric is truly a key cost differentiator within the supply chain, which makes the value of measuring them questionable. Consequently, these two metrics were not included in the phase 2 framework.

The main issue of the IDOS metric is that it did not take into account the lack of supply chain segmentation within the industry. Consequently, managers had difficulty splitting the average value of inventory (refer to equation 4.1) according to the four segments. The lack of a segmented view was however not the only problem with this metric: due to the fact that certain SKUs can be sold both locally or exported, managers could not allocate those SKUs as being either local or export products, since they were not sure whether the products will be sold locally or exported. Furthermore, as explained in the measurement results above, the IDOS measurement for bulk wine differs significantly according to the time of year in which the measurement is taken. This is also true for packaged wine: the amount of stock which a cellar keeps follows seasonal demand. A typical example of this is that cellars build up more stock before the end-of-year holidays. Hence, an IDOS measurement which was taken in June cannot be compared with one taken in November and therefore the metric should be segmented according to the time of year in which it is calculated. It was found that there are also other factors which should be taken into account when analysing IDOS. These factors include whether a cellar possesses its own packaging facilities, its own storage facilities, etc. This is further discussed in the development of the phase 2 framework.

4.3.3 Conclusions

In terms of data quality it was found that cellars' systems are lacking: firstly, cellar management does not possess the necessary supply chain focus and therefore data such as reliability issues and lead times are not being captured per order. Secondly, the supply chain data which is captured is mostly not in the correct format, such as inventory levels which are captured for packaged wine, but not segmented for different supply chains. This lack of data and data quality makes the value of the sample benchmarks questionable. In fact, it questions the very act of benchmarking an industry with low levels of supply chain maturity.

For the phase 2 framework, it was decided to gather data from both cellars and freight forwarders. This will benefit the cellars in the sense that less data will be required from them, resulting in less effort from their side. Furthermore, it is assumed that data from freight forwarders adhere better to the requirements listed in Table 2.2 than that of cellars, which may improve the quality of benchmarks for the phase 2 framework.

Through the findings of the phase 1 framework, certain metrics were included in the phase 2 framework, depending on their practicality. The inclusion of phase 1 metrics in the phase 2 framework is summarised in Table 4.7.

Table 4.7: Phase 1 metrics included in phase 2 framework

Att	**Phase 1 metric**	**Included in phase 2 framework**
RS	Order fulfillment cycle time	✓
RL	Perfect order fulfillment	✓
AG	Upside supply chain flexibility	
	Upside flexibility (Source)	
	Upside flexibility (Make)	
	Upside flexibility (Deliver)	
CO	Storage cost	
	Transportation cost	
AM	Inventory days of supply	✓

For the phase 2 framework, more detail is added to the three identified metrics. For order fulfillment cycle time it was found that dwell time should be deducted in order to portray the true value of the metric. The calculation of the IDOS metric should be altered to remove the difficulties associated with the phase 1 calculation.

CHAPTER 5

Phase 2 framework

Contents

The phase 1 framework consisted of generic measurements for all four supply chain segments. This chapter aims to develop a measurement framework which is designed to custom-fit the packaged export segment by focussing on supply chain differentiators and strategies associated with the packaged export segment.

5.1 Context of the phase 2 framework

This section describes the context and background in which the phase 2 framework was developed. This includes the nature of data collection, the design of the framework and the scope of decision support.

5.1.1 Data collection for the phase 2 framework

As explained in Chapter 4, due to the lack of supply chain maturity within the wine industry, data for certain metrics was either not available or the data was not in the appropriate format. Examples are the lack of data to base agility metrics on or, due to the lack of supply chain segmentation within the industry, metrics such as IDOS could not be split between the packaged export and packaged local segments. Due to this lack of data for certain metrics, not all the metrics which should ideally have been included in the phase 2 framework were actually included. Instead these metrics were either adapted to accommodate the lack of data or moved to the ideal framework.

Since the phase 2 framework would consist of more metrics than the phase 1 framework and would therefore require more detailed data, an important trade-off came into play. The trade-off was between the amount and detail of data required from the cellars and the completeness of responses received from the cellars. One extreme of the trade-off was that the amount and level of detail required is too low to reach any meaningful conclusions. The other extreme was that the amount and level of detail required is too high, leading to both time and confidentiality issues which could have resulted in cellars not wanting to supply any data. The ideal trade-off laid between these two extremes.

In view of this trade-off, it would have been advantageous if less data was required from cellars without compromising the ability to come to meaningful conclusions. This could have been accomplished by gathering data not only from cellars, but also from other industry players who capture the desired data, provided the cellars gave permission. For the phase 2 framework, these players were freight forwarders, who capture order data, as stated in Chapter 4.

5.1.2 Supply chain segments and demographics

In Section 2.6 it was explained that supply chains must often be segmented in the interest of meaningful comparisons between metrics, which are the content of a performance measurement system. Section 2.6 also explained that there are four main factors which affect supply chain segmentation, namely product factors, market factors, source factors and geographical and commercial environment. This is further discussed for each SCOR attribute later in this chapter.

According to Section 2.4, a performance evaluation model should be based on the strategy of the organisation and therefore it is challenging to create a generic model. Seeing that the framework created for this thesis only focusses on the South African packaged export supply chain of natural wine, the framework can be generalised to a certain degree. This makes it possible to select a list of industry-specific demographics to add to the framework. By selecting a certain combination of these demographics, the framework can be customised to fit a certain type of cellar (for example a small private cellar which does not possess its own packaging and storage facilities). This satisfies the requirements stated in Section 2.2 by Cuthbertson & Piotrowicz (2011) and Lebas (1995), namely that there are also factors with regard to the conditions in which the supply chain operates (the context of a performance measurement system) which should be taken into account. Consequently, the framework will be flexible to a certain extent, which will enable more effective comparisons, both in terms of different types of cellars and the strategies of the cellars. This is further discussed later in this chapter.

The context of a supply chain is however mostly of no interest to the customer: the customer is only interested in reliable products or services delivered in an acceptable time-frame, at an acceptable price, which satisfies the required quality levels, etc. (the order winning and order qualifying criteria). Therefore, the context of a supply chain should not be taken into account when measuring supply chain performance. However, context is important for explaining results when comparing performance measurements from different supply chains with each other, which is called performance benchmarking according to Bhutta & Huq (1999), and to help identify areas for improvement. For these reasons the context of a supply chain must be taken into account when developing the phase 2 framework, since the main purpose of this thesis is to create a framework which can be used for performance benchmarking. To further clarify this argument, the following two examples are presented:

> *Example 1*
> Cellar 1 and cellar 2 each have one order. Cellar 1's customer is in the UK and cellar 2's customer is in China. The order fulfillment cycle time of the two cellars must be measured. The metric (content), namely order fulfillment cycle time, cannot be compared between the two orders due to the different geographical locations of the destinations. Consequently, the supply chain must be segmented according to geographical location.

Example 2
Cellar 1 and cellar 2 each have one order. Both cellars' customers are at the same geographical location. The cellars have different decoupling points: cellar 1 has make-to-stock products and cellar 2 make-to-order. The characteristics of the supply chains (context), namely whether a product is a make-to-stock or make-to-order product, will influence the order fulfillment cycle time. This, however, must not lead to supply chain segmentation, otherwise cellar 1 will not benefit from the shorter cycle time and the performance measurement system will not display meaningful results. Therefore, the metric should not be segmented according to the location of the decoupling points. The location of the decoupling point can however be displayed in the benchmark for the sake of additional information which may explain certain results.

From now on factors which influence the context of a supply chain are called demographics. Oxford University Press (2015) defines *demographic* as: "A particular sector of a population." A supply chain segment is thus seen as a population and demographics as sectors within that population.

5.1.3 Decision support scope

In Section 2.2 it was explained that the definition of performance is contextual and depends on the strategy of an organisation. Since the framework which is developed for this thesis will be used in different organisational contexts, each with different strategies, it is not possible to define good or bad performance. For example, if the strategy of a cellar requires the cellar to have an IDOS count of 50 days, it is incorrect to assume that a cellar with an IDOS count of 20 days is performing better. Another example is that a short lead-time cannot explicitly be defined as good performance, since it may often be better to have a few days longer lead-time with a make-to-order decoupling point compared to a make-to-stock one with a shorter lead-time. The purpose of the framework is therefore not to measure performance, but to propose a set of metrics which will enable managers to evaluate their supply chain's performance according to their definition of performance and thereby inform decision making by cellar management.

Ittner & Larcker (2003) conclude their study by stating that non-financial measures will offer little guidance unless the process for choosing and analysing them rely less on generic performance measurement frameworks and more on the factors actually influencing economic results. This raises the question whether the SCOR model, which is a generic performance measurement framework, will be able to facilitate effective performance measurement. The question can be answered by referring to the causal model designed by Lebas (1995) and discussed in Section 2.2.1. The model emphasises the need for measuring the cause of financial results, within the stem and roots of the metaphoric tree. Due to the scope and limitations of this study, measuring all the processes within the stem and areas within the roots is not possible. Therefore, the measurement focus is placed on the leaves, with certain processes within the stem being included. The framework is made less generic by adding certain demographics to enable a better fit to the packaged export wine supply chain. This enables the analysis of certain processes within the stem. For example, by adding the demographic of own versus outsourced labeling to the order fulfillment cycle time metric, the cellar can analyse the impact that this process (which is part of the stem) has on their lead time. This leads to a clearer understanding of the process of performance generation and can inform decision making as to whether an investment in a labeling machine would benefit their performance. However, since the emphasis is placed on the generic SCOR attributes, that fall within the leaves of the model, it is each cellar's responsibility to identify business-specific causes within the stem and roots, to define measurements for evaluating these causes and to then drive appropriate improvement initiatives.

To further clarify and add to the above discussion, reference can be made to strategy maps. A strategy map is a series of causal diagrams and consist of (Barber, 2008):

- *measurement* - the dimension of performance
- *target* - the actual level desired for each measurement
- *initiative* - a set of actions that are proposed to ensure the targets are met

It is proposed that cellars develop strategy maps to guide the execution of improvement initiatives. The framework developed for this thesis will aid the construction of strategy maps by proposing what should be measured. It is then each cellar's responsibility to develop the initiatives that will lead to supply chain improvement, ultimately resulting in the targets being met.

5.2 Developing the phase 2 framework

In Section 2.4 it was explained that the selection of a performance evaluation model depends on the level of supply chain maturity of a firm. The SCOR model was described as being appropriate mainly for firms that achieved level three to five maturity. As found by all three work streams, many South African wine cellars have not yet reached these levels, and therefore the SCOR model may not be applicable. However, considering that only a selection of SCOR metrics will be used in the framework, the SCOR model can be adapted to accommodate lower levels of maturity. The reason for doing this is to enable future scaling of the framework: as the cellars advance to higher maturity levels, the framework, being based on the SCOR model, can be expanded accordingly.

The phase 2 framework was developed by considering each of the five SCOR attributes. The attributes were each broken down into three categories, namely metrics, segments and demographics. In view of the trade-off discussed in Section 5.1, it was decided to collect all order data from freight forwarders. Freight forwarders generally also have much better software systems and capture more data than cellars. Other cellar-specific data was collected from each cellar through a survey using SurveyMonkey. The part of the survey that is applicable to the packaged export segment can be seen in Appendix B.

5.2.1 Responsiveness

The scope of the phase 1 framework for measuring responsiveness and reliability was defined as from when a customer places an order until delivery according to the FOB Incoterm. Seeing that the desired order data can be collected from freight forwarders, it was decided in meetings with three freight forwarding companies, Nell (2015), Van Lill (2015) and Franzen (2015), that the scope can be expanded downstream to the port of discharge (POD), since order data is already being captured up until that point in the supply chain. Freight forwarders do capture data as far down the supply chain as the importer's warehouse, but it was decided not to measure to this point. There are two reasons for this decision: firstly, measuring to the importer's warehouse would result in an unpractical amount of geographical segments, since the geographical location of the importer would have to be taken into account. Secondly, certain freight forwarders had confidentiality issues if measurements would have been taken to the importer's warehouse.

Metrics

Figure 5.1 illustrates how the order fulfillment cycle time metric was broken down into two sections, namely from the cellar to the Port of Cape Town, and from the Port of Cape Town to the POD. As stated above, in the phase 1 framework, order fulfillment cycle time was defined as the period of time from when an order is placed until the products are delivered according to the FOB Incoterm. This definition was sufficient for the phase 1 framework, since it was known that all the cellars within the packaged export segment only used the FOB Incoterm. For the phase 2 framework, the metric had to have a universal definition, regardless of the Incoterm used, since more cellars took part in the study and it was not known whether all of them only used the FOB Incoterm. Thus, the purpose of the "on board" term (refer to Figure 5.1) as the point to where cycle time is measured at the Port of Cape Town, was to replace the FOB term as used within the phase 1 framework. This created a generic definition for the cellar to port cycle time, regardless of the Incoterm used.

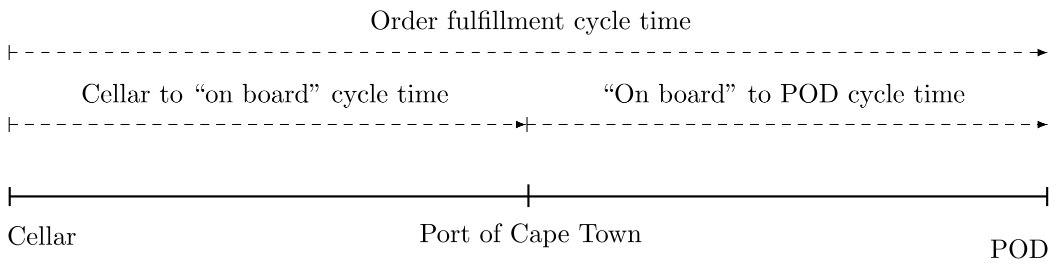


Figure 5.1: Breakdown of order fulfillment cycle time

The *On board to POD cycle time* metric was added as a cycle time metric, following the discussion at the beginning of this section. The length of this cycle time is mostly governed by the time it takes to transport the products by sea. Ocean freight times are more or less constant between two geographical areas and therefore the relevance of this metric is questionable. However, this metric was added for two reasons: the first reason is that, according to the research done in Chapter 2, the whole supply chain should be seen as one system and should be measured as such. Hence, even though the cellar has no influence on what happens during ocean freight, it is necessary for the cellar to have knowledge on how their supply chain partners are performing. The second reason is that, since cycle time would be measured to the POD, it becomes possible to easily compare South Africa's performance to that of competing countries such as Chile, Argentina and Australia, which is one of the ultimate goals of the overall supply chain project. This is another reason why measurements were only taken to the POD and not to the importer's warehouse: from the POD to the importer's warehouse all products, regardless of country, flow through the same supply chain, making measurements redundant.

The phase 1 framework measured the direct supply chain. It is important to note that, although the phase 2 framework measured further downstream, it still only measured the direct supply chain. In the phase 1 framework, FOB delivery was seen as the direct customer. This is however only a point in the supply chain between the cellar and the actual direct customer. The phase 2 framework measured to the POD, which is also only a point between the cellar and the actual direct customer, and therefore it also measured the direct supply chain.

