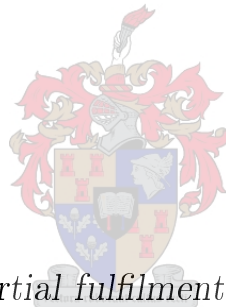


Providing decision support to FMCG market players in developing economies

by

Janti Kriel



Thesis presented in partial fulfilment of the requirements for the degree of Master of Engineering (Engineering Management) in the Faculty of Engineering at Stellenbosch University

Supervisor: Konrad von Leipzig

December 2016

Declaration

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Abstract

Providing decision support to FMCG market players in developing economies

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Resulting from a drop in commodity prices, foreign investment has largely been diverted to the consumer goods and services market in Africa. The aggressive expansion of ill-prepared companies into relatively unknown markets has led to gross inefficiencies reducing overall competitiveness and consumer satisfaction. The research was undertaken in response to the downstream distribution difficulties faced by the fast moving consumer goods industry. The issues at hand stemmed from a lack of easily obtainable information on retail markets within developing economies. The focus of the research became the primary and secondary distribution activities of incumbent and prospecting companies. Specifically, the research sought to improve the identification of business opportunities, improve distribution channel identification and identify best-suited transportation arrangements. Alarmingly over half the price paid by the consumer is spent getting the product to market. Thus as an initial attempt at elevating the competitiveness of market players, downstream distribution presented a logical kick off point. The first objective was to overcome the barriers to information collection in developing countries. In order to propose and trial an information collection tool, the research partnered with a consultancy called Hunting Dragons Consulting. The research then became part of a larger project undertaken in the Democratic Republic of the Congo. The project was initiated by investors to assess the viability of

a business manufacturing and distributing four liquid streams namely beer, opaque beer, soft drinks and spirits in the Katanga province. Through a door-to-door retail outlet survey, information on 168 unique products was collected from 2 081 retail outlets in and around the city of Lubumbashi. Information regarding product mixes, prices, sales volumes, stock and basic supply chain performance indicators allowed the research to reach a number of conclusions. By extrapolating the weekly sales volumes from the sample, the research concluded that 1,34 million hl of beer, 715 000 hl of soft drinks, 462 000 hl of opaque beer and 56 000 hl of spirits is sold annually in the three major towns of the Katanga province. As a result of stock outs and the subsequent missed sales opportunities, annual sales figures could be 48% higher for beer, 33% for soft drinks and 9% for spirits. The research identified superior distribution channels by which the additional volumes could be unlocked. For each of the four liquid streams different market segments were identified as key channel members. The analysis of the current routes to market employed by incumbent companies hinted towards best-suited transportation arrangements. However, the client input was sorely missing from the decision process. Thus the research sought to pragmatically incorporate client inputs into identifying a best-suited transportation arrangement. The developed decision support tool is able to distinguish an own fleet, owner driver, crowdsourced, third party logistics, fourth party logistics and distributor arrangements from one another based on two client assessments. From a strategic alignment and compatibility assessment, the tool ranks the six arrangements from best suited to worst suited. The tool was found to produce robust and consistent outputs based on six scenario tests and one case study.

Uittreksel

Die verskaffing van besluitnemingsondersteuning vir FMCG mark spelers in ontwikkelende ekonomieë

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As gevolg van 'n daling in kommoditeitspryse, het buitelandse beleggers hulle fokus in Afrika na die verbruikers goedere en dienste mark geskuif. Die aggressiewe uitbreiding van maatskappye in onbekende markte, gekoppel met swak voorbereiding lei tot ondoeltreffende ondernemings en swak verbruikers tevredenheid. Die kwessies byderhand het ontstaan uit 'n gebrek aan verkrygbare inligting oor kleinhandel markte in ontwikkelende ekonomieë. Die navorsing fokus op die primêre en sekondêre verspreidings aktiwiteite van beide gestigte en voornemende maatskappye. Die doel is om die identifisering van sakegeleenthede te verbeter as ook beste geskikte verspreidings kanale en vervoer verskaffers te identifiseer. Kommerwekkend word meer as helfte van die prys van produkte bestee aan die verspreiding daarvan. Dus sien die navorsing die verspreidings aktiwiteite van maatskappye as 'n logiese afskop punt om hul mededingendheid te verbeter. Die eerste doel was om die struikelblokke tot inligting versameling te oorkom. Die navorsing het 'n vennootskap gestig met 'n groep konsultante genaamd Hunting Dragons Consulting. Dit het toegelaat dat die navorsing 'n data versamelings instrument voorstel en toets. Die navorsing het deel geword van 'n groter projek in die Demokratiese Republiek van die Kongo. Beleggers wou bepaal of 'n daar 'n geleentheid in die Katanga provinsie is om bier, gaskoeldrank, drank en Bantu bier te vervaardig en versprei. Deur middel van 'n deur tot deur opname het die

navorsing inligting oor 168 produkte vanaf 2 081 kleinhandelaars ingesamel. Die opname het inligting oor die voorsienings ketting, produkte op rakke, pryse, volumes en voorraad ingesamel. Deur slim manipulerings van die data kon dit bepaal word dat 1,34 miljoen hl bier, 715 000 hl gaskoeldrank, 462 000 hl Bantu bier en 56 000 hl drank jaarliks in die drie groot dorpe van die provinsie verkoop. As gevolg van probleme met voorraad is verkoopsyfers drasties laer as verwag. Daar was geskat dat aanvraag soveel as 48% vir bier, 33% vir gaskoeldrank en 9% vir drank hoër is as die toevoer. Verder het die navorsing verspreidingskanale identifiseer wat die toevoer van produkte sal verbeter. Vir elk van die vier produk groepe is die belangrikste skakels in die voorsienings ketting geïdentifiseer. Dus is die navorsing in staat om pogings tot verhoogte mededingendheid te fokus. Die volgende doel was om 'n instrument te ontwikkel wat 'n bes geskikte vervoer verskaffer kan voorstel gebaseer op insette van die kliënt. Op grond van twee kliënte aanslae rangskik die instrument ses verskaffers modelle genaamd 'n eie vloot, eienaar en bestuurder, skare bron, derde party logistiek, vierde party logistiek en 'n klassieke verspreider. Die kliënt vul 'n strategiese belyning en verenigbaarheid assessering in, wat die finale rangskikking van die ses verskaffers bepaal. Na een gevallestudie en ses scenario toetse was dit bepaal dat die instrument beide robuuste en konsekwent uitsette lewer. Die uitsette is dus in staat om die onsekerheid rondom bestuur besluite te verminder.

Acknowledgements

I would like to express my sincere gratitude to the following people and organisations:

- Anglo American, for their financial contribution to my studies.
- Hunting Dragons Consulting, for affording me the opportunity to be part of the projects presented in my thesis.
- Konrad von Leipzig, for his guidance and critic of my thesis.
- Mark Eames, for his invaluable mentorship and words of encouragement.
- My parents, Johan and Elmaré Kriel, for their love and affording me the opportunity to further my studies.
- Machel Ferreira, for her love and unwavering patience.

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Nomenclature

Symbols

A	Pairwise attribute comparison matrix
A_{norm}	Normalised attribute pairwise comparison matrix
a	A matrix element
\bar{a}	Normalised A matrix element
B	Pairwise alternative comparison matrix
B_{norm}	Normalised pairwise alternative comparison matrix
b	B matrix element
C	Relative closeness
d	Separation measure
hl	Hectolitre
I	Set of positive attributes
J	Set of negative attributes
M	Number of observations
m	Number of alternatives
N	Number of nonzero weights
n	Number of attributes

NOMENCLATURE**xi**

R	Relationship
S	Matrix of option scores
s	S matrix element
v	Weighted normalised value
w	Attribute weight vector

Greek Symbols

λ_{max}	Maximum Eigenvalue
σ	Standard deviation

Superscripts

+	Positive ideal solution
-	Negative ideal solution
n	n^{th} attribute

Subscripts

i	i^{th} row of A
j	j^{th} column of A
k	k^{th} row of S
l	l^{th} column of S
n	n^{th} attribute

Abbreviations

3PL	Third Party Logistics
-----	-----------------------

4PL	Fourth Party Logistics
AHP	Analytic Hierarchy Process
AIJ	Aggregation of Individual Judgements
AIP	Aggregation of Individual Priorities
B-BBEE	Broad-Based Black Economic Empowerment
BEE	Black Economic Empowerment
BPO	Business Process Outsourcing
CI	Consistency Index
CR	Consistency Ratio
DRC	Democratic Republic of the Congo
DSD	Direct Store Distribution
EDI	Electronic Data Interchange
ERP	Enterprise Resource Planning
FMCG	Fast-moving Consumer Goods
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GSBPM	Generic Statistical Business Process Model
GIS	Geographic Information Systems
GPS	Global Positioning System
HR	Human Resources
HDC	Hunting Dragons Consulting
IS	Information Systems

IT	Information Technology
KPI	Key Performance Indicator
LSP	Logistics Service Provider
MADM	Multi-Attribute Decision Making
PDI	Previously Disadvantaged Individual
RBL	Resource Based Logistics
RBV	Resource Based View
RFID	Radio Frequency Identification
RI	Random Index
RTM	Route To Market
SCC	Supply Chain Council
SCM	Supply Chain Management
SCOR	Supply Chain Operations Reference Model
TAC	Total Acquisition Cost
TCE	Transaction Cost Economics
TMS	Transport Management Systems
TOPSIS	Technique for Order of Preference by Similarity to Ideal Solution
WMS	Warehouse Management Systems
YMS	Yard Management Systems

Chapter 1

Introduction

Despite the mineral wealth of Africa, its economic growth has been slow in the past. In fact, mineral wealth has fuelled political instability leading to poor economic performance. However, in the recent past, the African economy has achieved growth rates similar to that of Asia. In 2015 Africa achieved a gross domestic product (GDP) growth rate of 4.6 % [1]. Comparatively, in 2015 the world's fastest growing economy, East Asia, achieved a growth rate of 6.1 % [1]. Africa's retail market development has attributed much to the positive economic growth.

Despite a global decline in commodity prices, including metals, foreign direct investment (FDI) into Africa is predicted to reach USD 73.5 billion in 2015 [2]. Due to poor commodity prices, FDI flows have been diverted to the consumer goods and services market. This decision is driven by the rise of the African consumer and a rapidly growing middle class. The rapid growth of the African retail market has led to increased competition for the limited urban retail estate. In search of new opportunities, companies are attempting to service increasingly isolated populations. The aggressive expansion of companies into relatively unknown markets has emphasised the need for further research.

The majority of the population in developing economies live in rural areas. Often rural areas are geographically isolated by poor quality roads and infrastructure. This creates an information disparity that has routinely disconnected large populations from company value chains. Consequently, for the majority of consumers in developing countries, services and products are unavailable or more expensive or are of lower quality than their urban counterparts. Ultimately dissatisfied consumers hurt the competitiveness of a company.

In 1985 Porter [3] argued information is the fundamental source of a competitive advantage. The accompanying information revolution saw information technology transform the very nature of products, processes, companies and entire industries. Therefore the undertaken research is focused on determining how incumbent and new market players can become more competitive by overcoming the information barrier within developing countries.

1.1 Project relevance

In developed economies, companies have built their entire supply chains around information technology (IT) and its strategic significance [3]. In contrast, the lack of infrastructure and information systems (IS) in developing countries has kerbed the effectiveness of a similar approach. Consequently in developing countries supply chain links from the focal company down to the ultimate consumer is poorly understood. While incumbent companies have a limited insight into the downstream market, new market entrants have none. Thus the research places an emphasis on understanding the downstream supply chain of focal companies and the improvement thereof.

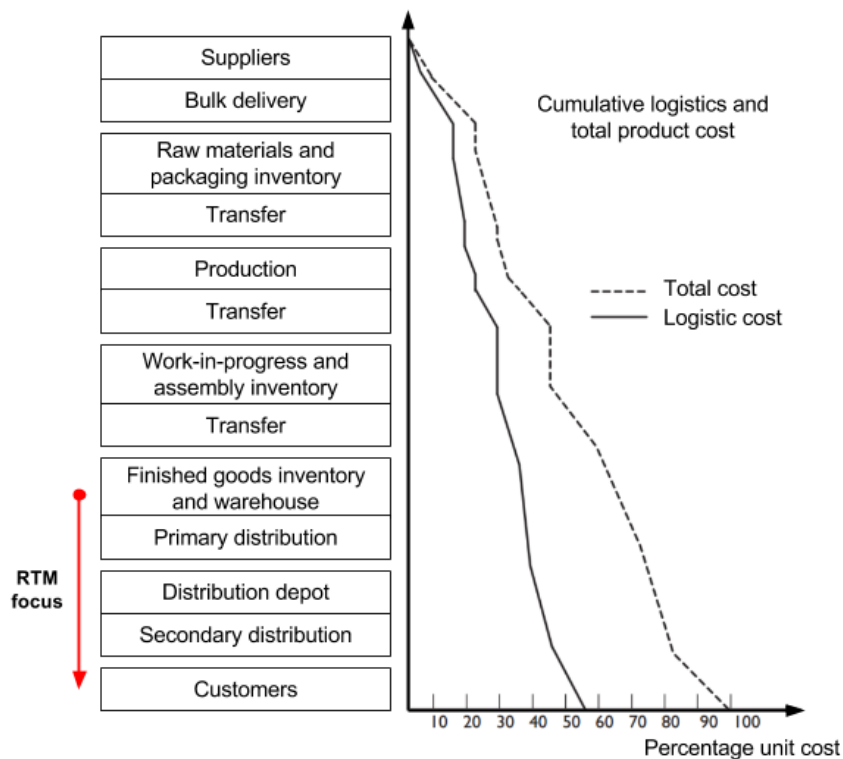


Figure 1.1: Exploring the composition of the ultimate cost incurred by the consumer by looking at the formation of an example supply chain, adapted and redrawn from [4].

The significance of primary and secondary distribution activities are highlighted in figure 1.1. Over half the price paid by consumers is spent getting the product to market. Each route to market follows a particular distribution channel with unique advantages, disadvantages and costs. Therefore the routes to market employed by a company directly influence its ability to deliver good levels of customer service at competitive prices. Nevertheless, few companies have a conceptual platform to collect information and subsequently optimise or create new routes to market.

The theory of route to market (RTM) allows companies to assess and optimise their routes to market. It allows companies to service more rural areas and increase competitiveness in urban settings through lowering consumer prices. The theory behind RTM aids strategies such as how to physically get to market, exploiting margins in the channel and identifying new market opportunities. The development of RTM strategies is driven by market information. Thus mindful of the current barriers, an alternative lens through which information can be obtained must be developed.

1.2 Project aims and objectives

In alignment with the development of an RTM solution addressing the difficulties of primary and secondary distribution, the following aims and objectives are proposed. The primary aim of the research is to improve the downstream supply chains of companies manufacturing and distributing fast-moving consumer goods (FMCG).

The research focuses on identifying an optimal transportation arrangement to carry out primary and secondary distribution activities. The research guides the decision process between insourcing and outsourcing transportation logistics to six different types of logistics service providers (LSPs). In order to choose an optimal transportation arrangement, the relevant distribution channel and strategy must first be identified.

The research has different implications for the incumbent and new market players. For incumbent market players, the research assesses their current distribution channel and proposes an optimal transportation arrangement. The insights gathered for new market entrants far exceed that. In developing an RTM solution, the viability of the market is assessed. The opportunity within the new market is quantified and similarly optimum distribution channels and transportation arrangements are proposed. The project aim is further broken down into key objectives:

1. Determine what information is required to characterise and understand the downstream supply chain of companies manufacturing and distributing FMCGs in developing countries within Africa.
2. Develop an alternative lens through which information can be gathered with a low reliance on information technology and systems.
3. Process and analyse the collected information in order to: (a) assess the viability of the business opportunity for new market entrants, (b) quantify the opportunity, (c) assess the current flow of volume and (d) propose an optimal distribution channel for both incumbent and new market players.
4. Develop a model to guide the decision process for choosing an optimal transportation arrangement based on various inputs not limited to the collected market information.

1.3 Project scope

The scope of the project is threefold. First, an alternate lens was developed to collect otherwise unobtainable information from a developing retail market. Secondly, a view of the downstream supply chain was created by structuring and analysing the data using the Excel add-in, PowerPivot. Finally, this drove the development of distribution strategies that elevate competitiveness.

The alternate lens allowed for the status quo of the downstream supply chain to be understood. A conceptual understanding of the problem was underpinned by the theory of supply chain management (SCM) and RTM. By understanding the structure and differentiating characteristics of distribution channels, a relevant data collection tool was developed.

A door-to-door survey was identified as the most appropriate vehicle to collect the proposed information. This decision reflects the lack of infrastructure and IS in developing countries. A case study was undertaken in the Democratic Republic of the Congo (DRC). In the DRC a retail outlet survey consisting of 2 081 unique outlets was completed. The case study served to evaluate the effectiveness and shortcomings of the data collection tool. The collected information was further employed to assess the viability of manufacturing and distributing four liquid streams in the focus market. The opportunity was quantified in terms of potential sales and the flow of volume was used to identify superior distribution channels.

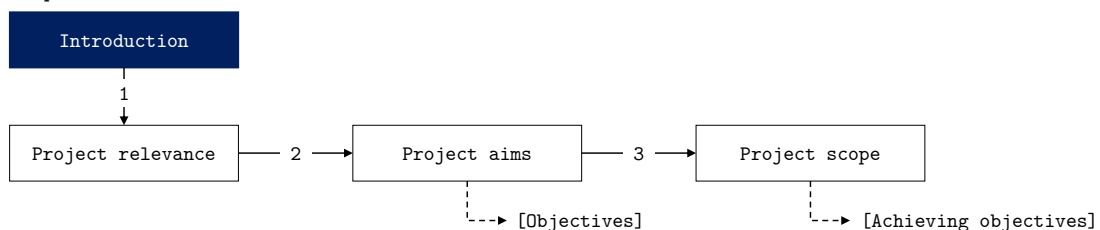
Finally, the research developed a generic model to identify an optimum transportation arrangement. Insights from a South African context brought important considerations to the research. For one, distributing products by rail, ship and air was deemed infeasible. As South Africa has long served as the gateway into Africa this approach was deemed appropriate.

Six distinct transportation arrangements exist in South Africa that distribute products by road. The first option is to insource transportation logistics by employing an own fleet. Alternatively, the outsourcing continuum consists of five types of logistics service providers: owner driver, crowdsourced, distributor, third-party logistics (3PL) and fourth party logistics (4PL).

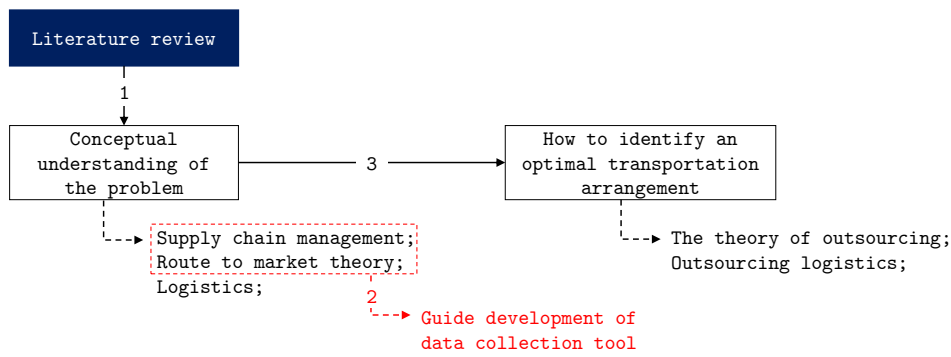
The generic model proposes an optimal transportation arrangement based on a multitude of considerations. First, the transportation arrangements are ranked according to their strategic alignment with the client company using a two-step analytic hierarchy process (AHP) and technique for order of preference by similarity to ideal solution (TOPSIS) methodology. The research has identified 11 strategic imperatives considered by companies when choosing transportation arrangements. The rankings are further adjusted using insights obtained from literature. The theories of transaction cost economics (TCE) and the resource based view (RBV) served to provide additional considerations for the decision between insourcing and outsourcing. Next considerations specific to outsourcing logistics were investigated. This allowed for the creation of a table appraising the strengths and weaknesses of each transportation arrangement. The table served as the last input to the generic decision tool.

1.4 Overview of project

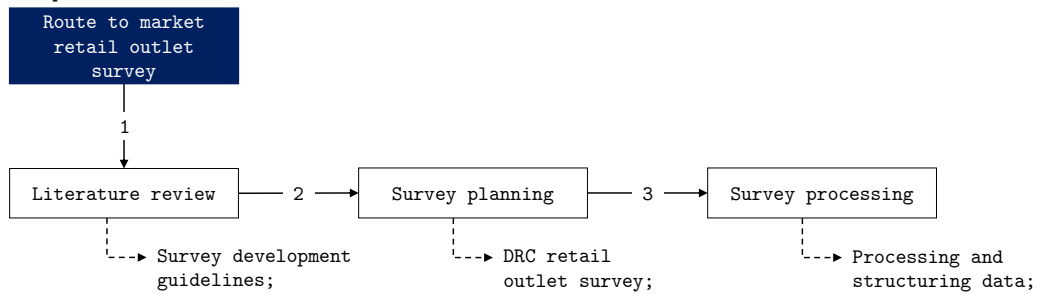
Chapter 1



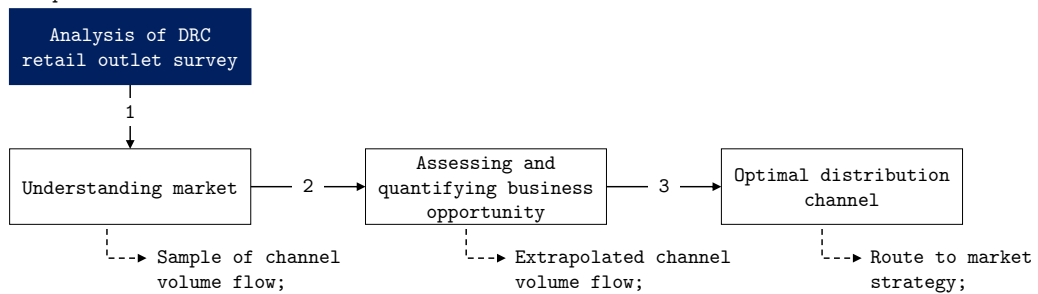
Chapter 2



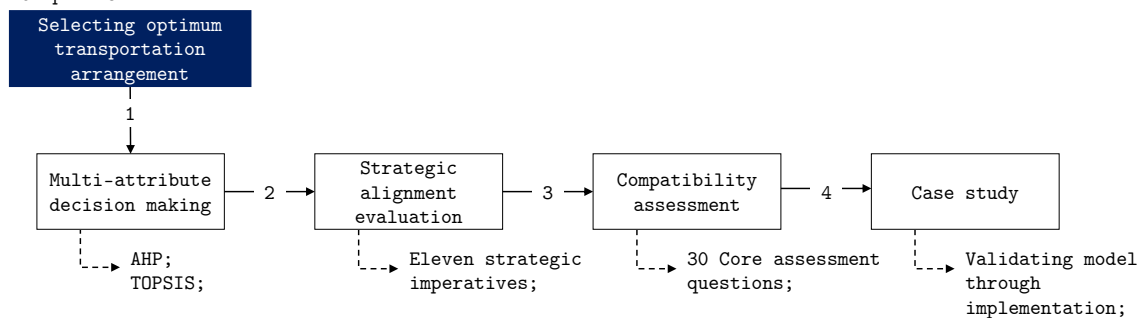
Chapter 3



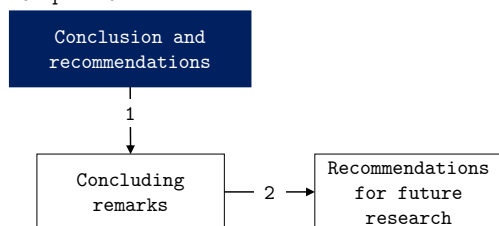
Chapter 4



Chapter 5



Chapter 6



Chapter 2

Literature review

An incumbent company has a host of advantages over new entrants. The incumbent has an established distribution channel, some market penetration and a delineated logistics operation. This does not mean incumbent companies cannot benefit from the proposed research. To compete effectively, new entrants to the market have to replicate or improve the current route to market strategy. Once the most effective distribution channel has been identified, the product has to be physically distributed. In alignment with the proposed aims and objectives, the research focuses on fundamental supply chain concepts, logistics and the decision support for identifying an optimal transportation arrangement. Understanding the complexities of outsourcing forms a cornerstone of the research.

By investigating fundamental concepts such as SCM, logistics and RTM theory a strong conceptual platform is created for further in-depth research. The insights gathered from RTM theory is employed to guide the development of a data collection tool.

The majority of the chapter focuses on understanding how types of transportation arrangements can be differentiated from one another. The decision between general insourcing and outsourcing is explored in depth. The arrangements found in the outsourcing continuum are further differentiated by insights gathered from logistics outsourcing literature.

2.1 Supply chain management

In the 1980s companies realised they could not compete effectively in isolation of their suppliers and other supply chain links [5][6]. Thus during the 1990s many service providers and manufacturers sought to improve their procurement and supply functions through increased collaboration. Subsequently, other functions including physical distribution and logistics were integrated under the new concept known as SCM [7]. Regrettably, there is no definitive definition of SCM or its activities [8]. Likewise, SCM literature is burdened by complicated terminology, impeding its effective application and understanding. Mentzer et al. [9] attempted to synthesise the various definitions of both supply chain and SCM in order to develop one comprehensive definition.

2.1.1 Defining the supply chain

La Londe and Masters [10] describe a supply chain as a set of companies passing materials forward. Similarly Lambert et al. [11] define a supply chain as an arrangement of companies constructed to bring services and products to market. Such a broad definition implies a supply chain linking each element between procuring raw materials, manufacturing, consumption and recycling. The definition implies the creation of value but does not specifically address it. Thus the complementary concept of the value chain was introduced. A value chain is described as a network of interdependent companies, each of which produces value in the form of products or services, which are ultimately brought to the consumer [9].

Mentzer et al. [9] define a supply chain as three or more entities, directly involved with the flow of products, services, finance and information between the source and ultimate customer. As a matter of course three degrees of supply chain complexity are defined: a direct supply chain, an extended supply chain and an ultimate supply chain as depicted by figure 2.1. The direct supply chain represents the simplest arrangement. A focal company is connected to a supplier and customer through the bidirectional exchange of products, services, information and finance. An extended supply chain is comprised of first-tier as well as second-tier suppliers and customers. In comparison to the direct and extended supply chains, the ultimate supply chain includes all the supply chain links from the source to the ultimate customer.

The ultimate supply chain illustrates the increasing complexity of real-world supply chains. Companies look towards other specialised companies from intermediate markets to source capabilities. Thus supply chains are best represented by networks rather than linear linkages. In the example, figure 2.1, third parties provide financing, perform logistics activities and conduct

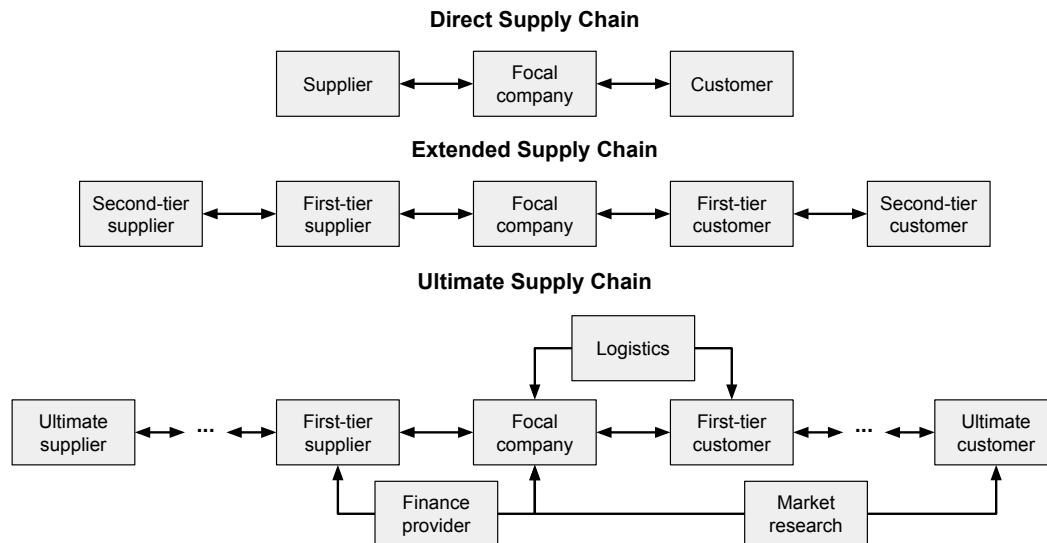


Figure 2.1: Three degrees of supply chain complexity, adapted and redrawn from [9].

market research. However, in reality companies can practically outsource any function creating more complex supply chains.

Mentzer et al. [9] argue supply chains exist whether they are actively managed or not. All companies form part of a larger supply chain, as they simply cannot exist in complete isolation of each other. Therefore it is important to draw a definite distinction between supply chains and SCM.

2.1.2 Defining supply chain management

SCM has continuously developed over at least four decades. Therefore many opposing views can be found in literature, burdening the understanding thereof. However, it is commonly agreed upon that SCM developed from logistics and purchasing [12]. Besides logistics, Hugos [13] argues the areas of marketing, finance and operations management were instrumental in developing SCM. According to Mentzer et al. [9] all definitions of SCM can be grouped into three categories: a management philosophy, implementation of a management philosophy and a set of management processes.

As a philosophy, SCM describes the supply chain as a set of unique companies collectively creating a single entity [9]. This suggests that the performance of the entire supply chain, as well as individual companies, are influenced both directly and indirectly by every supply chain member. Therefore the SCM philosophy attempts to align the operational and strategic capabilities of the supply chain as a whole. Mentzer et al. [9] suggest the alignment of supply chains improves competitiveness through creating

customer value and satisfaction. Thus beyond logistics, the SCM philosophy should include a multitude of activities to drive a customer orientated focus. Therefore a set of activities consistent with the SCM philosophy is defined.

1. *Integrating behaviour*: In order to dynamically respond to the ultimate customer, companies must expand their integrated behaviour with both suppliers and customers.
2. *Mutually sharing information*: For supply chain members to integrate their behaviour, information sharing must be prioritised. Information sharing is defined as releasing tactical and strategic data to other members of the supply chain. By sharing information, planning and monitoring processes can be aligned under the umbrella of the SCM philosophy.
3. *Mutually sharing risks and rewards*: By sharing risks individual companies limit their own exposure to hazards. Equally, as advantageous, risk sharing creates mutual rewards. This promotes cooperation between supply chain members, creating long-term competitive advantages [9].
4. *Cooperation*: Through cooperation companies create complementary capabilities and gain access to supplementary resources. Thus cooperation produces superior mutual outcomes that cannot easily be imitated by competitors.
5. *Aligning goals*: A successful supply chain relationship is characterised by a level of cooperation that increases efficiencies at a lower cost level while avoiding redundancies and overlap. According to La Londe and Masters [10] aligning goals and customer focus throughout the supply chain fosters such relationships.
6. *Integration of processes*: The SCM philosophy dictates that all processes from procuring raw materials to manufacturing and distribution must be integrated [9]. Supply chain integration is characterised by a focus on cost reduction and ultimately the full visibility of the supply chain.
7. *Selecting partners and maintaining relationships*: Effective SCM consists of a series of successful partnerships, extending beyond the time frame of the contract. Thus the long-term success of supply chain members is determined by their ability to select partners and maintain long-term relationships [9].

Instead of a set of activities, SCM can be defined in terms of management processes. The collection of management processes includes: relationship management, customer service management, demand and supply management, research and development, manufacturing flow management and commercialisation [9]. More generally management processes can be described as scheduling work activities across time and place, with specific deliverables, time frames and resources [14]. Accordingly La Londe and Masters [10] propose SCM is the synchronised management of information, relationships and the flow of products between supply chain members.

Arguably literature has defined two concepts with one term. Thus Mentzer et al. [9] draw a distinction between supply chain management and supply chain orientation. The idea of observing the coordination of a supply chain in its entirety and recognising the strategic implication of each tactical activity is more appropriately called supply chain orientation. SCM is concerned with the implementation of the supply chain orientation across several companies. Thus supply chain orientation can be viewed as a stepping stone towards successful SCM. In summary, supply chain orientation is a management philosophy as characterised by the set of SCM activities. While SCM is the collection of management decisions taken to realise that philosophy [9].

In conclusion, a single definition of SCM is proposed. SCM is defined as the systematic development of competitive advantages of both individual companies and entire supply chains through coordinating traditional business functions within particular companies and across supply chain members [9].

2.1.3 Supply chain operations reference model

The supply chain operations reference (SCOR) model is discussed in brief. The supply chain council (SCC) developed the SCOR model to evaluate and compare supply chain activities and performance [15]. Thus the SCOR model is explored for relevance to the design of distribution channels. The SCOR model consists of four sections which are organised around six management processes. The processes are described as plan, source, make, deliver, return and enable. These provide the basis for describing any supply chain irrespective of its complexity. The scope of SCOR includes four sections: performance, processes, practises and people.

The performance section of SCOR consists of two interdependent elements: performance attributes and metrics. Firstly performance attributes such as reliability, responsiveness and agility are used to express strategies. Performance attributes themselves cannot be measured [15]. Therefore each performance attribute is expressed by a group of metrics. Metrics measure the ability of the supply chain to achieve its strategic attributes.

In order to describe supply chains of varying complexity, the SCOR model is further deconstructed into four separate process levels. The top level is composed of process types. The second level is known as the configuration level where each process type is broken down into process categories. The third level or process element level decomposes each process to identify its strategic elements. The fourth level or implementation level defines each process element by creating a flow of tasks and activities. The scope of the SCOR model only includes the first three levels which are industry neutral as depicted in figure 2.2.

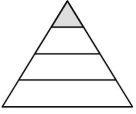
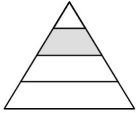
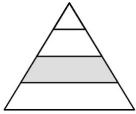
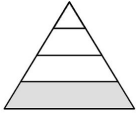
	Level	Description	Examples	Comments
Within scope of SCOR	1 	Process types	Plan, source, make, deliver, return and enable	Level-1 defines the scope and content of the supply.
	2 	Process categories	Make-to-stock, make-to-order, engineer-to-order	At level-2 the operations strategy is defined by setting the process capabilities of the supply chain.
	3 	Process elements	Schedule deliveries, receive product, verify product, transfer product, authorize payment.	Level-3 defines the configuration of individual processes by focussing on the right: <ul style="list-style-type: none"> - Processes - Inputs and outputs - Process performance - Practises - Technology capabilities - Skills of staff
Not in scope	4 	Activities	Activities	Level-4 defines practises to achieve competitive advantage and to adapt to changing market conditions.

Figure 2.2: Hierarchical representation of SCOR process model, adapted and redrawn from [15].

The practises section consists of emerging practices, best practices, standard practices and declining practises. Best practises focus on improving the overall supply chain operational performance. Conversely declining practises identify widespread practices that have proven to result in poor supply chain performance. Therefore each set of practices has different performance expectations and applications.

Lastly, the people section provides a standard for describing skills required to manage processes as well as perform tasks [15].

2.2 Route to market

With a clear understanding of both SCM concepts and its influential SCOR model, the theory of RTM is explored. RTM in its most fundamental understanding allows companies to take their goods and services to market in the most effective manner. Typically half of the market price of consumer goods is attributed to getting the product to market [16]. As the price of production has decreased over the past years, the price of distribution has increased. This results from increasingly complex and segmented channels of distribution. Thus to reduce costs and improve efficiencies, companies must evaluate and improve their distribution channels through adopting the theory of RTM.