It was mentioned in Chapter 4 that order fulfillment cycle time is a level 1 SCOR metric. The SCOR framework breaks this metric down into three level 2 metrics, namely source cycle time, make cycle time and deliver cycle time. The phase 1 framework only measured two of these metrics: deliver cycle time was measured if all the required products were in stock. Both make cycle time and deliver cycle time were measured if certain products had to be bottled, labeled or reworked before the order could be shipped. For the phase 2 framework, source cycle time was also taken into account, as this cycle time can sometimes be the longest of the three. With regard to measuring source cycle time, it is necessary to state which products' cycle times should be included, seeing that measuring all raw material purchases is unpractical. To determine which products to take into account, two product characteristics were considered: the typical source cycle time and the percentage that the product generally contributes to the cost of goods sold. Products with long source cycle times and/or which contributed a significant amount to the cost of goods sold were taken into account. These products are:

- Bottles
- Labels
- Corks (including screw caps)
- Capsules
- Boxes

The reason for including the percentage that the product generally contributes to the cost of goods sold, is that large quantities of these products are typically not kept in a raw material stock buffer for cash flow purposes. The result is that these products play a bigger role in source cycle time than, for example, bottle dividers, which can be kept in stock in large quantities due to its low cost (Roos, 2015a). Note that wine is excluded from the list of raw materials, which is explained in Section 5.2.5. Seeing that wine is excluded from raw materials, the items listed above can more appropriately be called dry goods. Hence, the source cycle time metric can be called *Dry goods cycle time*.

It was found through various discussions that managers could gauge the average cycle time of, for example, labels, but that they do not explicitly capture source cycle time. It was therefore decided to rather move the source cycle time metric, which is based on actual data, to the ideal framework and only to ask managers to approximate the source cycle time of each of the above mentioned dry goods for the phase 2 framework (refer to Question 14 in Figure B.2 of Appendix B).

In the wine industry, as within any industry, it sometimes happens that a customer places an order in advance. This is typically the case when a customer has a long term contract with a cellar. When the customer places an order in advance, the order fulfillment cycle time metric will portray the cellar's performance incorrectly, since the cellar will most likely not immediately start working on the order when it is placed. In view of this, it was decided that another metric should be included in the phase 2 framework, namely *Order fulfillment dwell time*. This is a level 3 SCOR metric (RS.3.94) and is defined by the SCC (2012) as:

> *Any lead time during the order fulfillment process where no activity takes place, which is imposed by customer requirements. Note that this dwell time is different from "idle time" or "non-value-add" lead time, which is caused by inefficiencies in the organisation's processes and therefore ultimately under responsibility of the organisation. This kind of idle time should not be deducted from order fulfillment cycle time.*

Therefore, to correctly calculate the order cycle fulfillment time, order fulfillment dwell time should be subtracted from the cycle time. However, as with all the other cycle time metrics, it was found that cellars do not measure order fulfillment dwell time. Therefore, this metric is also moved to the ideal framework. Seeing that this metric is important in portraying a cellar's cycle time, it was decided to include a compromised version of the metric in the phase 2 framework, namely that managers are only asked to estimate the percentage of orders for which there is normally dwell time (refer to Question 11 in Figure B.1 of Appendix B). Order fulfillment dwell time is then added to the phase 2 framework in the form of a demographic. This will, to a certain degree, facilitate fair comparisons in the sense that a cellar that has dwell time for 50% of its orders can compare itself with another cellar that has more or less the same percentage.

Segments

In the view of expanding the supply chain scope to the POD, another problem arose, namely that measurements are now being taken to various countries from around the world and not to a single geographical point, such as the Port of Cape Town in the phase 1 framework. This would result in the comparison of order cycle times from one order which had been sent to the UK and another which had been sent to China. To overcome this problem, the supply chain was segmented according to the geographic location of the POD.

Seeing that geographical segmentation is not necessary for the cellar to "on board" section of the supply chain, the *Cellar to on board cycle time* metric was not segmented according to the location of the POD. The segmentation only applies to the *On board to POD cycle time* metric. Since the *Order fulfillment cycle time* metric is the sum of these two metrics, it was also segmented according to the location of the POD.

Demographics

Each of the demographics for responsiveness will now be discussed.

1. *Location of the decoupling point*
   - Make-to-stock
     If products are made-to-stock, only delivery cycle time plays a role in order fulfillment cycle time. For the sake of this demographic, a product is classified as make-to-stock if no further work is required prior to shipment, with one exception: the addition of a sticker to each bottle indicating who the importer is.
   - Make-to-order with dry goods
     If products are made-to-order and all the required dry goods (bottles, labels, corks, etc.) are available in a dry goods stock buffer, both make and delivery cycle time plays a role in order fulfillment cycle time.
   - Make-to-order without dry goods
     If products are made-to-order and certain dry goods have to be sourced to finish the order, then source, make and delivery cycle time play a role in order fulfillment cycle time.

- Label-to-order
  It is a common practice in the wine industry to keep unlabeled wine in stock, which is then labeled-to-order. This is a postponement strategy which moves the decoupling point further down the production process. Source, make and delivery cycle time play a role in the order fulfillment process, however, the make cycle time excludes the bottling process. As with make-to-order, label-to-order should also specify whether there are dry goods (labels, capsules and boxes) in stock or whether certain of these materials had to be sourced.

2. *Order fulfillment dwell time*
   This demographic is included following the discussion in the beginning of this section.

3. *Consolidation*
   If an order is not sufficient in size to fill a container, the order has te be consolidated with other cellars' orders for the sake of filling the container. Even though the costs associated with a consolidated container is more than that of a full container, it is still less that that of shipping a container which is only half full. Consolidation will have an impact on order fulfillment cycle time, since the cycle time is dependent on more than one cellar. If one cellar is late with the order, the performance of all the others is negatively affected. Order consolidation also requires more product handling and transportation, since all the products have to be loaded at the cellar, transported to a consolidation warehouse, unloaded, reloaded into a container and shipped to the port in contrast to a full container being loaded at the cellar and shipped directly to the port.

4. *Incoterm*
   The Incoterm, which is chosen by the importer, governs the trade terms which are used. This includes terms such as who pays insurance while the products are transported on sea, whether customs costs are included in the quoted price, etc. Various Incoterms exist, the two extremes being Ex works (EXW) and Delivery duty paid (DDP). For EXW, the importer arranges loading at the cellar and is responsible for all the operations, costs and risks associated with transporting the products to the named place of destination. For DDP, the cellar delivers the products at the named place of destination and is responsible for all the operations, costs and risks associated with transporting the products to the named place of destination. The speed and efficiency with which either the cellar or importer completes the tasks, and factors such as the accuracy with which documents are

completed, may affect order fulfillment cycle time.

5. *Shipping line*
   Seeing that the shipping line is another player in the "on board" to POD section of the supply chain that can affect performance, the shipping line used for a specific order is also taken into account. This can give both the cellar and freight forwarder valuable insight into the performance of the various shipping lines.

6. *Own vs outsourced facilities*
   This demographic takes into account whether a cellar has its own packaging - (bottling, labeling, bag-in-box, etc.) and storage facilities or whether these facilities are outsourced. If, for example, bottling is outsourced, the cellar may have to wait for a period of time before the company to which bottling is outsourced has time available to do the bottling. This will impact order fulfillment cycle time. Mobile bottling and labeling, in which the bottling and labeling facilities are brought to the cellar, are also seen as outsourced facilities, since the cellar may also have to wait for the availability of these facilities.

7. *Own vs outsourced transportation*
   Following the same argument as above, when a cellar outsources transportation to the port or to the consolidation warehouse, the cellar may have to wait for the availability of transportation. This has a significant effect on cellars located far from the port or consolidation warehouse according to Nell (2015).

8. *Number of stock keeping units (SKUs)*
   The purpose of this demographic is to take the complexities associated with each cellar's production into account. Gunasekaran *et al.* (2004) state that organisations with a wide range of products are likely to perform less well in areas such as speed of delivery and reliability. It was decided to portray a cellar's supply chain complexity though the number of SKUs that the cellar has. Raw material SKUs (the five dry goods listed above plus wine) and finished goods SKUs are both included separately in the demographic. The reason for this is to take standardisation into account, i.e. the scenario where a small number of raw material SKUs are used to manufacture a large number of finished goods SKUs.

9. *Business size*
   Business size is measured in terms of the amount (litres) of packaged wine sold per year. The rationale for including this demographic is that a large cellar will typically have an employee whose main job role is to manage orders. The employee

will probably have a streamlined process for fulfilling the orders. This is in contrast to a small private wine cellar in which the winemaker also handles all the orders. Another way in which business size may affect the order fulfillment cycle time is through the influence it has on source cycle time. A large cellar may have more bargaining power when it comes to sourcing raw material than a small cellar, due to long term contracts and the amount of material purchased. This will lead to the supplier giving preference to the order of the larger cellar.

All nine demographics, except shipping line, are applicable to the *Cellar to on board cycle time* metric. The shipping line demographics is applicable to the *On board to POD cycle time* metric. The business size demographic is applicable to the *Source cycle time* metric.

The first five demographics are linked to individual orders. The next four demographics are based on the cellar as a whole. Since the five SCOR attributes are trade-offs of each other, it would be beneficial to compare the impact that a demographic has not only on a single attribute, but also on the combination of different attributes. For example, when filtering the results of order fulfillment cycle time according to the location of the decoupling point, the results of reliability are also filtered according to the location of the decoupling point. To be able to accomplish this, demographics should be kept as uniform as possible for all the attributes in which each demographic is applicable and data should be collected in such a way to enable this filtering.

A single order can consist of a combination of make-to-stock, make-to-order and label-to-order products. Therefore, the first demographic should be captured for each order line. If all order lines within an order are make-to-stock products, the entire order is classified as a make-to-stock order. If at least one order line is a make-to-order product, the entire order is classified as a make-to-order order. The reason for this is that the cycle time of the entire order will be governed by the make-to-order products and not the make-to-stock ones. The same can be said for order fulfillment dwell time: if all order lines have dwell time, the entire order is classified as a dwell time order. If the cellar has to start working immediately on at least one order line, the entire order is seen as an order without dwell time. The next three demographics (number 3 to 5 in the list above) should be collected per order. However, due to a lack of supply chain maturity and the limitations of certain freight forwarders' software systems, it was not always possible to collect the demographics per individual order, let alone order line.

Three of the nine demographics, namely consolidation, Incoterm and shipping line were captured for each individual order by the freight forwarders. However, due to the design of certain freight forwarders' systems, the required demographics could not be included in a single report. This meant that those freight forwarders had to refer to hard copies of each order to be able to gather the required data.

Data for the rest of the demographics was collected from each cellar, using Survey-Monkey. The following questions were asked to collect the data (refer to Appendix B for the detailed version of each question):

1. Please estimate the percentage of orders for which you had all the required products in a stock buffer.
2. What percentage of your stock buffer is labeled?
3. What percentage of your orders are normally placed in advance?
4. What percentage of bottling, labeling and storage do you outsource?
5. What percentage of transportation do you outsource?

It was found that neither freight forwarders, nor cellars capture whether an order consisted of make-to-stock or make-to-order products (the location of the decoupling point). Therefore, in the phase 2 framework, a more high level version of this demographic was included in the cellar survey by asking managers the first two questions in the list above. The first question gave an indication of the number of orders for which the cellar had a make-to-stock decoupling point. The second question gave an indication of the number of orders for which the cellar had a label-to-order decoupling point. It was decided not to distinguish between make-to-order with dry goods and make-to-order without dry goods orders in the phase 2 framework, simply to reduce complexity. The same applied for the label-to-order decoupling point. Data for the order fulfillment dwell time demographic was collected through question 3.

The own versus outsourced facilities demographic was collected through question 4. The own versus outsourced transportation demographic was collected through question 5. During two meetings with cellar managers (De Vries (2015); Roos (2015b)) in which the survey was discussed to test its applicability and level of practicality, it was found that neither manager understood the concept of SKUs, even though the survey supplied a definition. For this reason, together with a concern from Van Niekerk, P (2015) of Vinpro that the survey might be too long, it was decided not to measure this demographic in the phase 2 framework, but to include it in the ideal framework. Lastly, the business size demographic could be derived from the total amount of packaged litres of wine sold per year, which was already included in the survey (Question 18 of Figure B.3 of Appendix B).

5.2.2 Reliability

As mentioned in Chapter 4, the level 1 SCOR metric for reliability is perfect order fulfillment. This metric was also included in the phase 2 framework, but was divided into the four level 2 SCOR metrics to enable a more in-depth analysis of reliability issues. Each of the level 2 metrics are defined in Table 5.1.

Table 5.1: SCOR level 2 reliability metrics (SCC, 2012)

Level 2 metric	**Definition**
Percentage of orders delivered in full	Percentage of orders which all of the items are received by the customer in the quantities committed.
Delivery performance to customer commit date	The percentage of orders that are fulfilled on the customer's originally committed date.
Documentation accuracy	Percentage of orders with on time and accurate documentation supporting the order, including packing slips, bills of lading, invoices, etc.
Perfect condition	Percentage of orders delivered in an undamaged state that meet specification, have the correct configuration, are faultlessly installed (as applicable) and accepted by the customer.

The *Delivery performance to customer commit date* metric was divided into two metrics, namely *On time for requested shipping date (RSD)* and *On time for requested delivery date (RDD)*. RSD is the date the order should leave the Port of Cape Town and RDD is the date the order should be delivered at the importer. This enabled a more detailed anaysis of the metric. If all the level 2 metrics are satisfied, the level 1 metric is satisfied. Only level 2 metrics are measured and the results are aggregated to determine the level 1 metric. The data required for the level 2 metrics was collected from freight forwarders.

For the phase 2 framework, reliability metrics were not segmented. In terms of demographics, all the demographics associated with responsiveness can also affect reliability. Therefore, all nine demographics developed in the previous section were kept the same for reliability metrics. This also enables the filtering of both attributes according to the same demographic. The applicability of each demographic to each metric is shown in Table 5.2.

5.2.3 Agility

The main purpose of agility measurements, as stated in the definition of agility in Section 2.4, is to measure the ability of an organisation to react to external influences, such as market changes. The ability to effectively scale up or scale down production according to market changes is especially important in the export segments of the wine supply chain. The reason for this is that the supply and demand characteristics do not only depend on South African's supply and demand, but on global supply and demand. This is a major contributing factor to the demand fluctuations seen in Figure 1.5. For this reason, it is important for cellars within the packaged export segment to be agile and therefore agility metrics should be included in a supply chain measurement framework. The argument can however be made that no cellar selected agility to be superior in terms of strategy (refer to Table 4.2), with only one cellar selecting it to be advantage and therefore, according to the criteria listed in Section 2.2.4, agility should not be included in such a framework. Interestingly, in a survey conducted by PwC (2014), cellars selected *Global supply and demand* to be the most important factor influencing their strategy.

Chapter 2 described the view of Beamon (1999), in which at least one resource measure, one output measure and one flexibility measure should be included in a performance measurement system. It was also described how the five SCOR attributes can be assigned to each of these three performance measurement fields. The agility attribute is the only SCOR attribute that can be assigned to flexibility measures, and should therefore be included in a performance measurement system. Hence, according to cellars' strategies, agility should not be included, but according to Beamon (1999), it should be included. In the introduction of this chapter, the trade-off between the amount of data required from cellars and the number of responses received from cellars was discussed.

Taking this trade-off into account, it was decided not to include agility metrics in the phase 2 framework, but to include it in the ideal framework. The decision was supported by findings of a project conducted in work stream 3, namely that agility is very complex and will require a significant amount of data to be measured effectively.

5.2.4 Costs

Due to the difficulties experienced with the cost metrics in the phase 1 framework, it was decided not to include any cost metric in the phase 2 framework. According to the three categories of Beamon (1999), this is acceptable, on the condition that metrics associated with asset management are included to adhere to the requirement that resource measures should be included.