RTM attempts to align and optimise spending in marketing, sales and distribution. RTM is characterised by four qualities: (a) it is customer focused (b) coherent (c) balanced (d) and flexible [17].

1. *Market driven*: RTM is focused on ensuring customer satisfaction. In order to ensure customer satisfaction does not loose out to internal considerations such as ease of implementation, RTM considerations are developed with the ultimate customer in mind [17]. Accordingly, the array of customers is carefully characterised. Each customer is characterised according to their geographic location, market segment, sales volume, inventory, profitability and growth potential.
2. *Coherent*: To ensure customer satisfaction, RTM employs a framework that uses both top-down and bottom-up logic. The RTM framework is represented as a pyramid structure in figure 2.3.

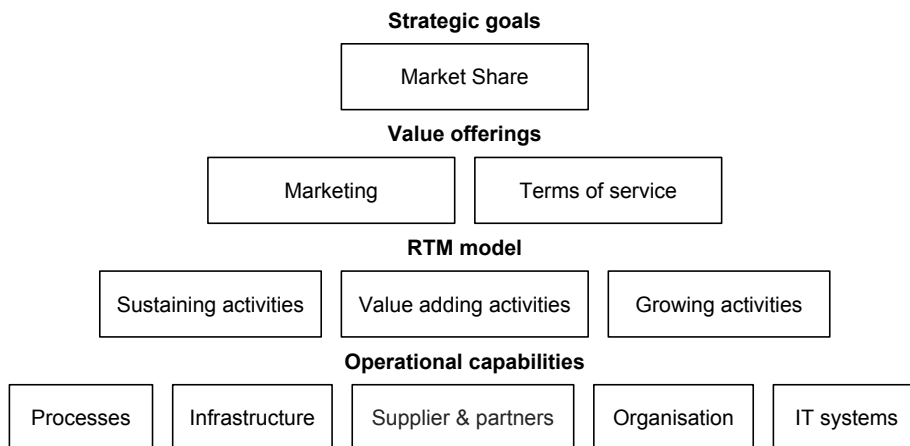


Figure 2.3: High-level framework for RTM, adapted and redrawn from [17].

Decisions flow down from strategic goals in order to guide model development and operational capabilities. In turn capabilities and support flow from the bottom shaping the value offerings and ultimately determining the strategic goals of the company. RTM creates a synergy between operational capabilities and the strategic goals of the company.

3. *Balanced*: To ensure maximum efficiency, the needs of the customer need to be balanced with economic feasibility [17]. Whether a market segment or individual customer is serviced, is determined by the associated cost to serve. The cost to serve is driven down by increased market share and volumes. In turn, the revenue growth and potential of a segment or customer affects commitment to larger volumes. Finally, both potential and revenue growth are driven by customer satisfaction. In summary, the success of RTM is determined by how well it balances the multitude of influential factors.
4. *Flexible*: External pressures create additional complexities. Disruptive innovations from competitors force companies to adapt to remain competitive. Internally customer needs are also growing more complex. Thus the single most important quality of RTM is flexibility. Flexibility allows companies to be responsive to any strategy, customers and internal growth.

2.2.1 Functional view of route to market

RTM consists of three activity types; sustaining, value adding and growing activities. Navarro et al. [17] suggested that the theory of RTM is based on a holistic approach. The interdependence of the three activities is illustrated in figure 2.4.

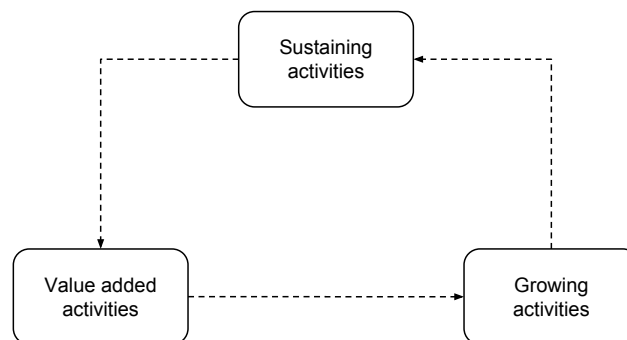


Figure 2.4: Holistic view of an RTM model, adapted and redrawn from [17]

In order to expand the reach of a company, growing activities are required. Acquiring additional customers and developing returning customers contribute

to the overall growth of a company. Secondly, to both acquire and develop customers, sustaining activities are required. Activities such as distribution and collection do not directly contribute to revenue generation but are essential to the continuity of a company. To aid growth, value-added activities are introduced. Through focusing on undertakings such as quality assurance the perceived value of a brand is improved. Through improving the customer experience value adding activities generate a positive return on investment. The three activity types can be further broken down into their fundamental tasks. Through understanding, each fundamental task and its context within a larger system the overall efficiency is improved.

2.2.2 Designing routes to market

New companies entering an unfamiliar market can ensure competitiveness by understanding how routes to market are designed. Likewise, the basic principles of RTM design can improve the competitiveness of incumbent companies. West [18] defines RTM design as an evolutionary process with various steps:

- Selecting suitable distribution channels in general.
- Selecting specific channel members.
- Establishing specific or broad agreements with channel members.
- Motivating selected channel members.
- Evaluating and benchmarking selected channel members.
- Redefining distribution channels and channel members.

By adopting a systematic approach to RTM design, companies attain distinct advantages. A systematic approach aids the effective setting and coordination of distribution objectives [18]. Likewise, the accurate assessment and definition of routes to market reduces conflict and ensures high efficiencies.

The characteristics of distribution channels determine the level of investment and management time required [18]. Thus in alignment with RTM theory the output criteria of the distribution channel must be defined down to the ultimate consumer. Output criteria determine what distribution channels can achieve and therefore directly influence company distribution strategies. West [18] defines four distinct output criterion: (a) volumes, stock holding and market entry, (b) products, (c) cash flow (d) and pricing. The implications of each output criterion are explored. The understanding of each criterion underpins the development of the route to market survey.

1. *Volumes, stock holding and market entry:* Firstly companies are concerned with selecting distribution channels with complementary volume requirements. Each type of distribution channel has unique channel members with specific volume and stock holding requirements. Thus the type of channel affects both production management and the provision of working capital [18]. Consequently, certain channels are deemed inappropriate as companies cannot fund the required stock level. The flow of volume is another important consideration for market entry. New companies have to compete with well-established incumbent companies with limited resources. Thus selecting distribution channels with a high volume flow ensures the product obtains maximum market penetration.
2. *Products:* West [18] argues there must be a harmony between product requirements and distribution channels. Firstly companies are concerned with the positioning of their products. Distribution channels have a large impact on the perceived value of the product. Thus companies selling premium products want their distribution channel to reflect it. Additionally, different distribution channels have distinct product range mixes. Distribution channels such as wholesalers typically buy a larger range of sizes and varieties compared to supermarkets. Lastly companies are concerned with controlling the final destination of their products [18]. By controlling the distribution of products companies can obtain good market penetration without inviting a violent response from incumbent companies.
3. *Cash flow:* The time between selling goods or services and receiving payment varies between different distribution channels. This affects how companies employ tools such as credit. Generally, small accounts receive limited credit, while larger accounts are afforded repayment periods in excess of 70 days [18]. However, the increased cost of revenue collection from small accounts offsets its relative advantage. Understanding how incumbent companies manage credit and payment terms allow new companies to limit their risk.
4. *Pricing:* The evaluation of distribution channels must include profitability [18]. Different types of distribution channels have a varying capacity to influence pricing policies. Thus the chosen channel affects the ultimate revenue of the company. Additionally by evaluating pricing, the margin in the channel can be identified. Typically channels with more intermediates have smaller margins compared to channels with few intermediates.

2.2.3 Application of SCOR: Designing routes to market

West [18] identified both key steps and output criteria for designing routes to market. The SCOR model is reviewed to determine whether it can supplement the findings from literature.

SCOR identifies five core supply chain performance attributes: reliability, responsiveness, agility, costs and asset management. Table 2.1 identifies relevant strategic metrics from each performance attribute.

Table 2.1: SCOR performance attributes and metrics.

Attribute	Metric
Responsiveness	<ul style="list-style-type: none"> • RS1.1 - Order fulfilment cycle time <li style="padding-left: 20px;">– RS.2.1 - Source cycle time <li style="padding-left: 20px;">– RS.3.107 - Receive product cycle time
Cost	<ul style="list-style-type: none"> • CO.1.001 - Total cost to serve <li style="padding-left: 20px;">– CO.2.008 - Cost of goods sold
Asset management efficiency	<ul style="list-style-type: none"> • AM.1.1 - Cash-to-cash cycle time <li style="padding-left: 20px;">– AM.2.2 - Inventory days of supply

The SCOR model is able to evaluate and improve supply chains. However, the metrics fail to gather all the information required to design a new route to market or distribution channel in an unknown market. Therefore to evaluate existing routes to market and design new distribution channels, the metrics together with literature theory and considerations from industry are employed.

2.3 Logistics

Essentially RTM theory allows companies to take their goods or services to market in an efficient manner. By characterising distribution channels, sources of competitiveness can be identified. However, by simply characterising distribution channels, the question of how to physically get products and services to market is not addressed. Thus the complementary concept of logistics is explored.

2.3.1 Defining logistics

Akin to the concept of SCM, logistics has changed both in scope and influence over the decades. Therefore to define logistics, the evolution thereof is explored. Logistics can be understood in five different contexts, each brought forth by an evolutionary progression [19]. The five phases of logistics: workplace, facility, corporate, supply chain and global logistics are illustrated in figure 2.5.

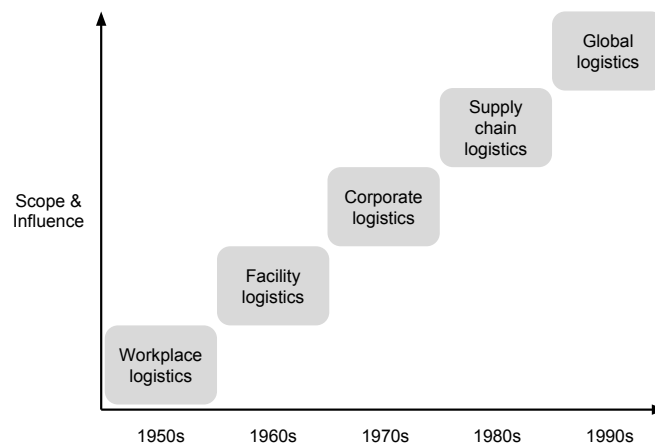


Figure 2.5: The evolution of logistics, adapted and redrawn from [19].

The principles and theory of workplace logistics were developed in the 1950s [19]. More recently referred to as ergonomics, it ensures the activities of individual workers at machines and along assembly lines are optimised. Likewise facility logistics ensures the flow of materials between workstations within the same facility are optimised. However important the theories are, neither of the two phases is a true representation of logistics. Rushton et al. [4] concur that distribution systems were largely unplanned and unformulated in the 1950s and 1960s. In the 1960s and 1970s, the concept of physical distribution was developed. It described interrelated activities such as transport, warehousing and materials handling (facility logistics). The accompanying concept of business logistics described procurement, marketing

and customer service. By assimilating the separate departments into two functions, the 1970s saw the first true application of logistics [19]. Logistics became a valid area for managerial involvement with corporate logistics becoming synonymous with reducing total logistic costs and maintaining good customer relations. Corporate logistics became strongly associated with physical distribution as it describes the flow of materials and information between facilities [19].

The introduction of IT in the 1980s allowed companies to broaden the scope of functions that could be integrated [4]. Supply chain logistics is described as the flow of products, services, finance and information between companies. Both supply chain and global logistics describe a common set of activities. However, global logistics describe the activities with respect to countries rather than companies. The set of activities is explored to better define the scope and influence of logistics in general.

2.3.2 Logistics activities

Frazelle [19] describes five interdependent logistics activities as illustrated in figure 2.6. The undertaken research is focused on the transport aspect of logistics. However, each logistics activity is briefly explored in order to understand its objective and subset of activities.

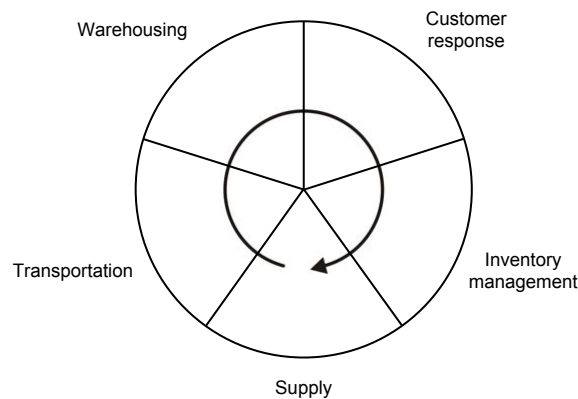


Figure 2.6: The five key activities of logistics, adapted and redrawn from [19].

Most modern supply chains have warehouses in different geographic areas and at different stages of the supply chain. Warehouses are used to store and handle raw materials, work in progress, and finished products [4]. Predominantly this serves as a buffer to market volatility and shortens lead times. Additionally, strategic storage allows companies to be more responsive to the immediate needs of customers. Therefore the objective of warehouses is to minimise the cost of operation while ensuring a good customer response.

Customer response includes a multitude of components such as on-time delivery, order fulfilment accuracy and ease of order taking. Rushton et al. [4] argue the objective of customer response is to ensure the right place, time, customer, product, cost, quantity and condition. Undoubtedly the processes of logistics and distribution are linked to customer response.

The level of customer response determines how companies manage their inventories. By reducing inventories, companies reduce the overall cost of warehousing and management. However by reducing inventories companies are less protected from market volatility and product range proliferation. Thus inventory management consists of a subset of activities that include forecasting, order quantity engineering and service level optimisation.

Supply rests upon activities from inventory management such as forecasting. Frazelle [19] defines supply as the process of building inventory through acquisition or manufacturing. By managing supply the total acquisition cost (TAC) is minimised while simultaneously ensuring good customer response.

The activity of transport links the entire supply chain together. The objective of transportation is thus to link all the pick-up and deliver-to points within an agreed upon time and cost framework [19]. The subset of activities within the concept of transportation include:

1. Network design and optimisation.
2. Shipment management.
3. Fleet and container management.
4. Carrier management.
5. Freight management.

2.3.3 Transportation logistics

An important consideration of RTM is how to physically get products to market. Here RTM theory draws from the transportation aspect of logistics and distribution management. If companies choose to outsource transportation, they are presented with a complicated selection process. A broad collection of external service providers classifies themselves as logistics service providers (LSPs). Each offers a different set of capabilities within transportation or within the broader field of logistics and distribution management. By understanding the scope of transportation activities, comparisons can be drawn to simplify the outsourcing process.

Beyond the five primary activities, the complete set of transportation planning considerations are explored in figure 2.7.

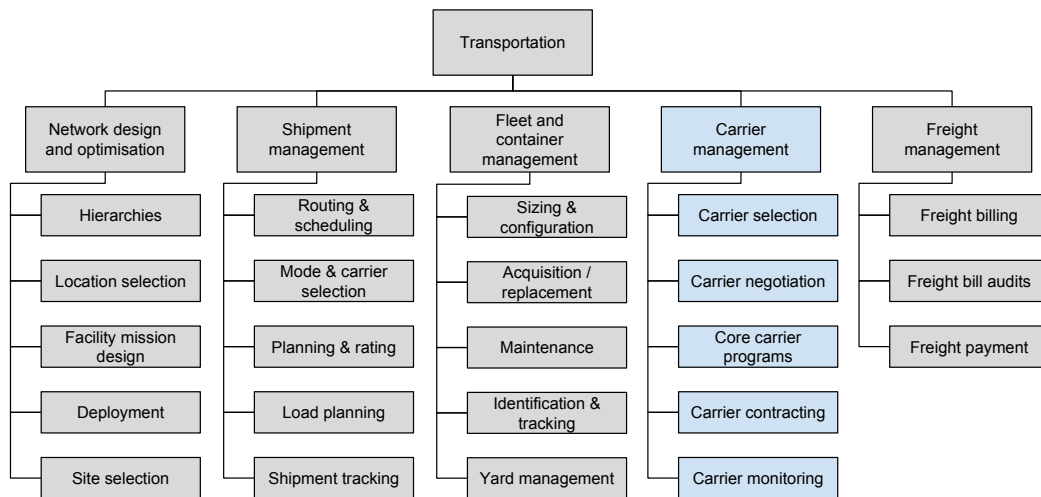


Figure 2.7: The identification of individual planning considerations within transportation, adapted and redrawn from [4].

Network design and optimisation has evolved from a cost minimisation process to a business enabling process [20]. Business drivers such as leanness, agility and speed are directly influenced by network design. Therefore the fundamental planning processes have become crucial to the overall competitiveness of a company. Frazelle [19] identifies hierarchies¹, location selection, facility mission design, deployment and site selection as key planning processes.

Shipment management starts at determining which orders can be shipped together. The most efficient mode, carrier, load size and rating² is determined for a group of orders. Simultaneously each individual order is routed and scheduled to ensure the highest level of customer satisfaction. The tracking of shipments and unique orders create an overall visibility for suppliers, carriers and customers alike.

Fleet and container management presents a crucial part of internally managing a transportation solution. Firstly the optimum number of containers and vehicles must be determined to satisfy the hourly, daily, weekly and monthly shipping requirements [19]. Next, the identified number of vehicles and containers must be sourced. A fleet can be sourced through either direct ownership, rental or dedicated contracts. Depending on how the fleet has been

¹Hierarchies determine the number of intermediates involved in bringing the product to the ultimate consumer.

²Rating is the process of determining the transportation cost of each unique shipment.

sourced, it must be maintained and augmented to satisfy customer demands. In addition, the entire fleet must be monitored. This not only improves security but ensures routes and schedules are adhered to. Lastly, the docks, yards and ports must be properly managed. By optimising these crucial nodes in the transportation network, performance indicators such as turn around times are positively affected.

Carrier management is included under the scope of transportation activities. However, it simply introduces practises required to manage the outsourcing of transportation activities. The processes are focused on selecting service providers, negotiating contracts and ultimately monitoring contract performance. Lastly, any transportation solution requires document management. If the process is poorly executed, it could incur avoidable costs. Therefore irrespective of whether the process is outsourced or not, freight billing, auditing and payment must be executed efficiently.

2.3.4 Types of logistics service providers

The categorisation of LSPs is complicated by conflicting definitions and perspectives. One solution is to classify LSPs according to their scope of services offered. Therefore the breadth of outsourcing opportunities is explored. The one extreme is identified by total internal asset management. The opposing extreme is identified by total external asset management. An example of the outsourcing continuum is further explored in figure 2.8.

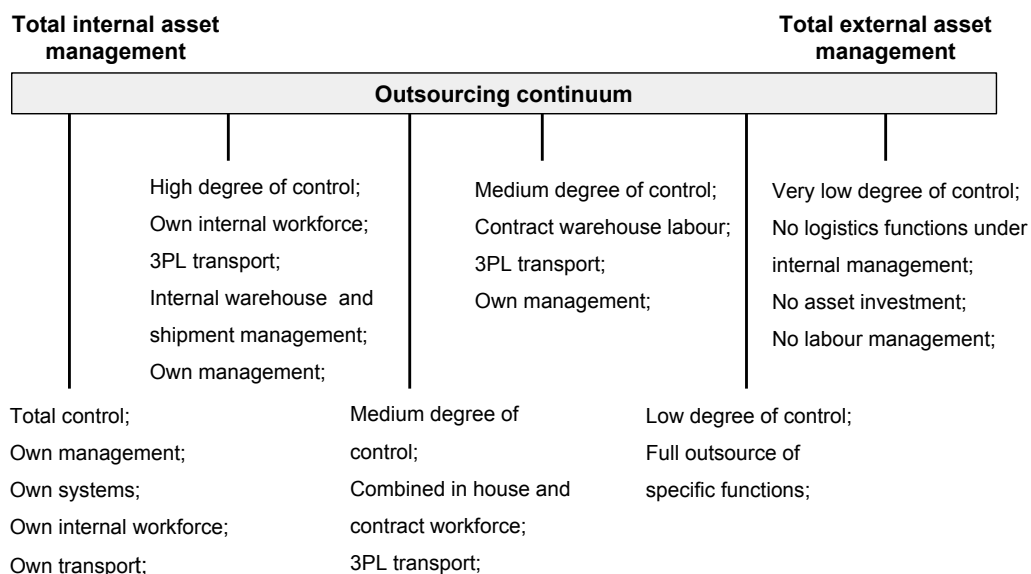


Figure 2.8: Continuum of logistics outsourcing, adapted and redrawn from [4].

The relinquish of control poses an important barrier to outsourcing. As the scope of outsourced functions grows, companies retain less control. Therefore within the outsourcing continuum, control serves as an important differentiator among types of LSPs. Broadly LSPs can be classified as dedicated or multi-user operations [4][21]. The choice between the two operations presents another important differentiating factor.

1. *Dedicated operation*: A complete logistics or distribution operation is provided by an external LSP [4]. The sourced LSP provides the client with all the necessary capabilities and resources. Additionally, the entire operation is exclusive to the client company.
2. *Multi-user operation*: With a multi-user operation, the service provider's operation is comprised of multiple clients. Generally, LSPs attempt to group clients with similar needs to improve operational efficiencies.

Typically dedicated operations are employed by large companies who require high service levels irrespective of cost. By employing exclusive operations, companies create barriers to entry for smaller competitors. Without the benefit of sharing costs, small companies are unable to recreate the same effective and profitable routes to market. For smaller companies cost usually becomes the deciding factor. The chosen operation must create a suitable balance between service requirements and costs. The deciding factors are summarised in figure 2.9.

	Dedicated	Multi-user	
Advantage	<ul style="list-style-type: none"> - Capabilities and resources focused on single client; - High degree of confidentiality; - High barrier to entry; - Specialism of depot, handling equipment and delivery vehicles; 	<ul style="list-style-type: none"> - Scale of economies; - Consolidation of loads; - Opportunity to find clients with different business seasonality; 	Service
			Cost
Disadvantage	<ul style="list-style-type: none"> - Single client responsible for total cost of operation; - During off-peak season, resources and capabilities are underutilised; 	<ul style="list-style-type: none"> - Conflicting demands; - Competitor products on same vehicle; - Equipment is not specialised; - Cross subsidisation; 	Cost
			Service

Figure 2.9: A comparison of dedicated and multi-user operations, emphasising cost and service considerations, adapted and redrawn from [4].

Three components to classifying LSPs have been proposed: (a) scope of services offered (b) degree of control relinquished (c) and the type of operation. According to the three components, six unique arrangements have been identified within the outsourcing continuum. The arrangements are described as: (a) own fleet (b) owner driver (c) crowdsourced (d) distributor (e) 3PL and (f) 4PL. The six arrangements are compared with one another according to the three proposed classifications in figure 2.10. The periphery of the plot represents the highest degree e.g. complete relinquish of control, while the centre represents the lowest degree.

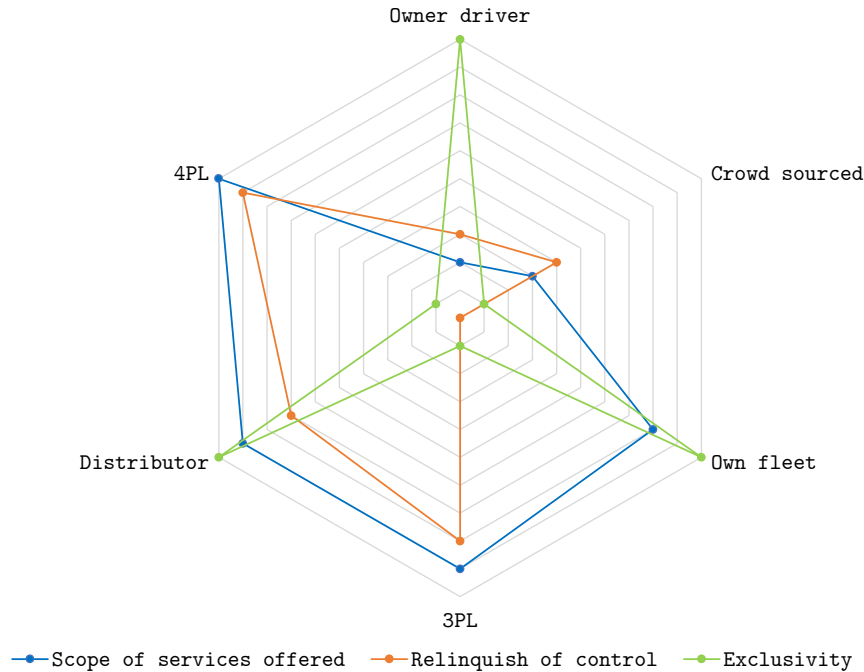


Figure 2.10: A comparison of the six identified arrangements.

Companies can invest in their own fleet to perform logistics and distribution functions. This arrangement is characterised by total internal asset management and control. The first partial outsourcing arrangement is described as an owner driver operation. It is similar to operating an own fleet, as it retains a large proportion of logistics functions in-house. However, the responsibility of the delivery vehicle is shifted towards the owner driver. An owner driver operation provides ownership opportunities, while retaining a high level of control over the delivery function.

Crowdsourcing refers to an Uber model tailored towards distributing products. Similar to owner driver operations, the responsibility of the delivery vehicle is outsourced. Crowdsourcing describes an on-demand service, free of contracts. Therefore the degree of control retained by the company is drastically diminished. However, the flexibility of the distribution function

is greatly increased. With no formal contracts, the arrangement becomes a multi-user operation.

A 3PL service provider specialises in the integration of logistics activities. Activities typically include warehousing and transportation, but may include value added activities such as the procurement of goods. A distributor, 3PL and 4PL do not offer substantially different services. However, with regards to control and operation type, distinctions can be made. The highest degree of outsourcing is attained by employing a 4PL service provider. It is a non-asset service provider that manages a multitude of LSPs on behalf of the client company. High efficiencies are achieved through economies of scale and consolidation. Additionally, the cost of the entire operation is split among multiple clients. Similarly, distributors take over the entire logistics section of the company. However, distributors remain exclusive³ and only manage a small percentage of the total product output. This allows companies to retain a high degree of control.

Companies can either partially or entirely outsource their scope of logistics functions to a 3PL. This creates a clear distinction between 3PLs and 4PLs, as 4PLs take over the entire logistics function. Although 3PLs are multi-user operations, they do not consolidate loads⁴. A 3PL provides each of its clients a unique and exclusive service. Companies are able to choose the degree of control retained, by choosing which functions to outsource.

³Distributors are assumed to be exclusive.

⁴It is assumed 3PLs do not consolidate loads.

2.4 The theory of outsourcing

Outsourcing has been practised since the 1950s, yet it was only widely adopted as an organisational strategy in the 1980s [22]. Before outsourcing, successful companies attempted to obtain ownership of most of their own supply chain. This allowed companies to gain maximum efficiency through what was known as vertical integration [13].

Vertical integration allowed Henry Ford to manufacture a complete automobile within 81 hours after mining the iron ore [13]. To accomplish this feat no model could be customised. The Ford model T stands testament to the lack of novelty involved in manufacturing. It could be ordered in any colour as long as it was black. By focusing on efficiencies and ignoring customer desires Ford obtained a 50% market share by the 1920s. Undeniably vertical integration was perfectly suited to the slow moving mass markets of the early 20th century. But as the market grew along with the expectations of customers the model became obsolete [13].

The new fast moving markets required a more flexible and responsive supply chain giving way to the first wave of outsourcing. The development of outsourcing as a strategy can be grouped into three distinct phases: the tactical, strategic and transformational phase [22]. With the widespread adoption of outsourcing in the 1980s companies reduced costs by outsourcing non-core business processes [23]. Accordingly, the first phase of outsourcing is characterised by its focus on reducing operational costs. The second phase of outsourcing moved the focus of the strategy from cost reduction to value enhancement [24]. The strategic phase of outsourcing allowed companies to focus on core competencies while acquiring external skills and knowledge through outsourcing. Lastly, the transformational phase of outsourcing describes a phase where outsourcing has become the norm instead of a competitive differentiator [23]. From the 1980s outsourcing has developed from an ancillary strategy to a business model upon which companies are built.

The main motivating factors for outsourcing include cost reduction, resource and capability acquisition, a focus on core activities and flexible management [25][26]. In contrast information security concerns, loss of management control and labour unions discourage outsourcing as a strategy [25]. Thus companies must understand the why, what, where and how of outsourcing. The potential benefits and risk factors should be weighed against one another and a framework developed to guide the process. A number of theories from different disciplines have been proposed to guide the outsourcing process and aid the development of frameworks. The most notable theories include TCE, the RBV and the core competence approach.

2.4.1 Defining outsourcing

Originally the term outsourcing was understood to be an abbreviation for "outside resource using" [25][27]. This understanding failed to differentiate between tangible and intangible value creation. The make or buy decision from manufacturing dealt with tangible value creation, but failed to address intangible value creation. Accordingly, supplementary work was done to further define intangible value creation. This stream has mainly dealt with IT and IS outsourcing. Further from IS outsourcing business process outsourcing (BPO) was developed. Competencies such as accounting, finance, facility operations, logistics, legal services, marketing and public relations can all be contracted externally under BPO [25]. In broad terms, BPO refers to the outsourcing of all competencies which are non-essential to the market position of the company. Evidently, the definition of outsourcing is dependent on the relevant research stream. Accordingly for the purposes of this research outsourcing is defined as an organising arrangement to secure external capabilities while developing internal capabilities to ensure future competitiveness, flexibility and innovation [24].

2.4.2 Outsourcing engagements

Before companies address the what, where and how of outsourcing, it must be clear why to outsource or not. According to Gunasekaran et al. [23] outsourcing decisions are influenced by the categories of outsourcing engagements. Two dimensions are identified by Sanders et al. [28] that differentiate outsourcing engagements. Primarily outsourcing engagements are differentiated by the scope of the function outsourced and to a lesser extent the associated criticality of the function.

The scope of the outsourced function can range from a simple task to a complex management process. Therefore the scope of the function has a direct relationship with the level of responsibility relinquished. Outsourcing engagements are divided into four categories based on their associated scope. The four categories include *out-tasking*, *co-managed services*, *managed services* and *full outsourcing* [28]. Each category is defined below.

1. *Out-tasking*: The simplest form of outsourcing involves relinquishing responsibility for a single task, where a function is composed of multiple tasks. In logistics, an example of such a simple task is restocking shelves.
2. *Co-managed services*: In this case the client and supplier share responsibility. The relationship is usually described as a collaborative one. The scope of the tasks or functions are typically larger than with out-tasking, but with minimal strategic significance.

3. *Managed service*: Here an entire function is outsourced. The scope of the function includes all the steps from design to implementation to the management thereof. A managed service implies that an external company delivers an end-to-end solution [28].
4. *Full outsourcing*: This category describes the highest level of responsibility outsourced. In addition to delivering end-to-end solutions, the external company determines the strategic direction of the function.

Apart from the scope of outsourced functions, the criticality of the functions also determines the level of engagement. Out-tasking and co-managed services describe tactical tasks and functions with low criticality. In contrast managed services and full outsourcing describe strategic functions with high criticality. Therefore the criticality of a task or function is defined as the impact it has on the ability of a company to compete effectively and perform core competencies [28].

The criticality of tasks and functions determine the nature of the relationship entered by the client and supplier. In order to counteract the increased risk with outsourcing functions with a high degree of criticality, companies move from arm's length to more intense relationships. The intensity of the relationship is dependent on both the scope and criticality of the function. Therefore four categories of relationships are proposed by Sanders et al. [28]. Each category corresponds to a combination of the two dimensions of outsourcing engagement. Each of the four relationships is described below.

1. *Nonstrategic transactions*: These transactions have a very limited scope and low criticality. Typically the transactions are related to commodity exchanges and first-time transactions [29]. As many alternative forms of supply exist for commodity items, the relationship does not develop and is managed by an arm's length approach.
2. *Contractual relationship*: Contractual relationships are entered to achieve greater control over business activity between the client and supplier [29]. Although the scope and criticality of the outsourced functions remain low, the volume of business conducted merits a more intense relationship. The increased volume of business creates a dependency between the client and supplier.

3. *Partnerships*: Rinehart et al. [29] describe a partnership as a relationship with a deep mutual trust and high level of commitment. While the scope of the outsourced functions remains low, the criticality is high. A well-suited example of this arrangement could be the just in time sourcing of a critical component [28]. Further Kedia and Lahiri [24] propose three types of partnerships, represented by different degrees of value proposition and supplier involvement as depicted in figure 2.11. Typically companies are involved in many tactical partnerships, but only a few strategic and transformational partnerships.

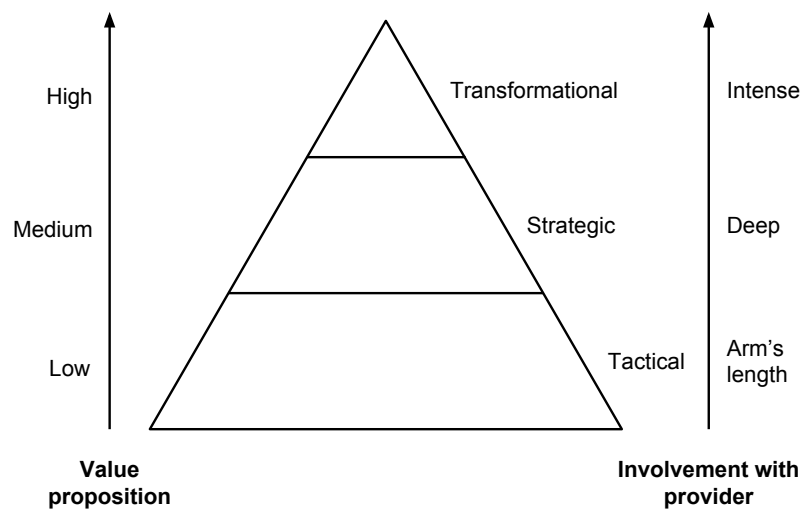


Figure 2.11: Different types of partnerships, adapted and redrawn from [24].

4. *Alliances*: An alliance represents the most extensive outsourcing relationship. The relationship is characterised by a high level of commitment, frequent interaction and a deep mutual trust [28][29]. Lastly, this relationship is only entered into when the scope is large and the criticality of the function is high.

Sanders et al. [28] stress that the time and resource commitment to each relationship must be factored into any outsourcing decision. Typically more intense relationships with strategic implications require an internal structure prepared to manage ongoing relationships. In contrast less intense or arm's length relationships only require performance monitoring as the outsourced functions are only tactical in nature. Due to the time and resource commitment of intense relationships, companies only enter few alliances and partnerships. As the degree of criticality and scope decreases less extensive relationship management is required. Therefore companies enter many contractual and nonstrategic relationships.

Figure 2.12 provides a concise summary of the multidimensional nature of outsourcing engagements. It illustrates how the scope and criticality of the function determine the category of outsourcing. Additionally, it indicates which relationship corresponds to the scope, criticality and outsourcing category.

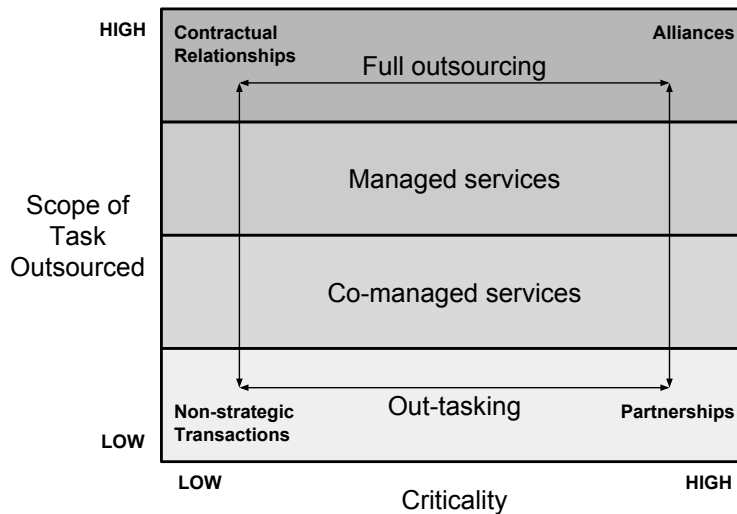


Figure 2.12: Multidimensional nature of outsourcing engagements, adapted and redrawn from [28].