Another reason why cost metrics were not included in the phase 2 framework is due to the context of the phase 2 framework. For example, packaging cost could have been included in the phase 2 framework, but due to low levels of supply chain maturity, many cellars do not capture the packaging cost associated with each packaging run. Cost metrics are included in the ideal framework due to the importance of monitoring costs and the different context in which the ideal framework was developed.

5.2.5 Assets

Metrics

As explained in the results of the phase 1 framework, cellars had difficulty calculating IDOS per segment, since they were not always sure whether packaged wine will be sold locally or exported. To bypass this problem in the phase 2 framework, it was decided not to divide IDOS between packaged export and packaged local wines, but to measure IDOS for all packaged products.

Through an interview with Janse van Rensburg (2015b) from PWC, another issue with the calculation of IDOS emerged which had not been mentioned by any cellar manager. According to Janse van Rensburg (2015b), a clear definition of what should be included and excluded in cost of goods sold does not exist. The main issue is the value of wine: cellars value wine subjectively. Furthermore, some cellars intentionally value wine in stock differently to when the same wine is sold, for insurance purposes. Therefore, in order to calculate IDOS correctly and maintain fair comparisons, a generic cost of goods sold definition needed to be established and each cellar would have had to recalculate their cost of goods sold. This was not practical since it would have required too much time and effort for the cellars. A solution to these problems was to base the IDOS calculation on the volume of wine rather than on cost of goods sold and the monetary value of inventory (financial data). The following equation can be used to calculate IDOS based on volumes:

$$\frac{Average\ volume\ of\ finished\ goods\ inventory}{Volume\ of\ goods\ sold} \times 91 \tag{5.1}$$

From now on this metric is called *Finished goods IDOS*. In terms of data collection, monthly inventory levels were used to calculate the average volume of finished goods inventory per quarter (refer to Question 18 in Figure B.3 of Appendix B). This included all packaged wine in the stock buffer, both labeled and unlabeled. The volume of goods sold per quarter (all packaged wine) was also collected through the survey (refer to Question 19 in Figure B.3 of Appendix B).

During a meeting at one particular cellar a suggestion was made that IDOS should also be measured for raw material (Heckroodt, 2014b). The reason was that, due to the large number of SKUs of that cellar, they had to carry more raw material than other cellars, which can have a significant effect on cash flow. IDOS of raw material can inform decision making not only in terms of increasing or decreasing SKUs, but also in terms of changing decoupling points, standardising dry goods, etc. It was therefore decided to include this metric in the phase 2 framework. IDOS for raw material is a level 3 SCOR metric (AM.3.16), which is calculated as follows:

$$\frac{Value\ of\ raw\ materials}{Cost\ of\ goods\ sold} \times 365 \tag{5.2}$$

Due to the problems associated with cost of goods sold, as explained earlier, together with a lack of available data in terms of raw material inventory, Equation 5.2 was not included in the phase 2 framework. Instead the size of a cellar's raw material buffer was calculated in terms of its investment in the buffer using the following equation:

$$\frac{Average\ value\ of\ dry\ goods\ (R)}{Total\ amount\ of\ packaged\ litres\ sold\ per\ year} \tag{5.3}$$

Equation 5.3 will give an indication, in terms of Rand per litre, of the relative amount of raw material which a cellar has in stock. Due to the difficulties associated with the value of wine, and also taking the scope of the thesis into account, it was decided not to include a cellar's bulk wine buffer in this calculation. Also, cellars often do not know whether bulk wine will be sold as bulk or packaged wine, adding more difficulties to the calculation if bulk wine is included in the raw material buffer. Therefore, the raw material buffer was defined as the buffer of the materials listed in Section 5.2.1, namely bottles, labels, etc. (dry goods). Seeing that many cellars have bulk wine in stock as a result of their own harvests, the most significant value of this metric lies in aiding managers with decision making in terms of their dry goods buffer, which adds to the argument of excluding bulk wine from the raw material buffer. Since wine had been excluded, the metric was called *Dry goods buffer investment*. The average value of dry goods was calculated as the Rand value at any given time of each of the dry goods. Due to the lack of data, this value was based on an estimation by cellar managers (refer to Question 15 in Figure B.2 of Appendix B).

Segments

As explained in Chapter 4, due to the cyclic nature of the demand for wine during a year, cellars do not carry a fixed amount of stock. It is therefore necessary to segment finished goods IDOS according to demand variation, which is a type of market factor segmentation according to the list of four possible types of segmentation discussed in Section 2.6. To overcome this problem, the IDOS metric was segmented according to the time of the year to which the measurement is applicable. One way of doing this is to segment the metric into the twelve months of the year which will ensure fair and meaningful comparisons. However, to reduce the complexity of both the framework and the data collection, it was decided to segment IDOS into the four quarters of a year, which still portrays the cyclic nature of demand. This is why the metric in Equation 5.1 is multiplied by 91 days (one quarter).

In order to further reduce complexity, it was decided to only segment the IDOS of finished goods. Ideally, the *Dry goods buffer investment* metric should also be segmented per quarter. However, asking managers to estimate the average buffer values of each of the five dry goods according to the four quarters was deemed too complex. Hence, *Dry goods buffer investment* was not segmented per quarter in the phase 2 framework.

Demographics

If a cellar has a make-to-stock decoupling point, it will most likely have a higher finished goods IDOS count than a cellar with a make-to-order decoupling point. The opposite is true for dry goods: a make-to-order decoupling point will require more dry goods than a make-to-stock one. Hence, the location of the decoupling point demographic is applicable to the abovementioned metrics. Other demographics that can also have an effect on these metrics are order fulfillment dwell time and business size.

5.3 The phase 2 framework

The phase 2 framework is presented in Table 5.2. The framework is divided into four sections (metrics, segments, demographics and data collection) following the above discussions.

Table 5.2: Phase 2 framework

Att	Metric	Segment	Demographic	Data collection	Demographics legend
RS	1. Order fulfillment cycle time	Geographical	1-8	Calculation	1. Location of the decoupling point 2. Order fulfillment dwell time 3. Consolidation 4. Incoterm 5. Shipping line 6. Own vs. outsourced facilities 7. Own vs. outsourced transportation 8. Business size
	2. Cellar to on board cycle time		1-4,6-8	Cellar and FF	
	3. On board to POD cycle time	Geographical	5	FF	
	4. Source cycle time		8	Cellar	
RL	1. Perfect order fulfillment		1-8	Calculation	
	2. Order delivered in full			FF	
	3. On time for RSD		1-4,6-8		
	4. On time for RDD		1-8		
	5. Documentation accuracy		8		
	6. Perfect condition				
AM	1. Finished goods IDOS	Quarters	1,2,8	Cellar	
	2. Dry goods buffer investment				

The phase 2 results will now be analysed. As with the phase 1 framework, the analysis is done in two parts, i.e. measurement results and framework results. In contrast to the phase 1 framework, each metric is shown and discussed individually, due to a more in-depth analysis. Hence, for document layout purposes, both measurement results and framework results are analysed together. The demographics applicable to each metric are shown with the metric to illustrate how the demographics can be used to filter the data.

5.4 Results of the phase 2 framework

In order to collect quantitative data for the phase 2 framework, a survey was sent to 18 cellars using SurveyMonkey. As with the phase 1 framework, not all the cellars completed all the questions. Order data for export orders was received from freight forwarders for nine of these cellars, of which eight had at least one packaged export order. The following data was required from the freight forwarders:

Table 5.3: Data required from freight forwarders

Data field	**Purpose**
Cellar name	To distinguish between different cellars
Importer's purchase order number	To distinguish between different orders
FOB and importer's agent	Interpreting freight forwarders' performance
POD	To calculate *On board to POD cycle time*
Requested shipping date (RSD)	To calculate *On time at for RSD*
Actual shipping date	To calculate *On time at for RSD*
Requested delivery date (RDD)	To calculate *On time for RDD*
Actual delivery date	To calculate *On time for RDD*
Reliability issues	To calculate the remaining reliability metrics
Consolidation	For the *Consolidation* demographic
Incoterm	For the *Incoterm* demographic
Shipping line	For the *Shipping line* demographic
Volume	To determine sample representativeness

It was found that sometimes a customer uses a unique purchase order number for each order line within a single order. These entries had to be removed in order to calculate reliability and lead times correctly. Hence, these entries were removed by using

Microsoft Excel's "Remove duplicates" function. All orders with the same cellar, RSD, actual shipping date, RDD, actual delivery date, POD and shipping line were seen as the same order, and duplicates were removed.

5.4.1 Responsiveness

It was found that cellars do not always contact their freight forwarders immediately when a customer places an order. Consequently, freight forwarders do not know when a specific order had been placed. Therefore, the *Cellar to on board cycle time* metric could not be calculated from the freight forwarders' data alone. Each of the nine cellars from which order data had been received was asked whether or not they capture the date on which a customer places an order. From the eight responses received only three capture this date. One of the cellars that capture the date said that, due to confidentiality, they would not supply this data. Hence, only two of eight, or 25%, of cellars in the sample captured the date and were willing to supply the data. The decision was therefore made to exclude the *Cellar to on board cycle time* metric from the quantitative data analysis. This is why there is no data field in Table 5.3 which specifies when an order had been placed by the customer.

Freight forwarders do capture the dates when an order was shipped from the Port of Cape Town and when it arrived at the POD. Hence, the *On board to POD cycle time* metric could be calculated. The metric was calculated by subtracting the actual departure date from the actual arrival date. The results are shown in Figure 5.2. Seeing that all containers are treated the same, regardless of content, from loading onto the ship to unloading at the POD, it was decided that the *On board to POD cycle time* metric can include both bulk and packaged orders. This increased the sample size of the metric.

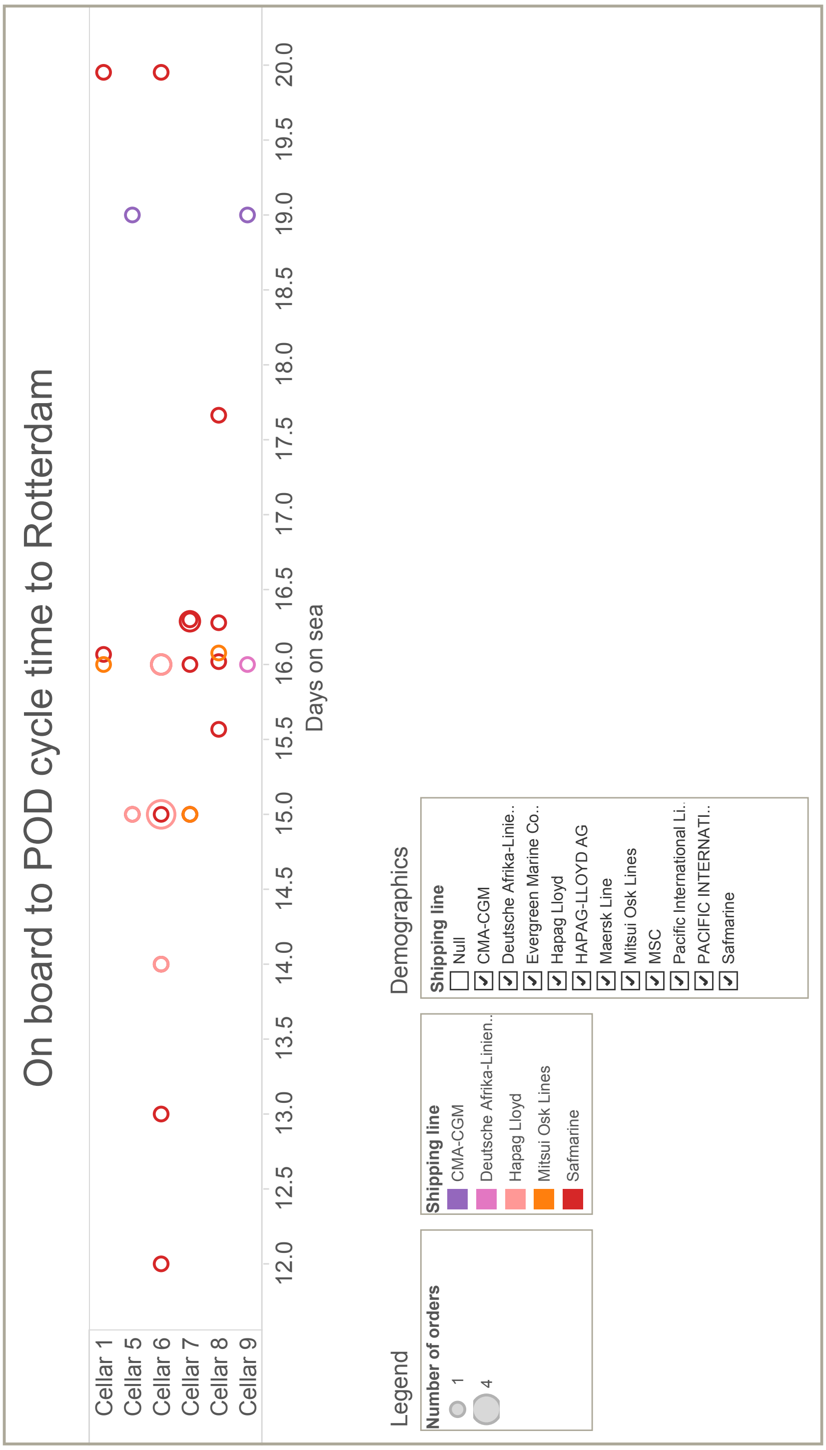


Figure 5.2: On board to POD cycle time

Figure 5.2 shows the on board to POD cycle time (ocean freight time) to Rotterdam for all applicable shipping lines. All shipping lines have an average ocean freight time of between 15 and 19 days. Furthermore, the figure shows that the Safmarine line has the most variation (standard deviation of about two days), compared to the others (standard deviation of about a half day). The variation in freight times may affect the reliability of delivery to the customer (importer). Hence, this data, both in terms of average and variation, can aid decision making by freight forwarders, who choose the shipping line.

It should be said that the sample consists of only 34 orders to Rotterdam. The sample of orders should be increased to determine whether there is truly a difference in the performance of the shipping lines, and to decide whether the difference is substantial enough to influence decision making. Data for other PODs is also not sufficient in this regard. However, some data hints that there may be value in this metric, such as one shipping line having a variation of 13 days to a single POD. Another example is the performance of two shipping lines to Montreal: Hapag Lloyd shipped two orders with an average of 37 days, and MSC eight orders with an average of 44 days. Through a discussion with the freight forwarder who supplied the data, it was found that MSC has a longer lead time due to transshipment on this route. Seeing that MSC takes longer to transport the goods, it is likely a cheaper option than Hapag Lloyd. The metric can thus also be used to analyse trade-offs such as lead times versus costs. As a result, this metric is included in the ideal framework. Another reason why this metric is included in the ideal framework, as discussed in Section 5.2, is that the metric enables the comparison of South Africa's performance to that of competing countries.

As explained in the development of the phase 2 framework, the source cycle time metric can be filtered according to the business size demographic. Figure 5.3 illustrates the sourcing time of all the cellars who completed the survey for packaged products, except one cellar that did not supply the necessary data for the calculation of its business size.