2.4.3 Understanding tactical and strategic outsourcing decisions

Companies have always had to make decisions on determining the scope and boundaries of the company [30][31]. However, in recent years the complexity of boundary decisions has intensified. It follows from increased competition and accelerated innovation specifically in information and communication technologies. This has led to the rapid growth of outsourcing and its scope of tasks and functions [31][32].

The type of outsourcing engagement should be selected to support the business objectives the company is attempting to realise [28]. Therefore the right questions must be asked to identify and understand the reason for outsourcing. Questions that need to be asked include: What problem or inefficiency is the company attempting to address? Is reducing costs or asset investment the main motivating factor? Does the company require external knowledge and experience? Is the company attempting to increase its global footprint?

More tactical engagements such as out-tasking and co-managed services are generally focused on financial considerations [28]. In addition to financial considerations, tactical engagements can also address resource objectives. For example, outsourcing can increase the geographic footprint of a company without increasing the staffing burden. As the scope and criticality increase with managed services and full outsourcing additional considerations are required. In these strategic engagements financial and resource objectives are not the dominant considerations. Two influential theories, TCE and the RBV of the company, have been proposed to better understand strategic outsourcing [31].

Strategic outsourcing allows companies to source specialised capabilities from intermediate markets in order to complement internal capabilities. TCE stipulate conditions under which economic exchanges must either be managed internally or externally [31][33]. This theory focuses on governance structures and their related transactions costs. Williamson [34] argues due to the bounded rationality of people ⁵ all complex contracts are incomplete bringing about transaction costs. Transactions costs include all costs related to negotiating, contracting, and the monitoring thereof. In short, TCE examines the impact of governance structures on outsourcing decisions and the resulting performance [30]. The governance structure is intended to provide adequate safeguards and control for complex outsourcing engagements such as full outsourcing. By contrast, for simple outsourcing engagements such as out-tasking, the governance structure must be simplified to ensure swift decision making and flexibility.

Alternatively, the RBV perceives the company as a collection of assets, which if utilised properly can create a competitive advantage [35]. It is especially relevant to strategic outsourcing as it incorporates both tangible and intangible resources. The primary concern of the RBV is determining how the capabilities of a company determine its competitive position and performance [31]. This allows the boundaries of the company to be determined, guiding the strategic decision of whether to outsource. If an arrangement of assets creates a competitive advantage, the function should be kept internal to the company. On the contrary, if the absence of an asset or inferior arrangement impacts performance negatively, the function should be outsourced. Therefore, according to the RBV, the decision to outsource is influenced by the following: Can a competitive advantage be maintained through developing and investing in the capability? Does the capability impact performance negatively due to a lack of assets? Does performing the capability internally provide any advantage over outsourcing?

⁵According to bounded rationality people are inherently rational but in a restricted sense. Thus people are neither completely rational nor irrational, but are simply attempting to rationally endure.

2.4.4 Transaction cost economics

Following the brief introduction to the theory of TCE, key assumptions, constructs and propositions are detailed to further the understanding thereof. TCE explores outsourcing from an economic standpoint. Therefore the decision to outsource is essentially determined by the comparable risk and cost of internal and external operations [36].

The associated risk and cost is determined by the governance structure chosen to manage the client-supplier transactions. All transactions occur in an environment where all participants are kerbed by their own bounded rationality and are exposed to opportunism by other participants [36][37][38]. Bounded rationality implies complex contracts cannot account for every circumstance and the impact thereof on the transaction. The resulting omissions in complex contracts result in self-interested strategic behaviour [37]. Such strategic behaviour includes renegotiating conditions and subtle violations of the agreed upon conditions. Both the notion of bounded rationality and opportunism result in transaction costs. In order to minimise transaction costs, TCE puts forth the theory of discriminating alignment [39].

Each transaction has its own specific set of attributes. These attributes determine the associated contracting hazards and the subsequent safeguards. While TCE aims to minimise the cost of transactions, the misalignment of transactions and governance structures lead to inefficiencies. Inefficiencies can result from either inadequate safeguards against hazards or from excessive governance [39]. Inadequate safeguards result in costs related to opportunistic behaviour, potential delays and challenges in monitoring. In contrast, excessive governance generates transaction costs through additional administration. In sum, discriminating alignment attempts to match simple transactions with simple governance structures, while complex transactions are matched with increasingly complex governance structures.

In order to better understand strategic outsourcing and its related transaction based considerations, the composition of transaction costs are explored. Transactions costs are typically defined in terms of two components as described by equation 2.1 [38][40]. For companies to compete effectively in a supply chain or bilateral arrangement information must be exchanged. The cost of exchanging and incorporating information into decision-making processes are defined as coordination costs. The information typically includes demand forecasts, availability and pricing structures. Additionally coordination costs include the cost to inform and to be informed of changes on short notice. To ensure changes are effected consistently and on time coordination costs are increased [40].

$$\textit{Transaction costs} = \textit{Coordination costs} + \textit{Transaction risk} \quad (2.1)$$

Transaction risks are described by three transaction based considerations: asset specificity, small numbers bargaining and uncertainty [30][36][37][38][39].

1. *Asset specificity*: Wever and Trienekens [37] describes an asset as specific if its value decreases when it is deployed to an alternative use. Likewise, Holcomb and Hitt [30] argue asset specificity refers to the degree to which an asset can be transferred without forgoing its productive value. A number of assets can be considered specific. Examples include training employees or investing in physical assets to cater to the idiosyncratic needs of a particular client [38]. Asset specificity puts a company at risk of opportunism when it creates a bilateral interdependence. Such a situation exposes the company to hazards including fluctuating prices and reduced service levels [36]. Accordingly, the level of asset specificity directly increases the associated transaction costs. Consequently, companies are more likely to forgo the increased costs and risk by keeping asset specific functions in-house.
2. *Small numbers bargaining*: If a small number of specialised companies exist in the intermediate market transaction risks are greatly increased. This is referred to as small numbers bargaining. It creates market inefficiencies and increases the occurrences of opportunistic behaviour [30]. The occurrences of opportunistic behaviour are magnified when a transaction-specific investment is large. Small numbers bargaining skews the bargaining power of participants in a bilateral relationship. Holcomb and Hitt [30] as well as Bacharach and Lawler [41] refer to bargaining power as the ability to exert influence over one another in order to effect the outcome of negotiated terms. In highly competitive environments companies have diminished influence resulting in more collaborative relationships. Collaborative relationships allow transaction participants to share scale economies, dampens opportunistic behaviour and ultimately reduces transaction costs. In contrast, the effect of small numbers bargaining and uncompetitive environments increases transaction costs and serve as a strong deterrent to outsourcing.
3. *Uncertainty*: Ellram et al. [36] propose two types of internal uncertainty: uncertainty in terms of requirements and uncertainty regarding performance. Bounded rationality implies people are neither truly rational nor completely irrational. This suggests with limited rationality and foresight actors cannot always fully grasp the requirements of complex functions. When the requirements for a specific function is unclear, outsourcing presents a number of hazards. Poorly understood functions are kept in-house to retain control of unanticipated benefits and costs [36]. Additionally due to the nature of some complex transactions, actors are unable to verify whether the obligations of the

contract have been fulfilled [33]. This leads to opportunism and increased transaction costs. Therefore companies are more likely to insource such functions in order to limit their exposure to additional risks. More generally Wever and Trienekens [37] refer to uncertainty as unexpected changes concerning the transaction and larger contract environment.

According to the TCE framework, varying contracts can be employed to reduce the magnitude of transaction risks. The chosen contract and governance structure create value through minimising the collective cost of governance and opportunism [37]. Consequently, TCE examines the comparable advantages of different contracts and governance structures. According to Williamson [33] transactions can either occur in the market or within a company. This represents two polar contracting modes: market contracts and hierarchical contracts. Hybrid contracting represents an intermediate contracting mode instead of one of the two polar representations. Each contracting mode has a relative cost advantage based on the transaction type. Market contracts are best applied to non-strategic transactions. In comparison, hierarchical contracts are best suited to transactions described as both high risk and strategic [37]. Williamson [34] proposed a simple contractual schema to summarise the alignment of governance structures and transactions, illustrated in figure 2.13.

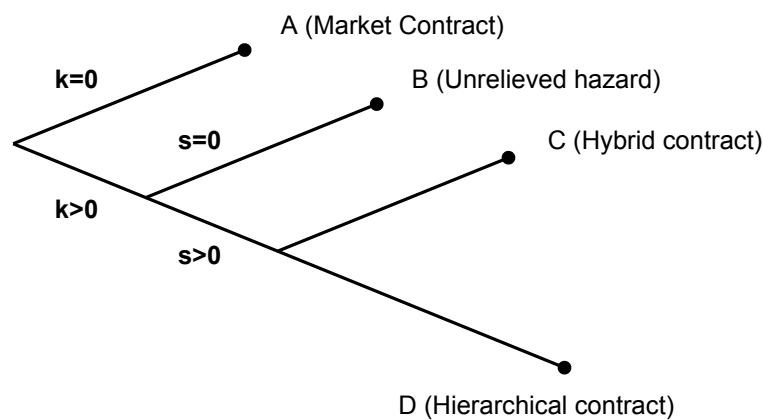


Figure 2.13: Simple contractual schema, adapted and redrawn from [34].

Williamson [33] notes asset specificity as the principle contributing factor to transaction costs. Suitably the contractual schema proposed by him three decades later is focused on asset specificity. It is assumed the focal company can either outsource or maintain any function in-house. Letting k represent the level of asset specificity, $k=0$ represents a low level of asset specificity or general purpose asset. Correspondingly $k>0$ represents specific assets. Increased levels of asset specificity create bilateral dependencies between

transaction participants. In order to mitigate the hazards introduced by asset specificity, companies introduce safeguards. An $s=0$ condition represents a transaction with no safeguards, while $s>0$ signifies the introduction of appropriate safeguards.

Node A represents an ideal transaction in law and economics where a low level of asset specificity requires no safeguards [34]. The transaction is governed by the competition between faceless participants and disputes are settled by the court of law. Transactions belonging to node B are characterised by specific assets ($k>0$) and a lack of safeguards ($s=0$). Instead of implementing safeguards, the associated risks are priced out [34]. The chosen governance structure represented by node C and D mitigate hazards through interfirm contractual safeguards. However, if transaction costs remain high at node C despite best efforts, a function can be vertically integrated under node D. Williamson [34] describes vertical integration as a last resort to maintain control over higher degrees of asset specificity and uncertainty.

According to TCE appropriate governance reduces the overall cost of transactions. Subsequently, the cost of a particular transaction will be higher under node B than C. The added safeguards introduced under node C reduces contractual hazards and contingency costs. This implies transaction participants do not need to be petitioned to offer safeguards [34]. Credible commitments become the norm when participants strive to lower transaction costs through implementing adequate safeguards. Therefore node B implicitly represents a less efficient governing structure than node C and is not recognised as a viable outsourcing arrangement by TCE.

The propositions gathered from TCE are summarised to emphasise its significance with regards to outsourcing decisions.

Table 2.2: Summary of key propositions gathered from TCE literature.

Transaction consideration	Proposition	Reference
Asset specificity	If a transaction requires a large asset specific investment with limited opportunity for redeployment, the function must not be outsourced.	Holcomb and Hitt [30], Ellram et al. [36], Grover and Malhotra [38].
Asset specificity	If an asset specific investment encourages collaboration between transaction participants while decreasing cases of opportunism, strategic outsourcing must be pursued.	Holcomb and Hitt [30].

Transaction consideration	Proposition	Reference
Small numbers bargaining	The likelihood of pursuing strategic outsourcing is positively related to the number of specialised companies in the intermediate market.	Holcomb and Hitt [30].
Uncertainty	The volatility of the supply market is inversely related to the likelihood of outsourcing an affected function.	Ellram et al. [36].
Uncertainty	The more uncertain companies are of the requirements of any specific function, the more inclined companies are to vertically integrate.	Ellram et al. [36].
Uncertainty	If the complexity of the function hinders the verification of contractual performance, the function must be maintained in-house.	Ellram et al. [36].
Uncertainty	Technological uncertainty has a non linear effect on the likelihood of outsourcing. High levels of technological uncertainty create information deficits that deter outsourcing. Conversely, at moderate levels of technological uncertainty, outsourcing is preferred in order to transfer the risk of variability. At low levels of technological uncertainty function are maintained in house.	Holcomb and Hitt [30].

Lastly, to fully understand the impact of TCE on the outsourcing decision, its shortcomings and critique must be assessed. While TCE offers a powerful theoretical assessment of governance structures, its restrictive assumptions have been challenged [30][38].

Early TCE literature failed to account for the effect of existing governance structures and value chain activities. Thus the early conceptualisation of TCE implied separate companies faced with similar transaction attributes will reach the same conclusion as whether to outsource or not [42]. However based on an industry-wide comparison of outsourcing decisions such a proposition is unattainable. While companies such as IBM have remained vertically integrated, Dell has achieved similar success by outsourcing a variety of both tactical and strategic functions [30]. In response Nickerson et al. [43] and other authors have addressed the effect of existing company governance structures. Despite the well-documented shortcomings of TCE, a number of criticisms remain unaddressed. Geyskens et al. [44] notes the TCE framework

examines transaction risks in isolation of one another. Thus companies are unable to mitigate multiple transaction hazards when TCE proposes conflicting contractual solutions. Likewise, the understanding of relations between governance structures and transaction costs are largely confined to bilateral transactions [45].

In order to limit the risk of opportunistic behaviour, companies are encouraged to insource functions associated with a high degree of transaction risk. Alternatively, companies can limit their exposure to hazards through entering long-term formal contracts with adequate safeguards [37]. Therefore to control the exposure to transaction risks, suppliers require long-term formal contracts which for example guarantees the focal firm will purchase x amount of the total output. Although the focal company has minimised transaction costs and secured a supply of products, it is still exposed to demand-side uncertainty resulting in inefficiencies. In this regard, TCE fails to address two particular issues. Firstly the impact of decisions on the wider supply chain environment is poorly understood by TCE literature. Secondly, transaction risks cannot be mitigated through governance structures when the consumer is part of the transaction. As a result, the possible interdependencies between separate transactions must be taken into account by the TCE framework [46]. In sum the TCE framework has been criticised for the following reasons:

1. TCE ignores the importance of a company's existing governance structure and portfolio of transactions.
2. TCE fails to acknowledge that a hierarchical construct could encourage opportunistic behaviour.
3. The notion of trust fostered by personal relationships or social norms are underrepresented in TCE considerations.

Thus only using economic motives limits the quality of discourse surrounding the decisions behind outsourcing engagements [30]. Therefore the following section considers the implications of the resource based view.

2.4.5 Resource based view

In a critique of TCE, McIvor [31] argues its value lies in avoiding negative opportunism. Conversely, the RBV considers the company an arrangement of assets⁶ that can potentially create a competitive advantage. The degree to which an asset can create a competitive advantage is determined by four criteria: value, rarity, imitability and organisation [31].

An asset is considered valuable if it facilitates the pursuit of opportunities, allow companies to adapt to changing markets and respond to competitive threats. Likewise, the rarity criterion is a strong component of any competitive advantage. An asset that exists in abundance in the free market cannot be considered a competitive differentiator, while increasingly rare assets serve as distinct competitive advantages. In addition to being both valuable and rare an asset must serve as a sustainable source of competitiveness. If an asset can be replicated by competitors with ease, its potential value to the company is lost. Lastly, the degree of competitive advantage provided by an asset is determined by its surrounding organisational structure. This includes reporting structures, management systems and compensation policies [31].

Beyond the four criterion, the RBV argues the pursuit of competitive advantages obtained through market relationships influence strategic outsourcing [30][47][48]. Altering the organisational structure of existing assets can create both value and decrease the threat of imitation. However without acquiring new assets companies limit their scope of capabilities and competitive advantages [48]. Further, Holcomb and Hitt [30] argue the value of strategic outsourcing is dependent on different conditions. Thus four resource based considerations and their significance to strategic outsourcing are explored. These conditions include complementarity of capabilities, strategic relatedness, relational capability-building mechanisms and cooperative experience.

1. *Complementarity of capabilities:* Companies pursue strategic outsourcing to gain access to new and unique competencies. However the performance of value chains are improved when participants not only gain access to unique but complimentary capabilities [49]. Complementary capabilities are defined as different, but mutually supportive competencies. Likewise Hitt et al. [50] argues companies attempt to leverage their assets by pursuing outsourcing engagements with complementary capabilities. Such engagements can potentially improve scale economies, innovation, quality and responsiveness to market conditions [30]. Further, the possibility of imitation is reduced. In order to duplicate such a capability, competitors need to recreate

⁶By definition an asset is identified by five categories: financial, human, physical, technological and reputation [47].

two separate competencies and the coordination thereof with different assets.

2. *Strategic relatedness*: Broadly strategic relatedness is a measure of the strategic similarities between companies. A high degree of strategic relatedness implies both companies have related knowledge and capabilities thus encouraging cooperation [51]. Further Holcomb and Hitt [30] argue strategic similarities ultimately creates common goals. Outsourcing engagements characterised by common goals present a number of advantages. Firstly as both companies have similar interests, performance measurements can be aligned. Secondly, similar operational, strategic and performance objectives reduce monitoring and enforcement costs and increase synergies [30]. Lastly, these synergies lead to increased cooperation, decreased opportunism and encourages further outsourcing engagements.
3. *Relational capability-building mechanism*: Companies develop capabilities over time implying a dynamic approach to the RBV is required. In response Helfat and Peteraf [52] defines dynamic capabilities as a company's ability to build, integrate and reconfigure assets in response to competitive threats. The theory of dynamic capabilities suggests companies who are able to both develop and manage a capability over its life cycle have an added competitive advantage. The ability to create and leverage specialised capabilities is described as capability-building mechanisms by Holcomb and Hitt [30]. These mechanisms allow companies to acquire, integrate and employ capabilities in pursuit of both present and future opportunities. Relational capability-building mechanisms allow companies to better manage outsourcing engagements creating increased synergies and efficiencies.
4. *Cooperative experience*: In contrast to TCE, the RBV incorporates foregoing relationships into the outsourcing decision. Holcomb and Hitt [30] argue the social context of outsourcing engagements affect decision making. Thus repeat engagements with specialised companies from intermediate markets create cooperative experience. Increased cooperative experience facilitates information and capability sharing while building a basis of trust. Importantly the RBV recognises mutual trust as an important driver to lower transaction costs and complexity. With increased mutual trust companies reduce occurrences of opportunistic behaviour and increase the overall efficiency of outsourcing engagements. In sum cooperative experience leads to increased outsourcing engagements which broaden company scope and capabilities. Over time the value chain of the focal company is improved as a result.

Moreover, the RBV provides a framework to determine which functions must be outsourced or retained in-house. In this regard, the core competencies approach is considered one of the most influential theories. By outsourcing ancillary functions companies increase managerial attention and resource allocation to core competencies [53]. This ultimately improves the performance of the firm. While short-term success depends on the price and attributes of the service or product, developing core competencies ensure the long-term competitiveness of the company. Similarly, the RBV identifies rarity and imitability as key drivers of competitiveness.

The RBV helps companies to identify critical assets and capabilities which form core competencies. The identification of core competencies allows companies to enter beneficial outsourcing engagements by outsourcing ancillary functions. In contrast, companies must not outsource core competencies, but implement systems to protect it [30]. Further Gilley and Rasheed [53] argue company performance is influenced by the intensity with which near-core competencies are outsourced. By outsourcing near-core or strategically important functions, companies increase competition from the market and endangers future competitiveness. Complimentary to the core competencies approach, Grant [54] proposed a framework to guide strategy development illustrated in figure 2.14.

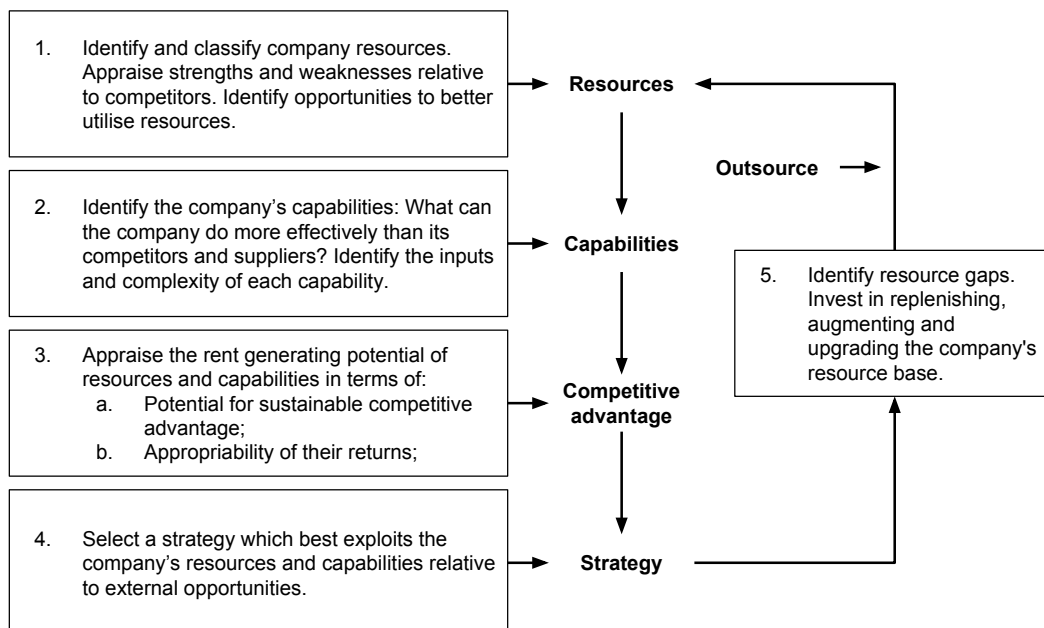


Figure 2.14: A resource-based approach to outsourcing strategy, adapted and redrawn from [47][54].

The framework recognises company resources ⁷ and capabilities as the main considerations in formulating strategies [47]. The framework consists of five procedures: evaluate company resources, assess company capabilities, explore the profit earning potential of both company resources and capabilities, selecting strategy and upgrading the company resources base. Grant [54] argues in order to fully exploit a company's existing resources and capabilities, and to develop future competitive advantages, the pursuit of new capabilities through strategic outsourcing is necessary. Any resource can be acquired through purchases or strategic alliances to improve strategy and pursue new opportunities.

In agreement with TCE, the RBV argues asset specificity influences the outsourcing decision. Creating capabilities to develop specific assets can be done in-house at a lower cost than through outsourcing engagements [47]. Barney [55] argues the decision to create or acquire capabilities is not only influenced by asset specificity, but by the associated cost as well. When the cost of hierarchical governance is high, companies will pursue outsourcing engagements, irrespective of the level of asset specificity. Thus capabilities are an important factor in determining the boundaries of the company as capabilities can be costly to develop or acquire through vertical integration. Therefore according to the RBV, investing in the creation of capabilities that can be obtained from the market will not lead to any competitive advantage [47].

In summary of the RBV and its significance to strategic outsourcing, key propositions are gathered from literature.

Table 2.3: Summary of key propositions gathered from RBV literature.

Proposition	Reference
<ul style="list-style-type: none"> • The degree of complementarity between a company's internal capabilities and that of company from the intermediate market, positively affects the pursuit of strategic outsourcing. 	Holcomb and Hitt [30].
<ul style="list-style-type: none"> • The more valuable and specific the resource and capabilities are, the less likely it is to be outsourced. 	Espino-Rodriguez and Padron-Robaina [47].
<ul style="list-style-type: none"> • Common goals between a focal and specialised company from the intermediate market encourages outsourcing engagements. 	Holcomb and Hitt [30].
<ul style="list-style-type: none"> • If capabilities can easily be replicated by competitors, the likelihood of outsourcing is low. 	Espino-Rodriguez and Padron-Robaina [47].

⁷The terms resources and assets are used interchangeably.

Proposition	Reference
<ul style="list-style-type: none"> • Access to relational capability-building mechanisms increases the likelihood a company will engage in strategic outsourcing. 	Holcomb and Hitt [30].
<ul style="list-style-type: none"> • Functions representative of ancillary capabilities are very likely to be outsourced. 	Espino-Rodriguez and Padron-Robaina [47].
<ul style="list-style-type: none"> • Cooperative experience defined by the length and quality of previous engagements increases the likelihood of strategic outsourcing between a focal and specialised company from the intermediate market. 	Holcomb and Hitt [30].

Lastly, the complimentary nature of TCE and the RBV is explored. TCE cites asset specificity and opportunism as the principle factor creating transaction costs. Thus to lower transaction costs and the risk of opportunism, functions characterised by a high degree of asset specificity must be retained in-house. Likewise, the RBV argues functions comprised of idiosyncratic resources must be developed in-house to reduce the cost. Therefore both perspectives look towards the degree of asset specificity and capabilities to determine the company boundaries [47].

TCE opposes outsourcing functions with a high degree of asset specificity as the cost of governance and protection is high. The RBV proposes another consideration beyond the transaction cost perspective. If the cost of development is sufficiently lowered through obtaining external knowledge, capabilities and assets the function must be outsourced nonetheless. Likewise Ray et al. [56] stress functions must be outsourced if internalisation negatively affects the potential competitive advantage. TCE does not recognise the need for companies to focus on core competencies to ensure future competitiveness. Thus TCE does not consider preserving strategic assets or the influence of current relationships and transactions [55]. The study of both TCE and the RBV enriches the outsourcing perspective. The complimentary nature is summarised in table 2.4.

Table 2.4: A summary of TCE and the RBV of the company, adapted from [47][57].

	Transaction cost economics	Resource based view
Unit of analysis	<ul style="list-style-type: none"> • Transactions 	<ul style="list-style-type: none"> • Assets and capabilities
Assumptions	<ul style="list-style-type: none"> • Bounded rationality • Opportunism 	<ul style="list-style-type: none"> • Bounded rationality
Considerations	<ul style="list-style-type: none"> • Asset specificity • Uncertainty • Small numbers bargaining 	<ul style="list-style-type: none"> • Strategic relatedness • Cooperative experience • Complementarity of capabilities • Capability-building mechanisms
Objective	<ul style="list-style-type: none"> • Transaction cost minimisation 	<ul style="list-style-type: none"> • Observe creation of value
Risks	<ul style="list-style-type: none"> • Dependence on supplier • Hidden costs • Post-contractual threat 	<ul style="list-style-type: none"> • Loss of critical capabilities

2.5 Outsourcing logistics

Transportation represents one set of activities within the broad field of logistics. Outsourcing any logistics activity is accompanied by both advantages and disadvantages. Due the mutual dependencies between all logistics activities, common advantages and disadvantages can be identified. Therefore to understand the insourcing and outsourcing of transportation, considerations from logistics as a whole are explored. The ultimate decision is more complex than weighing expected benefits and drawbacks against one another. A company's strategy is instrumental in determining what benefits are desirable and what drawbacks are acceptable.

Strategic considerations determine what operational capabilities are required, conversely infrastructure availability and IT systems determine what strategy can be employed. Therefore the capabilities and resources essential to implementing an internal transportation solution must be identified. Resource and capability shortfalls do not necessarily influence the feasibility of insourcing transportation. Therefore a company's willingness to invest in such shortfalls are incorporated in the evaluation. Beyond internal considerations, logistics solutions are influenced by the economic and political climate. Lastly within the paradigm of outsourcing transportation, different types of service providers exist. Therefore the differentiating attributes and factors are explored within the context of transportation.

2.5.1 Benefits and risks of outsourcing logistics

There are a variety of advantages and disadvantages claimed for and against outsourcing or insourcing logistics [58]. These can be categorised as finance and operations related.

Logistics outsourcing offers a diverse set of cost-related advantages. In particular, the elimination of asset ownership serves as a strong proponent of outsourcing. By reducing the capital cost of logistics activities, more capital becomes available to fund profitable core activities [59][60]. By converting fixed costs into variable costs, the associated responsibility and risk of asset ownership are eliminated. Additionally, multi-user LSPs are better able to spread costs and utilise capacity [58][60]. This allows even small accounts to benefit from cost advantages achieved through consolidation. However, outsourcing does not always bring about cost reductions. Wilding and Juriado [61] cite unrealistic fee structures and margins as barriers to outsourcing. Lastly, the changeover costs of outsourcing must be considered. Certain costs simply cannot be recovered, such as long-term leases on properties [4]. Although cost objectives are important, it cannot be regarded as the primary factor influencing the outsourcing decision [58][61][62].

Wilding and Juriado [61] cites a focus on core functions, LSP competencies and flexibility as the three main drivers for logistics outsourcing. Besides the three main drivers, an operational perspective produces a number of advantages and disadvantages. Primarily companies employ outsourcing as an organisational strategy to focus on core competencies. Companies strive to become leaders in no more than five or six fundamental competencies [63]. Besides costs, the advantages gained are difficult to measure. However, by concentrating on managing only a few business functions, companies are able to drastically improve their efficiencies.

The appeal of outsourcing logistics is improved by superior LSP competencies. LSPs employ IT as a key differentiator to deliver value added services [64]. By employing technology such as radio frequency identification (RFID) and geographic information systems (GIS), LSPs can provide an improved management experience. However the majority of companies who outsource logistics functions, are dissatisfied with the IT capabilities of LSPs [58][64][65]. Despite this, outsourcing logistics does provide access to wider knowledge.

By outsourcing logistics, companies improve their operational flexibility. LSPs are able to provide companies with a broader geographical coverage of their products [4][20]. This can aid the effective early expansion of companies. By using LSPs, there is no need to develop expensive logistics infrastructure for markets or products with no guarantee of success. Likewise, by not entering long-term financial commitments e.g. long-term lease, companies are better able to respond to variable demand.

In an operations context, a number of disadvantages and risks to outsourcing logistics must be addressed. By outsourcing logistics, companies lose expertise and often experience a lack of improvement and innovation. LSPs often lack the necessary incentives to innovate [66]. Even if companies revert to an in-house operation, the loss of expertise and innovation places the company at a disadvantage. Companies also experience a loss of control. The lack of control over the distribution function constitutes the primary concern. Companies argue LSPs are unable to provide extraordinary superior services [67]. LSPs are often unable to deal with emergency circumstances or special product needs. Moreover, for many companies, delivery drivers create a physical link with their customers. This is especially true in developing economies where the only means by which customers can place orders are through the delivery driver. By outsourcing logistics to a multi-user operation, the physical link with customers is lost. Brand integrity and confidentiality concerns are of particular concern to companies who employ multi-user operations. Only a small percentage of companies cite loss of branding on delivery vehicles as a noteworthy concern [4]. In contrast, the

lack of confidentiality constitutes a major concern. Multi-user operations consolidate loads and mix competitor products. In addition to a loss of confidentiality, barriers to entry are lowered. Smaller competitors are able to employ superior routes to market by sharing costs and through cross subsidisation. The discussed advantages and disadvantages are summarised in table 2.5.

Table 2.5: Expected advantages and disadvantages of outsourcing logistics.

Expected advantages	Expected disadvantages
Elimination of asset ownership	Unaccounted costs
Economies of scale	Loss of control
Cost reduction	Loss of expertise
Allow focus on core competencies	Lack of innovation and improvement
Improved overall efficiencies	Lack of confidentiality
Access to external competencies and value added services	Reduced branding
Increased management capabilities	Driver link to customers lost
Improved flexibility	
Reduced labour exposure	

2.5.2 Auxiliary influences

Besides the advantages and disadvantages of logistics outsourcing, a number of auxiliary influences exist. These include consumer pressures, legal consequences, labour issues, economic considerations and political influences.

Consumers are strongly influenced by environmental concerns [68]. Therefore reducing a product's carbon footprint can provide a distinct advantage over competitors. The combination of consumer pressure and regulatory requirements is driving the implementation of green initiatives [69]. The transportation sector represents a major contributor to air pollution. As a result, green considerations are instrumental to the logistics outsourcing decision.

Outsourcing logistics functions is often accompanied by an unavoidable retrenchment of staff. This regularly results in the early termination of contracts with legal consequences. Highly unionised labourers further increase the threat of strikes and legal action [4]. Besides legal consequences, the retrenchment of staff has a number of consequences. Retrenchment may disconcert the remaining staff resulting in reduced efficiencies. Additionally, retrenchment negatively impacts the loyalty of staff. Therefore companies who pursue outsourcing must fully assess and understand the impact of retrenchment.

Due to the high capital requirement of insourcing logistics, the economic climate plays an instrumental role. High interest rates on loan repayments reduce the feasibility of in-house logistics operations. Likewise, a weak currency increases the cost of specialised imported equipment such as vehicles and trailers.

Lastly, the political climate represents an important consideration. In South Africa companies need to adopt and comply with legislative measures aimed at black economic empowerment (BEE) [70]. A company's compliance is measured using a BEE scorecard. Ultimately the scorecard determines a company's broad-based black economic empowerment (B-BBEE) status. A favourable status can ensure the longevity of a company [70]. LSPs such as owner drivers can improve the B-BBEE status of a company by providing ownership opportunities to previously disadvantaged individuals (PDIIs).

2.5.3 Resource and capability identification

Companies who have operated an in-house fleet have a clear understanding of the resource and capability requirements. Their experience and insights are leveraged to effectively employ logistics outsourcing. On the contrary, new companies have none of the relevant experience or insights. Therefore the resource and capability requirements for performing logistics in-house are explored. Capability and resource shortfalls should not be considered a barrier to insourcing. The decision between insourcing and outsourcing should rather be determined by a company's willingness to invest in such shortfalls.

To perform transportation logistics, a company requires a host of resources and capabilities outside the scope of transportation. Therefore to identify the full scope of requirements, the capabilities and resources of LSPs are explored. By acquiring an assortment of logistics resources such as transportation, shipping expertise, warehousing and IT capabilities, LSPs are able to service a variety of clients [71].

In order to create a balanced logistics outsourcing process, the unique components of LSP resources and capabilities must be classified. Many of the classifications found in literature follow the RBV. The RBV suggests classifying capabilities and resources as tangible and intangible resources. Hunt [72] assessed a company's ability to compete effectively according to six resource classifications: financial, physical, human, organisational, informational and relational resources. From the RBV Karia and Wong [71] developed the concept of resource-based logistics (RBL). It serves to assess the performance of LSPs according to their logistics resources and capabilities. RBL describes two tangible and three intangible resources: physical, technological, management expertise, organisational and relational resources.

Alkhatib et al. [60] proposed a classification similar to that of RBL. However, intangible resources were classified according to the concept of intellectual capital. Intellectual capital is generally classified as human, structural and relational capital. This research classifies LSP resources and capabilities as physical, technological, human and organisational resources. Relational resources do not affect insourcing considerations and is therefore excluded from the scope of the investigation.

For each of the four classifications, relevant measurements are identified from literature. A summary of the findings are provided in table 2.6 and table 2.7 .

Table 2.6: Tangible logistics resources.

Resource	Classification	Measures	References
Physical resources	Warehousing and transportation facilities.	Logistics service centres, logistics hubs, warehouses and vehicles.	Alkhatib et al. [60], Karia and Wong [71], Wong and Wong [73].
Technological resources	Information and communication systems.	Computers, internet/intranet, wireless communication, financial systems, barcoding and scanning, electronic data interchange (EDI), route planning and optimisation, transport management systems, warehouse management systems, enterprise resource planning, global positioning system (GPS), automated storage and retrieval systems.	Pokharel [74], Lai [75].