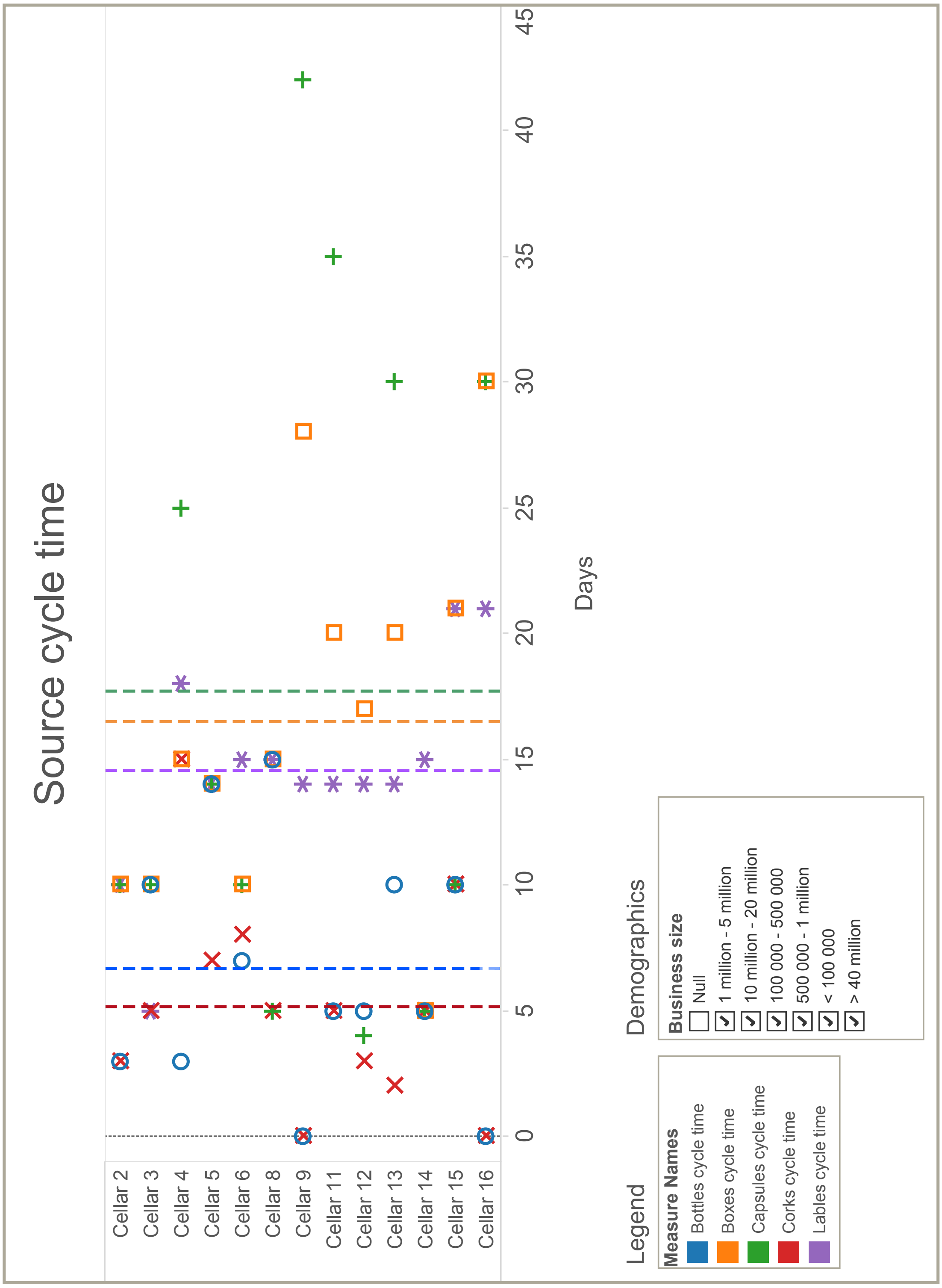


Figure 5.3: Source cycle time

Figure 5.3 shows that sourcing time of dry goods varies from 0 days to 42 days. The average sourcing time per type of material is shown using the reference lines. For outsourced packaging a sourcing time of 0 days can be possible for bottles and corks in the event that the cellar does not buy these materials, but that the price of the materials is included in the bottling cost. A bottling company will more often than not carry generic bottles and corks in a dry goods buffer, hence, in the view of the cellar, the sourcing time of those dry goods is 0 days.

Boxes and capsules seem to be the dry goods with the longest sourcing time. However, since boxes and capsules are relatively low cost materials, it can be kept in stock in large quantities to ensure the availability of these materials when needed. Through various meetings at cellars and from findings in works streams 1 and 3, it was determined that the sourcing time of labels often plays the most significant role in the order fulfillment process. The reason for this is that there are two variables which must be printed on a label, namely the batch number of the bottling process and the alcohol percentage of the wine. Even though the batch number can be determined in advance, the alcohol percentage can only be determined when the wine is bottle-ready. Consequently, cellars cannot carry labels in a dry goods buffer and therefore the two to three weeks it takes to source labels is often the bottleneck in the packaging process.

When filtering the data in terms of business size, it was found that a cellar's size, and therefore the number of labels it orders, has an effect on the sourcing time: cellars which sold more that 1 million litres in 2014 experienced an average label sourcing time of 12.4 days, while that of cellars which sold less than 1 million litres was 16 days. The difference in sourcing time of the other dry goods does not have the same significance in terms of business size.

The source cycle time metric can be useful to cellars in the sense that it enables them to evaluate the performance of their suppliers. For example, the cellar with a sourcing time for capsules of 42 days can see that the sourcing time of other cellars varies from 4 to 35 days, with an average of 15.7 days. The cellar can then use the data as bargaining power to require its supplier to reduce its sourcing time, or the cellar can simply use another supplier. The source cycle time metric is therefore included in the ideal framework.

5.4.2 Reliability

Freight forwarders were asked to supply their available reliability data, which would then be classified as one of the four metrics listed in Table 5.1. It was found that the only available reliability data is on time delivery according to the customer's request, namely on time for the RSD and on time for the RDD. The RSD and actual shipping dates could be used to calculate the *On time at for RSD* metric. Seeing that the RDD is the date requested for the products to be at the importer's warehouse and not at the POD, and seeing that freight forwarders only capture the arrival date at the POD and not the importer's warehouse, the *On time for RDD* metric could not be calculated. The average on time reliability of packaged exports per cellar for the RSD is shown in Figure 5.4. In total 121 packaged export orders were received from freight forwarders. Only 87 orders, or 72%, had a RSD associated with it and only 71 orders, or 59%, a RDD.

As stated above, the RDD and the date on which an order arrived at the POD were known. If an order arrived at the POD on say 15 January 2015, and the RDD is 5 January 2015, the order is already late when it arrived at the POD. Using this rationale, one is able to determine which orders were definitely late. It was determined that 31% of all packaged orders had already been late for the RDD on arrival at the POD.

Figure 5.4 shows that the on time reliability for the RSD is about 25% on average. This is much less than the results of the phase 1 measurement, namely 80%. Even though the measurements for the two frameworks were not taken for the same period, it is very unlikely that cellars' reliability would have decreased so significantly. The difference in sample size could not have affected the measurements to this extent, as the phase 1 measurement consisted of five cellars and the phase 2 measurement of eight cellars, with three cellars supplying data for both measurements. Hence, either data from the cellars, freight forwarders, or both are unreliable.

Examples of unreliable orders include an order which was 142 days late with regard to the RSD, but one day early with regard to the RDD; another order was 32 days early with regard to the RSD, but 22 days late with regard to the RDD. Seeing that the data received from the freight forwarders contains these noticeable errors, the accuracy of the entire dataset must be questioned.

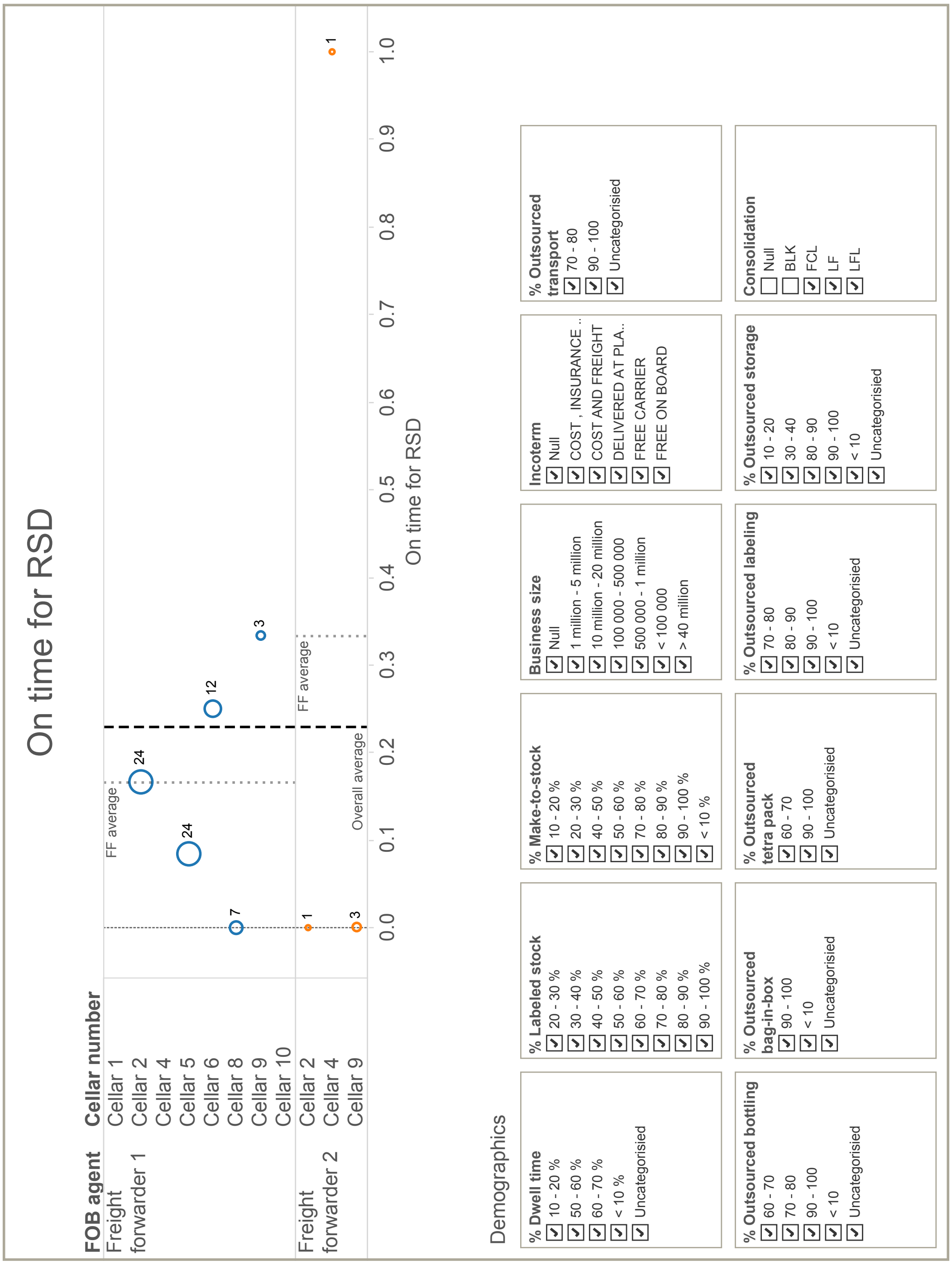


Figure 5.4: On time for RSD

There are a number of reasons why the data may be incorrect. Firstly, the customer may be the cause of a late delivery, as it was found that sometimes the customer has not yet made out a letter of credit, resulting in the cellar intentionally holding back an order. Another scenario is that when a container misses a ship by one day, it has to wait about seven days for the next ship. Other external factors which may affect reliability are, for example, strong winds which prevent containers to be loaded or unloaded. In a meeting with a freight forwarder it was found that sometimes the RDD is adjusted, but the RSD is not adjusted accordingly, which also explains some of the anomalies in the data.

In addition to incorrect data, the data can also be incorrectly interpreted. When interpreting the metric, one should realise that the section of the supply chain being measured does not only include the cellar: the performance of freight forwarders, outsourced facilities, outsourced transportation, etc. also influence reliability. Hence, even though the metric indicates the reliability of a cellar, one should keep in mind that the metric actually represents the reliability of a section of the supply chain and not just a single player in the supply chain.

Reliability is the second most important attribute in terms of strategy with regard to the packaged export segment. Therefore, even though the data needed to measure reliability metrics was not available, except for the *On time for RSD* metric, all the reliability metrics in the phase 2 framework (refer to Table 5.2) are included in the ideal framework. Freight forwarders will have to start capturing whether orders are delivered in full, with correct documentation and in the correct condition. In terms of the *On time for RDD* metric, freight forwarders will have to start capturing the date on which the products arrived at the importer's warehouse.

5.4.3 Asset Management

Figure 5.5 shows the cellars' investment in dry goods. The reason why cellars are not listed in numerical order is simply to prevent text from overlapping.

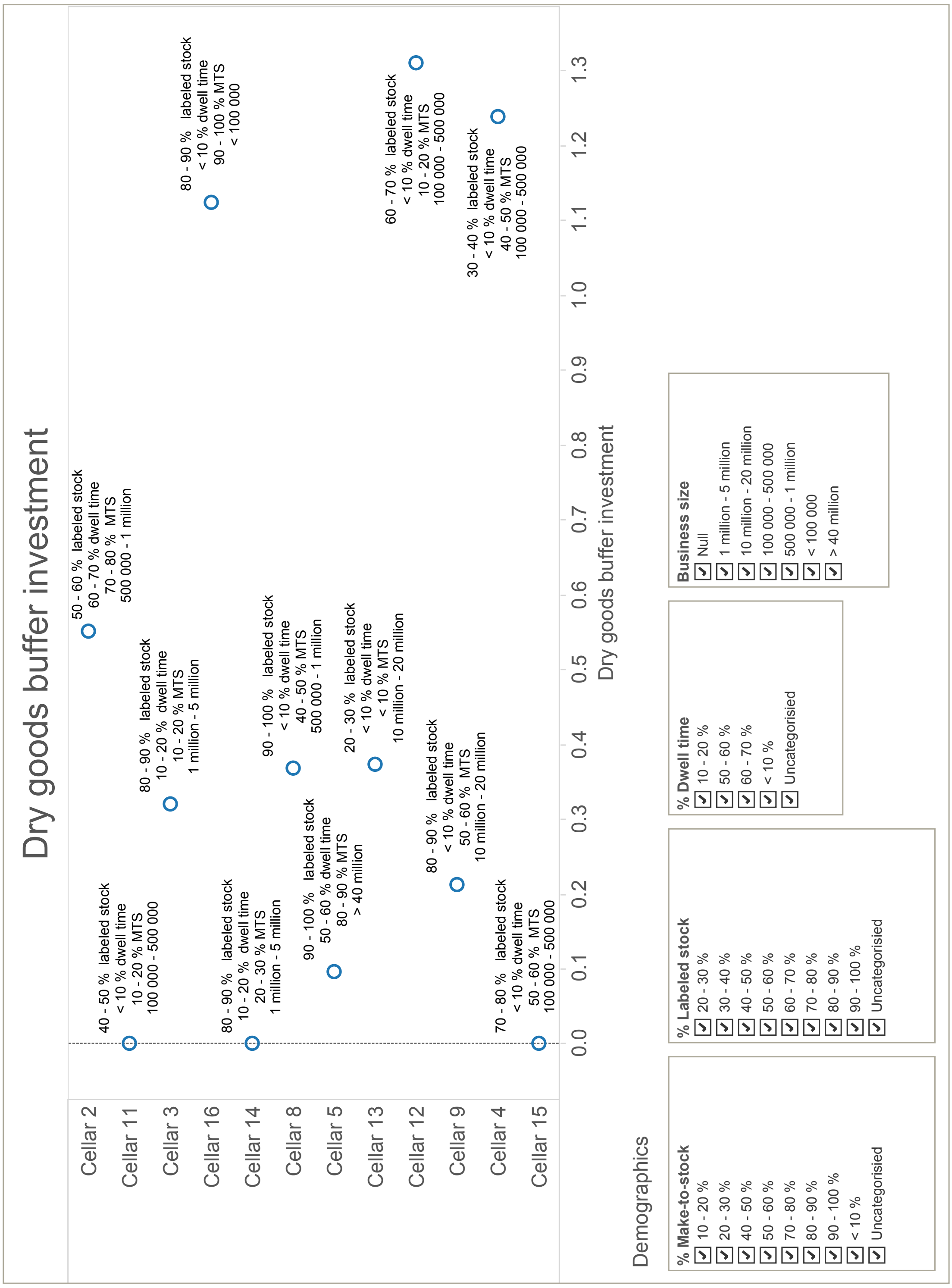


Figure 5.5: Dry goods buffer investment

Figure 5.5 shows the demographics associated with each measurement next to the measurement. This is done to show that there is no clear relationship between the amount of dry goods and a demographic when the demographic is seen in isolation. For example, there is no clear pattern which shows that cellars that have 80-90% make-to-stock products carry more or less dry goods than the others. In order to interpret the data in a meaningful way, all the demographics should be seen as a combination which represents the dry goods policy of a cellar. A larger sample may give better insight into patterns within this metric. As stated in Section 5.2, this metric is a compromise to the *Raw material IDOS* metric, which is included in the ideal framework.

Figure 5.6 shows the finished goods IDOS for each quarter of 2014 for ten cellars. As discussed in the development of the phase 2 framework, three demographics were used to filter the data. The first two filters represent the location of the decoupling point.

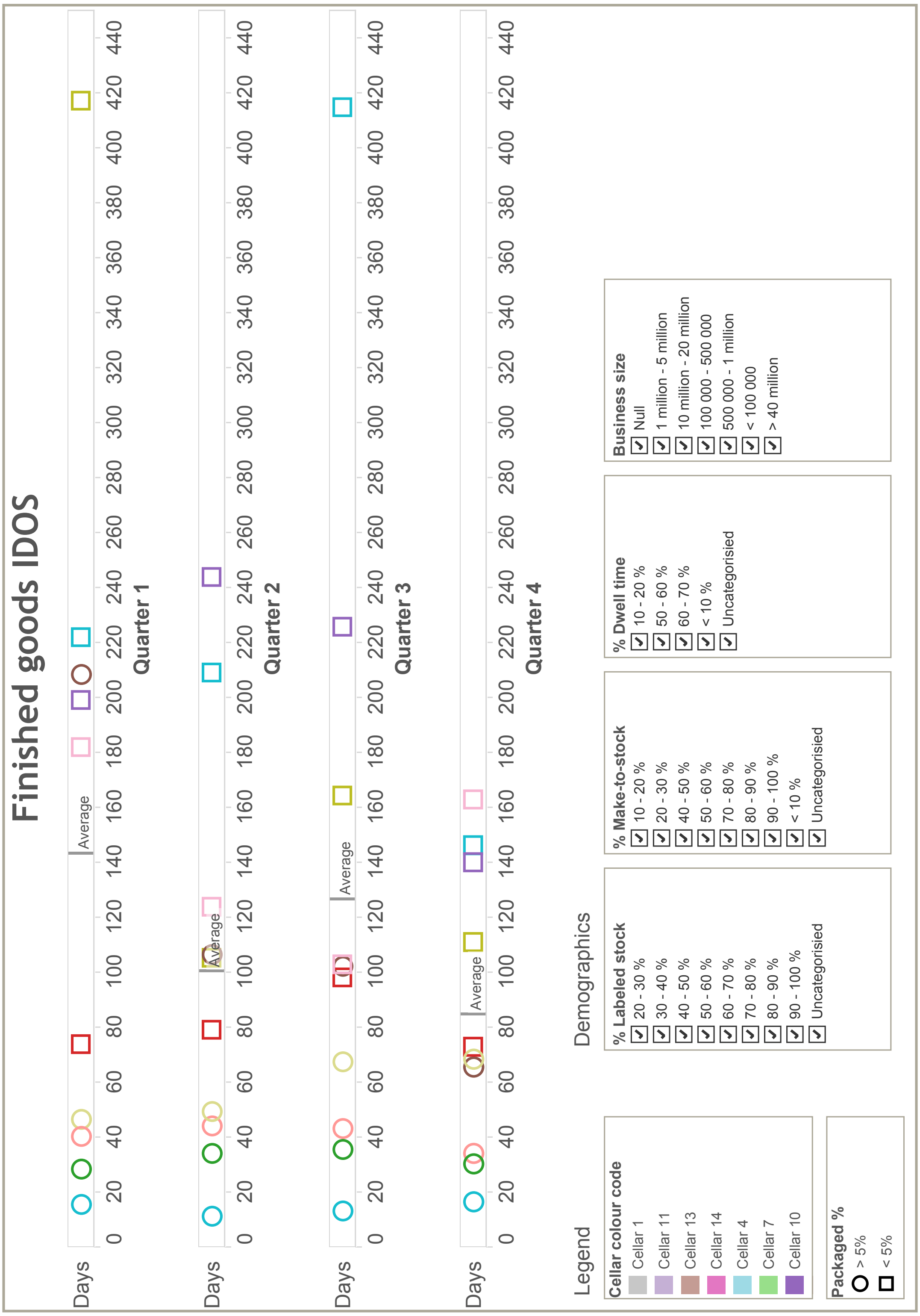


Figure 5.6: Finished goods IDOS

As can be seen in the legend of Figure 5.6, cellars which sell more than 5% (in terms of volume) of their wine as packaged wine are illustrated as circles, while cellars that sell less than 5% as packaged wine are illustrated as squares. The reason for illustrating the data in this way is that it was found that cellars that sell less than 5% as packaged wine (and which therefore focus on bulk sales) often only package wine two or three times a year, with certain SKUs even being packaged less often. In other words, these cellars knowingly package too much wine, but this will not have a significant impact on their cash flow due to the small amounts being packaged. This explains these cellars' larger IDOS, as can be seen in Figure 5.6: the average IDOS for all four quarters for cellars selling less than 5% packaged wine is 174 days, while that of cellars selling more than 5% is 53 days. The IDOS results were validated for three cellars, with managers at all three cellars stating that the results seem correct (this included one of the cellars with an IDOS count of about 400 days).

When filtering the data using the demographics, certain trends become visible, such as the average IDOS of cellars with more than 50% dwell time is 45 days, whereas that for cellars with less than 50% dwell time is 121 days. Another example is that the average IDOS of cellars that sold less than 1 million litres of packaged wine is 142 days, whereas those that sold more than 1 million litres is 29 days. Hence, as explained in Section 5.2, the addition of demographics makes the framework flexible to a certain degree which enables more meaningful comparisons.

5.5 Conclusions

Due to the shortfalls of freight forwarders' data, together with the findings of the phase 1 framework which are confirmed by the phase 2 framework, namely that cellars' data quality is not up to standard, it was decided not to create sample benchmarks for the phase 2 framework. Establishing benchmarks would result in a "garbage-in-garbage-out" situation. Rather, it is suggested that cellars and freight forwarders first start measuring the necessary metrics and improve the quality of those already being measured. This will enable much more straightforward benchmarking.

Unfortunately the volume representation of the phase 2 framework could not be determined, as freight forwarders do not capture the volumes of orders. Freight forwarders do capture the weight of orders, but it was not possible to convert weight into volume, as the weight of the packaging was unknown.

When analysing the phase 2 framework according to the CCP (context, content, processes) principle, which was discussed in Section 2.2.2, the phase 2 framework has various improvements compared to the phase 1 framework. Firstly, in terms of context, the phase 2 framework incorporated nine demographics, both in terms of the organisational context (for example the effect business size has on sourcing time) and the supply chain context (for example the effect dwell time has on finished goods IDOS). Secondly, in terms of content, the phase 2 framework consisted of more metrics, both in terms of the "width" and the "depth" of measurement. Thirdly, in terms of processes, data capturing was improved by gathering data from both cellars and freight forwarders. The development of the phase 2 framework also had much more input than that of the phase 1 framework. This included the findings of both the phase 1 framework and work stream 1, together with further interviews, work shops and literature reviews.

The survey included three medium-sized private cellars, two of which were not able to supply the volumes of finished goods they had in stock per month in 2014. Even though the sample of private cellars was very small, this confirms that the systems of private cellars are lacking compared to producer cellars, even though producer cellars' systems are also not up to standard.

Due to the lack of data availability within the industry, metrics and demographics had to be altered in such a way that the available data could be used in a meaningful way. One of the reasons for this is that the wine industry is at level 1 of the framework proposed by Holmberg (2000), which is discussed in Section 2.2.2. At level 1, organisations do not recognise the relationship between phenomena and the context in which they operate. Since this relationship is not recognised, the data which is necessary to portray the relationship is also not captured. The framework developed in the next chapter, namely the ideal framework, proposes a set of metrics which should be measured given that industry players capture the necessary data.

Table 5.4 is a summary of all the metrics in the phase 2 framework and whether or not the metrics are included in the ideal framework. Order fulfillment dwell time, which was estimated using a demographic in the phase 2 framework, is included as a metric in the ideal framework.

Table 5.4: Phase 2 metrics used in the ideal framework

Att	Phase 2 metric	Included in ideal framework
RS	Order fulfillment cycle time	✓
	Cellar to on board cycle time	✓
	On board to POD cycle time	✓
	Source cycle time	✓
RL	Perfect order fulfillment	✓
	Percentage of orders delivered in full	✓
	Order delivered on time for RSD	✓
	Order delivered on time for RDD	✓
	Documentation accuracy	✓
	Perfect condition	✓
AM	Finished goods IDOS	✓
	Dry goods buffer investment	

The only metric not included in the ideal framework is the *Dry goods buffer investment* metric, which is replaced by *Raw material IDOS*. According to the quantitative analysis, all the metrics show potential to aid decision making, even though many cellars in the sample had predominantly a bulk focus. The value of the quantitative information is expected to increase even further in terms of decision support if the sample becomes more representative of packaged wine. For a number of these metrics, the way in which the metric was calculated is different for the ideal framework, as discussed in Section 5.2.

CHAPTER 6

Ideal measurement framework for the packaged export supply chain

Contents

This chapter outlines the development of an ideal supply chain measurement framework for the packaged export segment. As explained in Chapter 3, the framework is ideal based on the process followed and inputs received. Results of the phase 1 and phase 2 frameworks, together with findings through various interviews and workshops, are used as inputs to the development. The framework should be adjusted and updated as the industry progresses and new information becomes available.

6.1 Context of the ideal framework

Even though the framework developed in this chapter is called the *ideal* framework, it is important to keep in mind that the framework should still be as practical and realistic as possible. For example, it will be pointless to suggest that cycle times should be measured to the end customer. Hence, there exists a delicate balance between what is really ideal and what is possible, given the context of the South African wine industry. The framework developed in this chapter strives to achieve the optimum balance.

6.2 The ideal framework

The ideal framework is shown in Table 6.1. The framework consist of 21 metrics, two segments and twelve demographics. Table 6.1 also specifies who is responsible for capturing the data required for each metric. The development of the ideal framework is discussed in Section 6.3.

Table 6.1: Ideal framework

Att	Metric	Segment	Demographic	Data collection	Demographics legend
RS	1. Order fulfillment cycle time	Geographical	1-11	Calculation	1. Location of the decoupling point 2. Consolidation 3. Incoterm 4. Shipping line 5. Own vs. outsourced facilities 6. Own vs. outsourced transportation 7. Business size 8. Number of SKUs 9. Protein and cold stabilisation 10. Branded vs unbranded dry goods 11. Information sharing 12. Packaging type
	2. Cellar to on board cycle time		1-3,5-11	Cellar and FF	
	3. On board to POD cycle time	Geographical	4	FF	
	4. Order fulfillment dwell time		7,11	Cellar	
	5. Source cycle time		7,10	Cellar	
RL	1. Perfect order fulfillment		1-11	Calculation	
	2. Order delivered in full			FF	
	3. On time for RSD		1-3,5-11		
	4. On time for RDD		1-11		
	5. Documentation accuracy		7		
	6. Perfect condition				
	7. Forecast accuracy		7,11	Cellar	
AG	1. Custom-made metric			Cellar	
CO	1. Bottling and packaging		7,8,12	Cellar	
	2. Permanent labour		5		
	3. Temporary labour				
AM	1. Cash-to-cash cycle time	Months	1,7,8,11	Calculation	
	2. Finished goods IDOS			Cellar	
	3. Dry goods IDOS				
	4. Days sales outstanding		7	Cellar	
	5. Days payable outstanding				

6.3 Developing the ideal framework

This framework was developed following the same methodology as the phase 2 framework. Metrics, segments and demographics are discussed per attribute of the SCOR model. Suggestions are also made regarding the most appropriate approaches for collecting data.

6.3.1 Responsiveness

In terms of the supply chain scope of measurements, it was decided not to expand the scope to the importer's warehouse, for the same reasons as those explained in Chapter 5.

Metrics

Seeing that the supply chain scope for measurements had not been expanded, the three cycle time metrics, namely *Cellar to on board cycle time*, *On board to POD cycle time* and *Order fulfillment cycle time*, were kept the same in the ideal framework. The source cycle time metric was however changed in terms of the data collection: rather than relying on the estimation of cellar managers, source cycle time should be captured for every purchase of the five types of dry goods listed in Chapter 5.

In order to determine the actual cycle time of an order, the ideal framework measures order fulfillment dwell time per order, according to the definition supplied by the SCOR framework, which can be seen in Section 5.2.1. This dwell time should then be subtracted from the order fulfillment cycle time to determine the actual order fulfillment cycle time.

With regard to the data collection for the responsiveness metrics, cellars and freight forwarders will have to implement a standard procedure in which the dates listed below are captured. These dates, together with the dates already being captured, will enable the calculation of the responsiveness metrics.

1. It is cellars' responsibility to capture the date when an order was placed by the customer: necessary for calculating order fulfillment cycle time.
2. It is cellars' responsibility to capture the date when the cellar started working on the order (including plan and source activities): necessary for calculating order fulfillment dwell time.
3. It is cellars' responsibility to capture the dates when dry goods were ordered and delivered: necessary for calculating source cycle time.

4. It is freight forwarders' responsibility to capture the date when an order arrived at the importer's warehouse: necessary for calculating on time delivery for the RDD.

Segments
As in the phase 2 framework, *Order fulfillment cycle time* and *On board to POD cycle time* was segmented according to the geographical location of the POD. The rest of the metrics were not segmented.

Demographics
In contrast to the phase 2 framework, where the decoupling point demographic was measured for the cellar as a whole, the location of the decoupling point needs to be measured per order line for the ideal framework. This will enable a much more detailed insight into the cycle time of an order. For the ideal framework the decoupling point demographic was further altered, namely that it takes into account whether there had been dry goods in stock for both make-to-order and label-to-order orders, or whether dry goods first had to be sourced (refer to demographic 1 in Section 5.2.1). By adding these two functionalities to the decoupling point demographic, one is able to determine whether an order only had delivery cycle time (make-to-stock), make and delivery cycle time (make-to-order, including label-to-order, with dry goods) or source, make and delivery cycle time (make-to-order, including label-to-order, without dry goods).

The number of SKUs demographic, which had not been included in the phase 2 framework, was included in the ideal framework, since the complexity of a supply chain plays a significant role in all five SCOR attributes. It was assumed for the ideal framework that cellar managers understand the concept of a SKU.