Table 2.7: Intangible logistics resources.

Resource	Classification	Description	References
Human resources	Experience, knowledge, training and skills.	The accumulated logistics experience, knowledge and education of staff.	Alkhatib et al. [60], Karia and Wong [71].
Organisational resources	Strategic planning and managerial commitment.	Business strategy development, resource management, financial planning and adapting to changing opportunities.	Gunasekaran and Ngai [76], Wong and Karia [73].

2.5.4 Carrier attributes

Thus far the section has: (a) evaluated the benefits and risks of outsourcing, (b) explored auxiliary influences and (c) identified logistics resources and capabilities. The advantages and disadvantages of outsourcing logistics guide the decision between insourcing and outsourcing. The auxiliary influences explored additional barriers to outsourcing. Similarly, the resource and capability requirements of logistics represent key considerations for insourcing logistics. As yet the research has not identified considerations to differentiate outsourcing arrangements. The focus of the research is placed on transportation logistics considerations. Thus to distinguish types of LSPs from one another, desirable carrier attributes are identified.

The attributes are categorised as reliability, flexibility, resources and capabilities, performance, cost and customer service related. The identified attributes are summarised in table 2.8.

Table 2.8: A summary of carrier attributes.

Reference	Reliability	Flexibility	Resources and capabilities	Performance	Cost	Customer service
Lambert et al. [77].	On time pick up. On time delivery. Consistent transit time.		Status information on delivery. Insurance coverage. Status information on tracking. Direct delivery.	Accurate billing. Promised length of transit time.	Competitive rates.	Assistance in handling loss and damage claims. Prompt action on complaints. Prompt response to claims. Good attitude towards complaints. Quality dispatch personnel, driver, sales force and management.
Lu [78].	Low damage/loss record. On time pick up.	Willing to negotiate. Pricing flexibility in meeting competitor rates.	Availability of cargo space. High frequency of delivery. Door-to-door service. Good geographical coverage. Consolidation service. Storage service. Non standard equipment. EDI. Cargo tracing.	Accurate documentation. Short transit time.	Simplified tariffs. Competitive rates. Provide discounts.	Ability of sales force to handle problems. Knowledgeable sales force. Prompt response to complaints. Prompt response to claims.

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Reference	Reliability	Flexibility	Resources and capabilities	Performance	Cost	Customer service
Pearson and Semeijn [79].	Pickup service reliability. Transit time reliability. Low damage/loss record. Reputation of reliability.	Willingness to enter service contract. Price flexibility. Ability to handle special products.	Good geographic coverage. Computerised billing. EDI. Delivery information/confirmation. Tracing and tracing. Insurance coverage. Consolidation service.	Short transit time.	Competitive rates.	Prompt claim settlement. Quality of carrier personal.
Voss et al. [80].	Delivery reliability. Reputation of reliability.		Availability of equipment.	Billing accuracy.	Competitive rates.	Security assurances. Quality of drivers. Prompt complaint follow up.
Anderson et al. [81].	On time delivery. Low damage/loss record.	Special pick up and delivery. Ability to handle significant changes in volume.	Seasonal warehousing. Ability to innovate. Up to the minute tracking and tracing.	Short transit time.		Effective handling of requests and questions. Prompt and emphatic recovery and resolution of errors or problems. Knowledgeable of product and services. High degree of information sharing and trust.

Reference	Reliability	Flexibility	Resources and capabilities	Performance	Cost	Customer service
Banomyong and Supatn [82].	Consistent service. Reputation of reputability. Low damage/loss record.	Variety of services.	Track and trace service offering. Offering of one-stop service. Modern equipment. EDI and E-commerce. Owned container freight station. Consolidation offering. Express delivery service. Customer relationship management.	Accurate documentation. Short transit time.	Reasonable price. Ease of payment. Appropriate credit term. Discount offering.	Staff's knowledge and expertise. Confidentiality of information. Fast response to customer's requests. Staff's willingness to provide service.
Dobie [83].	On time pick up. On time delivery. Financial stability. Low damage/loss record. Reputation of dependability.	Willingness to negotiate rates. Special service offering.	Frequent pick-up and delivery. Tracing capability.	Short transit time.	Competitive rates.	Driver quality. Prompt settlement of claims. Sales staff competence.

Reference	Reliability	Flexibility	Resources and capabilities	Performance	Cost	Customer service
Premeaux [84].	On time pick up. On time delivery. Financial stability. Reputation of dependability.	Emergency or unexpected deliveries. Handling expedited deliveries. Flexible rates. Flexible scheduling. Handling special products. Diversion and reassignment privileges.	Web-enhanced EDI. Computerised billing and tracing options. Good geographic coverage. Condition of equipment. Consolidation service.	Short transit time.	Discounted services.	High degree of cooperation. Ease of claim settlement. Attitude towards acceptance of small shipments. Honour routing requests. Overcharge claims service. Feedback from consignee. Courtesy if vehicle operators.

2.5.5 Appraisal of transportation arrangements

Based upon insights gathered from the preceding section, the six transportation arrangements are appraised as in table 2.9. The considerations produced by literature are supplemented by insights from industry.

Table 2.9: Appraisal of six identified transportation arrangements.

Arrangement	Advantages	Disadvantages
Own fleet	<ul style="list-style-type: none"> • Complete dedication of resources; • High levels of customer service; • Complete flexibility with regards to deliveries; • Complete control over delivery process; • Driver link to customers in trade; 	<ul style="list-style-type: none"> • High initial capital investment in physical, technological, human and organisational resources; • Management of drivers and crew requires additional resources; • Industrial relations and human resource issues must be managed; • Difficult to reduce heads and resources when volume demand is low; • Resources are not agile enough to handle significant increases in volume;
Owner driver	<ul style="list-style-type: none"> • Motivated small business owners focused on profit and growth; • Owner driver responsible for day to day deliveries and query resolution; • Complete dedication of resources; • High levels of productivity; • Very high levels of customer service; 	<ul style="list-style-type: none"> • High initial capital investment in physical, technological, human and organisation resources; • The company is regarded as a sponsoring corporate and is extensively involved in the owner driver's business; • Managerial oversight of owner driver requires additional resources;
Crowd sourced	<ul style="list-style-type: none"> • Complete flexibility with regards to deliveries; • High levels of productivity; • Large and diverse pool of resources; • No binding contracts; 	<ul style="list-style-type: none"> • Drastically reduced control over delivery process; • Inconsistent level of customer service;
Distributor	<ul style="list-style-type: none"> • Very agile and responsive; • Relationship with small drop outlets; • Minimum turnaround times; 	<ul style="list-style-type: none"> • System and information limitations (Computerised billing, sales and delivery feedback);
3PL and 4PL	<ul style="list-style-type: none"> • Existing relationship with retail outlets; • Infrastructure in place including physical, technological, human and organisation resources; • Reputation of reliability; • National footprint; • End to end solution including importation, bonded warehouses, hauling, warehousing and distribution; • Resources able to accommodate significant changes in volume; 	<ul style="list-style-type: none"> • Minimum volume requirements; • Minimum revenue requirements; • Limited flexibility outside of delivery schedule; • Lower levels of customer service;

Chapter 3

Route to market retail outlet survey

The introductory chapter of this research called for the development of an alternate lens through which companies can assess new and unknown market conditions. Information can be valuable in allowing new market entrants to compete against well established incumbent companies.

In order to compete with the incumbent, new companies must acquire a portion of the market share. Companies typically acquire market share by introducing superior products, or by ensuring their products are more affordable. An often overlooked source of a competitive advantage can be attained by simply getting the distribution channel right. A well-designed distribution channel allows a company to cost effectively distribute its products while simultaneously ensuring maximum market penetration.

The collection of the information discussed in section 2.2.2 facilitates the design of superior distribution channels. This chapter introduces a high-level framework to design and conduct such a survey. The framework is employed in order to plan, develop and execute a survey in the DRC. The DRC project presents an opportunity to both test the survey and assess the value of the collected information.

3.1 Survey production process

A survey is defined as a quantitative method for collecting data from a sample of a population [85]. This seemingly simple process consists of a number of processes and sub-processes related to the planning, designing and conducting surveys. Snijkers et al. [85] proposed using the generic statistical business process model (GSBPM) as a high-level framework for executing business surveys.

The GSBPM framework describes the required processes and sub-processes to produce statistical outputs from any type of source. The generic framework is therefore not specifically tailored towards producing statistical outputs from surveys. However, the top level processes identified in figure 3.1 provide a basis for establishing a survey production process.



Figure 3.1: Top level processes from the GSBPM framework, adapted and redrawn from [85].

Table 3.1 serves to provide a high level overview of the processes presented in figure 3.1. While remaining consistent with the GSBPM framework, the sub-processes and activities have been selected to specifically address the survey production process.

Table 3.1: Processes and sub-processes in executing surveys, adapted from [85].

Phase	Process	Sub-process and activities
Pre-field phase	Specify survey needs.	Consult with stakeholders to determine information needs.
	Plan the survey.	Plan all phases of the survey. Develop project plan.

Phase	Process	Sub-process and activities
	Design, build and test.	Design survey frame and sample. Select survey mode and design questionnaire. Design survey communication strategy. Design data collection process. Design data processing procedure. Build and test the data collection tool.
Field phase	Collect and process.	Implement the survey. Conduct the survey. Begin data processing including data capture, coding, cleaning.
Post-field phase	Process Analyse	Finalise data processing. Analyse data and produce deliverables.

All three survey phases are described to present a complete framework. However in alignment with the scope of the research, only a few sub-processes are elaborated on. The remainder of the section only addresses the following points: (a) survey frame and sample (b) survey mode and questionnaire (c) and the data processing procedure.

3.1.1 Survey frame and sample

The survey sample is an account of the businesses to be surveyed. Before selecting a sample, five particulars are required: (a) a target population (b) sample units (c) register (d) sample frame (e) and sample design [85].

The scope of the research addresses the inadequacy of information on retail markets in developing countries. Therefore the population of interest is defined as the retail market of developing countries. The survey sample units are defined as individual retail outlets. After defining the survey target population and sampling unit, a register must be created. The register contains information on both the target population and type of unit to be surveyed.

Next, a sample frame must be created. The sample frame is defined as a list of the target population, from which a sample is drawn [86]. In the case of a census, the survey frame is simply the entire target population. A complete census is normally not considered feasible for a simple business

survey. Therefore to identify a manageable sample of retail outlets, maps are used as a survey frame. Together with local resources and expertise, a map represents a powerful frame to narrow the target population down to a few areas or regions.

Ultimately the sample design depends on the project. The country and retail outlet density greatly affects the sample design. Therefore it is addressed on a project basis. Additionally, the project requirements determine what retail outlets are relevant to survey.

3.1.2 Survey mode and questionnaire

The choice of survey mode is strongly influenced by the following considerations and constraints: financial resources, relevant expertise, time and the production environment [85]. While financial resources, expertise and timelines can vary greatly between projects, the production environment remains constant. The research specifically addresses the need for collecting market information in developing countries throughout Africa. As African countries have diversified access to infrastructure and information technology, the survey mode seeks to address to lowest common denominator. Therefore telephone, postal and web-based surveys are not considered feasible. A door-to-door survey is identified as the most appropriate survey mode. It has a low reliance on information technology and does not require detailed registers on the sample population.

The content of the questionnaire is largely dependent on the requirements of the project. However, to design a distribution channel, the survey must deliver information on four distinct outputs: (a) volumes, stock holding and market entry (b) products (c) cash flow (d) and pricing. The output criteria are described in detail in section 2.2.2. Beyond the four identified outputs, the questionnaire is amended for each project based upon the requirements of the relevant stakeholders.

Finally, the questionnaire design must take into account the response burden. The response burden of a survey is measured as the time taken to complete it. Time is generally regarded as a better measure of the burden than the number of questions [85]. The burden of response is perceived differently by different subjects. Depending on the relationship between the expectations and experience of the subject, the response burden is perceived differently.

3.1.3 Data processing procedure

Data processing includes all activities related to the capture, coding, editing and imputation of data [85]. In order to capture the data produced by the survey, electronic data entry is employed. The questionnaire is integrated with a smartphone application used by the surveyor. The collected data can immediately be uploaded to a database, subject to a simple quality control check. Iarossi [87] identifies three types of quality control checks:

- Range checks ensure the data falls within a predetermined range. Percentages or yes/no answers are examples of ranges.
- Logical checks ensure the survey follows the correct flow. Skipping patterns allow the survey to skip certain questions based on previous answers.
- Reliability checks ensure answers are coherent and do not produce opposing data.

To ensure the survey design facilitates timely data analysis, coding is employed. The process of coding is divided into two parts. Before implementing the survey, coding identifies categories of answers for open-ended questions [87]. With limited categories, patterns can easily be identified and conclusions drawn. In addition to identifying categories of answers, it identifies the cause of non-responses. For non-responses, figure 3.2 illustrates how the item must be marked.

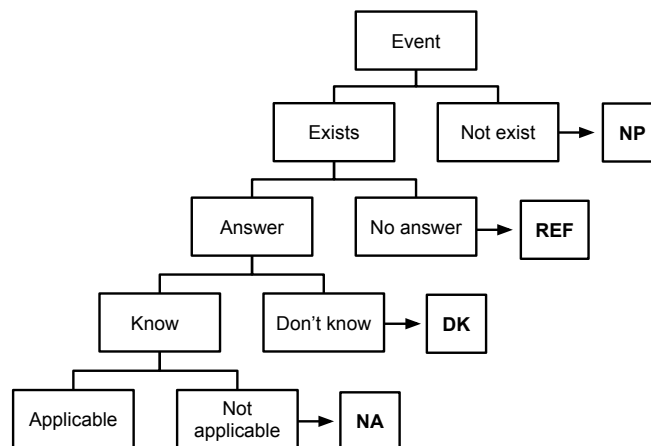


Figure 3.2: The identification of causes of non-responses, adapted and redrawn from [87].

If the item does not exist it is marked as NP (not provided). If the item does exist, but the respondent refuses to provide an answer, it must be marked

REF (refusal to answer). If the item exists and the respondent is willing to answer but does not know the answer, it is marked as DK (do not know). If the item exists, the respondent is willing to answer, the answer is known, but it is not applicable, it should be marked NA (not applicable). After the data has been collected, coding is used to organise the data into a form that allows it to be analysed using spreadsheet software.

The process of editing detects and corrects errors in the collected data. To ensure the data collected is complete, accurate and consistent, methods for identifying and handling implausible data must be developed. Data can be validated through consistency edits, range edits, logical edits and statistical edits [85].

Consistency edits check the logical consistency by comparing answers from the same record. This technique is especially suited for editing pricing data. Retail outlets price products very similarly to their immediate competitors. Thus implausible data can easily be recognised. Range edits determine whether records are outside predetermined bounds, for example, the individual sales of a product cannot be higher than the total sales of the retail outlet. Logical edits are specified by linear equalities or inequalities [85]. The inequalities create an acceptance region such as illustrated in figure 3.3. Any entries that lie outside of the acceptance region is considered to be implausible.

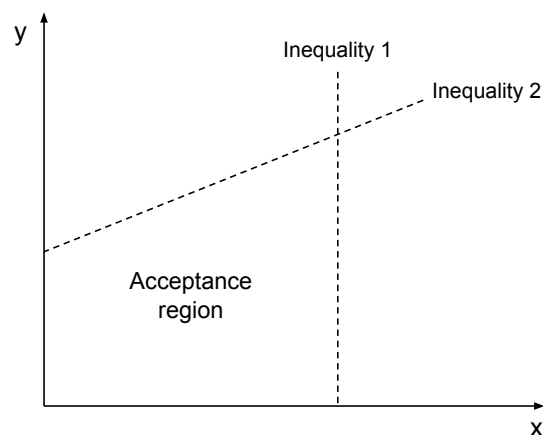


Figure 3.3: An example of an acceptance region.

Lastly, data can be validated through statistical edits. Statistical edits are useful for data where it is difficult to identify logical inconsistency or establish bounds and acceptance regions. A useful way to identify outliers from data is to use the statistical mean and variance. Although there are no hard rules to exclude outliers from data, the standard deviation is often used to determine whether an entry is an outlier or not.

3.2 DRC survey planning

The DRC project is an exploratory project undertaken by Hunting Dragons Consulting (HDC) to determine if a viable business opportunity exists for the production and distribution of four liquid streams: (a) spirits (b) soft drinks (c) clear beer (d) opaque beer.

The preliminary business case seeks to service the Katanga province of the DRC. The business case requires an understanding of how products will reach the market in the Katanga province. Therefore the customer segments and retail outlets must be identified and characterised. As the DRC does not have complete or up to data directories of retail outlets, the required information is not easily obtainable through conventional routes. Therefore the project presents a valuable opportunity to develop and test a door-to-door retail outlet survey.

3.2.1 Survey scope

Initially, the project defined the target population as any retail outlet in the Katanga province selling at least one of the four liquid streams. The Katanga province covers an area of 496 871 km² and is home to an estimated 12 million people. The last population census was conducted in 1981. Consequently, the existing official demographic records are outdated and cannot be used to develop a survey frame.

In order to develop a survey frame from limited information, a top-down approach was followed. Web mapping services such as Google Maps and spatial data from a GIS was used to develop the survey frame. Firstly administrative boundaries within the Katanga province were identified. The administrative boundaries divide the province up into districts and territories.

The retail environment of the Katanga province differs greatly between populated places. Therefore the survey frame had to identify relevant populated places to survey within each territory. Additionally, the survey had to remain within the time and cost constraints set by the project. The scope of the survey was eventually reduced to a sample within Lubumbashi and its surroundings. The decision was primarily driven by cost constraints. However, many of the territories are simply inaccessible due to poor road conditions.

The top-down approach leading up to the development of the ultimate survey frame is described in the remainder of the section.

3.2.1.1 Administrative divisions

At the highest level, the entire country is divided up into three administrative divisions. The primary division divides the country into 10 provinces and one city province. The provinces are divided up into districts and territories. For each district, an identifying letter was assigned. Likewise, each territory is distinguished by an alphanumeric identifier. The districts and territories are detailed in table 3.2 and illustrated in figure A.1 in appendix A.

Table 3.2: Administrative divisions of the Katanga province.

Province	District		Territory	
	ID	Name	ID	Name
Katanga	A	Lualaba	A1	Kapanga
			A2	Dilolo
			A3	Sandoa
	B	Haut-Lomami	B1	Bukama
			B2	Kabongo
			B3	Kamina
			B4	Kaniama
			B5	Malemba-Nkulu
	C	Haut-Shaba	C1	Kambove/Likasi
			C2	Kasenga
			C3	Kipushi
			C4	Mitwaba
			C5	Pweto
			C6	Sakania
	D	Kolwezi	D1	Lubudi
			D2	Mutshatasha/Kolwezi
	E	Lubumbashi	E1	Lubumbashi
	F	Tanganika	F1	Kabalo
			F2	Kalemie
			F3	Kongolo
			F4	Manono
			F5	Moba
			F6	Nyunzu

3.2.1.2 Populated places

A list of populated places in the DRC with coordinates were obtained from [88]. The list identified all known populated places and represented the first step in identifying populated places relevant to the project. The entries were grouped according to their respective territories and districts. The amended list identified 3 355 places within the Katanga province.

The entries were plotted and a random sample inspected to confirm the accuracy and validity of the data. Upon inspection two problems with the data became apparent. The list included entries of populated places as small as a few huts with no visible retail activity. Secondly the data included entries that could not be identified as populated places from satellite imagery.

An additional list of populated places was obtained from [89] that identified the 180 largest populated places within the DRC. The most recent measure included in the repository, is a calculation of the total population per place. The calculation is based on an annual growth rate determined from the 1981 census and a population estimate from 2004. The complete list was amended to only include entries within the Katanga province as in table A.1. Although the data is neither up to date or completely accurate it served as a tool to identify populated places relevant to the project.

3.2.1.3 Exclusion criteria for populated places

The amended list identified 33 places relevant to the survey in the Katanga province. The list was reviewed by a local resource in the DRC. The review process eliminated populated places based on the proposed exclusion criterion. The exclusion criteria were chosen with no dependence on accurate or up to date population statistics:

1. Territories initially excluded from the scope of operation due to their distance from the proposed manufacturing site.
2. Territories and populated places with no access to serviceable roads or waterways.
3. Rural populated places with no retail footprint.
4. Populated places with no economic infrastructure where the purchasing power of customers is too low to justify an investment.

The three largest populated places in the Katanga province were identified as Lubumbashi, Kolwezi and Likasi. Kolwezi is linked to Lubumbashi with a well maintained paved road. Due to their accessibility, retail footprint and economic

infrastructure the three towns were identified as primary focus points. The surrounding territories formed secondary focus points, highlighted in figure 3.4. The remaining districts and territories were excluded from the survey. The time and cost constraints of the project served to further narrow the proposed survey coverage.

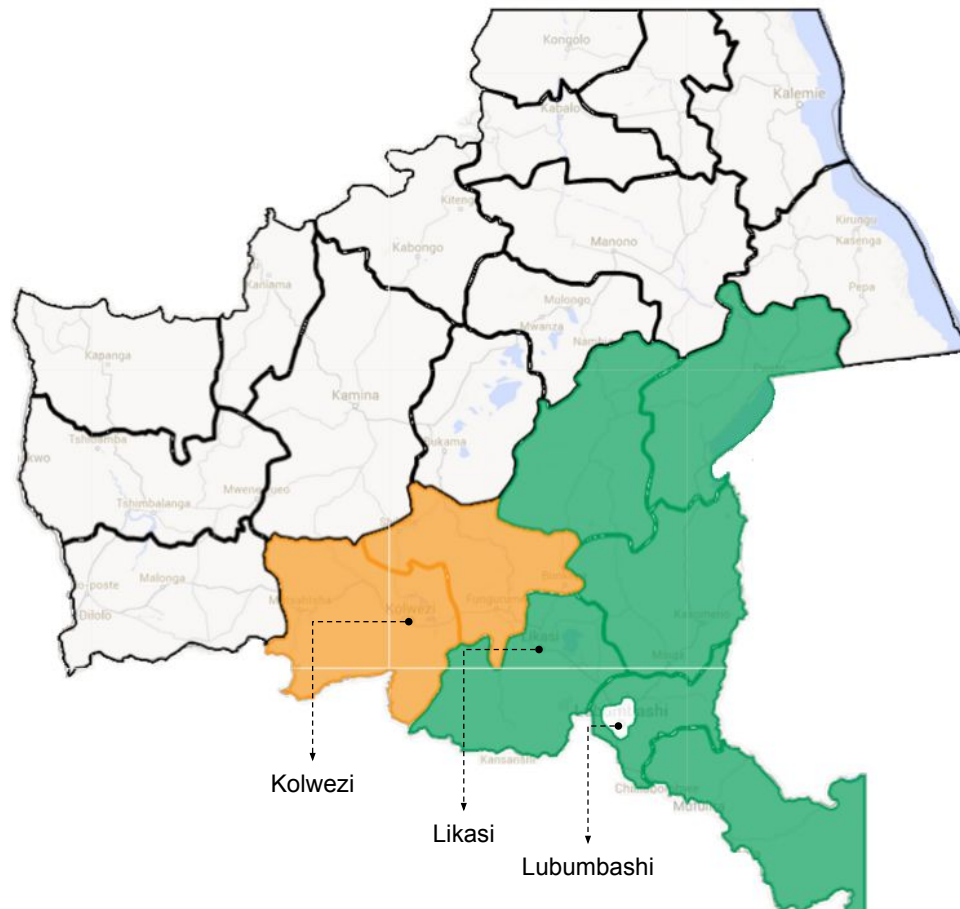


Figure 3.4: A map of the Katanga province and its administrative boundaries indicating territories included in the survey scope.

3.2.1.4 Final survey frame

A company (company A) was contacted to estimate the associated cost. Company A had executed a similar survey two years prior. The survey was geographically confined to Lubumbashi, Likasi and Kolwezi. The cost for the survey was in excess of USD 50 000. In order to bring the cost of the survey down, the scope had to be drastically altered.

Thus three urbanisation types were identified, representative of the entire Katanga province namely, urban, peri-urban and rural. To ensure the total cost of the survey remained low, examples of the three types were found within close proximity of Lubumbashi. This meant transport and other expenses remained low as the survey team was based in Lubumbashi. The first group of surveys would be confined to urban Lubumbashi. Fourteen sub-regions of Lubumbashi were identified representing low, middle and high-income populations. A further eight peri-urban regions were identified on the outskirts of Lubumbashi. Lastly, seven villages outside of Lubumbashi were identified. The breakdown of the regions is detailed in figure 3.5.

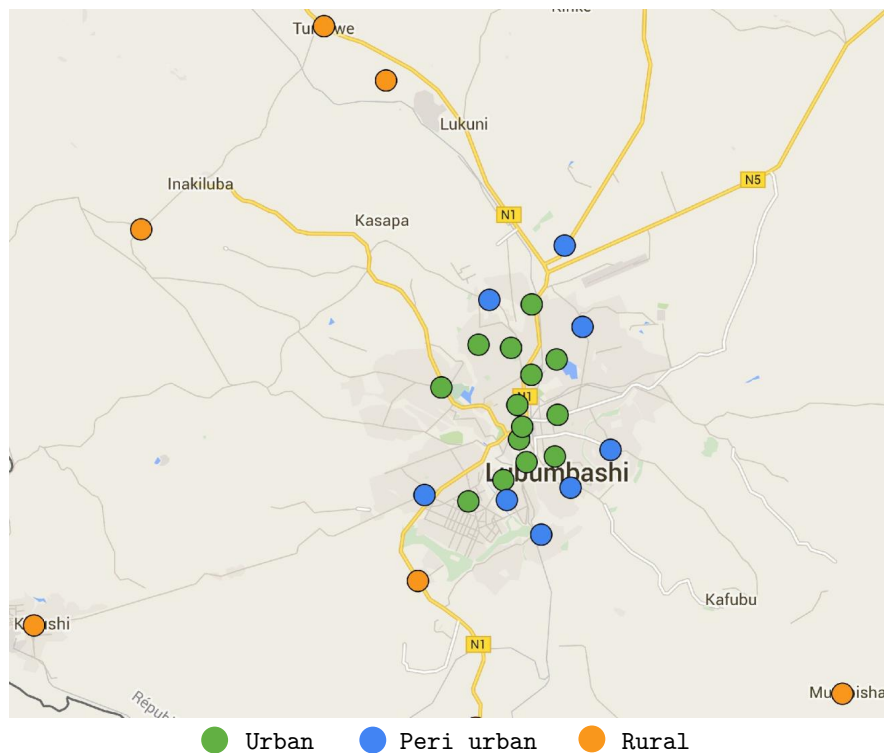


Figure 3.5: Twenty nine sub regions of Lubumbashi and its surroundings.

Within each of the 29 sub regions, 16 market segments were identified. The different market segments are detailed in table 3.3. The segments are further split according to whether purchased goods are consumed on or off premise.

Table 3.3: A description of the 16 different market segments found within Lubumbashi and its surroundings.

Segment	Description
Off premise	
Brewery A depot	Supplies local outlets in the area with products from brewery A only.
Brewery B depot	Supplies local outlets in the area with products from brewery B only.
Depot	Supplies local outlets in the area with only non beer products.
Depot not exclusive	Supplies local outlets in the area with products from both brewery A and brewery B.
General dealer	Sells a variety of consumer goods, including food, vegetables and beverages.
Kiosk	Basic items sold over the counter, limited variety of products.
Street vendor	Basic items sold from a temporary static structure or mobile stand.
Supermarket	Sells a variety of consumer goods, including food, vegetables and beverages as part of a supermarket chain.
Take away	Food prepared and purchased here but consumed off premise.
On premise	
Bar/terrace	Seated consumers are served with a variety of alcoholic and non-alcoholic beverages.
Boutique	Both food and beverages are sold here. The outlets do cater for on premise consumption, but most of the purchases are consumed off premise.
Hotel	Room and restaurant service available to patrons.
Household	Informal structures found on the outskirts of town. Basic items such as eggs, fruit and vegetables are sold.
Nganda	Offers entertainment such as music and pool tables. Only found in villages and predominantly sells opaque beers.
Night club	Offers a venue with music and dance floor.
Restaurant	Meals are prepared and served to seated consumers by waitrons.

3.2.2 Survey structure and questionnaire

In this section, an overview of the survey structure and questionnaire is provided. Three separate sources were used to develop the content of the questionnaire. The output criterion identified in section 2.2.2 provided a frame for the questionnaire content. Together with insights gathered from previous surveys conducted by HDC and the project requirements, the frame was altered to produce the final questionnaire.

The survey is divided into five subsections: (a) administrative information (b) establishment information (c) product information (d) supply chain information and (e) correspondence information.

The subsection administrative information serves two purposes. It records the location of potential customers and monitors the progress of surveyors. By monitoring the progress of surveyors, potentially falsified survey data can be identified. The section establishment information categorises retail outlets by identifying key characteristics. The section product information collects information on four liquid streams namely beer, soft drinks, spirits and opaque beer. The data includes prices, sales volume and stock. Supply chain information provides an overview of the current route to market strategy of the focus market. Key supply chain links are identified through determining how products flow along the supply chain. Lastly correspondence information attempts to determine how future communications with retail outlets can be facilitated. This is intended to aid the process of obtaining up to date route to market information without conducting a costly retail survey.

Table 3.4 simply provides an overview of the unique questions contained in the survey. For the complete survey structure and content consult appendix A.2.

Table 3.4: Survey questionnaire content.

#	Survey item
Administrative information	
1	Surveyor name.
2	Time stamp.
3	Location.
4	District.
5	Territory.
6	Town.
Establishment information	
7	Record the market segment.
8	Record the outlet storage size in m ² .

Survey item

Product information

- 9 Record the brands of beer on premise.
- 10 Record the number of cases sold per week of each brand of beer.
- 11 Record the price per case of each brand of beer.
- 12 Record the stock on floor per case of each brand of beer.
- 13 Record the brands of soft drinks on premise.
- 14 Record the number of cases sold per week of each brand of soft drink.
- 15 Record the price per case of each brand of soft drink.
- 16 Record the stock on floor per case of each brand of soft drink.
- 17 Record the brands of spirits on premise.
- 18 Record the number of bottles sold per week of each brand of spirit.
- 19 Record the price per bottle of each brand of spirit.
- 20 Record the stock on floor per bottle of each brand of spirit.
- 21 Record the volume sizes of opaque beer containers on premise.
- 22 Record the number of litres sold per week of each opaque beer container.
- 23 Record the price per container of each opaque beer volume size.
- 24 Record the combined sales volume of all beer products.
- 25 Indicate whether beer products are ever out of stock.
- 26 Record the combined missed sales volume of all beer products.
- 27 Record the combined sales volume of all soft drink products.
- 28 Indicate whether soft drink products are ever out of stock.
- 29 Record the combined missed sales volume of all soft drink products.
- 30 Record the combined sales volume of all spirit products.
- 31 Indicate whether spirit products are ever out of stock.
- 32 Record the combined missed sales volume of all spirit products.

Supply chain information

- 33 Record the largest supplier of beer products.
- 34 Record the percentage of total stock brought from the indicated supplier.
- 35 Specify whether the indicated supplier delivers.
- 36 Record the frequency and day of deliveries of the indicated supplier.
- 37 Record the lead time of deliveries from the indicated supplier.
- 38 Specify whether the indicated supplier provides credit.
- 39 Record the amount of credit provided by the indicated supplier.
- 40 Record the largest supplier of soft drink products.
- 41 Record the percentage of total stock brought from the indicated supplier.
- 42 Specify whether the indicated supplier delivers.
- 43 Record the frequency and day of deliveries of the indicated supplier.
- 44 Record the lead time of deliveries from the indicated supplier.

#	Survey item
45	Specify whether the indicated supplier provides credit.
46	Record the amount of credit provided by the indicated supplier.
47	Record the largest supplier of spirit products.
48	Record the percentage of total stock brought from the indicated supplier.
49	Specify whether the indicated supplier delivers.
50	Record the frequency and day of deliveries of the indicated supplier.
51	Record the lead time of deliveries from the indicated supplier.
52	Specify whether the indicated supplier provides credit.
53	Record the amount of credit provided by the indicated supplier.
Correspondence information	
54	Indicate for which of the four liquid streams the retail outlet requires information.
55	Indicate what information the retail outlet requires about competitors.
56	Indicate whether the retail outlet would complete the survey on a monthly basis.

3.3 DRC survey processing

In this section, an overview of the data processing is provided. The survey coverage is evaluated to ensure the survey collected a sample representative of all the market segments and urbanisation types. Additionally, the coding and structuring of the data are described. Lastly, the process of cleaning and editing is reviewed.

3.3.1 Summary of the collected data

Due the relatively small sample size, the survey data could be biased. Surveyors potentially surveyed a disproportionate number of retail outlets in larger and more accessible market segments. Company A provided historical data from a previous retail outlet survey to assess the coverage of the survey.

Table 3.5: A comparison of the achieved market segment split between the collected and historical data.

Market segment	Collected data		Historical data	
	Count	Percentage	Count	Percentage
Bar/Terrace	482	23%	2 467	18%
Boutique	396	19%	3 975	29%
<i>Brewery A</i> depot	63	3%	223	2%
<i>Brewery B</i> depot	101	5%	363	3%
Depot	81	4%	284	2%
Depot not exclusive	25	1%	90	1%
General dealer	144	7%	411	3%
Hotel	21	1%	137	1%
Household	263	13%	3 016	22%
Kiosk	64	3%	548	4%
Nganda	100	5%	960	7%
Night club	37	2%	274	2%
Restaurant	93	4%	274	2%
Street vendor	159	8%	411	3%
Supermarket	10	0%	137	1%
Take away	42	2%	137	1%
	2 081	100%	13 707	100%

The collected data is relatively consistent with the historical data as detailed in table 3.5. The growth and development of the retail market over the past two years accounts for the small variations. Profitable market segments such as bars are expected to grow. However two market segments, households and boutiques, were underrepresented in the survey data.

The variation seen in outlets described as households can be accounted for by the difficulty of locating the outlets. Household outlets are typically operated from informal dwellings with no or inadequate signage. Therefore household retail outlets are overlooked by surveyors operating within strict schedules. In summary the collected data represents an acceptable distribution between the different market segments.

Next the coverage of the three urbanisation types were assessed. During visits to the DRC, the different retail markets were well documented. Thus the make up of the retail market within each geographic region is known.

Table 3.6: A description of the split between urban, peri urban and rural outlets per market segment.

Market segment	Urban outlet count	Peri urban outlet count	Rural outlet count
Bar/Terrace	368	77	37
Boutique	180	163	53
<i>Brewery A</i> depot	56	5	2
<i>Brewery B</i> depot	77	19	5
Depot	42	35	4
Depot not exclusive	17	8	0
General dealer	96	36	12
Hotel	18	2	1
Household	83	70	110
Kiosk	41	16	7
Nganda	54	20	26
Night club	33	3	1
Restaurant	78	11	4
Street vendor	48	88	23
Supermarket	8	2	0
Take away	32	7	3
	1 231	562	288

The split of retail outlets between the different geographic regions conforms to anecdotal observations made in the DRC. More than half of the surveyed outlets are found within urban regions. Only around 13% of the surveyed outlets are located in rural areas. The rural areas are typically impoverished and more formal market segments such as bars and depots are scarce. However informal market segments such as household outlets are more prevalent.

3.3.2 Structuring survey data

In order to summarise, analyse and present the survey data PowerPivot was utilised. PowerPivot is an add-in for Microsoft Excel that allows data to be imported from multiple sources to one workbook. Relationships can be created between heterogeneous data and measures used to create calculated columns.

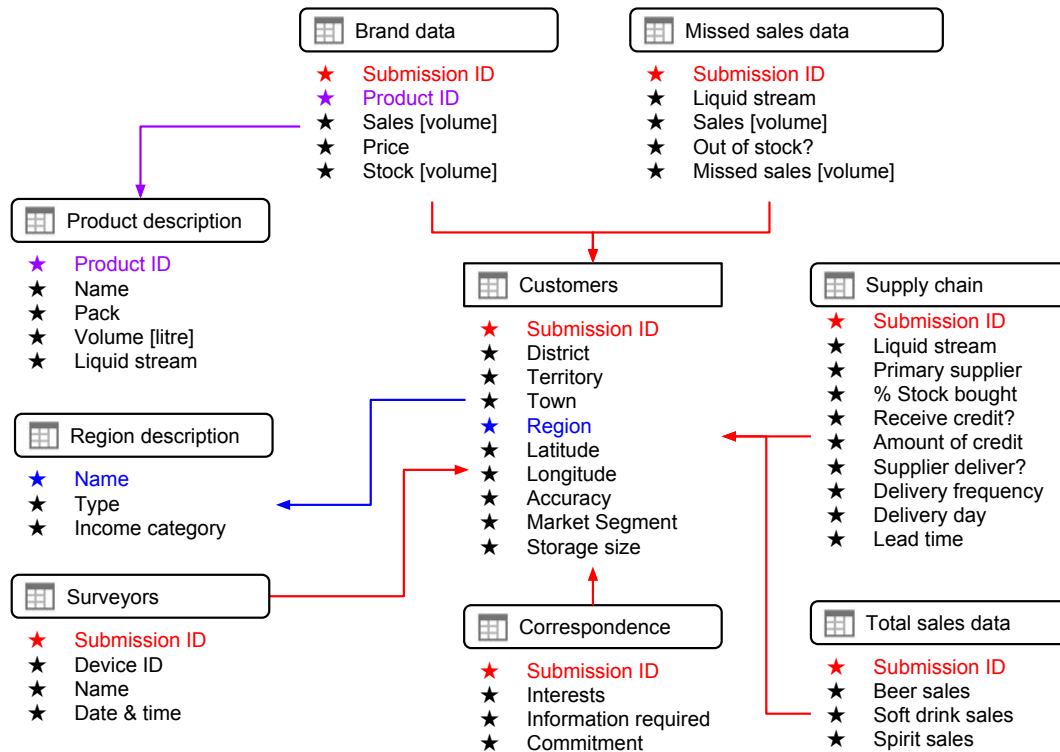


Figure 3.6: Diagram view of the PowerPivot content.

Figure 3.6 illustrates how the PowerPivot content is structured. Originally the survey was divided into five subsections. The subsections were restructured to group more relevant data together. Administrative and establishment information was restructured as customer and surveyor tables. Product information was divided into three separate tables namely brand, total sales and missed sales data. The table brand data contains a record of the sales volume, price and stock on floor for each brand of product. The table missed sales data contains a record of whether the retail outlet experienced stock outs for any liquid stream. Lastly, the table total sales data contained a record of the total sales volume of each liquid stream per retail outlet. Additionally, two extra tables were created to classify and describe the regions covered and the unique brands surveyed.

A record is created in the customers table for each questionnaire submitted to the database. Within the customers table, a submission ID is assigned to

each record. The red arrows in figure 3.6 illustrate how the submission ID has been used to link all the relevant tables together. Lastly, two descriptive tables have been included namely product and region description. The purple and blue arrows indicate how the descriptive tables are linked to the collected survey data.

3.3.3 Cleaning and editing survey data

After structuring and reviewing the collected data, four tables presented problematic data:

1. Customers table
2. Brand data table
3. Missed sales data table
4. Supply chain table

A review of the data is intended to identify both incomplete and incorrect data. Throughout the review, any modification to the raw data is kept at a minimum. Additionally, all modifications and additions to the source data are detailed in the subsequent section.

3.3.3.1 Customers table

Initially, the survey scope included the entire Katanga province. Accordingly, the smartphone application recorded the district, territory and town name applicable to each collected survey. After the scope of the survey was narrowed to areas in urban, peri-urban and the surrounding rural areas of Lubumbashi the breakdown became too broad ¹. Thus the coordinates of each survey were used to narrow the geographical description. The 2081 collected surveys were grouped into 29 regions within Lubumbashi and its surroundings.

¹The application had been developed before the survey scope was further narrowed.

3.3.3.2 Brand data table

The brand data table contains five columns as described in table 3.7. All numerical entries within the table, except for opaque beer pricing data, was reviewed using a combination of consistency and range edits. The opaque beer pricing data was reviewed using statistical edits.

Table 3.7: A description of the brand data table content.

Column	Description
Submission ID	Unique survey identifier
Product ID	Unique product identifier
Sales [volume]	Sales volume per week
Price	Price per unit
Stock [volume]	Volume of stock on floor

The recorded sales volume was reviewed first. For beer, soft drink and spirit brands with a weekly sales volume of more than 1000 units flagged the entry for review. If the sales volume of any brand of product is more than the total sales volume of the applicable liquid stream, the entry is deleted. Table 3.8 contains a full record of the review process.

Table 3.8: Identification of incorrect product sales volume.

Submission ID	Liquid stream	Product sales	Total sales	Decision
7716483	Beer	1 000	10 000	Keep
7716483	Beer	1 400	10 000	Keep
7719227	Beer	2 114	15	Delete
7735004	Beer	1 050	500	Delete
7735004	Beer	1 200	500	Delete
7745228	Beer	18 000	55	Delete
7779948	Beer	36 000	21	Delete
7779299	Spirits	27 000	3	Delete
7779321	Spirits	1 400	7 000	Keep
7779321	Spirits	2 800	7 000	Keep
7779323	Spirits	3 500	13 300	Keep
7779323	Spirits	4 200	13 300	Keep
7779323	Spirits	5 600	13 300	Keep
7779332	Spirits	4 200	11 340	Keep
7779332	Spirits	7 000	11 340	Keep

To review the pricing data, the product description table was used to group similar products. Firstly products of the same liquid stream were grouped together. Secondly within each grouping, products with the same volume size were grouped together. The review process is described for each liquid stream using one volume size as an example.

Beer and soft drink pricing information was reviewed using a common procedure. For both of the categories the major cause of errors are finger errors and recording the unit price rather than the price per case. Table 3.9 illustrates how the two types of errors were accounted for.

Table 3.9: An example of a record kept after correcting and deleting pricing data.

Recorded price	Count	Price A	Count A	Price B	Count B	Decision
1 000 FC	1	10 000 FC	11	12 000 FC	30	12 000 FC
1 300 FC	2	13 000 FC	3	15 600 FC	6	15 600 FC
1 400 FC	1	14 000 FC	48	16 800 FC	1	14 000 FC
1 500 FC	3	15 000 FC	21	18 000 FC	82	18 000 FC
10 000 FC	11					
12 000 FC	30					
12 500 FC	18					
13 000 FC	3					
13 200 FC	2					
13 500 FC	4					
14 000 FC	48					
14 400 FC	4					
15 000 FC	21					
15 600 FC	6					
15 800 FC	1					
16 000 FC	3					
16 800 FC	1					
18 000 FC	82					
20 000 FC	20					
20 400 FC	1					
24 000 FC	32					
25 000 FC	1	NA	0	NA	0	Delete
28 000 FC	1	NA	0	NA	0	Delete
30 000 FC	1	NA	0	NA	0	Delete
42 000 FC	1	NA	0	NA	0	Delete

Based on the count of each recorded price, a lower and upper bound was established as indicated by the dotted line in table 3.9. Due to the high frequency of occurrence, prices within the dotted rectangle are considered correct. For each recorded price below the lower limit a corrected price is calculated. The corrected price is based on the recorded price missing a zero (price A) or recorded as a unit price (price B). The corrected price can only be considered a viable correction if it can be found within the recorded price column. The corrected price with the highest recorded count (count A or count B) is considered to be the more likely correction. The same process is followed for entries above the upper limit, except a finger error is classified as a price with one too many zeros. Entries above and below the limits with no feasible correction are simply deleted. Due to the observed pricing variation in the hotel segment, the upper limit for entries from hotels were increased to 90 000 FC for all beer and soft drink products.

Spirit products consisted of five volume sizes. The procedure for identifying incorrect prices is unique to the category. The pricing is strongly dependent on the specific brand and therefore prices fluctuate considerably. Further spirit products are relatively unpopular in the region and limited data was obtained from the survey. Thus a fixed upper and lower bound for correct prices could not be established. The data was reviewed and edited according to observations made in the market, obvious errors were deleted while the majority of the data remained unchanged.

Opaque beer was found in four container sizes. The category is a low cost product consumed in rural areas, therefore the pricing is extremely sensitive. Due to the sensitivity of the data, statistical edits were used to ensure the editing did not introduce any biases. First the recorded prices and their respective frequency counts were compiled as detailed in table 3.10.

Table 3.10: A list of the recorded prices and their respective frequency counts for one container size of opaque beer.

Recorded price	Count
100 FC	138
200 FC	3
800 FC	2
1 000 FC	1
1 500 FC	1
2 000 FC	2
2 100 FC	1
2 200 FC	1
2 500 FC	1
3 000 FC	1

From the tabulated data a weighted average price was calculated using equation 3.1. The average was weighted using the count of each recorded price.

$$\bar{x}^* = \frac{\sum_{i=1}^N w_i x_i}{\sum_{i=1}^N w_i} \quad (3.1)$$

$$\sigma = \sqrt{\frac{\sum_{i=1}^N w_i (x_i - \bar{x}^*)^2}{\frac{M-1}{M} \sum_{i=1}^N w_i}} \quad (3.2)$$

where:

N is the number of observations or count.

M is the number of nonzero weights.

w_i is the weights.

x_i is the recorded prices.

With the weighted average price, the weighted standard deviation can be calculated using equation 3.2. From the weighted standard deviation, the maximum accepted price is determined. Due the sensitivity of the pricing for opaque products, any entry further than one standard deviation from the median price was deleted. A more conservative measure would be three standard deviations, but would skew the pricing information. The weighted average and standard deviation were calculated from table 3.10.

$$\bar{x}^* = 213.91 \text{ FC}$$

$$\sigma = 457.61 \text{ FC}$$

From the calculations, it was determined a maximum price of 557.61 FC must be considered correct. Therefore all entries in table 3.10 above 200 FC were deleted.

Lastly, the stock column was reviewed. Entries which recorded a stock on floor figure of higher than 1000 units were flagged for review. The weekly sales figures were used to determine whether the outlet could possibly carry such a large volume of stock. If the sales per week for an outlet with a stock figure of more than 1000 units was less than 100 units per week the entry was deleted.

3.3.3.3 Missed sales data table

The missed sales data table contains five columns as described in table 3.11. The numerical entries were edited using logical edits to identify an acceptance region.

Table 3.11: A description of the missed sales data table content.

Column	Description
Submission ID	Unique survey identifier
Liquid stream	Applicable category of product
Sales [volume]	Sales volume per week
Out of stock?	A yes/no indication of stock outs
Missed sales [volume]	An estimation of the missed sales volume

For three liquid streams; beer, soft drinks and spirits the retail outlet was asked to estimate the number of missed sales resulting from stock outs. It is assumed there is a strong correlation between the actual sales and missed sales of each retail outlet. Therefore the actual sales volume was used to determine whether the retail outlet had overestimated the sum of missed sales.

The data is evaluated for each market segment and category of product. A trend line is plotted to establish a linear relationship between the sum of actual sales and sum of missed sales as in figure 3.7.

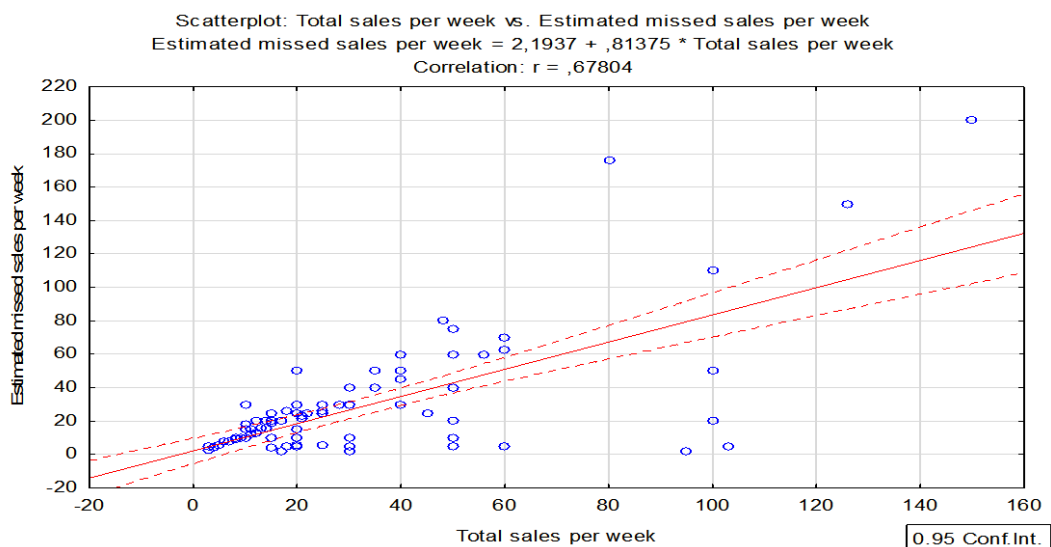


Figure 3.7: Total sales per week versus estimated missed sales.

The trend line is used to calculate a more conservative measure of the

sum of missed sales. Thus all entries above the 95% confidence interval is recalculated according to the straight line formula of the line of best fit. The measure is based on the following assumptions:

- There exists a linear relationship between the actual sales and sum of missed sales irrespective of the size or popularity of the retail outlet.
- Entries above the 95% confidence interval are overestimated.
- Entries in and below the 95% confidence interval are correct.

As the data is intended to identify an opportunity within the market, the assumptions are tailored towards producing conservative data.

3.3.3.4 Supply chain table

The supply chain information table contains 12 columns as described in table 3.12.

Table 3.12: A description of the supplier information data table content.

Column	Description
Submission ID	Unique survey identifier
Liquid stream	Applicable category of product
Primary supplier	Largest supplier per category
% Stock bought	Percentage of the total stock the outlet buys from the primary supplier
Receive credit?	Determine whether the outlet receives credit from the primary supplier
Amount of credit	The dollar amount of credit provided by the primary supplier
Supplier deliver?	Determine whether the primary supplier delivers to the outlet
Delivery frequency	The number of times deliveries are received per week
Delivery day	The day/s of the week deliveries are received
Lead time	The lead time between placing and receiving an order

With a 100% coverage as initially anticipated, the primary supplier column was intended to be linked back to the customers table. This would have allowed the identification of the entire supply chain from the suppliers down to the consumers. As a result of only obtaining a sample of the retail market, the

customer table is incomplete and does not contain a record of all the possible suppliers.

Additionally, retail outlets provided ambiguous names for primary suppliers as per example neighbourhood depot. The primary supplier column was used to determine whether any of the recorded entries could be found within the customer table. A total of 154 primary suppliers were found within the customer table. The remainder of the entries were grouped according to the categorisation detailed in figure 3.8.

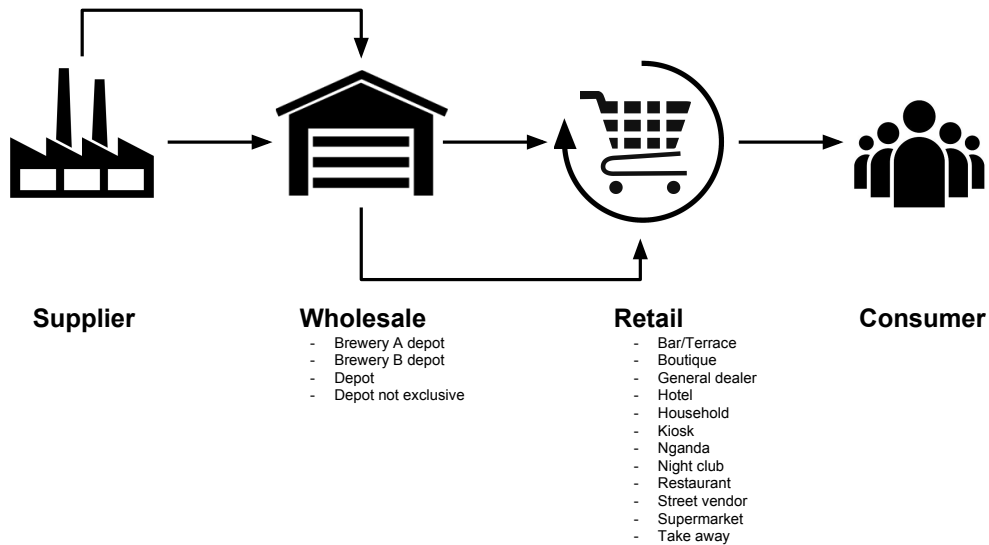


Figure 3.8: Categorisation of the recorded primary suppliers.

As depicted in figure 3.8 it should be noted that there exists redistribution within the retail market. Further suppliers and wholesalers also deliver directly to the retail market through a mechanism called runners.

Chapter 4

Analysis of DRC retail outlet survey

By processing, structuring and analysing the collected data, the research was able to: assess the viability of the business opportunity, quantify the opportunity, assess the current flow of volume and lastly, propose an optimal distribution channel for each liquid stream. Thus this chapter is presented in fulfilment of objective three as proposed in section 1.2.

The chapter is divided into three subsections. The first subsection explores the volume figures produced by the retail outlet sample. It allows the research to assess the relative popularity of the four liquid streams in different urbanisation types and market segments. The insights produced allude to potential distribution channels for each liquid stream.

The second subsection focused on quantifying and validating the business opportunity. The sample figures were extrapolated to present annual volume figures for the three towns of Lubumbashi, Likasi and Kolwezi. By exploring the extent of missed opportunities, both incumbent and new market players can potentially draw benefit from the research.

Lastly, the flow of volume between the key supply chain links produced a picture of the current route to market. For each liquid stream the current route to market is illustrated and a superior strategy is proposed based on the collective insights gathered from the retail outlet survey and analysis.

4.1 Sample of channel volume flow

Among the key outputs, the DRC project must determine whether a viable business opportunity exists for the production and distribution of four liquid streams. Without extrapolating the figures produced by the survey sample, a number of key insights can be gathered.

4.1.1 Sample of weekly sales volume by category

The first step is to calculate the weekly sales volume for each liquid stream.

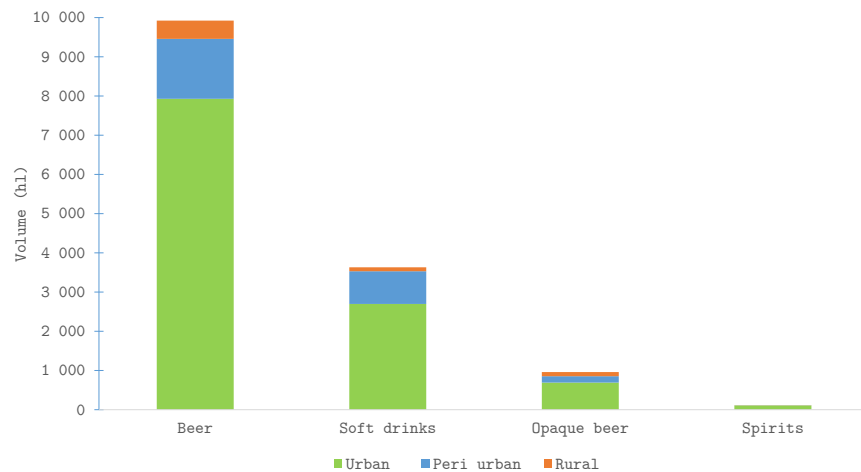


Figure 4.1: A breakdown of the total weekly sales volume per urbanisation type.

In terms of volume, figure 4.1 illustrates that beer is the best selling liquid stream followed by soft drinks, opaque beer and in last place, spirits. According to the survey sample, 9 920 hl of beer is sold on a weekly basis, compared to 114 hl of spirits. As anticipated the majority of sales for beer, soft drinks and spirits occur in urban settings. Less than 4% of the total spirits sales occur in peri-urban and rural settings. This highlights the fact that no significant market for spirits products exists outside of the city and town centres.

Before the survey, the viability of manufacturing and distributing a commercial opaque beer product was put into question. It was presumed that opaque beer was primarily consumed in rural settings where it is brewed. Locally brewed opaque beer is sold at a very low price point, decreasing the competitiveness of commercially brewed alternatives. Typically rural areas are too far from the manufacturing site to sell a commercial opaque beer at the same price point. However, according to the sample, 72% of all opaque beer

sales occur in urban settings. Therefore a viable business opportunity does in fact exist for the manufacturing and distribution of opaque beer.

A more detailed account of the information presented in figure 4.1 can be found in appendix B.1.1. As is, the information does not compensate for double counting. For example, a case of beer is sold by a depot to a household retail outlet. Both of the outlets are surveyed, and therefore the recorded sale is double counted. Therefore, the data in appendix B.1.1 is only used to make relative comparisons.

By comparing the total sales of each market segment, well-suited distribution channels can be identified for each liquid stream. A comparison of the total sales per market segment for beer is illustrated in figure 4.2.

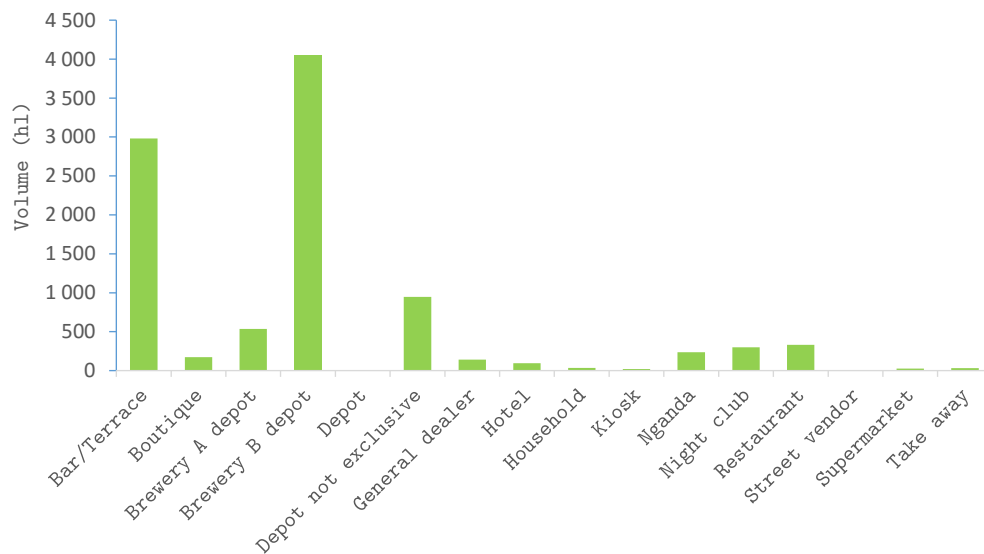


Figure 4.2: A breakdown of the total weekly beer sales per market segment.

Depots exclusively selling beer from brewery B account for nearly 41% of the total recorded weekly beer sales. By ensuring depots remain exclusive, brewery B has created a large barrier to entry for new market entrants. Even though brewery A and B only directly sell to exclusive depots, a number of non-exclusive depots exist. Non-exclusive depots account for around 10% of the total weekly sales. A new market entrant can achieve good market penetration by enlisting the support of non-exclusive depots. Additionally, it is much more cost effective servicing a handful of wholesalers, compared to the large and dispersed bar/terrace market segment.

As illustrated in figure 4.3 informal household retail outlets account for around 61% of the total opaque beer sales. The brewing and selling of opaque beer earn them a livelihood. Therefore household retail outlets might be opposed to distributing a commercial alternative. Interestingly the bar/terrace market segment accounts for 18,5% of the total sales. This segment might be more open to selling a higher quality commercial alternative as it only represents one of their many revenue streams.

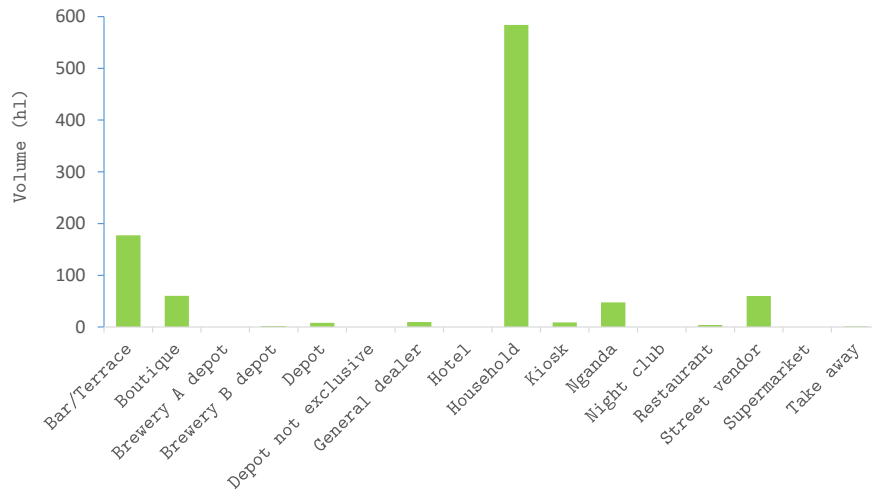


Figure 4.3: A breakdown of the total weekly opaque beer sales per market segment.

For soft drinks the market segment, depot, is vital. The segment is not exclusive to any brewery and accounts for 13,3% of the total weekly sales. This represents the fourth largest market share as illustrated in figure 4.4.

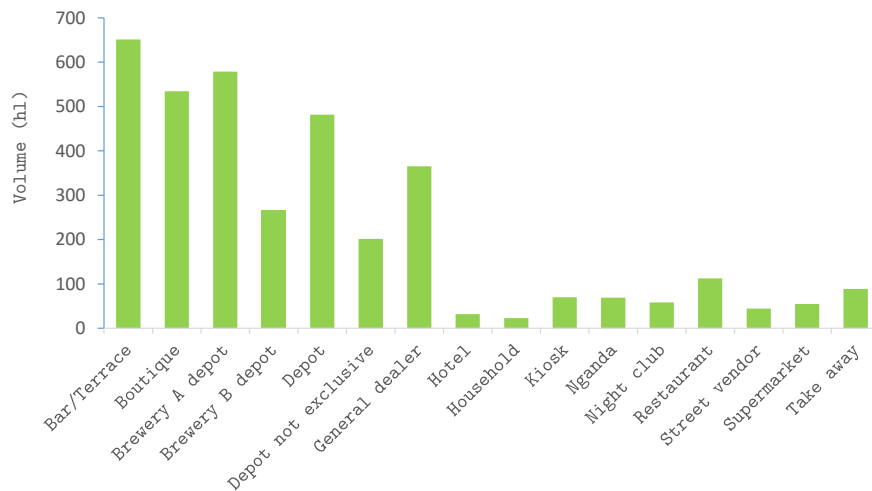


Figure 4.4: A breakdown of the total weekly soft drinks sales per market segment.

Again the wholesale route is preferred above delivering directly to retail outlets such as boutiques. The depicted volume for boutiques is split among 396 outlets, compared to 81 outlets categorised as depots. Therefore although the market share gained by non-wholesalers is attractive, the cost to serve would simply be too high.

The sample has shown spirits is less popular than beer throughout Lubumbashi and its surroundings. Boutiques account for 72,6% of the total weekly sales, as depicted in figure 4.5. Surprisingly bars and terraces only account for 0,03% of the total weekly sales. Boutiques primarily sell low-cost spirits imported from Zambia, while bars and terraces sell internationally recognised brands. Clearly, the popularity of the market segment is strongly linked to the price point at which it sells spirits.

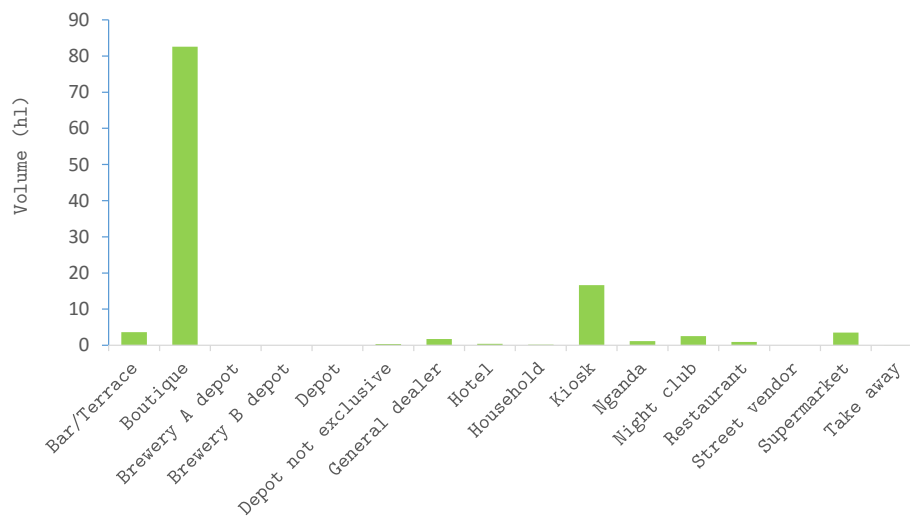


Figure 4.5: A breakdown of the total weekly spirits sales per market segment.

4.1.2 Sample of weekly sales volume by product

For three liquid streams, the weekly sales of the six most popular products were recorded. For opaque beer, there are too few commercial alternatives to follow a similar approach. Therefore the sales volume for opaque beer was captured for different container sizes rather than brands. Before implementing the survey, a detailed record of the most popular products found in trade was created. An extract from the table is illustrated in table 4.1.

Table 4.1: Extract from the product table.

Product ID	Category	Brand	Pack	Volume (l)	Case size
P01	Beer	####	Glass	0.330	6
P02	Soft drinks	####	Plastic	0.375	24

P168	Spirits	####	Glass	0,750	24

Within trade 66 spirit products, 28 beer products and 70 soft drink products were identified. Additionally, opaque beer was found to be sold in four separate container sizes. This brings the total number of unique products to 168. To ensure the confidentiality of the information, the brand names are obscured. The analysis of the product information falls outside the scope of the research. However, the value and flexibility of the data model is illustrated through a simple example.

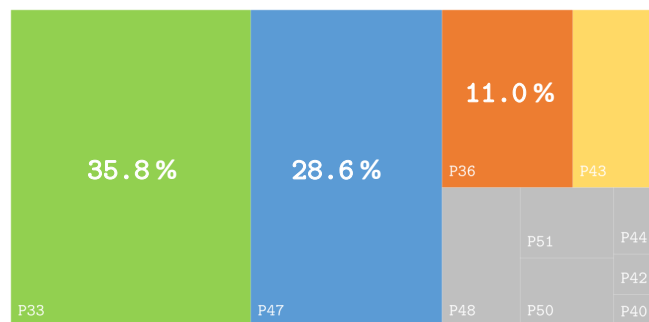


Figure 4.6: Weekly beer sales volume per product in urban settings.

Figure 4.6 depicts the sales volume of the ten most popular beer products in urban settings. This simple analysis shows that even in urban areas, the low-cost alternative, product P33, captured the largest market share. The popularity of the different products can be assessed according to brand, pack and container volume. This allows a market profile to be created for each urbanisation type or income category. The data used to produce figure 4.6 can be found in appendix B.1.2.

4.2 Extrapolated channel volume flow

For each of the four liquid streams, the survey sample has illustrated the popularity of the different market segments. However, without having surveyed the entire universe of retail outlets, the potential of the market cannot yet be gauged.

In section 3.3.1 the survey coverage was validated by its similarity to the market composition detailed by a previous retail outlet survey. The previous retail outlet survey surveyed the entire towns of Lubumbashi, Likasi and Kolwezi. Therefore the size and composition of the entire universe is known. The historic data is therefore used to extrapolate the volumes produced by the survey sample.

Table 4.2: Assumptions and basis employed during the extrapolation of sampled data.

Market segment	Redistributed	Customer count	
		Sample	Historical
Bar/Terrace	5,0%	482	2 467
Boutique	0,0%	396	3 975
Brewery A depot	90,0%	63	223
Brewery B depot	90,0%	101	363
Depot	90,0%	81	284
Depot not exclusive	90,0%	25	90
General Dealer	0,0%	144	411
Hotel	0,0%	21	137
Household	0,0%	263	3 016
Kiosk	0,0%	64	548
Nganda	0,0%	100	960
Night club	0,0%	37	274
Restaurant	0,0%	93	274
Street Vendor	0,0%	159	411
Supermarket	2,0%	10	137
Take Away	0,0%	42	137

Additionally, double counting errors are avoided by calculating what percentage of the sales volume is redistributed back into retail. The redistribution figures are assumed based on observations made in trade and detailed in table 4.2.

4.2.1 Sales volume by category

The effect of double counting is illustrated in figure 4.7. Of the recorded beer sales volume, 51,8 % has been redistributed. This implies that less than half of the recorded sales volume is actually bought by the consumer. The remainder of the volume is redistributed between retail outlets. This gives an important insight into the actual potential for the manufacturing and distribution of each liquid stream. It should be noted that only a negligible amount of opaque beer and spirits are redistributed. A detailed account of the information can be found in appendix B.2.1

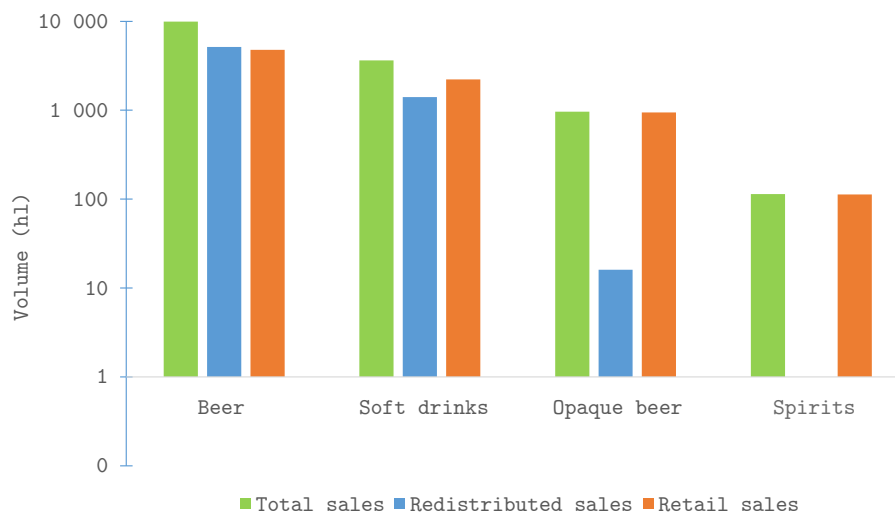


Figure 4.7: Comparison of redistributed and retail volume for the four liquid streams.

The potential of each liquid stream is determined by consumption at a consumer level. Therefore the retail sales figure determines the viability of the business case. In the remainder of the section, the data is extrapolated to assess the potential of each liquid stream in the three major towns of the Katanga province.

For each market segment, the recorded sales volume is recalculated as an average figure per retail outlet. Then the extrapolated weekly sales in the universe are calculated by multiplying the average volume per outlet by the number of outlets in the universe. The annual redistributed and retail volume is then calculated. Only then can the viability of the business case be assessed. The supporting tables can be found in appendix B.2.1.