Through further research it was found that not all wines are made bottle-ready by following the same process. Certain wines undergo protein stabilisation and cold stabilisation, after which it needs to be filtered; others are only filtered and others are already bottle-ready. Protein stabilisation and cold stabilisation together takes about seven days, and filtering one day (Roos, 2015c). Seeing that seven days have a significant impact on lead time, it was decided to include a demographic which specifies whether wine underwent protein and cold stabilisation. Filtering is not taken into account, since a single day's effect on lead time does not justify a new demographic at this stage.

A problem with the source cycle time metric was that the cycle time differs significantly for branded and unbranded dry goods. For example, at one cellar it was found that the cycle time for unbranded corks is about three days, whereas for branded corks it is about three weeks. Consequently, for the ideal framework, a demographic was added to the source cycle time metric, specifying whether the sourced material was branded or unbranded. This is a type of source factor segmentation, which is one of the four possible types of segmentation discussed in Section 2.6. This applies to bottles, corks and capsules. Labels are always branded and it is assumed that boxes are also always branded.

In certain cases it was found that the player in the supply chain after the cellar has information which can benefit the cellar in planning production activities. This information is however not shared with the cellar. In Section 2.2 the need for effective information sharing was discussed. Barber (2008) lists key information areas which should be shared, namely inventory levels, demand forecasts and real-time sales activity. Consequently, it was decided to add a demographic to the ideal framework in which managers are asked whether these types of information are being shared or not. The purpose of the demographic is simply to make managers aware of the possibility of sharing information, which will decrease adverse factors such as the bullwhip effect. The data for this demographic can be collected using the following table:

Table 6.2: Data collection for information sharing demographic

Information type	% Information sharing
Inventory levels	
Demand forecast	
Real-time sales activity	

It is probably the case that information is not shared between a cellar and all of its customers. Therefore, managers are asked to supply the percentage of times in which information is being shared. This percentage is based on volumes sold per year. For example, if information sharing is relevant to 2000 litres sold, and the cellar's total sales were 10 000 litres, the percentage of information sharing will be 20%. This should be calculated only for packaged wines. The rest of the demographics in the phase 2 framework were kept the same for the ideal framework. The demographics applicable to each metric are illustrated in Table 6.1.

6.3.2 Reliability

The metrics for reliability were kept the same as those of the phase 2 framework, i.e. the level 1 and level 2 SCOR metrics. However, to adhere to the need stated by Barber (2008), namely that a performance measurement system should measure predictive powers, the level 3 SCOR metric *Forecast Accuracy* (RL.3.37) was added to the ideal framework. This metric is calculated as follows (SCC, 2012):

$$\frac{Sum\ actuals\ -\ Sum\ of\ variance}{Sum\ actuals} \tag{6.1}$$

"Sum actuals" is the sum of actual sales data, and "Sum of variance" is the difference between the sum of actual sales data and the sum of forecasted sales data. Findings from both qualitative and quantitative data suggest that it is not necessary to segment reliability metrics. The demographics for reliability are the same as those for responsiveness, as discussed in the previous section. The demographics applicable to each metric is illustrated in Table 6.1.

6.3.3 Agility

The agility metric *Upside supply chain flexibility* was included in the phase 1 framework. As explained in the findings of Chapter 4, the shortfall of this metric is that it is a subjective metric. Through further research, it was found that all SCOR agility metrics have the same drawback. Other models proposed in the literature were also evaluated, such as the framework developed by Koste & Malhotra (1999), but it was found that many of these models were either too complex and extensive to include as part of the framework, or that the models had little relevance to the wine industry, let alone the packaged export segment. Hence, it was decided to develop an agility metric which is objective, not overly complex and relevant to the packaged export segment.

As with any metric, the developed metric should aid management with decision making. It was therefore decided to develop a metric which will evaluate whether a cellar is agile or not given the design of its internal processes (thus processes over which management has control and responsibility for decision making) and the level of the cellar's demand variability. Seeing that the focus is on the packaged export segment, it was assumed that cellars view short lead times as important. The proposed metric is shown in Figure 6.1, after which its development is discussed.

		Low demand variability				
		Location of decoupling point				
		Make-to-stock		Label-to-order		Make-to-order
	Utilisation	Low IDOS	High IDOS	Low IDOS	High IDOS	
Botting	Low	Work on continuous replenishment basis. Small batch sizes. High margin wines (cost of packaging not significant).	High IDOS, together with low utilisation, hence high demand buffering, but unnecessary for low demand variability.	Work on continuous replenishment basis. Small batch sizes. High margin wines (cost of packaging not significant).	High IDOS, together with low utilisation, hence high demand buffering, but unnecessary for low demand variability.	Demand buffering is extra capacity (no inventory), thus require low utilisation.
	High	Reorder point / batch runs bigger. Cost of packaging more significant.	Low demand variability with High IDOS. Will "always" have stock. Thus high utilisation rates before decoupling point.	Reorder point / batch runs bigger. Cost of packaging more significant.	Low demand variability with High IDOS. Will "always" have stock. Thus high utilisation rates before decoupling point.	Need low utilisation after decoupling point (make-to-order environment).
Labeling	Low	Work on continuous replenishment basis. Small batch sizes. High margin wines (cost of packaging not significant).	High IDOS, together with low utilisation, hence high demand buffering, but unnecessary for low demand variability.	Labeling after decoupling point. Thus make-to-order environment and utilisation should be low to medium.	Labeling after decoupling point. Thus make-to-order environment and utilisation should be low to medium.	Demand buffering is extra capacity (no inventory), thus require low utilisation.
	High	Reorder point / batch runs bigger. Cost of packaging more significant.	Low demand variability with High IDOS. Will "always" have stock. Thus high utilisation rates before decoupling point.	Need low utilisation after decoupling point (make-to-order environment).	Need low utilisation after decoupling point (make-to-order environment).	Need low utilisation after decoupling point (make-to-order environment).
Storage	Low	Low demand variability, therefore stock buffer will stay more or less constant and extra storage capacity not needed.	Low demand variability, therefore stock buffer will stay more or less constant and extra storage capacity not needed.	Low demand variability, therefore stock buffer will stay more or less constant and extra storage capacity not needed.	Low demand variability, therefore stock buffer will stay more or less constant and extra storage capacity not needed.	
	High	Storage is seen as part of manufacturing process with decoupling point just after storage. Thus require high utilisation.	Storage is seen as part of manufacturing process with decoupling point just after storage. Thus require high utilisation.	Storage is seen as part of manufacturing process with decoupling point just after storage. Thus require high utilisation.	Storage is seen as part of manufacturing process with decoupling point just after storage. Thus require high utilisation.	

Figure 6.1: Agility metric for low demand variability

According to Perez (2013), the most important aspects of a business's internal processes are asset utilisation and the location of the decoupling point. As stated in Section 2.1.2, there exist a high degree of interdependence between these two factors, which in turn govern other factors, such as push versus pull methodologies, batch sizes, etc. (refer to Figure 2.2). Knowing the location of a cellar's decoupling point and whether the cellar has high or low asset utilisation, one is able to evaluate the effectiveness of the cellar's internal processes. For example, if the cellar has a make-to-stock decoupling point it should have a push system for its packaging process. If the utilisation of bottling and labeling is low, the cellar is wasting extra capacity on these processes and a proposal can be made to management to, for example, consider offering packaging services to other cellars. By dividing the packaging process into three sub-processes, namely bottling, labeling and storage, and by classifying the location of the decoupling point as either make-to-stock, label-to-order or make-to-order, a three by three matrix can be constructed.

The abovementioned argument can be taken further by specifying whether a cellar has a high or low demand variability: by analysing the connection between a cellar's internal processes and demand variability, and realising that a cellar can buffer demand uncertainty by either carrying stock or having extra packaging capacity (low asset utilisation), one is able to evaluate whether a cellar is effective both in terms of its internal processes and level of demand buffering. For example, if a cellar experiences high demand variability and has a make-to-stock decoupling point, the cellar can buffer demand by either carrying large quantities of stock or by having extra packaging capacity, so that it is possible to make-to-order when needed. This adds more rows and columns to the three by three matrix: each of the packaging processes is classified as having either high or low utilisation and both the make-to-stock and label-to-order decoupling points are classified as having high or low IDOS.

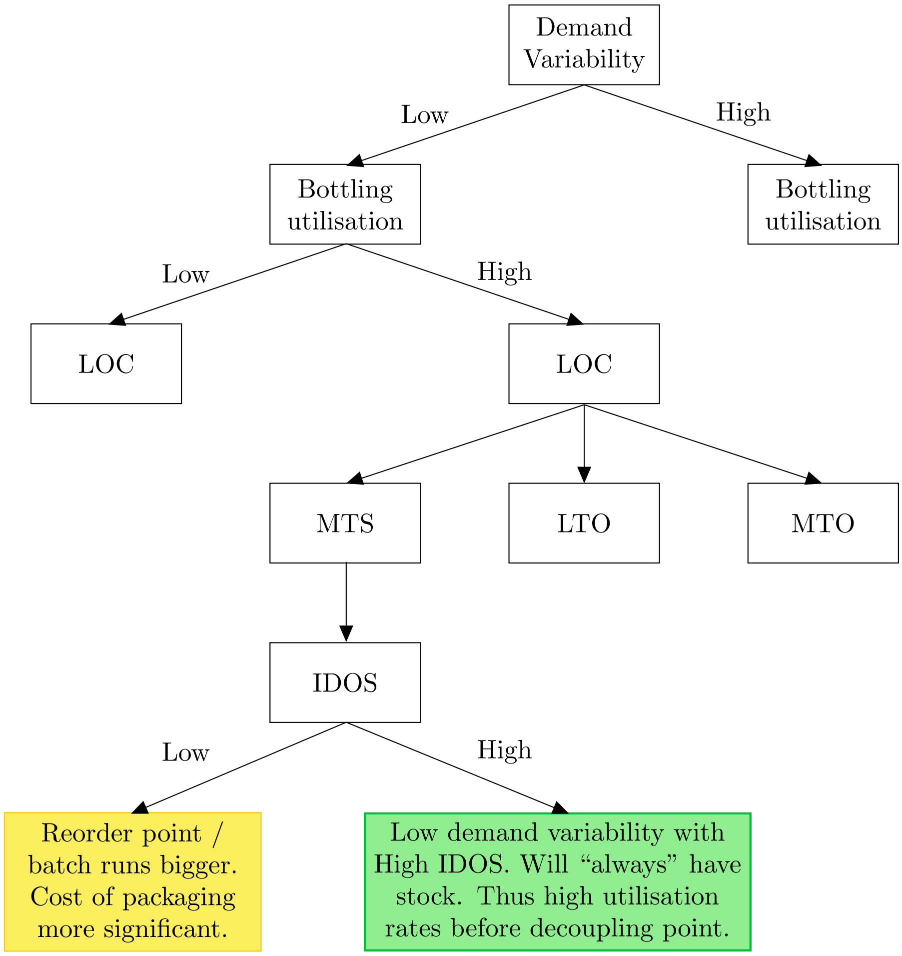
Following this argument, demand can also be buffered by implementing a combination of buffer stock and extra capacity: a cellar can carry small quantities of stock and work on a continuous replenishment basis with small batch sizes, which requires low asset utilisation. Therefore, in my own view, it is not always ideal to have high utilisation before the decoupling point, as proposed by Perez (2013): if a cellar produces premium wine, which cannot be kept in stock in large quantities for cash flow purposes, and the cellar prioritises short lead times, a suitable inventory policy is to carry small quantities in stock (make-to-stock) and to use small batch sizes to replenish the buffer. This way the cellar can have short lead times, since it has products in stock, whilst maintaining cash flow. Through these arguments, each of the possible scenarios in the matrix can be classified as either good (green), bad (red) or neutral (yellow). A neutral scenario can be either good or bad, depending on its context.

The metric will give an indication of whether the cellar is potentially agile or not. Furthermore, it will aid managers with arguably the main issue found by all three work streams: inventory management. The metric is constructed separately for low and high demand variability. The metric for low demand variability is shown in Figure 6.1, while the one for high demand variability is shown in Appendix C.

Showing Figure 6.1 to a cellar manager, who often does not have a background in supply chain management, may be unpractical due to the complexity of the metric. Therefore, it was decided to make the metric more user-friendly by presenting it in the form of a decision tree: managers are asked certain questions, the answers of which are used to determine the cellar's position in Figure 6.1 and the manager only receives a "good", "bad", or "neutral" answer, along with the description of the position. The following questions are asked:

- On cellar level
  - What is the utilisation percentage of your bottling line?
  - What is the utilisation percentage of your labeling line?
  - What is the utilisation percentage of your storage facility?
- On SKU level
  - Do you make-to-stock, label-to-order, or make-to-order?
  - Please supply the monthly stock and sales data for the SKUs which you want to measure.

The monthly stock and sales data are used to calculate the IDOS of the SKU. The monthly sales data is used to determine the coefficient of variance of the SKU, from which its demand variability can be derived. The IDOS and demand variability, together with each cellar's utilisation, are then classified as high or low relative to the other cellars in the sample. SKUs with the same demand variability, level of IDOS and location of decoupling point can be grouped together. Figure 6.2 illustrates one branch of the decision tree.



Note: LOC = Location of decoupling point

Figure 6.2: A branch in the agility decision tree

The branch in Figure 6.2 is specifically for the bottling process. Both labeling and storage should be constructed similarly. The figure shows how the list of questions on the previous page is used to determine a cellar's position from the 56 possibilities in the agility metric.

The metric can be expanded by, for example, including a medium option for utilisation and IDOS. Possible criticism of the metric is that it does not take aspects such as market mediation costs into account, which can have an effect on a cellar's internal processes. For example, if a cellar experiences severe penalties when stock-outs occur, the decision can be made to buffer demand both by carrying large quantities of stock and having low asset utilisation, even if demand variability is low. Hence, there are exceptions in which, for example, a red scenario can be good. However, due to the decision support that the metric offers, specifically in terms of inventory management, it was decided to include the metric in the ideal framework.

6.3.4 Costs

Metrics

Even though costs are generally not a differentiating factor in the packaged export segment, cost metrics were included in the ideal framework. The reason is that, as cellars improve their performance in the other attributes, costs may rise to unacceptable levels. For example, to reduce raw material IDOS, a cellar may decide to rather order smaller quantities of labels on a more frequent basis. This will increase the cost per label. Packaging cost should therefore be monitored to ensure it remains within an acceptable level.

In the 2014 version of PWC's annual wine insights survey the following findings, refer to Table 6.3 below, are presented regarding costs of packaged wine. In order to determine which of these costs should be included in the ideal framework for monitoring, two criteria were used: (1) the cost had to be significant in terms of the percentage it contributes to total cost and (2) the cost had to have the potential to increase as performance in other attributes improve.

Table 6.3: Costs attributable to packaged wine in 2013 (PwC, 2014)

Cost	Rand per litre	Percentage of total
Permanent labour	1.04	7.6
Temporary labour	0.02	0.1
Insurance	0.05	0.4
Marketing and sales	2.64	19.2
Bottling and packaging	7.40	53.9
Chemicals, cleaning and filtration	0.10	0.7
Distribution	0.78	5.7
Sundry administrative expenses	0.79	5.7
Sundry cellar expenses	0.38	2.8
Electricity and water	0.06	0.4
Finance charges	0.11	0.8
Rent payed	0.05	0.4
Repairs, maintenance and cellar consumables	0.14	1.0
Telephone and postage	0.03	0.2
Depreciation	0.15	1.1
Total	13.74	1.0

Table 6.3 shows that bottling and packaging is by far the biggest expense for packaged wines, with 53.9% of total costs being attributable to this expense. Furthermore, PWC's survey also shows that bottling and packaging cost had increased with an average of 16% per year since 2009. As explained above, this cost also has the potential to increase as performance in other attributes improve. Hence, it was decided to include bottling and packaging cost as a metric in the ideal framework. According to Janse van Rensburg (2015a) from PWC, bottling and packaging cost is simply the cost of dry goods used in the packaging process, which are mainly bottles, labels, corks, capsules and boxes. The second biggest cost is marketing and sales at 19.2%. Seeing that marketing and sales cost is not seen as a supply chain cost, and the purpose of this thesis is to measure supply chain performance, this expense was not included in the ideal framework.