In Namibia and South Africa, SABMiller PLC reported a sales volume of 27,245 million hl of lager in 2014 [90]. According to the extrapolated totals presented in figure 4.8, 1,34 million hl of beer is sold annually in Lubumbashi, Likasi and Kolwezi. This indicates a significant volume flow, however, to place the figures in context, the consumption per capita is calculated. South Africa is ranked 35th worldwide at 58,4 litres of beer consumed per capita [91]. The calculated consumption per capita in the three towns was calculated at 50 litres of beer consumed per capita. This strongly indicates that there exists a large market for the manufacturing and distribution of beer. Soft drinks and opaque beer were calculated at 27 and 17 litres consumed per capita respectively.

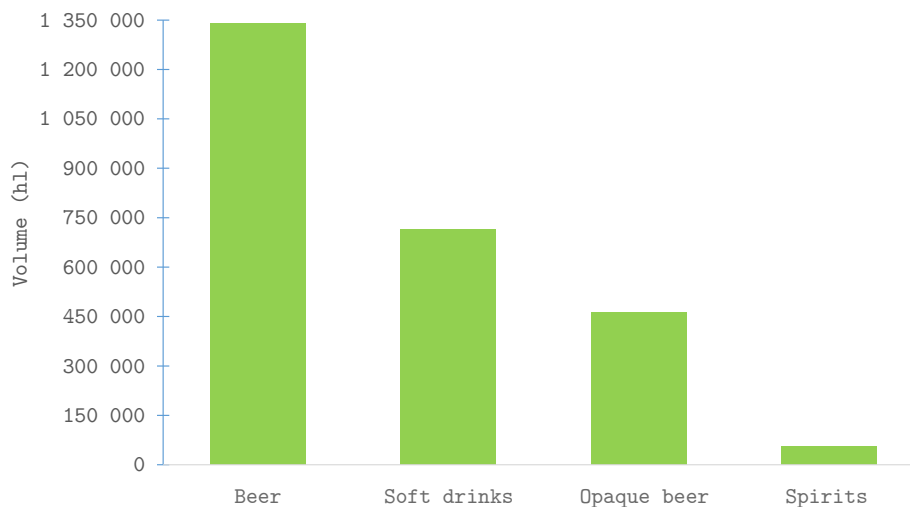


Figure 4.8: Annual extrapolated retail volume by category.

Figure 4.8 does not accurately reflect the market size of spirits. Therefore to fully understand the demand for spirits, the consumption per capita of ethanol is used as a measure. The percentage of ethanol in spirits and beer is assumed at 40 % and 4 % respectively. In the three towns, 2,09 litres of spirits is consumed annually per capita. This translates to 0,84 litres of pure alcohol. In comparison, through beer 2 litres of pure alcohol is consumed per capita annually. While beer remains the most popular alcoholic beverage, the consumption of spirits in Lubumbashi, Likasi and Kolwezi supports the manufacturing and distribution of spirits as a business. In fact, the consumption of spirits is 12 times higher than national average of 0,07 litres of ethanol consumed per capita annually [92].

The research thus far indicates that a healthy market exists for the manufacturing and distribution of beer, opaque beer, soft drinks and spirits. However, it is not known if the market demand is saturated. Therefore the next section investigates the missed sales by category.

4.2.2 Missed sales volume by category

This section determines whether the consumer demand for beer, soft drinks and spirits surpasses the supply. It is assumed opaque beer is never in short supply as it is brewed quickly and on the site of consumption. Therefore the retail outlet survey did not investigate the volume of missed sales for opaque beer.

First, the number of outlets experiencing stock outs of any beer, soft drinks and spirits products are investigated. This measure also gives an insight into which market segments are better serviced.

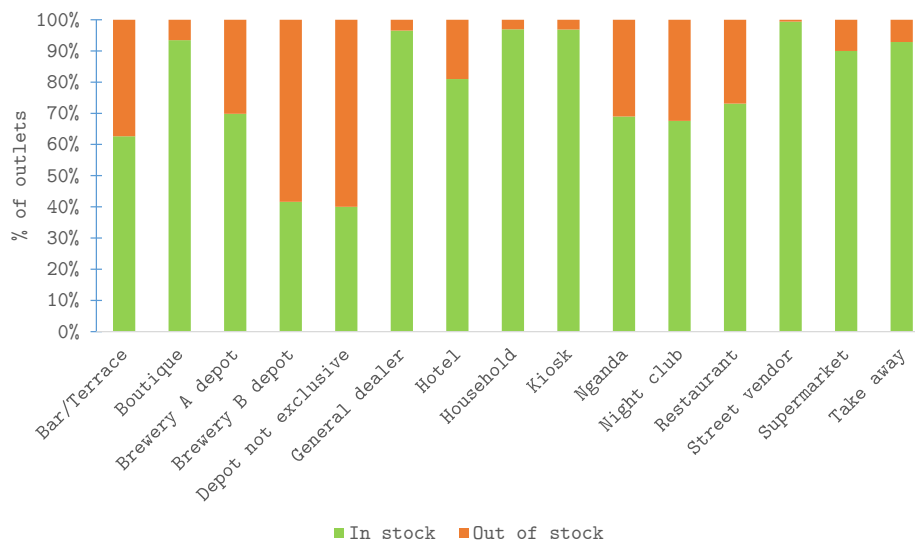


Figure 4.9: Outlets experiencing stock outs of beer products.

For each market segment figure 4.9 indicates the percentage of outlets experiencing stock outs versus outlets in stock. On average 20,6 % of all outlets selling beer products experience stock outs. This alone indicates the consumer demand is not satisfied. The percentage of out of stock retail outlets is a symptom of problems further up the supply chain. Of the market segments described as wholesalers, 49,5 % experience stock outs. This indicates the ultimate suppliers are the bottleneck. Of the 101 brewery B depots 58,4 % experience stock outs. This figure is only slightly better than the 60 % of non-exclusive depots who experience stock outs. Therefore a new market entrant can enlist the support of non-exclusive depots by providing higher levels of service than what exclusivity can guarantee.

For soft drinks, the average number of outlets experiencing stock outs are not greatly different to that of beer. From the recorded results 19,6 % of all outlets selling soft drinks experience stock outs. However as seen in figure 4.10, the wholesalers are better serviced. Only 30,9 % of all wholesalers experience

stock outs. As before, a viable opportunity does exist for a new market entrant that can better service the supply chain.

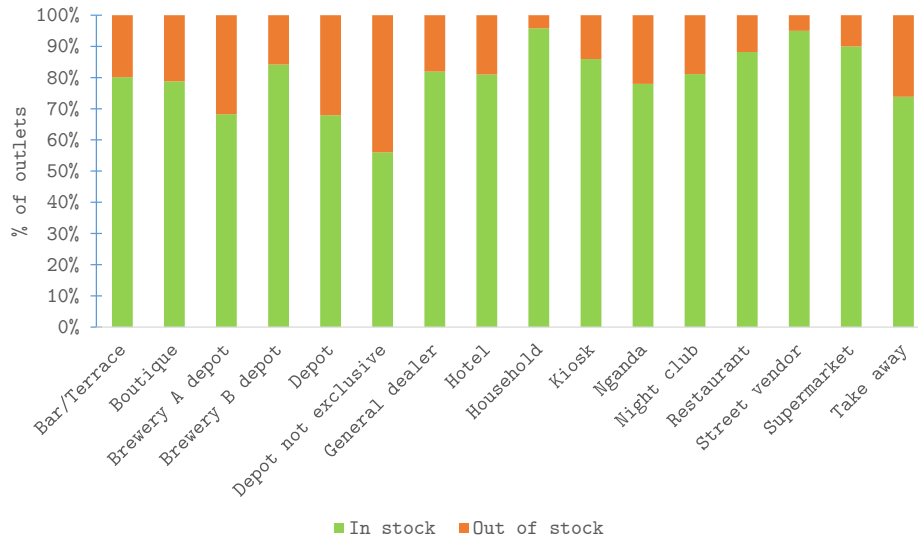


Figure 4.10: Outlets experiencing stock outs of soft drink products.

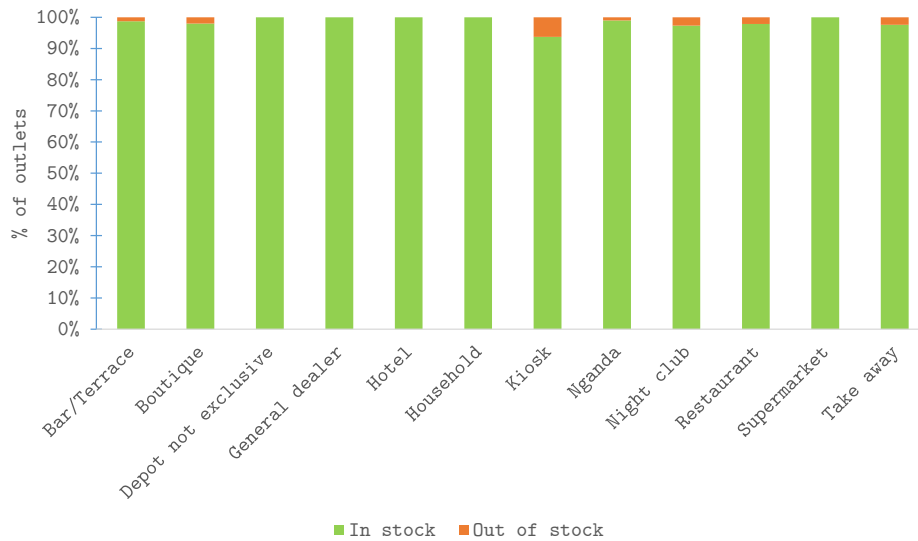


Figure 4.11: Outlets experiencing stock outs of spirit products.

Figure 4.11 indicates that all market segments selling spirits are well stocked. This, however, does not diminish the viability of the business opportunity. It simply implies there exists little slack in the supply chain that can easily be taken up by new market entrants. All the supporting tables can be found in appendix B.2.2.

In order to quantify the consumer demand not met by the available supply, the missed sales volume by category is investigated. The estimated missed sales have been extrapolated to present annual figures and split up into redistributed and retail volumes. As before the retail volumes are used to determine the actual consumer demand. Figure 4.12 compares the extrapolated sales volume with the extrapolated missed sales volume.

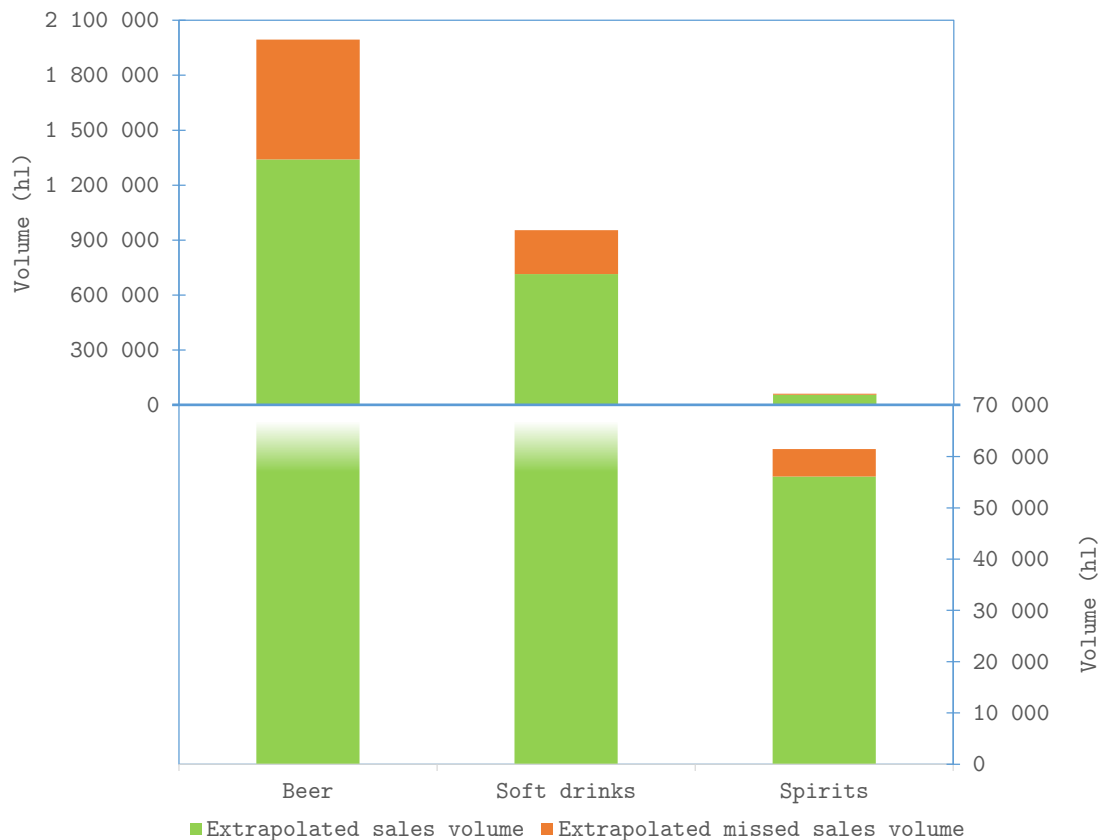


Figure 4.12: A comparison of the annual sales volume and missed sales volume by category.

An additional 653 858 hl of beer can be sold on an annual basis or 48,8 % more than the current volume. A new market entrant can gain a large portion of the available market share by simply picking up the slack of the incumbent companies. A similar opportunity exists for the manufacturing and distribution of soft drinks. The estimated missed sales volume for soft drinks amounts to 238 746 hl annually. As expected the missed sales volume of spirits is relatively small compared to that of beer and soft drinks. An additional 5 367 hl or 9,6 % of the current sales volume can be sold by meeting the consumer demand. Evidently, the market is not saturated for all three of the investigated liquid streams.

4.3 Route to market strategy

This subsection explores the current route to market strategy by depicting the flow of volume, identifying opportunities and proposing improvements to weaknesses. The analysis also examines how credit is employed in the supply chain. Additionally, key performance indicators (KPIs) including delivery frequency and average lead times are assessed.

4.3.1 Supply chain norms

The data obtained from the 2 081 retail outlets regarding credit terms, delivery frequency and delivery lead times are averaged and summarised in table 4.3. Of the surveyed outlets, only 58 retail outlets receive credit from their suppliers. The majority of retail outlets have a major cash flow problem and do not receive credit to alleviate the problem. Thus outlet owners typically wait to sell all their stock, in order to finance further purchases. This, combined with poor lead times result in missed sales and reduced profitability.

Table 4.3: Summary of the supply chain norms gathered from the survey.

Market segment	Average credit (\$)	Customer count		Data on customers receiving deliveries		
		Sample	Credit available	Customer count	Average frequency (days)	Average lead time (days)
Bar/Terrace	\$2 538,75	482	22	155	5,41	1,25
Boutique	NA	396	4	13	2,48	1,27
Brewery A depot	\$100,00	63	2	47	5,00	1,85
Brewery B depot	\$266,67	101	6	69	3,78	3,96
Depot	NA	81	1	1	3,14	1,94
Depot not exclusive	NA	25	1	17	4,23	1,19
General Dealer	\$2 000,00	144	2	10	3,07	1,45
Hotel	NA	21	2	9	3,93	1,07
Household	NA	263	1	8	4,42	3,50
Kiosk	NA	64	1	2	3,59	1,83
Nganda	NA	100	5	28	5,63	1,00
Night club	NA	37	2	15	5,76	0,94
Restaurant	\$265,00	93	4	23	5,41	0,75
Street Vendor	\$175,00	159	3	2	5,75	NA
Supermarket	NA	10	0	1	3,61	5,17
Take Away	\$10,00	42	2	2	5,13	0,75
Total		2081	58	402		

Brewery B depots experience the worst average lead times at 3,96 days. Combined with virtually non-existent credit terms, it comes as no surprise that 58,4 % of brewery B depots experience stock outs. In order to capitalise on the missed sales volumes, both incumbent and new market players need to introduce favourable credit terms. By combining favourable credit terms with increased delivery frequencies, the competitiveness of manufacturers can be improved by reducing stock-outs and missed sales volumes.

Both brewery A and brewery B deliver directly to a large proportion of their exclusive depots. Determining the optimum number of distributors falls

outside the scope of this research. However, evidently the high number of distributors cannot be effectively managed. Thus to improve competitiveness, suppliers need to reduce the number of distributors who receive direct deliveries. The number can be reduced according to the Pareto principle¹. Fewer distributors can be serviced more effectively without requiring any additional investment.

4.3.2 Distribution channel analysis

For each of the four liquid streams the current route to market is depicted. The flow of volume is presented as a percentage of the total recorded sales volume for the liquid stream. The percentages represent the share of stock bought into the market and not the total stock distributed by the channel player.

Percentages in black circles indicate the total volume share and thus represents the importance of the channel player. Blue arrows represent the volume delivered to the channel player, while red arrows represent the volume collected by the channel player. Lastly, black arrows indicate assumed volume flows and the boxed numbers indicate key discussion points.

¹The Pareto principle is also known as the 80-20 rule. In the context of the research, it thus implies 20 % of the retail outlets account for 80 % of the volume.

4.3.2.1 Analysis of beer distribution channels

The current distribution channels of beer products are illustrated in figure 4.13.

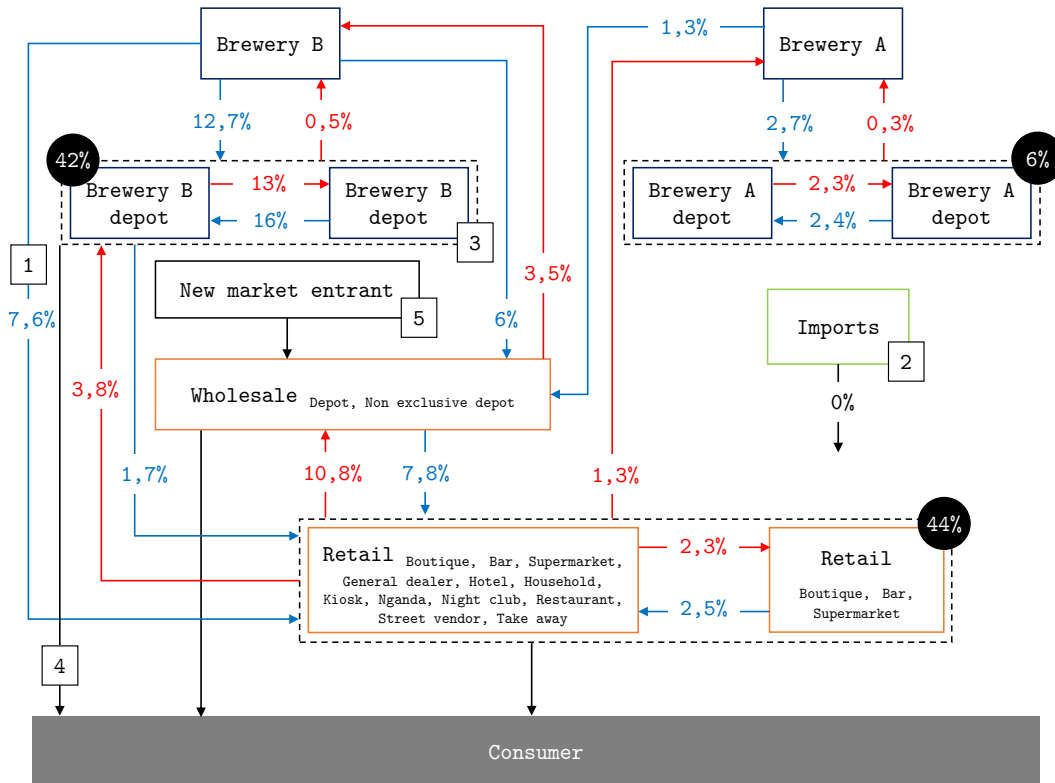


Figure 4.13: Current distribution channel for beer.

1. Brewery B delivers 7,6 % directly into retail. Delivering smaller drop sizes directly into retail is very costly. Additionally, by circumventing their own exclusive distributors, brewery B has failed to execute their own strategy properly.
2. The incumbent companies face no competition from imported beer products.
3. A huge volume interplay exists between brewery B depots. Twenty-nine percent of the volume is moved between bigger and smaller depots. Ultimately this increases the complexity of the supply chain and increases consumer prices.
4. Forty-eight percent of the total volume passes through the exclusive depots. However, of the 48 %, only 6,8 % appears to make it into retail. This indicates a large proportion of the total sales volume is collected directly from depots by the ultimate consumer.

5. New market players should attempt to cut out as much of the existing channel confusion as possible. By enlisting the support of non-exclusive wholesalers a new market entrant can create a simple distribution channel with existing links to both retail and the ultimate consumer.

In summary, the existing distribution channels are highly confusing and consequently difficult to manage. Therefore incumbent manufacturers struggle to position their products and manage the price thereof. Additionally, the distribution channel relies on a great deal of direct delivery by both of the major players. In order to be competitive, a new market player must keep its distribution channel simple.

4.3.2.2 Analysis of opaque beer distribution channels

Likewise, the distribution channels of opaque beer is illustrated in figure 4.14.

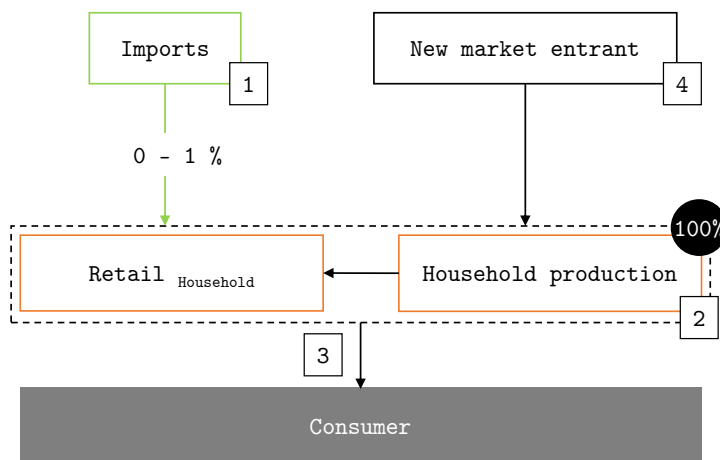


Figure 4.14: Current distribution channel for opaque beer.

1. Commercial opaque beer cartons imported from Zambia was found in trade. Due to its high price, the volume found in trade is extremely small. This iterates the fact that price is the single most important determinant to successfully distributing opaque beer products.
2. Almost 100 % of local opaque beer is brewed in the household where it is sold.
3. Typically households that produce local opaque beer have facilities for the product to be consumed. Some of these outlets send salespeople with gourds of opaque beer and sell door-to-door.

4. Opaque beer requires a different distribution channel to beer, soft drinks and spirits. The nature of the product, continued maturation, different retail outlets and short shelf life all require a different focus. The best option is to distribute the product through van sales² where the product is collected daily from a central warehouse.

4.3.2.3 Analysis of soft drinks distribution channels

The distribution channel of soft drinks is illustrated in figure 4.15.

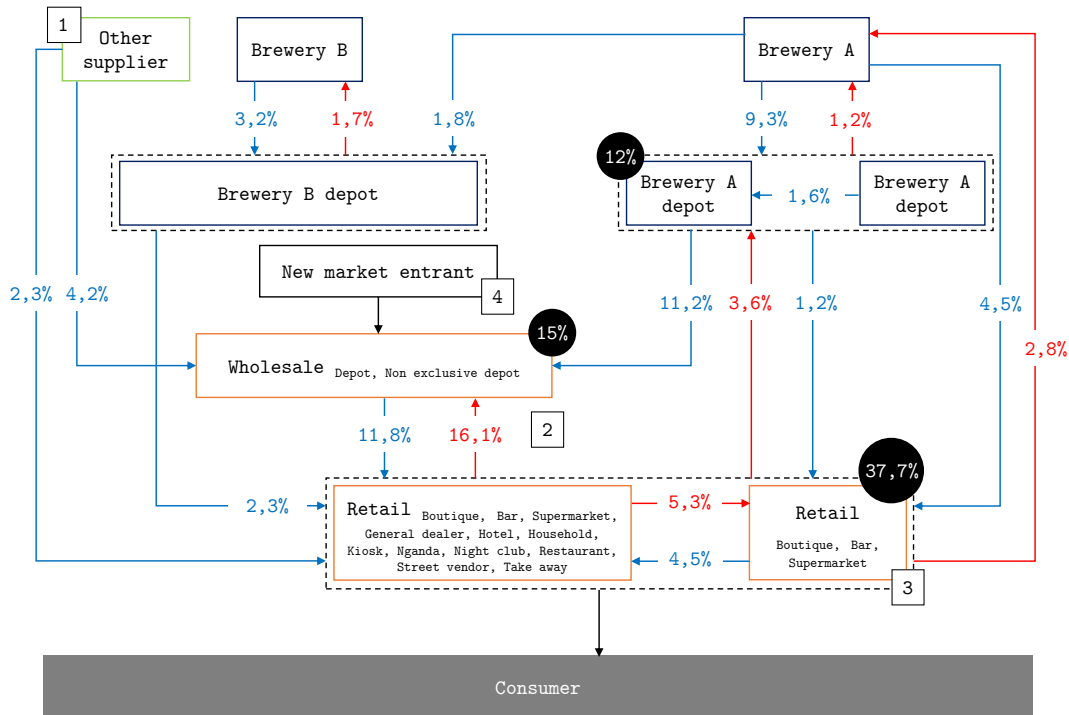


Figure 4.15: Current distribution channel for soft drinks.

1. Within trade products from a third manufacturer exclusively producing soft drinks were found. The manufacturer supplied 6,5 % of the total soft drinks volume. A much simpler and effective distribution strategy is followed by delivering all of their stock down the channel.
2. Deliveries to retail level are highly complex and from multiple sources.
3. A large share of the volume is sold at a retail level. The high share is in part created by suppliers delivering directly in retail and circumventing their own distribution channels.

²Van sales are also referred to as direct store distribution (DSD). Trucks loaded with inventory sell to customers along preassigned routes acting as a mobile warehouse.

- Any new route to market for soft drinks must cut through the clutter in the channel by using non-franchised wholesalers and keeping it simple.

4.3.2.4 Analysis of spirits distribution channels

The distribution channel of soft drinks is illustrated in figure 4.16.

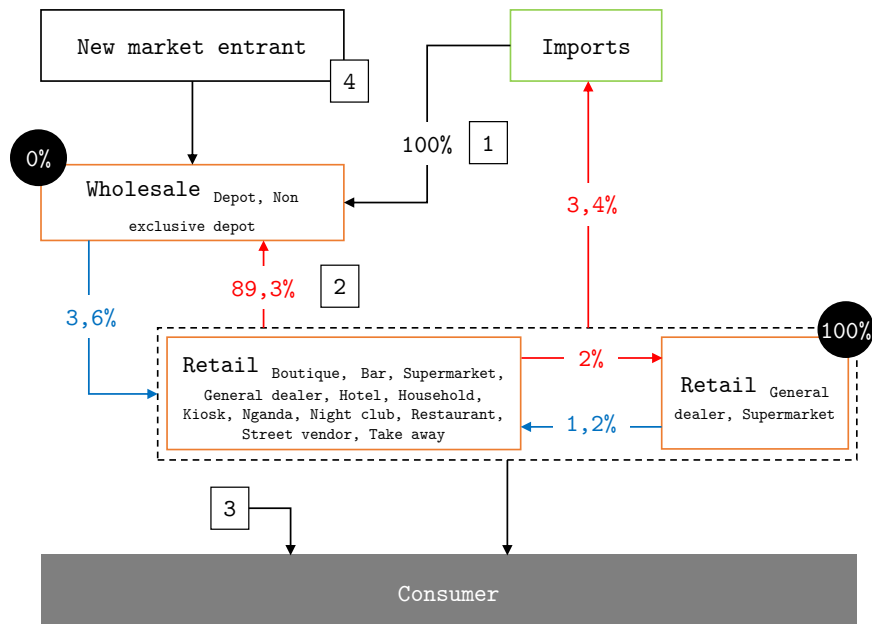


Figure 4.16: Current distribution channel for spirits.

- Hundred percent of all spirits products are imported. No local production exists in the Katanga province.
- Retail outlets receive most of their stock from wholesalers. These wholesalers are categorised as non-exclusive depots and in all likelihood have their own arrangements to import spirits from other countries (i.e. India and Zambia), not necessarily directly from the supplier.
- The survey did not look at illicit liquor production. This is a completely uncontrolled environment and locally produced spirits should make inroads here.
- The distribution of spirits must be done in conjunction with that of beer and soft drinks while the volume remains relatively small. However, as the volume of spirits grows, it must be rethought. The distribution of spirits does not naturally compliment that of beer and soft drinks

In summary spirits brands must be preferable in price and quality in order to convert existing wholesale relationships. A crackdown by the government on illicit production would help locally produced spirits gain traction.

4.4 Concluding remarks

In conclusion, a host of insights in-line with the stated aims and objectives of the research could be produced from analysing the collected data. The preceding section did not assess all the data produced from the survey, most notably the product specific information and continual correspondence data was not incorporated into the analysis.

The survey collected a broad assortment of data. As repeating a retail outlet survey is extremely costly, some of the data collected falls outside the scope of the current research requirements. Unfortunately, the data on continual correspondence could not produce any valuable insights. The majority of the surveyed retail outlets simply do not want to engage on a continued basis or provide information. Without providing any monetary insensitive, the risks to confidentiality for retail outlet owners simply outweigh the benefits.

Lastly by assessing the current distribution channels, a number of inefficiencies and opportunities were identified. The chosen transportation arrangement of both major players is exclusive distributors. While this implies there lies some value in utilising distributors for the specific environment, it does not imply the arrangement will align with the strategic narrative of other companies. The current route to market strategy has provided valuable insights, but in alignment with the stated aims and objectives a different, more generic approach is required to identify an optimal transportation arrangement.

Chapter 5

Decision support for selecting transportation arrangements

An analysis of the data collected in the DRC has shown that there lies value in incorporating independent distributors into the route to market. The value of distributors is reaffirmed by the reliance of incumbent players upon them. While distributors are a strong candidate for an optimal transportation arrangement, the decision process has not taken into account any inputs from the client.

Thus the research proposes a generic decision support tool to incorporate client input in identifying an optimal transportation arrangement. The tool is specifically developed to remain independent of the retail outlet survey. This is done to provide direction at a strategic level without undertaking a time consuming and costly retail outlet survey.

The proposed decision support tool is comprised of two parts: (a) a strategic and (b) compatibility assessment. The strategic assessment determines the relative importance of 11 strategic imperatives to the client and scores each transportation arrangements accordingly. The compatibility assessment consists of 30 core questions regarding insourcing and outsourcing, highlighting the strengths and weaknesses of each transportation arrangement. A scale is used to determine how comfortable the client is with each statement. Based upon the inputs, the tool then scores the transportation arrangement. The combined assessment is presented as in figure 5.1.

Each of the six arrangements is plotted according to their strategic alignment and compatibility score. The discussion of the decision support tool is presented as three subsections. First, the mechanics of the strategic alignment assessment is discussed. Secondly, the compatibility assessment and the interpretation thereof is explained. Lastly, the tool is validated by testing

CHAPTER 5. DECISION SUPPORT FOR SELECTING TRANSPORTATION ARRANGEMENTS 101

six different scenarios with the help of subject matter experts.

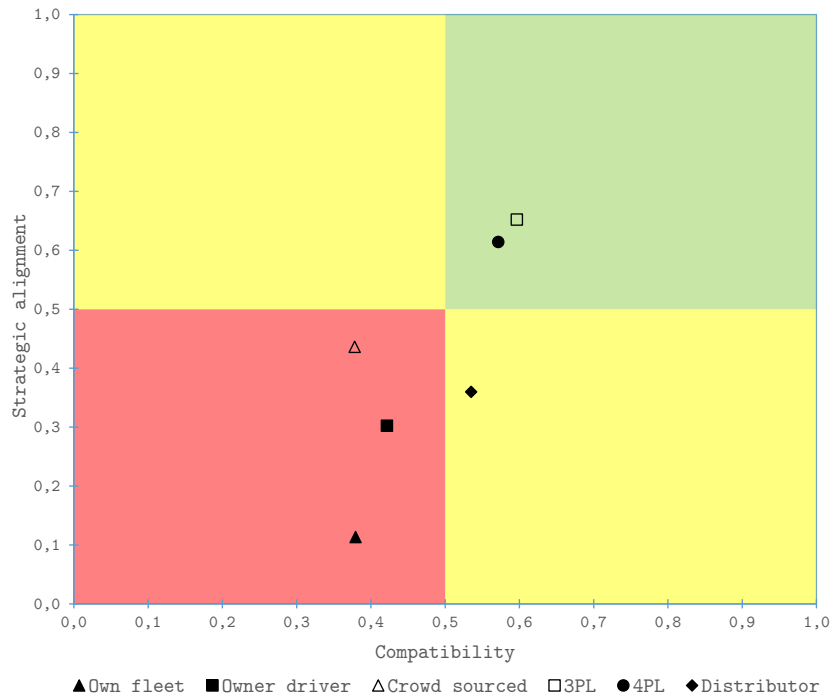


Figure 5.1: Visual output from the decision support tool.

5.1 The two step AHP and TOPSIS methodology

This section introduces the first part to identifying an ideal transportation arrangement. The two step AHP and TOPSIS methodology ultimately determines which of the six transportation arrangements best compliment the strategy pursued by a client company. The methodology levels are explored in figure 5.2. Levels 1 - 3 are explored in this section, while levels 4 - 7 are presented as a validation exercise in section 5.3.

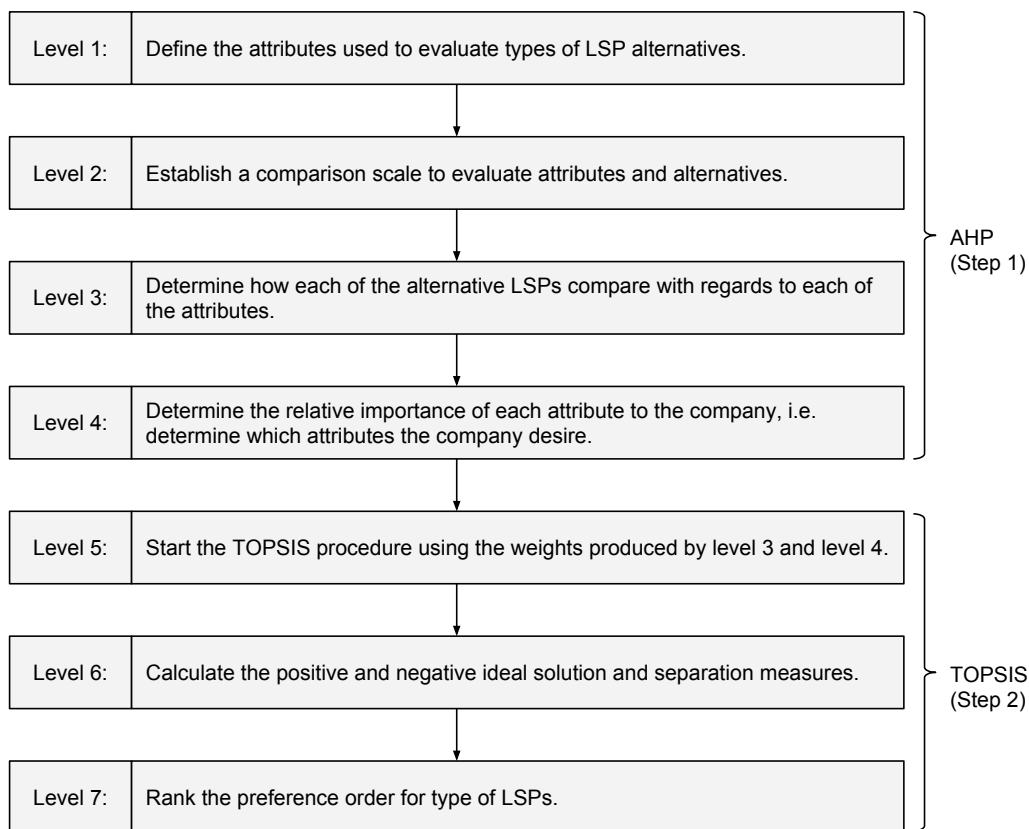


Figure 5.2: The levels of the two-step AHP and TOPSIS methodology.