Other costs which are both significant according to Table 6.3 and which can potentially increase as performance in other attributes improve, are permanent labour cost and distribution cost. Permanent labour cost had increased with an average of 12% per year since 2009. Furthermore, the PWC survey indicates that managers regard increasing labour cost as the most significant risk to their business. Consequently, permanent labour cost was included in the ideal framework. One way to decrease lead times is to make use of temporary labour when the workload becomes high. Hence, even though temporary labour cost is not significant according to Table 6.3, it was decided to include temporary labour costs in the ideal framework, given its potential to increase and the level of risk associated with labour costs. Including labour costs in the ideal framework also adheres to the criteria proposed by Thakkar *et al.* (2009), namely that the effective monitoring of human resources is paramount, especially for SMEs.

Seeing that PWC did not distinguish between local and export wines, it cannot be assumed that the 5.7% distribution cost is relevant to export wines. According to the phase 1 measurement results, which can be seen in Appendix A.1, the average distribution cost for local wines is R1.43 per litre, whereas export wines is only R0.54 per litre. Therefore, it was decided not to include distribution cost in the ideal framework. All three cost metrics (bottling and packaging, permanent labour and temporary labour) should be measured in the same way as in PWC's survey. According to PWC's definition of these metrics, no segments are required.

Demographics

Three demographics were added to the *Bottling and packaging cost* metric: firstly, as with the *Dry goods buffer investment* metric in the phase 2 framework, the size of a cellar can play a role in its bottling and packaging cost due to possible economies of scale. Secondly, the *Number of SKUs* demographic was added to the metric as it may also have an effect on economies of scale. Thirdly, the type of packaging was taken into account by adding a *Packaging type* demographic, as the packaging costs may differ significantly for according to packaging type. Packaging is classified as either glass, bag-in-box, tetra pack or plastic.

Only one demographic was added to the *Permanent labour cost* and *Temporary labour cost* metrics, namely the *Own vs outsourced facilities* demographic. The reason being that a cellar which does not have these facilities also does not require the labour associated with it.

6.3.5 Assets

Metrics

Due to the difficulties associated with the calculation of cost of goods sold, as explained in Chapter 5, finished goods IDOS should be calculated in the same way as in the phase 2 framework. As with the phase 2 framework, the ideal framework also includes a metric to measure the size of a cellar's raw material buffer. Equation 5.2 is used in this regard, but, as in the phase 2 framework, wine is excluded from the metric, as a generic definition on how to value wine is not practical, even for the ideal framework. Hence, the metric is used to calculate the IDOS of dry goods (bottles, labels, corks, boxes and capsules). Equation 5.2 is therefore adapted as follows:

$$\frac{Average\ value\ of\ dry\ goods\ buffer}{Value\ of\ dry\ goods\ used} \times 31 \tag{6.2}$$

Equation 6.2 is called *Dry goods IDOS*. The value of dry goods used is simply the value of all dry goods that are taken out of the dry goods buffer, for example, the value of corks that are taken out of the buffer for a bottling run. The value of dry goods used is already being captured for the *Bottling and packaging cost* metric. Cellar managers will have to start capturing the value of their dry goods buffer.

In the wine industry, as with most industries, cash flow plays an important role. In the various interviews with industry players, the importance of cash flow was repeatedly highlighted. Therefore, it was decided to include the metric *Cash-to-cash cycle time* in the ideal framework. This metric is described by the SCC (2012) as: "The time it takes for an investment made to flow back into the company after it has been spent on raw materials." The metric is calculated as follows:

$$\begin{aligned} Cash-to-cash\ cycle\ time &= IDOS + Days\ sales\ outstanding \\ &\quad -Days\ payable\ outstanding \end{aligned} \tag{6.3}$$

The IDOS required for Equation 6.3 is the IDOS of all inventory, namely raw material inventory, work-in-process inventory and finished goods inventory. Consequently, the issue of valuing wine also comes into play for this metric. Furthermore, it is difficult to determine exactly when money had been spent on wine if the cellar did not buy the wine but obtained it from its own harvest. Following the same argument as in Section 5.2.5, it was decided to exclude wine from the calculation and to rather measure the cash-to-cash cycle time of the packaging process (wine is not included in the raw material buffer). Hence, the metric measures the time it takes for money spent on dry goods to flow back into the business. Since work-in-process IDOS is small in comparison to that of dry goods and finished goods, it was excluded from the IDOS calculation, which simplifies data collection and analysis. IDOS for the cash-to-cash cycle time is then calculated by adding the two IDOS metrics which are already being calculated as individual metrics, namely *Dry goods IDOS* and *Finished goods IDOS*. Even though the volume of wine is used for the calculation of finished goods IDOS, the metric can also be seen as the amount of days which dry goods spend in the finished goods buffer. Hence, the IDOS part of the cash-to-cash metric is effectively the time which dry goods spend in the dry goods buffer plus the time dry goods spend in the finished goods buffer. In my own view, excluding wine from the cash-to-cash metric is beneficial seeing that managers want decision support in terms of the process from when wine is packaged to when the wine is sold, and not in terms of the amount of days which bulk wine spends in the cellar.

In order to calculate the cash-to-cash (excluding bulk wine) cycle time, *Days sales outstanding* and *Days payable outstanding* must first be calculated. Hence, these two metrics were also added to the ideal framework. These metrics are calculated as follow (SCC, 2012):

$$Days\ sales\ oustanding = \frac{Monthly\ average\ of\ gross\ accounts\ receivable}{Total\ gross\ monthly\ sales} \times 31 \quad (6.4)$$

$$Days\ payable\ oustanding = \frac{Monthly\ average\ of\ gross\ accounts\ payable}{Total\ gross\ monthly\ material\ purchases} \times 31 \quad (6.5)$$

The gross accounts payable and the gross material purchases are that of dry goods for all packaged wine, since managers cannot segment their buffers in terms of local or export wines. The gross accounts receivable and gross sales are that of only packaged export wine. This enables the calculation of the cash-to-cash cycle time of the packaged export segment, seeing that both packaged local and packaged export wines are treated mostly the same up to the decoupling point. The required data is available at the cellars' auditors. However, asking an auditor to calculate these metrics every month is not practical. Therefore, it is suggested that cellars capture the required data.

Segments

In the phase 2 framework, finished goods IDOS was segmented according to the four quarters in a year to take seasonal fluctuations in demand into account. Ideally the finished goods IDOS metric should be segmented per month to follow seasonal demand more accurately and to inform decision making with up to date information. Therefore it was decided to segment finished goods IDOS per month in the ideal framework. IDOS of dry goods should also segmented per month.

Days sales outstanding and days payable outstanding should also be segmented per month, for the same reasons as discussed above. Cash-to-cash cycle time is then calculated for each month using the average dry goods IDOS plus the average finished goods IDOS for the corresponding month. It is suggested that monthly averages are calculated by capturing the opening and closing amounts of each data field, for example, finished goods IDOS should be calculated as the average of opening and closing inventory for each month.

Demographics

The demographics for the IDOS metrics were kept the same as those for the asset management metrics in the phase 2 framework, except for dwell time which is a metric in the ideal framework and not a demographic. Two demographic were added to the IDOS metrics in the ideal framework, namely the amount of SKUs which a cellar has and the level of information sharing. The cash-to-cash cycle time has the same demographics as the IDOS metrics. The demographics applicable to each metric is illustrated in Table 6.1.

All of the metrics for this attribute are calculated for all packaged products as managers cannot determine whether wine in stock will be sold locally or exported, except for the days sales outstanding metric. To overcome this problem, the following rationale can be applied: opening inventory + bottling quantities − sales = closing inventory. Using this and working backwards, one is able to determine the quantity of wine that was exported and the quantity that was sold locally of a historical finished goods buffer. The same method can be applied to segment dry goods. However, seeing that it is mostly the case that all wines are treated exactly the same up to the decoupling point, it was decided not to incorporate this rationale into the ideal framework, as its contribution to decision support is questionable.

6.4 Conclusions

As stated in Chapter 3, the ideal framework was developed by executing step four of the SCORmark process. The ideal framework consists of metrics from all five SCOR attributes. Responsiveness and reliability metrics were included in the ideal framework, as these attributes are the main focus in terms of strategy with regard to the packaged export segment. To adhere to the requirement by Barber (2008), a forecasting accuracy metric was added to the framework. Due to fluctuations in global supply and demand, and to adhere to the requirement by Beamon (1999), an agility metric was included. Cost metrics were included to monitor certain key costs as cellars improve their performance in other attributes. Lastly, asset management metrics were included to measure the performance of two key areas, namely inventory management and cash flow.

The ideal framework adheres to the criteria proposed by, Amaratunga & Baldry (2002), Baltzan (2012), Barber (2008), Beamon (1999), Berrah & Clivill (2007), Bititci *et al.* (1997), Chan (2003), Cuthbertson & Piotrowicz (2011), Eccles (1991), Fisher (1997), Gunasekaran & Kobu (2007), Holmberg (2000), Ittner & Larcker (2003), Kaplan & Cooper (1997), Lebas (1995), Morgan (2004) and Thakkar *et al.* (2009). Hence, according to the literature reviewed, the ideal framework is able to effectively measure supply chain performance, contribute to decision support and it can be used to set benchmarks.

Through the cellars' strategies it can be derived that cellars want to improve their performance by, for example, decreasing lead times and increasing reliability. Since the majority of cellars do not measure their performance, they are not able to evaluate their progress towards these goals. Through the use of the proposed framework, cellars will benefit by transforming the existing open-loop systems into closed-loop systems (refer to Figure 2.3), thereby providing the feedback needed to identify and assess improvement initiatives.

Table 6.4 summarises the data fields that need to be captured in order to measure supply chain performance using the ideal framework. The data fields are required for either metrics, segments or demographics. The table also specifies whose responsibility it is to capture each data field and the frequency with which the data should be captured. Data required for the agility metric is not included in Table 6.4, as it is a once-off measurement.

Table 6.4: Proposed data capturing for the ideal framework

Type	Data to be captured	Frequency	Responsibility
Metrics	1. Date order placed at cellar	Order	Cellar
	2. Date cellar started working on order	Order line	Cellar
	3. Date dry goods ordered	Order	Cellar
	4. Date dry goods received	Order	Cellar
	5. Date order loaded onto ship	Order	FF
	6. Date ship left Port of Cape Town	Order	FF
	7. Date ship arrived at POD	Order	FF
	8. Reliability issues	Order	FF and cellar
	9. Forecasted sales data	Monthly	Cellar
	10. Bottling and packaging cost	Monthly	Cellar
	11. Permanent labour cost	Monthly	Cellar
	12. Temporary labour cost	Monthly	Cellar
	13. Value of dry goods buffer	Monthly	Cellar
	14. Value of dry goods used	Packaging run	Cellar
	15. Litres of packaged wine in finished goods buffer	Monthly	Cellar
	16. Litres of packaged wine sold	Monthly	Cellar
	17. Gross accounts receivable of packaged export wine	Monthly	Cellar
	18. Gross sales of packaged export wine	Monthly	Cellar
	19. Gross accounts payable for dry goods	Monthly	Cellar
	20. Gross dry goods purchased	Monthly	Cellar
Segments	1. Location of POD	Order	FF
Demo-graphics	1. Location of decoupling point	Order line	Cellar
	2. Consolidation	Order	FF
	3. Incoterm	Order	FF
	4. Shipping line	Order	FF
	5. Protein and cold stabilisation	Order	Cellar
	6. Branded vs unbranded dry goods	Order	Cellar
	7. Packaging type	Packaging run	Cellar

It is proposed that all monthly data is captured on the first day of the month. To calculate monthly averages, two consecutive months' data can be used. For example, the average of the opening stock levels of January and February can be used as January's average. Note that certain demographics within the ideal framework are not listed in the table, such as business size, number of SKUs, etc. The excluded demographics are those that are not needed for performance measurement, but required for benchmarking. The reason for this is that it was found that benchmarking an industry with low levels of supply chain maturity is not practical, as stated in Chapter 5. Therefore, it is recommended that performance is first measured by capturing the data in Table 6.4, after which benchmarking can easily be conducted. Hence, cellars should first start measuring and tracking their own performance, after which performance benchmarking and competitive benchmarking can follow.

CHAPTER 7

Conclusions and recommendations

Contents

This chapter consists of three sections. Section 7.1 summarises the work done in this thesis according to the thesis's objectives. In Section 7.2 certain recommendations are made with regard to the use of the developed framework. Lastly, in Section 7.3, suggestions are made with regard to future work, both in terms of this thesis and the application of supply chain management within the South African wine industry.

7.1 Thesis summary

Currently, in the South African wine industry, no supply chain benchmarks exist against which cellars can compare their performance to identify areas for improvement. Before benchmarks can be established, the question of what to benchmark must first be answered. This creates a gap in the SCOR implementation road map, i.e. if a cellar wants to improve its supply chain performance by applying the methodology of the SCOR road map, the cellar will not be able to reach its goal. The objective of this thesis was to remove the gap which currently exists in the SCOR implementation road map for the South African wine industry. This will enable more effective improvement initiatives with regard to supply chain management in the industry. From this main objective, three sub-objectives were derived: (1) to create a supply chain measurement framework for the packaged export segment, (2) to investigate the availability of data and (3) to establish sample benchmarks for the metrics in the framework.

In order to complete the abovementioned objectives, the SCORmark methodology was applied in a multi-phased manner to develop three measurement frameworks, namely a phase 1 framework, a phase 2 framework and an ideal framework. Qualitative and quantitative data were gathered for the development of the frameworks. The ideal framework is the main deliverable of the first objective: measuring the metrics specified in the ideal framework will describe the performance of a packaged export supply chain which in turn can be used for decision support. Each of the frameworks had been validated by various industry players, including cellar managers, freight forwarders, auditors and academics.

Table 7.1 summarises the findings of Chapters 4, 5 and 6 for the second objective, i.e. data availability. Data required for the measurement of each metric is classified as either available, partly available or not available (refer to Table 7.2), following the quantitative analysis of the phase 1 and phase 2 frameworks. If data is classified as available, it was both in the correct format and easily accessible, whereas partly available means it was either one or the other. Table 7.1 also summarises the metrics, segments and demographics associated with all three frameworks.