5.1.1 AHP and TOPSIS procedure

A multi-attribute decision making (MADM) problem consists of a finite number of known alternatives. The object is to represent each alternative in terms of its performance according to multiple attributes. The procedure allows an evaluator to identify the best alternative or to sort and classify all the alternatives. While a number of MADM methods exist, this research specifically explores the AHP and TOPSIS method. The methods were chosen based on their simplicity and ease of implementation.

5.1.1.1 AHP

AHP assumes a problem with m alternative solutions which are differentiated by n attributes. The first step in AHP is to compute the different weights for each attribute. This involves creating a pairwise comparison matrix A as illustrated by equation 5.1.

$$A = \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1j} \\ a_{21} & \cdots & \cdots & a_{2j} \\ \vdots & \vdots & \vdots & \vdots \\ a_{i1} & \cdots & \cdots & a_{ij} \end{pmatrix} \quad (5.1)$$

The matrix A is a $n \times n$ real matrix. Each entry a_{ij} represents the importance of the i^{th} attribute relative to the j^{th} attribute. The relative importance of each attribute is measured according to a numerical scale detailed in table 5.1.

Table 5.1: The Saaty comparison scale, adapted from [93].

Value of a_{ij}	Explanation
1	i and j are equally important
3	i is slightly more important than j
5	i is more important than j
7	i is strongly more important than j
9	i is absolutely more important than j

If the i^{th} attribute is equally or more important than the j^{th} attribute, a positive whole number between 1 and 9 is assigned to the entry a_{ij} . However if the i^{th} attribute is less important than the j^{th} attribute, the reciprocal of the degree of importance is assigned to the entry a_{ij} . Therefore the entries a_{ij} and a_{ji} satisfy the constraint in equation 5.2.

$$a_{ij} \cdot a_{ji} = 1 \quad (5.2)$$

Once matrix A has been constructed, the normalised pairwise comparison matrix A_{norm} can be calculated. The entries \bar{a}_{ij} are calculated by dividing each entry by the sum of the respective column as in equation 5.3.

$$\bar{a}_{ij} = \frac{a_{ij}}{\sum_{i=1}^n a_{ij}} \quad (5.3)$$

Once the normalised pairwise comparison matrix A_{norm} has been constructed, the attribute weight vector w can be calculated. The attribute weight vector w is calculated by averaging the entries on each row of A_{norm} as in equation 5.4.

$$w_j = \frac{\sum_{i=1}^n \bar{a}_{ij}}{n} \quad (5.4)$$

Next the matrix of option scores, matrix S , is constructed. Matrix S is a $m \times n$ matrix where each entry s_{kl} represents the score of the m^{th} alternative with respect to the n^{th} attribute.

For each of the n attributes, $n = 1, \dots, n$, a pairwise comparison matrix $B^{(n)}$ is constructed. Each entry $b_{kl}^{(n)}$ of the matrix $B^{(n)}$ represents a comparison between the k^{th} alternative and l^{th} alternative with respect to the n^{th} attribute. The process for creating the pairwise comparison matrix $B^{(n)}$ is identical to that of the pairwise comparison matrix A .

If the entry $b_{kl}^{(n)}$ is larger than one, the k_{th} alternative is better than the l_{th} alternative with respect to the n^{th} attribute. Likewise, if the entry $b_{kl}^{(n)}$ is smaller than one, the k_{th} alternative is worse than the l_{th} alternative with respect to the n^{th} attribute. If the alternatives are considered equivalent with respect to the n^{th} attribute, then $b_{kl}^{(n)}$ is set equal to one.

Next each of the pairwise comparison matrices $B^{(n)}$ are normalised. From the normalised matrix $B_{norm}^{(n)}$ the score vectors s^n are calculated by averaging the entries on each row of $B_{norm}^{(n)}$. For each alternative a score vector is created where n represents each attribute as in equation 5.5.

$$s = [s^1 \cdots s^n] \quad (5.5)$$

5.1.1.2 Consistency evaluation

The AHP produces a number of pairwise comparison matrices. Each of these matrices is constructed by evaluating the importance of one attribute with respect to another. When a large number of pairwise comparisons are performed, inconsistencies may arise [94].

The degree of consistency of matrix A and the matrices $B^{(n)}$ can be determined by calculating the consistency ratio (CR) of each matrix. In order to calculate the CR, the largest Eigenvalue and the consistency index (CI) of the pairwise comparison matrix must be calculated. A thorough explanation of the method for calculating λ_{max} is outside the scope of this research and can be found in [95]. The consistency index is calculated as in equation 5.6.

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad (5.6)$$

Saaty [93] proved that in order for a pairwise comparison matrix to be consistent, λ_{max} must be equal to the size of the matrix n . The CI calculates a useful measure from λ_{max} by determining the degree of consistency of the matrix. The CI does not determine what degree of consistency is acceptable.

Therefore Saaty [93] proposed the CR. The CR determines whether the degree of consistency is acceptable by comparing to the CI to a random consistency index (RI). The RI created by Saaty is detailed in table 5.2.

Table 5.2: The random consistency index, adapted and redrawn from [93].

n	1	2	3	4	5	6	7	8	9	10	11
RI	0,00	0,00	0,58	0,9	1,12	1,24	1,32	1,41	1,45	1,49	1,51

The CR is calculated as in equation 5.7 by dividing the CI by the RI determined by the size of the pairwise comparison matrix.

$$CR = \frac{CI}{RI} \quad (5.7)$$

If the CR is smaller than or equal to 0.1, the degree of inconsistency is acceptable. However, if the CR is larger than 0.1, the evaluation of the attributes or alternatives must be revised.

5.1.1.3 TOPSIS

TOPSIS is a multi-criteria decision analysis method to identify solutions from a set of alternatives [96]. The method creates two artificial alternatives, an ideal solution and a negative ideal solution. TOPSIS then selects the alternative which is the closest to the ideal solution and the farthest from the negative ideal solution [97]. The TOPSIS procedure is broken down into six steps:

Step 1: Construct the normalised decision matrix. To allow comparisons to be made across criteria, the attributes are transformed into dimensionless ratios. The normalised value n_{ij} is calculated in equation 5.8.

$$n_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}}, \quad i = 1, \dots, m; \quad j = 1, \dots, n \quad (5.8)$$

Step 2: Construct the weighted decision matrix. It is assumed a set of weights, where w_j is the weight of the j^{th} attribute and $\sum_{j=1}^n w_j = 1$ exist. The weighted value v_{ij} is calculated in equation 5.9.

$$v_{ij} = w_j n_{ij}, \quad i = 1, \dots, m; \quad j = 1, \dots, n \quad (5.9)$$

Step 3: Next the ideal solution A^+ and negative ideal solution A^- are determined. I represents a set of positive attributes while J represents a set of negative attributes such as cost and risk.

$$A^+ = v_1^+, \dots, v_n^+ \quad \text{where } v_j = (\max v_{ij} | i \in I), (\min v_{ij} | i \in J) \quad (5.10)$$

$$A^- = v_1^-, \dots, v_n^- \quad \text{where } v_j = (\min v_{ij} | i \in I), (\max v_{ij} | i \in J) \quad (5.11)$$

Step 4: Calculate the separation measures for each alternative. The separation from the ideal solution is calculated in equation 5.12.

$$d_i^+ = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^+)^2}, \quad i = 1, \dots, m \quad (5.12)$$

Similarly, the separation from the negative ideal solution is calculated in equation 5.13.

$$d_i^- = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^-)^2}, \quad i = 1, \dots, m \quad (5.13)$$

Step 5: Calculate the relative closeness to the ideal solution for each alternative as in equation 5.14.

$$C_i = \frac{d_i^-}{d_i^+ + d_i^-}, \quad i = 1, \dots, m \quad (5.14)$$

Step 6: Rank the alternatives in decreasing order according to their relative closeness C_i .

5.1.2 Attribute identification

The research has identified eleven strategic imperatives considered by companies during the identification of an ideal transportation solution. A brief overview of the 11 attributes are provided in table 5.3.

Table 5.3: A description of the 11 strategic imperatives.

ID	Attribute	Description
1	Economic development	Economic development refers to policies and programmes intended to promote job creation and entrepreneurship.
2	Control	Within the context of transportation, control refers to a business's ability to influence the delivery process. This includes the allocation of resources, routing and scheduling.

ID	Attribute	Description
3	Core competencies	A focus on core competencies describes a strategy whereby activities not considered core to the business are outsourced. Examples include human resources (HR) responsibilities and liabilities as well as all logistics activities. A focus on core competencies does not only focus management but allows business resources and finances to be re-purposed to more profitable activities.
4	Cost	A cost strategy focuses on minimising cost.
5	Customer service	Within the context of transportation, a number of criteria drive the level of customer service. Firstly clients seek prompt and emphatic recovery and resolution of errors, complaints and claims. Secondly, clients seek a high degree of information sharing and trust. Thirdly clients require quality dispatch personnel, sales force personnel, drivers and generally knowledgeable staff who are able to resolve problems. Lastly, clients want LSPs to facilitate feedback from the consignee.
6	Flexibility	Flexibility refers to the ability to accommodate significant variations in load size and volume. Additionally flexibility allows for the handling of special products, emergency or unexpected deliveries, expedited deliveries and provides diversion and consignment privileges.
7	Innovation	Innovation does not only imply superior resources and capabilities. A strategy of innovation refers to consistently investing in superior resources and capabilities to maintain a competitive advantage. Innovation within the context of transportation is primarily driven by technological innovations.
8	Performance	A performance driven strategy drives efficiency. In order to become more efficient, KPIs such as transit times and turn around times must be reduced.

ID	Attribute	Description
9	Reliability	Within the context of transportation, a business's reputation depends strongly on their reliability. Factors that influence reliability include on time pick up and deliveries, consistent transit times, low damage and loss records as well as the financial stability of the business.
10	Resources and capabilities	The acquisition of superior resources and capabilities through outsourcing represents an important strategy. Examples of superior resources and capabilities include superior geographical coverage, consolidation services, tracking and tracing, customer relationship management, insurance coverage, computerised billing, availability of delivery information/confirmation and e-commerce.
11	Risk	A risk adverse strategy could be employed in response to separate perceptions of risk. In the traditional sense, risk implies the possibility of the actual return being less than the expected return. This specifically addresses the risk associated with investing in an own fleet. Additionally, risk refers to transaction risk. Transaction hazards refer to opportunism brought about by incomplete and complex contracts.

5.1.3 Evaluation of alternatives

Before validating the proposed decision support tool, the six identified alternatives need to be classified. The classification requires the input of subject matter experts. Therefore, the research obtained the input from three consultants at Hunting Dragons Consulting. Collectively they have 16 years experience consulting throughout Africa in the RTM field. Each of the consultants evaluated the six alternatives in terms of the 11 identified strategies. For the final classification, the geometric mean of their collective input was taken.

The 11 attributes are identified by their respective ID's as in table 5.3. Likewise, the alternative transportation arrangements are identified by the following ID's in both figures and tables:

- A - Own fleet
- B - Owner driver
- C - Crowdsourced
- D - 3PL
- E - 4PL
- F - Distributor

The research sought the input of three consultants to ensure the decision support tool reconciled their different positions and priorities. The aggregation can be performed at two levels: (a) Aggregation of individual judgements (AIJ) or (b) aggregation of individual priorities (AIP) [98]. AIJ aggregates the individual pairwise comparison matrices, $A^{(k)}$, into one judgment matrix. Then the matrix is normalised and the weights for each alternative's attributes are calculated. In comparison, AIP first calculates the individual weights for each alternative's attributes. The matrix of option scores is then calculated by aggregating the individual weights produced by each consultant.

The research has chosen to employ the AIP method. AIP views the group of decision makers as independent agents maintaining their own identities [98]. Alternatively, AIJ views the group as one unit who share common values. As the consultants have only been working together for four years, the research deemed it more appropriate to view them as individuals to ensure the significance of their previous experience is not drowned out.

A consensus of each consultant's judgment is created by calculating the geometric mean of the alternative's attribute weights produced by each consultant. The attribute weights are again normalised to ensure the judgements remain a ratio scale. The final matrix of option scores is summarised in table 5.4. A complete step by step summary of the AHP can be found in appendix C. Additionally the individual aggregation of each consultant's evaluation is detailed in appendix C.1.4.

Table 5.4: Aggregated comparison of geometric mean of attribute weights.

Alternatives	w_1	w_2	w_3	w_4	w_5	w_6	w_7	w_8	w_9	w_{10}	w_{11}
A	0,0495	0,3127	0,0346	0,3681	0,1610	0,0556	0,0365	0,1396	0,1219	0,0471	0,0647
B	0,3516	0,2925	0,1132	0,1173	0,3125	0,1139	0,0537	0,3607	0,2804	0,0597	0,2138
C	0,1484	0,0809	0,0904	0,0907	0,1831	0,3759	0,0983	0,0565	0,0778	0,1478	0,2148
D	0,0863	0,0461	0,3129	0,1282	0,1132	0,1574	0,3416	0,0910	0,0845	0,3457	0,1133
E	0,0980	0,0461	0,3129	0,1048	0,0620	0,1574	0,3306	0,1033	0,1073	0,2937	0,2030
F	0,2661	0,2217	0,1359	0,1909	0,1682	0,1399	0,1393	0,2490	0,3280	0,1060	0,1904

The last step in classifying the alternatives is to ensure the judgements made by the three consultants are consistent. The consistency ratio of each pairwise comparison matrix produced by the three consultants were calculated and plotted in figure 5.3. Lin et al. [99] confirms that if the comparison matrices of all the decision makers pass the consistency test, the final group comparison matrix is consistent as well.

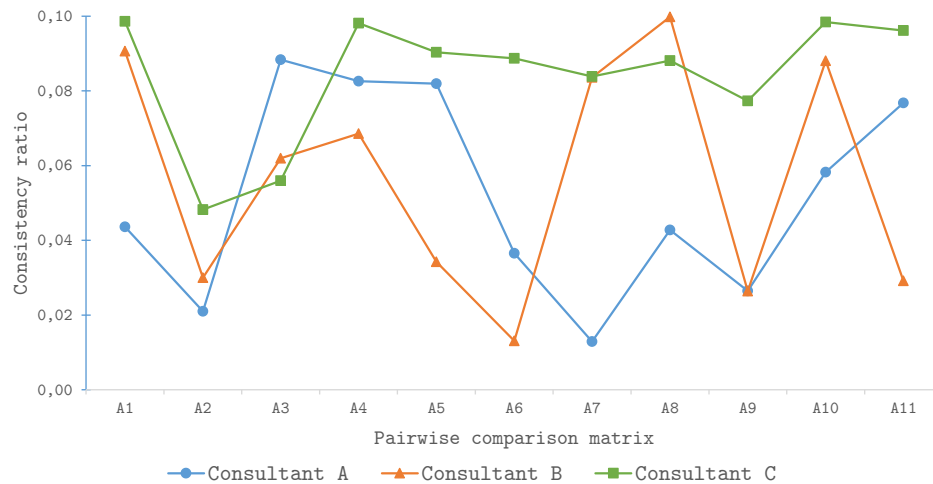


Figure 5.3: An evaluation of the quality of the individual ratio assessments.

All the matrices produced a consistency ratio of less than 0.1, satisfying Saaty's [93] requirements for consistency.

5.2 Compatibility assessment

The discussion around the compatibility assessment is structured to first introduce the 30 core questions and the surrounding organisation thereof. Secondly, the logic behind the process of scoring each transportation arrangement is explained.

The assessment has deliberately been designed to remain generic. While the research has placed an emphasis on FMCG, in principle the decision support tool can be applied to any industry. Likewise, the assessment has avoided questions that distinguish service providers within each arrangement. The tool is only intended to guide the decision process between the six core arrangements: (a) own fleet, (b) owner driver, (c) crowd sourced, (d) 3PL, (e) 4PL and (f) distributor.

5.2.1 Core questions

The compatibility assessment consists of 30 core questions divided up into seven areas of consideration: (a) industrial relations, (b) human resource management, (c) transaction cost economics, (d) resource based considerations, (e) country politics and economics, (f) competitive advantage and (g) management practises.

In figure 5.4 an extract from the Microsoft Excel document illustrates how the client inputs are captured. Each of the seven areas of consideration are detailed and discussed in the subsequent pages.

#	Considerations	Scoring									Score		
		0 = strongly disagree 10 = strongly agree											
Industrial relations													
1.	The formal workforce is highly unionised.	0	1	2	3	4	5	6	7	8	9	10	8
2.	The business has a competent human resources labour specialist, or is willing to engage the services of legal counsel or a labour relations consultant.	0	1	2	3	4	5	6	7	8	9	10	10
3.	The business is willing and able to reach collective agreements regarding wage scales, working hours, training, health and safety, overtime, grievance mechanisms and rights to participate in workplace affairs with a minimum of effort.	0	1	2	3	4	5	6	7	8	9	10	1
4.	The business has contingency plans in place to lessen to impact of strikes, pickets and other concerted refusals to work.	0	1	2	3	4	5	6	7	8	9	10	2

Figure 5.4: An extract from the client input sheet.

As a precursor to the core assessment, the tool enquires whether the client is currently operating a partially or fully insourced transportation arrangement. The answer affects how the different arrangements are scored, however this will be fully discussed in section 5.2.2.

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The first group of questions pertain to industrial relations and are recorded in table 5.5. The area of consideration simply determines how unionised the workforce is and whether the client is able to effectively manage the associated risk.

Table 5.5: Core questions grouped as industrial relations.

#	Consideration
1.	The formal workforce is highly unionised?
2.	The business has a competent human resources labour specialist, or is willing to engage the services of legal counsel or a labour relations consultant?
3.	The business is willing and able to reach collective agreements regarding wage scales, working hours, training, health and safety, overtime, grievance mechanisms and rights to participate in workplace affairs with a minimum of effort?
4.	The business has contingency plans in place to lessen to impact of strikes, pickets and other concerted refusals to work?

The human resource management considerations are presented in table 5.6. The line of questioning determines whether the client is willing and able to manage an internal workforce. This includes the process of recruitment, training, management and retrenchment.

Table 5.6: Core questions grouped as human resource management.

#	Consideration
5.	The business is willing and able to undertake to process of retrenchment, including the process of consulting with relevant trade unions?
6.	The business is willing and able to provide long-term contracts that ensure loads will be available to perform deliveries all year long, taking seasonality into account?
7.	The business is willing and able to undertake a thorough candidate sourcing and selection process?
8.	The business is willing and able to conduct operational, theoretical and business training?

Questions related to transaction cost economics are presented in table 5.7. The group of considerations guide the decision between insourcing and outsourcing by assessing the level of risk brought about by opportunism and incomplete contracts.

Table 5.7: Core questions grouped as transaction cost economics.

#	Consideration
9.	The availability of external service providers in the intermediate market create a competitive environment: <ol style="list-style-type: none"> a. 3PL service providers. b. 4PL service providers. c. Distributor service providers.
10.	The business has clearly defined what can potentially be outsourced and what it expects from external service providers?
11.	Any outsourced activities and the successful completion thereof (according to contractual agreements) can easily be verified?
12.	The business has the internal competency or is willing to engage the services of legal counsel to ensure: <ol style="list-style-type: none"> a. Adequate contractual safeguards to guard against opportunistic behaviour, potential delays and challenges in monitoring. b. The contracting environment does not generate avoidable costs or delays due to excessive governance.
13.	The business is willing and able to facilitate the exchange of information with external service providers to support bilateral coordination?
14.	The required resources for an insourced or partially insourced solution can easily be redeployed: <ol style="list-style-type: none"> a. Physical resources: <ol style="list-style-type: none"> i. Warehouse and offices. ii. Delivery vehicles and trailer. b. Technological resources: <ol style="list-style-type: none"> i. Physical IT infrastructure including desktop computers, servers, data centres, routers, network enablement, internet connectivity, firewalls, security and lastly tracking and tracing hardware. ii. Software resources such as Enterprise resource planning (ERP), Transport Management Systems (TMS), Warehouse Management Systems (WMS), Yard management Systems (YMS). c. Human resources: <ol style="list-style-type: none"> i. Distribution manager. ii. Warehouse manager. iii. Depot manager. iv. Drivers/crew.

Questions related to resource based considerations are presented in table 5.8. Resource based considerations are strongly driven by the resources and capabilities the client seek. However the line of questioning can not be pursued without distinguishing service providers within arrangements from one another. Therefore the resource based considerations are designed to determine whether the client has the resources and capabilities to effectively pursue and manage outsourced processes and activities.

Table 5.8: Core questions grouped as resource based considerations.

#	Consideration
15.	The business has access to relational capability-building mechanisms i.e. the business is able to purposefully alter its routines and resource base to achieve goals shared with partners?
16.	The business has cooperative experience (cooperative experience is defined by the length and quality of previous engagements)?
17.	The business is able to anticipate technological innovations within the transport paradigm and respond accordingly to remain competitive?
18.	The business is opposed to utilising a service with a broad variety of vehicles and drivers with different capabilities, attitudes and knowledge?

Table 5.9 outlines questions related to country economics and politics. The assessment is designed to determine whether financial or regulatory requirements are driving decision processes.

Table 5.9: Core questions grouped as country economics and politics.

#	Consideration
19.	The interest rate on loan repayments is considered too high to incur debt?
20.	The cost of specialised imported equipment is considered too high due to a weak currency?
21.	The business is able to purchase vehicles on credit?
22.	The business is willing to take up the responsibility of being regarded as the sponsoring corporate to financial institutions when negotiating finance regarding owner driver vehicles?
23.	Regulatory requirements call for the reduction of scope 1 and 2 carbon emissions?

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Questions identified as competitive advantage considerations are listed in table 5.10. The objective is to determine to what arrangements the client is opposed to, in order to maintain an advantage over competitors.

Table 5.10: Core questions grouped as competitive advantage.

#	Consideration
24.	The business is opposed to the practise of cross subsidisation?
25.	The business requires an exclusive operation?
26.	The business necessitates the branding of delivery vehicles?

Lastly core questions grouped as management practises are outlined in table 5.11. The assessment determines from a management point of view what insourcing and outsourcing practises are acceptable.

Table 5.11: Core questions grouped as management practises.

#	Consideration
27.	From a management aspect, the business is willing to be involved with the entire delivery process including functions such as picking, quality checking, packing, consolidation, load scheduling, route planning and order fulfilment?
28.	Co-managed services is an acceptable management practise within the business?
29.	Externally managed services is an acceptable management practise within the business?
30.	Full outsourcing is an acceptable management practise within the business?

The scoring approach is discussed in detail in section 5.2.2. The discussion outlines how the 30 core questions and seven areas of consideration are weighted. Additionally the discussion outlines how each of the six transportation arrangements are scored.

5.2.2 Scoring of transportation arrangements

An extract from the Microsoft Excel document has been included in figure 5.5 to facilitate the discussion surrounding the scoring approach.

Consideration	Score	Weight (/10)	Normalised weight	Impact calculation											
				Own fleet		Owner driver		Crowd sourced		3PL		4PL		Distributor	
				R	WS	R	WS	R	WS	R	WS	R	WS	R	WS
Industrial relations															
1.	8	10	0,3030	∝	0,61	∝	0,61	=	2,42	=	2,42	=	2,42	=	2,42
2.	10	5	0,1515	=	1,52	=	1,52	∝	0,00	∝	0,00	∝	0,00	∝	0,00
3.	1	10	0,3030	=	0,30	=	0,30	∝	2,73	∝	2,73	∝	2,73	∝	2,73
4.	2	8	0,2424	=	0,48	=	0,48	∝	1,94	∝	1,94	∝	1,94	∝	1,94
Sub total					2,91		2,91		7,09		7,09		7,09		7,09
Human resource management															
5.	10	10	0,3125	=	3,13	=	3,13	∝	0,00	∝	0,00	∝	0,00	∝	0,00
6.	10	10	0,3125	=	3,13	=	3,13	∝	0,00	∝	0,00	∝	0,00	∝	0,00
7.	10	6	0,1875	=	1,88	=	1,88	∝	0,00	∝	0,00	∝	0,00	∝	0,00
8.	3	6	0,1875	=	0,56	=	0,56	∝	1,31	∝	1,31	∝	1,31	∝	1,31
Sub total					8,69		8,69		1,31		1,31		1,31		1,31

Figure 5.5: An extract from the transportation arrangement scoring sheet.

For each consideration a weight was determined by a subject matter expert¹. The weights designated by the light blue column in figure 5.5 establish the importance of each question. The weights from each group of considerations are normalised to ensure the scores can be compared.

For each transportation arrangement a relationship is assigned underneath the column header, R. The relationship reflects how the client score impacts the specific transportation arrangement. One of three relationship types can be assigned as outlined in table 5.12. Based on the type of relationship, the final weighted score, WS, is calculated differently.

Table 5.12: The impact of different relationship types.

Relationship	Weighted score calculation
=	$WS = Score * Normalised\ weight$
≈	$WS = (10 - \frac{10 - Score}{2}) * Normalised\ weight$
∝	$WS = (10 - Score) * Normalised\ weight$

A direct relationship is denoted by the symbol, = . For an indirect relationship, ∝ , the client score has an inverse effect on the transportation arrangement score. Lastly, for a medium impact relationship, ≈ , the impact of the client score is reduced. A detailed record of the relationship types and weights assigned to each consideration is presented in appendix C.2.

¹A senior consultant from Hunting Dragons Consulting fulfilled the role.

For each of the 30 core questions, the scoring is quite simple with the exception of question 14. Question 14 consists of three sub-questions which in turn are composed of a number enquiries. The final score for each arrangement is calculated by averaging the scores from part a,b and c. In turn, the scores for part a,b and c are calculated by averaging the scores of their respective subsections.

For question 14 the relationship types assigned to each arrangement is influenced by the current solution employed by the client. If the client currently does not insource transportation, the relationship types remain as outlined in appendix C.2. The reason is as follows if the client does not operate an insourced transportation arrangement and the resources could potentially be difficult to redeploy, outsourcing is scored positively, while insourcing is scored negatively. However, if the client currently employs a partially or fully insourced transportation arrangement and the resources cannot easily be redeployed, the client cannot change. Therefore insourced arrangements are positively scored and outsourced arrangements are negatively scored.

As illustrated in figure 5.5, for each group of considerations a subtotal is calculated. The subtotal presents a score out of ten for each transportation arrangement. The last step in scoring the transportation arrangements is to weigh the subtotal scores. The weight assigned to each group of considerations in table 5.13 ensures groups with more considerations are weighted proportionality to smaller groups.

Table 5.13: An example of how each group of considerations is weighted during the compatibility assessment.

Consideration	Weight (/10)	Normalised weight	Weighted transportation arrangement score					
			Own fleet	Owner driver	Crowd sourced	3PL	4PL	Distributor
Industrial relations	4	0,1333	0,3879	0,3879	0,9455	0,9455	0,9455	0,9455
Human resource management	4	0,1333	1,1583	1,1583	0,1750	0,1750	0,1750	0,1750
Transaction cost economics	6	0,2000	0,0733	0,0733	0,8860	1,9474	1,9474	1,4123
Resource based considerations	4	0,1333	0,0889	0,5333	0,6444	0,7333	0,7333	0,7333
Country economics and politics	5	0,1667	1,1111	0,8889	0,5556	0,5556	0,5556	1,1111
Competitive advantage	3	0,1000	0,7750	0,9750	0,2250	0,4750	0,2250	0,7750
Management practises	4	0,1333	0,2000	0,2000	0,3500	1,1333	1,1333	0,2000
Compatibility %			37,95%	42,17%	37,81%	59,65%	57,15%	53,52%

The final output of the compatibility assessment is presented as a percentage score for each transportation arrangement. In section 5.3 the logic and assumptions of the entire decision tool is validated by testing six different scenarios.

5.3 Decision support tool validation

The purpose of this section is to test the assumptions and logic of the decision support tool. Six scenarios are tested to ensure the tool can differentiate between the six transportation arrangements based upon the client inputs. After the completion of the scenario testing, an external party is approached to further test the tool by means of a case study.

5.3.1 Scenario testing

For each of the six transportation arrangements both the strategic and compatibility assessment is completed. Together with the inputs of a senior consultant at Hunting Dragons Consulting the scenario testing is undertaken. The objective is to complete the assessments to favour a single arrangement at a time and confirm whether the model recognises the bias in the input. For example, if the inputs indicate a strong bias towards an own fleet, the decision support tool must identify it as an optimal arrangement.

The first scenario favouring a distributor is discussed in detail while only the results from the other five scenarios are presented. The alternative transportation arrangements have been classified according to 11 strategic imperatives in section 5.1.3. Therefore to complete the strategic assessment, the relative importance of each attribute must be determined by the client. The pairwise comparison matrix was completed to favour strategies where a distributor should perform better than the alternatives. The pairwise and normalised pairwise comparison matrix is presented in table 5.14 and 5.15. The pairwise comparison produced a consistency ratio of 0.03, well within the acceptable limits of inconsistency.

Table 5.14: Pairwise comparison of attributes favouring a distributor.

Attribute	1	2	3	4	5	6	7	8	9	10	11
1	1	5,0000	3,0000	3,0000	1,0000	3,0000	3,0000	3,0000	3,0000	5,0000	5,0000
2	0,2000	1	0,3333	0,3333	0,2000	0,3333	0,3333	0,3333	0,3333	1,0000	1,0000
3	0,3333	3,0000	1	1,0000	1,0000	1,0000	1,0000	3,0000	3,0000	5,0000	5,0000
4	0,3333	3,0000	1,0000	1	0,3333	1,0000	1,0000	1,0000	1,0000	3,0000	3,0000
5	1,0000	5,0000	1,0000	3,0000	1	3,0000	3,0000	3,0000	3,0000	5,0000	5,0000
6	0,3333	3,0000	1,0000	1,0000	0,3333	1	0,3333	1,0000	1,0000	1,0000	1,0000
7	0,3333	3,0000	1,0000	1,0000	0,3333	3,0000	1	1,0000	1,0000	3,0000	3,0000
8	0,3333	3,0000	0,3333	1,0000	0,3333	1,0000	1,0000	1	1,0000	3,0000	3,0000
9	0,3333	3,0000	0,3333	1,0000	0,3333	1,0000	1,0000	1,0000	1	3,0000	3,0000
10	0,2000	1,0000	0,2000	0,3333	0,2000	1,0000	0,3333	0,3333	0,3333	1	1,0000
11	0,2000	1,0000	0,2000	0,3333	0,2000	1,0000	0,3333	0,3333	0,3333	1	1

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Table 5.15: Normalised pairwise comparison of attributes favouring a distributor.

Attribute	1	2	3	4	5	6	7	8	9	10	11	w
1	0,2174	0,1613	0,3191	0,2308	0,1899	0,1837	0,2432	0,2000	0,2000	0,1613	0,1613	0,2062
2	0,0435	0,0323	0,0355	0,0256	0,0380	0,0204	0,0270	0,0222	0,0222	0,0323	0,0323	0,0301
3	0,0725	0,0968	0,1064	0,0769	0,1899	0,0612	0,0811	0,2000	0,2000	0,1613	0,1613	0,1279
4	0,0725	0,0968	0,1064	0,0769	0,0633	0,0612	0,0811	0,0667	0,0667	0,0968	0,0968	0,0805
5	0,2174	0,1613	0,1064	0,2308	0,1899	0,1837	0,2432	0,2000	0,2000	0,1613	0,1613	0,1868
6	0,0725	0,0968	0,1064	0,0769	0,0633	0,0612	0,0270	0,0667	0,0667	0,0323	0,0323	0,0638
7	0,0725	0,0968	0,1064	0,0769	0,0633	0,1837	0,0811	0,0667	0,0667	0,0968	0,0968	0,0916
8	0,0725	0,0968	0,0355	0,0769	0,0633	0,0612	0,0811	0,0667	0,0667	0,0968	0,0968	0,0740
9	0,0725	0,0968	0,0355	0,0769	0,0633	0,0612	0,0811	0,0667	0,0667	0,0968	0,0968	0,0740
10	0,0435	0,0323	0,0213	0,0256	0,0380	0,0612	0,0270	0,0222	0,0222	0,0323	0,0323	0,0325
11	0,0435	0,0323	0,0213	0,0256	0,0380	0,0612	0,0270	0,0222	0,0222	0,0323	0,0323	0,0325

The attribute weights from table 5.15 indicate a strong preference for economic development and customer service. Therefore the client attribute weights speak to the strengths of a distributor. The validation is then to confirm whether the aggregated classification of alternatives produced by the three consultants are correct and identify a distributor as the optimum solution.

Based on the relative closeness of each transportation arrangement, the TOPSIS procedure identified an owner driver as the ideal solution. The results are summarised in table 5.16.

Table 5.16: Ranking of transportation alternatives according to TOPSIS.

Alternative	Relative closeness	Rank
Owner driver	0,6790	1
Distributor	0,5213	2
3PL	0,4065	3
4PL	0,3948	4
Crowd soured	0,3852	5
Own fleet	0,1900	6

Upon closer inspection it became apparent that the alternatives had been wrongly classified with regards to economic development, core competency and customer service. The changes are detailed in table 5.17.

Table 5.17: Record of alteration to final classification of alternatives.

Alternative	Economic development		Core competency		Customer service	
	w_{old}	w_{new}	w_{old}	w_{new}	w_{old}	w_{new}
A	0,0498	0,0764	0,0346	0,0287	0,1610	0,0375
B	0,3697	0,2769	0,1132	0,1260	0,3125	0,0375
C	0,1484	0,1657	0,0904	0,1819	0,1831	0,0375
D	0,0859	0,0721	0,3129	0,2212	0,1132	0,3639
E	0,0975	0,0721	0,3129	0,2212	0,0620	0,3639
F	0,2487	0,3368	0,1359	0,2212	0,1682	0,1598

To ensure the classification of alternatives remained consistent, the weights could not simply be changed to any arbitrary values. Therefore the classifications from all three consultants were inspected and in the case of the erroneous classifications, the most apt classification from one consultant was chosen i.e. the final classification is not aggregated.

The changes ensured that the classification reflected the strengths of each alternative accurately. Therefore the weight for economic development assigned to the distributor arrangement was increased. All the outsourcing arrangements received the same weight for core competency and the customer service weight for own fleet, owner driver and crowd sourced was decreased. Finally the relative closeness produced by the TOPSIS procedure was again inspected as presented in table 5.18. The strategic assessment correctly identified a distributor as the optimal transportation arrangement.

Table 5.18: Ranking of transportation alternatives according to TOPSIS.

Alternative	Relative closeness	Rank
Distributor	0,5991	1
4PL	0,5438	2
3PL	0,5435	3
Owner driver	0,4395	4
Crowd sourced	0,3404	5
Own fleet	0,1074	6

The second step in the scenario test is to complete the compatibility assessment. As before the inputs were chosen to favour a distributor arrangement. The validation is thus to confirm whether the decision tool recognises the input bias. A summary of the inputs and transportation arrangement scores is provided in table 5.19.

It must be noted the consultant from Hunting Dragons Consulting completed the assessment with a minimal of understanding of the mechanics. This is done to ensure the set up of the scenario remains objective and reflects the performance of the tool accurately.

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Table 5.19: Summary of the compatibility assessment favouring a distributor.