Table 7.1: Summary of frameworks (legend in Table 7.2)

Att	Metric	Phase 1			Phase 2			Ideal		
		I	S	D	I	S	D	I	S	D
RS	Order fulfillment cycle time	✓			✓	1	1-8	✓	1	1,3-12
	Cellar to on board cycle time	✓			✓		1-4,6-8	✓		1,3,4,6-12
	On board to POD cycle time				✓	1	5	✓	1	5
	Order fulfillment dwell time				✓			✓		8,12
	Source cycle time				✓		8	✓		8,11
RL	Perfect order fulfillment	✓			✓		1-8	✓		1,3-12
	Order delivered in full				✓			✓		
	On time for RSD				✓		1-4,6-8	✓		1,3,4,6-12
	On time for RDD				✓		1-8	✓		1,3-12
	Documentation accuracy				✓		8	✓		8
	Correct condition				✓			✓		
	Forecast accuracy							✓		8,12
AG	Upside supply chain flexibility	✓								
	Upside flexibility (Source)	✓								
	Upside flexibility (Make)	✓								
	Upside flexibility (Deliver)	✓								
	Custom made metric									✓
CO	Storage cost	✓								
	Transportation cost	✓								
	Bottling and packaging							✓		8,9,13
	Permanent labour							✓		6
	Temporary labour							✓		6
AM	Cash-to-cash CT							✓	3	1,8,9,12
	Finished goods IDOS	✓			✓	2	1,2,8	✓	3	1,8,9,12
	Dry goods IDOS				✓		1,2,8	✓	3	1,8,9,12
	Days sales outstanding							✓	3	8
	Days payable outstanding							✓	3	8

Note: I = Included in framework ; S = Segments ; D = Demographics

Table 7.2: Table 7.1 legend

Legend	Number	Type
Segments	1	Geographical
	2	Quarters
	3	Months
Demographics	1	Location of the decoupling point
	2	Order fulfillment dwell time
	3	Consolidation
	4	Incoterm
	5	Shipping line
	6	Own vs outsourced facilities
	7	Own vs outsourced transportation
	8	Business size
	9	Number of SKUs
	10	Protein and cold stabilisation
	11	Branded vs unbranded dry goods
	12	Information sharing
	13	Packaging type
Data availability	✓ (green)	Available
	✓ (orange)	Partly available
	✓ (red)	Not available

Table 7.1 shows that out of the 19 metrics measured in the phase 1 and 2 frameworks, data for the calculation of only three metrics was available, nine partly available and six not available, with one metric being partly available for phase 1 and not available for phase 2. This illustrates the lack of supply chain management maturity within the wine industry.

In terms of the third objective it was found that trying to benchmark an industry with low levels of supply chain management maturity is a challenging exercise. Emphasis should first be placed on aiding cellars to measure various supply chain metrics, which will enable much more straightforward benchmarking. As a result, sample benchmarks were only established for the phase 1 framework. Hence, the third objective could not be completed and there still exists a gap in the SCOR road map for the wine industry, i.e. the Benchmark part of the Analyse phase.

7.2 Recommendations

It can be argued that, given the lack of supply chain maturity in the South African wine industry, starting to measure all the metrics in the ideal framework may be a challenging task. Therefore it is recommended that cellars start the measuring process by following these four steps:

1. Select important supply chain(s)
2. Prioritise attributes for the selected supply chain(s)
3. Measure important attributes of important supply chains
4. Expand measurements by adding more attributes and / or supply chains

By following this process, measuring a cellar's supply chain performance becomes much more practical. For example, if a cellar selects responsiveness as the prioritised attribute, the cellar should only start measuring five metrics for their most important supply chain(s).

Ideally, instead of just starting to measure certain aspects, cellars should strive to increase their supply chain management maturity. More specifically, cellars first need to adopt a supply chain orientation, as defined by Mentzer *et al.* (2001). An increase in maturity will automatically lead to effective supply chain performance measurement, as effective measurement is a characteristic of higher levels of maturity. One can argue that the opposite is also true: if cellars start measuring their performance they will develop a supply chain orientation which will increase their maturity. However, referring to the PDCA (Plan, Do, Check, Act) cycle discussed in Chapter 2, I believe it is better to start at "Plan", i.e. to first increase maturity, than at "Check", i.e. to start with measurements.

In terms of establishing benchmarks, it is recommended that cellars start measuring and tracking their performance by capturing the data fields listed in Table 6.4. Once a number of cellars have adopted the metrics, performance benchmarking can begin, through which cellars can gauge their performance against one another. The establishment of these industry benchmarks will remove the gap in the SCOR road map: the Scorecard deliverable is completed through the development of the ideal framework and therefore only the Benchmark deliverable remains. If possible, this can be taken further by conducting competitive benchmarking, in which the best competitors are included in the benchmarking exercise. Once benchmarks are established, cellars can create scorecards (refer to Figure 3.1). From the "Target gap" column, cellars can identify areas that need to be improved and it is recommended that cellars create strategy maps to drive improvement initiatives.

7.3 Possible future work

As explained in the previous section, implementing the entire ideal framework all at once might be too complex. Therefore, the proposal was made that cellars should start small by following the four-step process. Even though it is believed that this process can easily be implemented, it should be tested to see whether this assumption is true.

The scope of this thesis was to develop a framework to measure the direct supply chain. It is important to keep the systems view in mind, in the sense that, due to the scope of this thesis, sub-optimisation had been measured. Once the direct supply chain is sufficiently benchmarked through the use of the ideal framework, the extended supply chain can be incorporated over time and then the same can be done for the ultimate supply chain (refer to Section 2.1 for the definition of each supply chain). Hence, although this study only focussed on creating a measurement framework with sample benchmarks for the South African packaged export supply chain segment, it offers a starting point for further research with the goal of establishing benchmarks for the entire South African wine supply chain on a global scale, which is the most advanced level of benchmarking as defined by Watson (1993).

If a cellar starts using the ideal framework to measure and benchmark its supply chain performance, its performance will most probably increase over time, making the cellar more competitive. If a sufficient number of cellars start measuring and benchmarking their performance, the average performance of the entire South African wine industry will increase. Seeing that this thesis measured performance to the POD, it becomes possible to compare South Africa's performance to that of competing countries, such as Australia, Chile and Argentina. Hence, if South Africa can outperform these countries on a supply chain basis by starting to measure and benchmark its own performance, the wine industry can use its supply chain performance as a possible order winning criterion.

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APPENDIX A

Combined phase 1 results

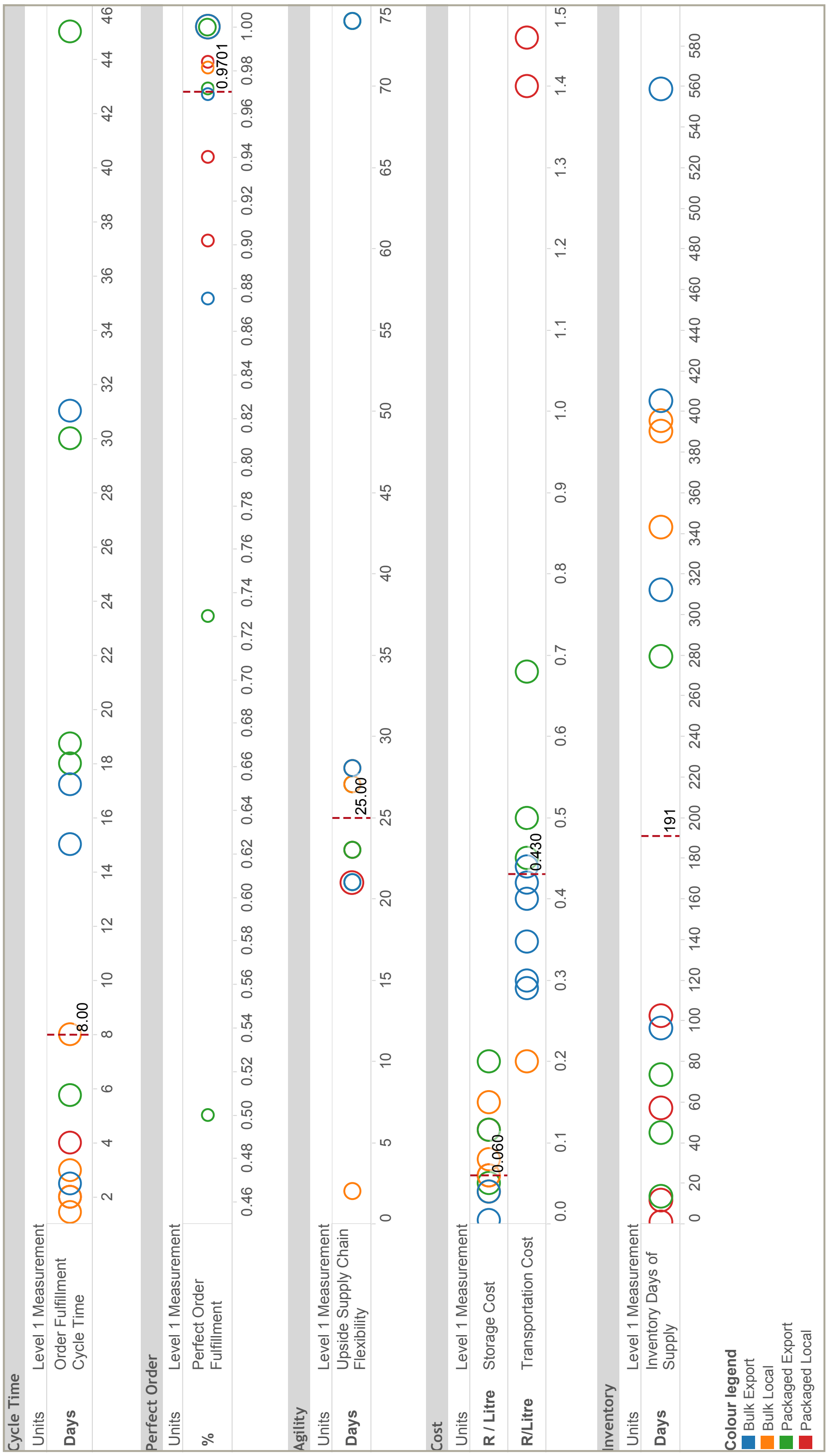

Figure A.1: Phase 1 results for all four segments

APPENDIX B

Cellar survey: packaged export segment

Wine Supply Chain Survey

4. Packaged Export

58%

Please complete the questions on this page for all PACKAGED EXPORT products.

*** 8. Do you outsource transportation for Packaged Export wines? Please estimate the % you outsource according to the volume % for which you use outsourced transport.**

	All own	10%	20%	30%	40%	50%	60%	70%	80%	90%	All outsourced
Volume % outsourced	○	○	○	○	○	○	○	○	○	○	○

9. If applicable, which companies do you use as freight forwarders for Packaged Export wines?

- ☐ JF Hillebrand
- ☐ Intersped
- ☐ Outsource Logistics
- ☐ Megafreight
- ☐ Kuehne & Nagel
- ☐ Hellmann
- ☐ Giorgio Gori
- ☐ N/A

Other (please specify)

*** 10. Please estimate the % of orders, during 2014, for which you had all the required products in a stock buffer? (No bottling, labeling or rework had to be done).**

*** 11. Please estimate the % of orders, during 2014, which have been placed in advance. This means that you do not have to start working on the order immediately (for example buying raw materials, bottling, etc.) .**

% of orders which have been placed in advance

Figure B.1: Packaged export section of survey

Wine Supply Chain Survey

5. Please complete the questions on this page for ALL packaged products (both local and export)

67%

Please complete the questions on this page for ALL packaged products (both local and export)

*** 12. Do you own any of the following facilities?**

	Yes	No
Bottling line	○	○
Bag-In-Box line	○	○
Tetra Pack line	○	○
Labeling line	○	○

*** 13. Do you outsource any of the following processes? Please estimate the % of volume outsourced.**

	All own	10%	20%	30%	40%	50%	60%	70%	80%	90%	All outsourced
Bottling	○	○	○	○	○	○	○	○	○	○	○
Bag-in-Box	○	○	○	○	○	○	○	○	○	○	○
Tetra Pack	○	○	○	○	○	○	○	○	○	○	○
Labeling	○	○	○	○	○	○	○	○	○	○	○
Storage	○	○	○	○	○	○	○	○	○	○	○

*** 14. What is the average sourcing time (days) from when an order is placed until delivery of the following dry goods?**

Bottles

Corks

Labels

Capsules

Boxes

*** 15. What is the average value (R) at any given time of the following dry goods?**

Bottles

Corks

Labels

Capsules

Boxes

Figure B.2: All packaged products section of survey (page 1 of 2)

* 16. How much labeled vs unlabeled stock do you carry? Please estimate the % of labeled stock carried for the first quarter of 2015.

	All unlabeled	10% labeled	20% labeled	30% labeled	40% labeled	50% labeled	60% labeled	70% labeled	80% labeled	90% labeled	All labeled
% Labeled stock (as % of total stock)	○	○	○	○	○	○	○	○	○	○	○

* 17. What % of wine goes into each packaging type? (Bulk wine excluded, thus the sum of all types should be 100%). Please provide the answer for the year 2014.

Glass

Plastic

Bag-In-Box

Tetra packs

Other

* 18. How much wine did you have, in the form of packaged products, in stock at the end of each month? (Litres)

January 2014

February 2014

March 2014

April 2014

May 2014

June 2014

July 2014

August 2014

September 2014

October 2014

November 2014

December 2014

* 19. How much wine did you sell, in the form of packaged products, during these periods? (Litres)

Begin January 2014 to end March 2014

Begin April 2014 to end June 2014

Begin July 2014 to end September 2014

Begin October 2014 to end December 2014

Figure B.3: All packaged products section of survey (page 2 of 2)

APPENDIX C

Agility: High demand variability

		High demand variability				
		Location of decoupling point				
		Make-to-stock		Label-to-order		Make-to-order
	Utilisation	Low IDOS	High IDOS	Low IDOS	High IDOS	
Botting	Low	Work on continuous replenishment basis. Small batch sizes. High margin wines (cost of packaging not significant).	High IDOS, together with low utilisation, hench high demand buffering. Packaging cost and asset utilisation is negligible.	Work on continuous replenishment basis. Small batch sizes. High margin wines (cost of packaging not significant).	High IDOS, together with low utilisation, hench high demand buffering. Packaging cost and asset utilisation is negligible.	Demand buffering is extra capacity (no inventory), thus require low utilisation.
	High	Potential for stockouts (low IDOS with high demand variability) and cannot replenish in time due to high utilisation rates.	Potentially problematic if stockout occur due to high demand variability.	Potential for stockouts (low IDOS with high demand variability) and cannot replenish in time due to high utilisation rates.	Potentially problematic if stockout occur due to high demand variability.	High utilisation with no inventory will lead to unacceptable cycle times.
Labeling	Low	Work on continuous replenishment basis. Small batch sizes. High margin wines (cost of packaging not significant).	High IDOS, together with low utilisation, hench high demand buffering. Packaging cost and asset utilisation is negligible.	Labeling after decoupling point. Thus MTO environment and utilisation should be low.	Labeling after decoupling point. Thus MTO environment and utilisation should be low.	Demand buffering is extra capacity (no inventory), thus require low utilisation.
	High	Potential for stockouts (low IDOS with high demand variability) and cannot replenish in time due to high utilisation rates.	Potentially problematic if stockout occur due to high demand variability.	Need low utilisation after decoupling point (MTO environment).	Need low utilisation after decoupling point (MTO environment).	High utilisation with no inventory will lead to unacceptable cycle times.
Storage	Low	Good if storage cost is not significant to cost of goods sold, given high demand variability.	Good if storage cost is not significant given high demand variability.	Good if storage cost is not significant to cost of goods sold, given high demand variability.	Good if storage cost is not significant to cost of goods sold, given high demand variability.	
	High	Good since storage is before the decoupling point. Bad if extra capacity is required to scale up IDOS as a result of high demand variability.	Good since storage is before the decoupling point. Bad if extra capacity is required to scale up IDOS as a result of high demand variability.	Good since storage is before the decoupling point. Bad if extra capacity is required to scale up IDOS as a result of high demand variability.	Good since storage is before the decoupling point. Bad if extra capacity is required to scale up IDOS as a result of high demand variability.	

Figure C.1: Agility metric for high demand variability