Consideration	Score	Weight (/10)	Normalised weight	Impact calculation											
				A		B		C		D		E		F	
				R	WS	R	WS	R	WS	R	WS	R	WS	R	WS
Industrial relations															
1.	4	10	0,3030	α 1,82	α 1,82	= 1,21	= 1,21	= 1,21	= 1,21	= 1,21	= 1,21	= 1,21	= 1,21	= 1,21	= 1,21
2.	9	5	0,1515	= 1,36	= 1,36	α 0,15	α 0,15	α 0,15	α 0,15	α 0,15	α 0,15	α 0,15	α 0,15	α 0,15	α 0,15
3.	1	10	0,3030	= 0,30	= 0,30	α 2,73	α 2,73	α 2,73	α 2,73	α 2,73	α 2,73	α 2,73	α 2,73	α 2,73	α 2,73
4.	2	8	0,2424	= 0,48	= 0,48	α 1,94	α 1,94	α 1,94	α 1,94	α 1,94	α 1,94	α 1,94	α 1,94	α 1,94	α 1,94
Sub total				3,97	3,97	6,03	6,03	6,03	6,03	6,03	6,03	6,03	6,03	6,03	6,03
Human resource management															
5.	10	10	0,3125	= 3,13	= 3,13	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00
6.	10	10	0,3125	= 3,13	= 3,13	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00
7.	10	6	0,1875	= 1,88	= 1,88	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00
8.	8	6	0,1875	= 1,50	= 1,50	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38
Sub total				9,63	9,63	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38
Transaction cost economics															
9.		10	0,2632	α 0,11	α 0,11	= 0,00	= 2,11	= 2,11	= 2,11	= 2,11	= 2,11	= 2,11	= 2,11	= 2,11	= 2,11
10.	9	4	0,1053	α 0,11	α 0,11	\approx 1,00	= 0,95	= 0,95	= 0,95	= 0,95	= 0,95	= 0,95	= 0,95	= 0,95	= 0,95
11.	9	4	0,1053	α 0,11	α 0,11	\approx 1,00	= 0,95	= 0,95	= 0,95	= 0,95	= 0,95	= 0,95	= 0,95	= 0,95	= 0,95
12.	9	5	0,1316	α 0,13	α 0,13	\approx 1,25	= 1,18	= 1,18	= 1,18	= 1,18	= 1,18	= 1,18	= 1,18	= 1,18	= 1,18
13.	6	5	0,1316	α 0,53	α 0,53	α 0,53	= 0,79	= 0,79	= 0,79	= 0,79	= 0,79	= 0,79	= 0,79	= 0,79	= 0,79
14.		10	0,2632	0,70	0,70	0,96	1,93	1,93	1,93	1,93	1,93	1,93	1,93	1,93	1,93
14.a.	8			=	=	α	α	α	α	α	α	α	α	α	α
14.b.	4			=	=	\approx	α	α	α	α	α	α	α	α	α
14.c.	10			=	\approx	\approx	α	α	α	α	α	α	α	α	α
Sub total				1,68	1,68	4,74	7,90	7,90	7,90	7,90	7,90	7,90	7,90	7,90	7,90
Resource based considerations															
15.	8	5	0,1667	α 0,33	\approx 1,50	α 0,33	= 1,33	= 1,33	= 1,33	= 1,33	= 1,33	= 1,33	= 1,33	= 1,33	= 1,33
16.	8	5	0,1667	α 0,33	\approx 1,50	α 0,33	= 1,33	= 1,33	= 1,33	= 1,33	= 1,33	= 1,33	= 1,33	= 1,33	= 1,33
17.	2	10	0,3333	= 0,67	= 0,67	\approx 2,00	\approx 2,00	\approx 2,00	\approx 2,00	\approx 2,00	\approx 2,00	\approx 2,00	\approx 2,00	\approx 2,00	\approx 2,00
18.	1	10	0,3333	= 0,33	= 0,33	α 3,00	= 0,33	= 0,33	= 0,33	= 0,33	= 0,33	= 0,33	= 0,33	= 0,33	= 0,33
Sub total				1,67	4,00	5,67	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00
Country economics and politics															
19.	2	10	0,2222	α 1,78	α 1,78	= 0,44	= 0,44	= 0,44	= 0,44	= 0,44	= 0,44	= 0,44	= 0,44	α 1,78	α 1,78
20.	2	10	0,2222	α 1,78	α 1,78	= 0,44	= 0,44	= 0,44	= 0,44	= 0,44	= 0,44	= 0,44	= 0,44	α 1,78	α 1,78
21.	4	10	0,2222	α 1,33	α 1,33	= 0,89	= 0,89	= 0,89	= 0,89	= 0,89	= 0,89	= 0,89	= 0,89	α 1,33	α 1,33
22.	2	10	0,2222	α 1,78	= 0,44	= 0,44	= 0,44	= 0,44	= 0,44	= 0,44	= 0,44	= 0,44	= 0,44	α 1,78	α 1,78
23.	10	5	0,1111	α 0,00	α 0,00	= 1,11	= 1,11	= 1,11	= 1,11	= 1,11	= 1,11	= 1,11	= 1,11	α 0,00	α 0,00
Sub total				6,67	5,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	3,33	6,67	6,67
Competitive advantage															
24.	4	5	0,2500	= 1,00	= 1,00	α 1,50	= 1,00	α 1,50	= 1,00	α 1,50	= 1,00	α 1,50	= 1,00	α 1,50	= 1,00
25.	5	10	0,5000	= 2,50	= 2,50	α 2,50	α 2,50	α 2,50	α 2,50	α 2,50	α 2,50	α 2,50	α 2,50	α 2,50	α 2,50
26.	1	5	0,2500	= 0,25	α 2,25	α 2,25	α 2,25	α 2,25	α 2,25	α 2,25	α 2,25	α 2,25	α 2,25	α 2,25	α 2,25
Sub total				3,75	5,75	6,25	5,75	6,25	6,25	6,25	6,25	6,25	6,25	3,75	3,75
Management practises															
27.	1	10	0,2500	= 0,25	= 0,25	\approx 1,38	α 2,25	α 2,25	α 2,25	α 2,25	α 2,25	α 2,25	α 2,25	α 2,25	α 2,25
28.	10	10	0,2500	α 0,00	= 2,50	= 2,50	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	= 2,50	= 2,50
29.	1	10	0,2500	α 2,25	α 2,25	α 2,25	= 0,25	= 0,25	= 0,25	= 0,25	= 0,25	= 0,25	= 0,25	α 2,25	α 2,25
30.	1	10	0,2500	α 2,25	α 2,25	α 2,25	= 0,25	= 0,25	= 0,25	= 0,25	= 0,25	= 0,25	= 0,25	α 2,25	α 2,25
Sub total				4,75	7,25	8,38	2,75	2,75	2,75	2,75	2,75	2,75	2,75	7,25	7,25

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The weighted sub totals outlined in table 5.20 confirm that a distributor had been identified by the decision support tool as the optimal transportation arrangement.

Table 5.20: Summary of results produced by the compatibility assessment favouring a distributor.

Consideration	Weight (/10)	Normalised weight	Weighted transportation arrangement score					
			Own fleet	Owner driver	Crowd sourced	3PL	4PL	Distributor
Industrial relations	4	0,1333	0,5293	0,5293	0,8040	0,8040	0,8040	0,8040
Human resource management	4	0,1333	1,2833	1,2833	0,0500	0,0500	0,0500	0,0500
Transaction cost economics	6	0,2000	0,3361	0,3361	0,9482	1,5807	1,5807	1,4009
Resource based considerations	4	0,1333	0,2222	0,5333	0,7556	0,6667	0,6667	0,6667
Country economics and politics	5	0,1667	1,1111	0,8889	0,5556	0,5556	0,5556	1,1111
Competitive advantage	3	0,1000	0,3750	0,5750	0,6250	0,5750	0,6250	0,3750
Management practises	4	0,1333	0,6333	0,9667	1,1167	0,3667	0,3667	0,9667
Compatibility %			44,90%	51,13%	48,55%	45,99%	46,49%	53,74%

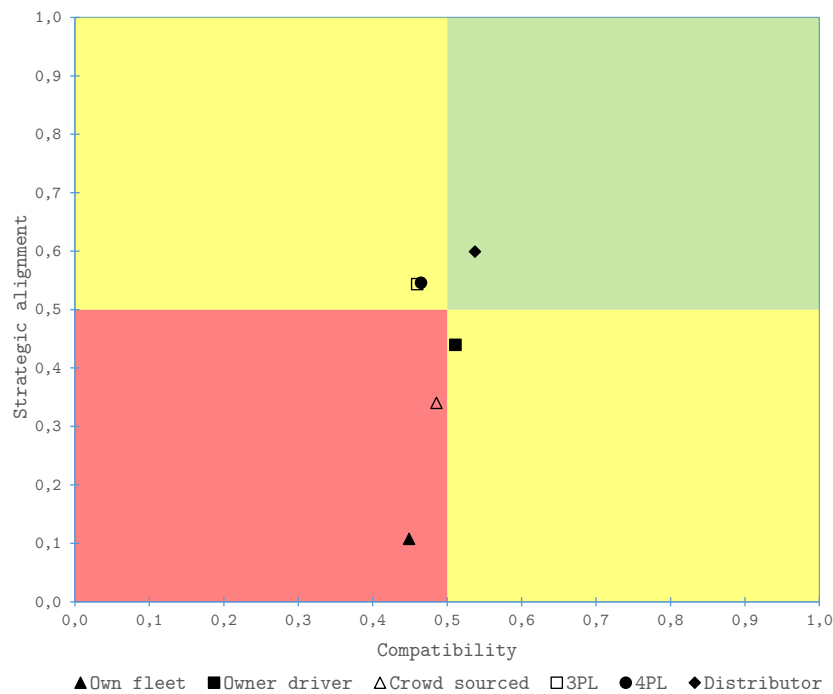


Figure 5.6: Final output of the distributor scenario test.

The final combined output of both the strategic and compatibility assessment is presented in figure 5.6. While one scenario test has been successful, the true validation is to determine whether the tool can accurately differentiate the remaining five arrangements with the changes made.

As previously mentioned for the remainder of the scenarios only the final output is presented. The final output is presented as a visual plot to easily verify whether the tool has successfully recognised the input bias. The supporting tables are presented in appendix C.3.

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The decision tool was able to correctly recognise the input bias for an own fleet scenario. An own fleet is closely followed by an owner driver as the second best-suited arrangement. Since an owner driver arrangement only outsources the truck, a strong similarity is to be expected as illustrated in figure 5.7.

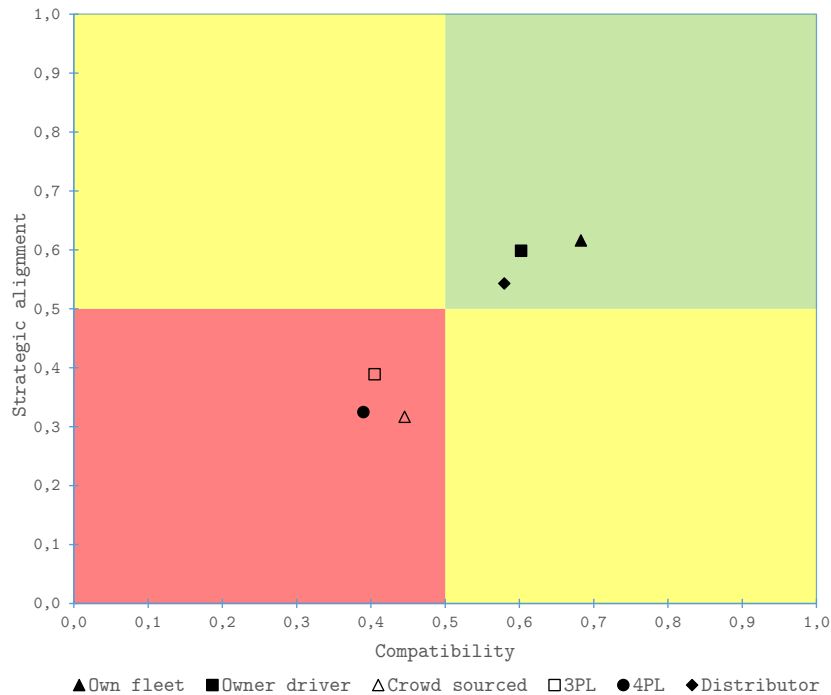


Figure 5.7: Final output of the own fleet scenario test.

Interestingly the owner driver scenario produced no such similarities as illustrated in figure 5.8. Economic development was designated unimportant during the own fleet scenario. However economic development is a strong determinant for selecting an owner driver arrangement, therefore the shift in strategic alignment caused the stark differences.

As illustrated in figure 5.9 the crowdsourced scenario test confirmed the decision support tool is not partial to insourcing arrangements. Both the distributor and 3PL arrangements were highly ranked during the scenario test. As expected an own fleet exhibited little similarities with a crowdsourced arrangement, where flexibility is key and control is diminished.

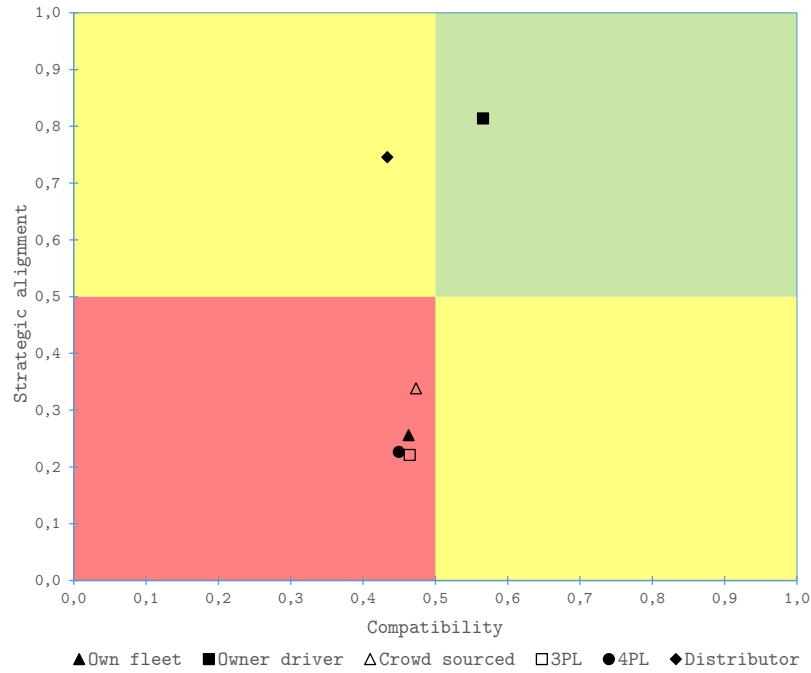


Figure 5.8: Final output of the owner driver scenario test.

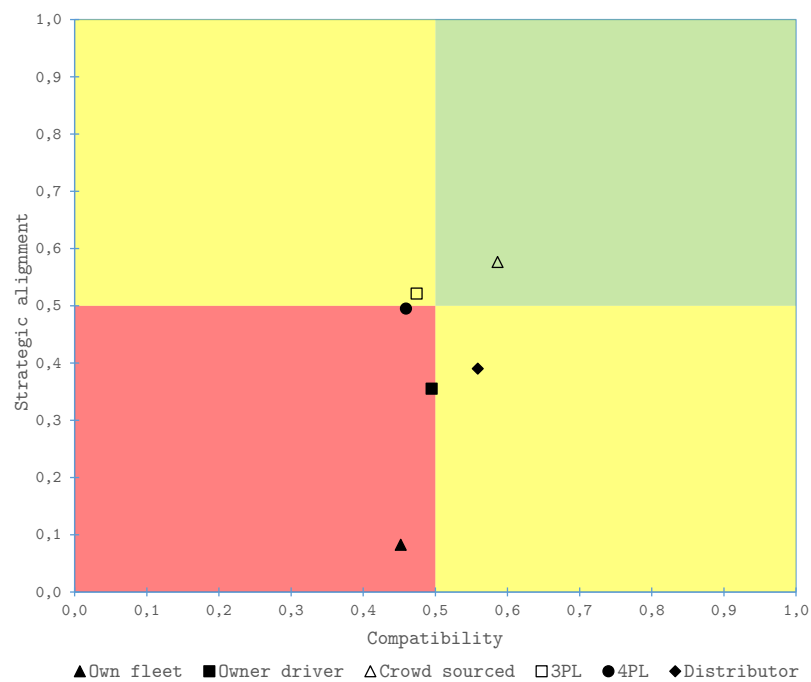


Figure 5.9: Final output of the crowd sourced scenario test.

The 3PL and 4PL scenario test is illustrated in figure 5.10 and 5.11 respectively. The scenario test indicated that the tool struggles to differentiate

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between 3PL and 4PL arrangements. However this is to be expected as a 4PL is simply an asset-less company employing a host of 3PLs.

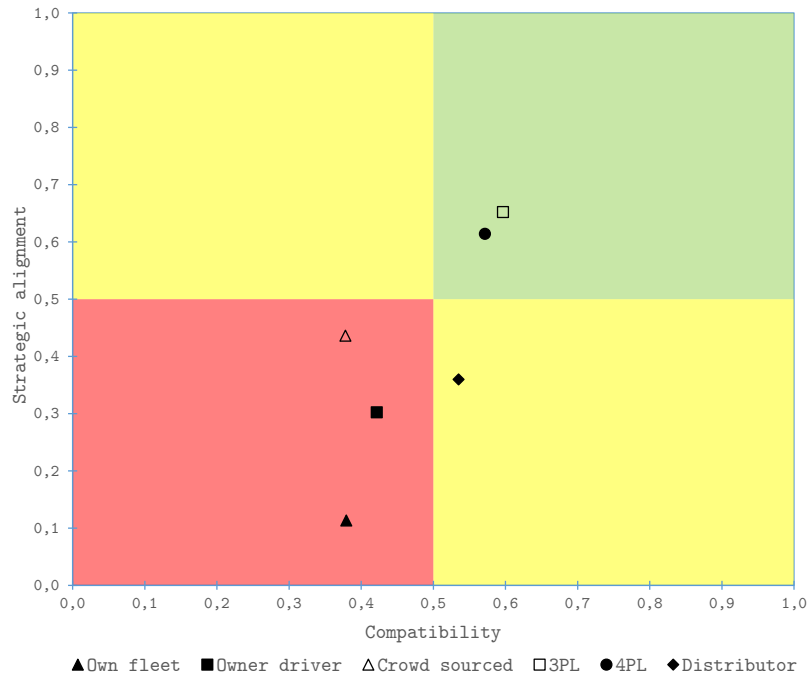


Figure 5.10: Final output of the 3PL scenario test.

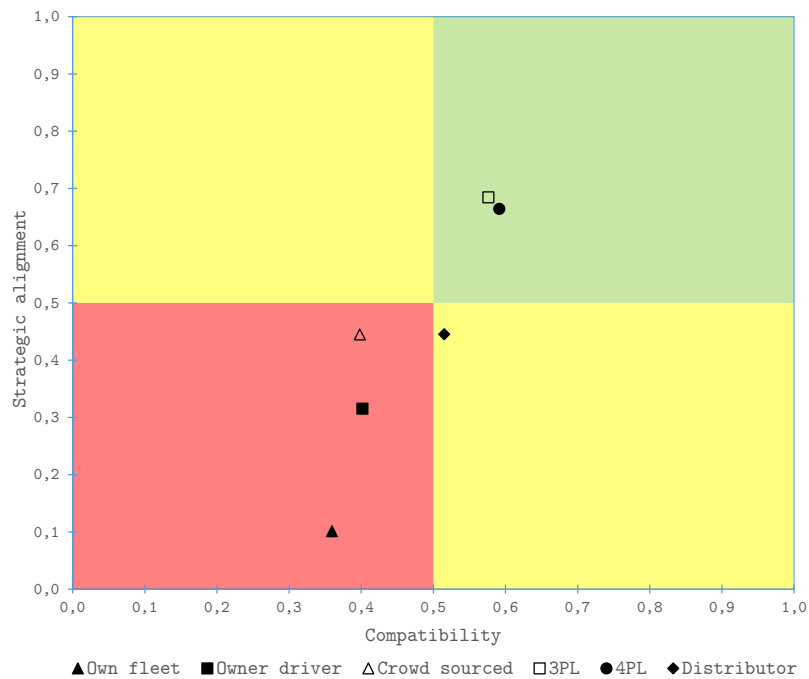


Figure 5.11: Final output of the 4PL scenario test.

5.3.2 Case study

The last step in validating the decision support tool is to apply it to a case study. A company operating seven spirit and wine distribution centres across the main provinces of South Africa was approached. The company, hereinafter referred to as company X, employs a host of different transportation arrangements including own fleet, owner driver and 3PL.

The case study is based on the Western Cape where company X employs an owner driver arrangement. Their operations director considers the owner driver arrangement best suited to their Western Cape operation. The challenge is therefore to determine if the tool can reproduce his point of view based on the provided inputs. As with the scenario tests, the strategic and compatibility assessment was completed. The outputs are compared to that of the owner driver scenario from section 5.2.2 to determine how robust the tool is.

First the strategic assessment produced by the case study is compared to that of the owner driver scenario. Figure 5.12 illustrates how the relative importance assigned to each attribute differs across the two tests.

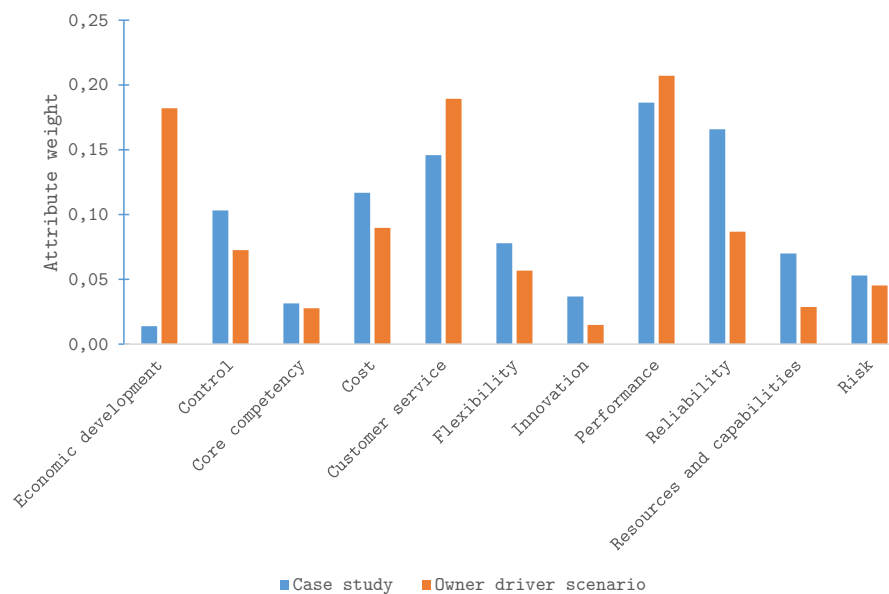


Figure 5.12: A comparison of the attribute weights produced by the case study and owner driver scenario.

It is clear that the owner driver scenario sought to minimise the weight of attributes where the arrangement would perform weakly such as (a) core competency, (b) innovation and (c) resources and capabilities. The case study presents a more realistic test where the weights assigned to each attribute are more consistent with one another. From the case study, TOPSIS produced a

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rank of transportation arrangements detailed in table 5.21. The case study has thus far shown the strategic assessment is able to determine the transportation arrangement best aligned with the client strategy. Arguably the tool is not too sensitive to produce robust results, however, additional case studies must be performed to confirm this.

Table 5.21: Ranking of transportation alternatives according to TOPSIS for the case study.

Alternative	Relative closeness	Rank
Owner driver	1	0,7283
Distributor	2	0,6713
Crowd sourced	3	0,3611
4PL	4	0,3269
3PL	5	0,3231
Own fleet	6	0,3059

Next the compatibility assessment was completed for the case study. A summary of the results and its comparison with the owner driver scenario is detailed in table 5.22. The case study produced results very similar to that of the owner driver scenario. This confirms that the compatibility assessment is able to provide consistent outcomes based on varied inputs. The case study thus partially confirms that the tool is an effective decision support aid.

Table 5.22: Summary of the results produced by the compatibility assessment during the case study.

Consideration	Transportation arrangement score											
	Own fleet		Owner driver		Crowd sourced		3PL		4PL		Distributor	
	Scenario	Case study	Scenario	Case study	Scenario	Case study	Scenario	Case study	Scenario	Case study	Scenario	Case study
Industrial relations	5,67	6,85	5,67	6,85	4,33	3,15	4,33	3,15	4,33	3,15	4,33	3,15
Human resource management	9,63	8,81	9,63	8,81	0,38	1,19	0,38	1,19	0,38	1,19	0,38	1,19
Transaction cost economics	3,31	2,15	3,05	1,88	4,88	4,78	5,55	6,49	5,55	6,22	5,67	5,36
Resource based considerations	1,67	3,67	4,00	6,00	5,67	5,17	5,00	6,50	5,00	6,50	5,00	6,50
Country economics and politics	4,00	5,33	6,22	6,67	6,00	4,67	6,00	4,67	6,00	4,67	4,00	5,33
Competitive advantage	4,75	6,50	6,75	8,00	5,25	3,50	6,75	5,00	5,25	3,50	4,75	6,50
Management practises	4,25	5,00	5,75	4,50	6,38	4,75	4,25	5,50	4,25	5,50	5,75	4,50
Total	33,27	38,31	41,06	42,71	32,88	27,20	32,26	32,49	30,76	30,73	29,88	32,53

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Figure 5.13 compares the final output of the case study (black markers) to that of the owner driver scenario (light grey markers). The plotted results confirm that the tool was able to identify the underlying bias even though the inputs differed. The strategic alignment of the owner driver arrangement decreased in the case study. This simply indicates how the scenario test was focused on testing the logic and assumptions by highlighting the strengths of each arrangement. The case study, of course, represents a more realistic set of inputs.

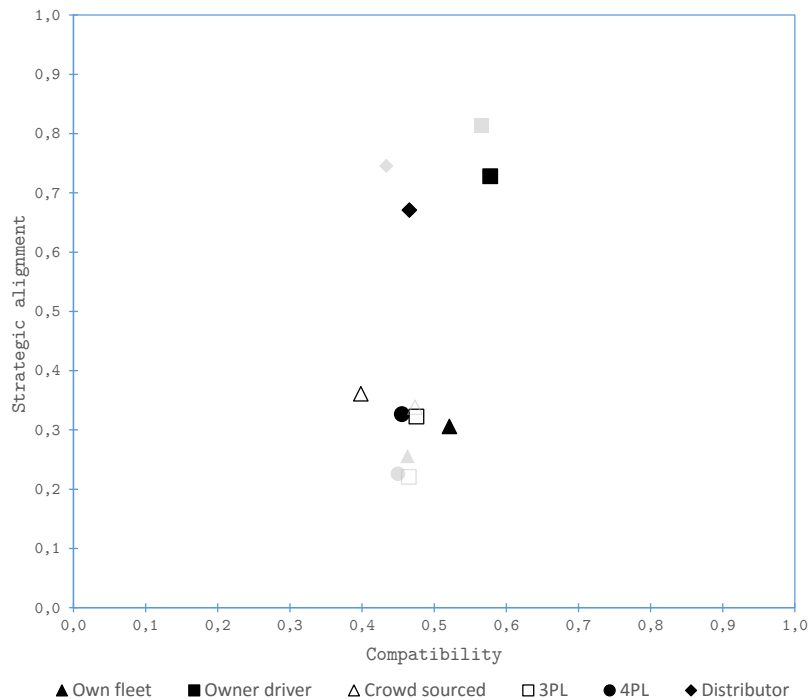


Figure 5.13: A comparison of the final output produced by the case study and owner driver scenario.

In conclusion, the scenario tests have illustrated that the tool is able to differentiate the six transportation arrangements from one another. The logic and assumptions employed by the tool are able to produce outputs aligned with that which is expected. Lastly, a comparison of the case study and owner driver scenario has proven the tool is robust in producing consistent outcomes. However, to fully confirm this, further case studies are required. Therefore the six scenario tests and case study only present a partial validation of the tool as an effective decision support tool.

Chapter 6

Conclusion and recommendations

The research was undertaken in order to provide decision support to FMCG role players in developing economies. The decision support mechanism took the form of a partial RTM solution focused on the primary and secondary distribution activities of focal companies. Ultimately this included identifying and quantifying new business opportunities, assessing existing distribution channels in order to propose superior alternatives and incorporating client input into identifying an optimal transportation arrangement.

A lack of easily obtainable information was identified as the biggest hurdle to developing an RTM solution. In response, the research proposed and tested an alternate lens through which data could be collected. The data collection tool was deployed in the Democratic Republic of the Congo. The setting presented a valuable opportunity to assess the effectiveness of the tool in a challenging environment. The tool was employed as part of a bigger project assessing the viability of manufacturing and distributing four liquid streams in the Katanga province.

The application in the Democratic Republic of the Congo allowed the research to achieve three of the four stated objectives. It illustrated that the barrier to information collection could be overcome. Although the collected data has a limited application within the broader African context, it illustrated the value and potential of such information. The processes, rational and arguments presented in the research can be applied to any developing country and company operating within the FMCG landscape. Changing the particulars of the data collection tool simply becomes an administrative exercise.

An analysis of the collected information hinted towards a best-suited transportation arrangement. However, the client input was sorely missing from such a high-level managerial decision. Therefore the research sought to develop a more formalised means of formulating the client input into a decision support tool. Unfortunately, the decision support tool could not

be applied to the same project as the data collection tool. From literature and industry considerations, a tool was produced that can guide the decision process between six transportation arrangements. Extensive scenario testing and a case study partially confirmed that the tool does in fact provide robust and consistent insets to high-level managerial decisions. The value of the decision support tool lies in its ability to focus managerial input. The tool does not identify a best-suited service provider, but considerably narrows the search for one.

The generic nature of the decision support tool represents focus areas for future work. A tool capable of guiding the decision process within distinct transportation arrangements will be of great value. This is of course only applicable to a distributor, 3PL, 4PL and crowdsourced arrangements. The research would include the identification of key KPIs able to distinguish a host of service providers from one another.

In summary, the research does hold value for companies operating within the consumer goods and services market of Africa. The processes and tools introduced are generic enough to not limit its application and render the research impractical.

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Appendices

Appendix A

Retail outlet survey

A.1 Survey scope

This section includes figures and tables referenced during the finalisation of the survey scope.

A.1.1 Administrative divisions

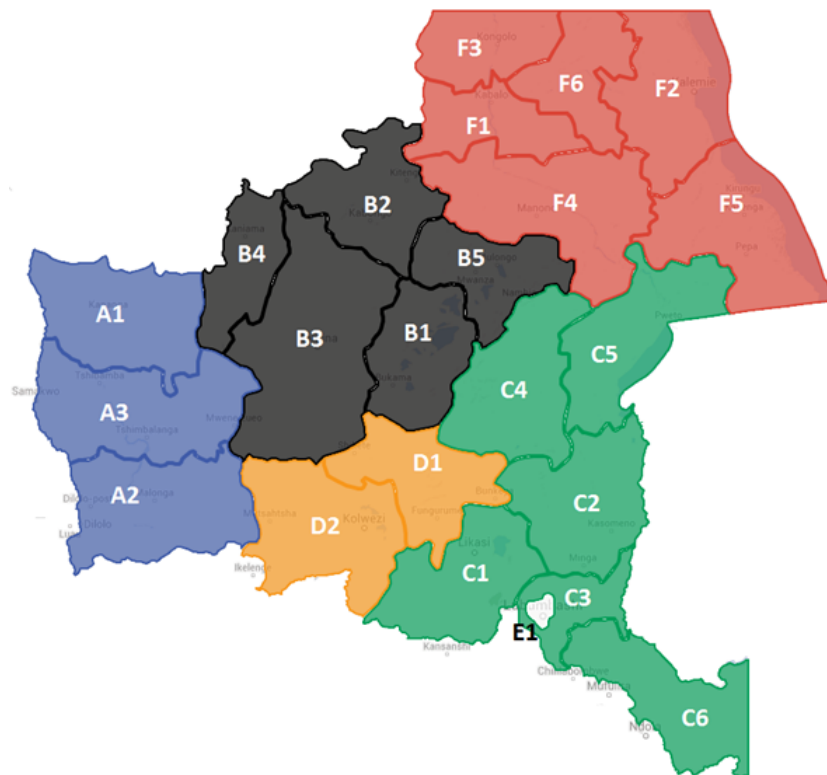


Figure A.1: Map of the administrative divisions of the Katanga province.

A.1.2 Populated places

Table A.1: Largest populated places of the Katanga province.

Name	Territory	1981 census	2004 estimate	2012 calculation	Latitude	Longitude
Balamba	C6		47 213	55 641	-12,790	28,650
Bukama	B1	33 094	60 954	82 688	-10,700	22,333
Dilolo	A2		15 582	18 364	-9,220	25,120
Fungurume	D1		28 938	34 104	-10,620	26,300
Kabalo	F1	25 466	46 896	63 622	-6,050	26,910
Kabongo	B2		12 486	14 715	-7,320	25,580
Kalemie	F2	73 528	92 971	92 789	-5,920	29,170
Kambove	C1	31 329	57 693	78 262	-10,870	26,600
Kamina	B3	62 789	115 626	156 761	-8,730	25,010
Kanteba	B3		15 464	18 225	-7,330	24,620
Kapanga	C1		1 941	2 287	-11,500	26,750
Kasenga	C1		19 114	22 526	-10,630	26,760
Kipamba	B1		26 818	31 605	-8,200	26,420
Kipushi	C3	53 207	97 981	132 861	-11,760	27,250
Kole	B3		4 062	4 787	-8,020	25,550
Kolwezi	D2	416 122	456 446	453 147	-10,700	25,660
Kongolo	F3	27 267	50 212	68 118	-5,380	26,980
Likasi	C1	213 862	367 219	447 449	-10,980	26,730
Lubudi	D1		18 914	22 290	-9,950	25,970
Lubumbashi	E1	564 830	1 283 380	1 786 397	-11,660	27,480
Lwambo	C1		11 300	13 317	-10,820	26,780
Malemba	B5		25 430	29 970	-8,030	26,800
Manono	F4	32 055	47 632	59 957	-7,300	27,450
Mitwaba	C4		3 676	4 332	-8,630	27,330
Moba	F5	25 463	46 890	63 613	-7,060	29,720
Mokambo	C6		20 079	23 663	-12,420	28,350
Mulongo	B5		51 603	60 815	-7,830	27,000
Mutshatsha	D2		5 908	6 963	-10,650	24,450
Nyunzu	F6		36 138	42 589	-5,950	28,020
Pweto	C5		22 121	26 070	-8,470	28,900
Sakania	C6		8 619	10 158	-12,750	28,570
Sandoa	A3		8 662	10 208	-9,680	22,870

A.2 Survey structure and questionnaire

This section provides a full overview of the survey structure, content and data collection requirements. To aid the understanding of the survey structure relevant flow charts are included. Additionally mock ups of unclear sections and survey questions are included to clarify the requirements for data collection.

A.2.1 Administrative information

1. Surveyor name

- The first item to be completed is the surveyor name. It should be a non-editable field and linked to the device name.

2. Timestamp

- As soon as the survey starts, the time and date must be recorded automatically.

3. Location

- The location should include the latitude, longitude, elevation and accuracy.

4. District

- Each province of the DRC is divided up into districts by administrative boundaries. The applicable district must be selected from a drop-down menu.

5. Territory

- Each district of the DRC is divided up into territories by administrative boundaries. The applicable territory must be selected from a drop-down menu.

6. Town

- The relevant town must be selected from a drop down menu. The fields *District* and *Territory* must narrow down the displayed options for the field *Town*.

A.2.2 Establishment information

7. Market segment

- The appropriate market segment must be selected from a drop down menu. The drop down menu options are detailed in table A.2.

Table A.2: Description of the different market segments.

Market Segment
Bar/terrace
Boutique
<i>Brewery A</i> depot
<i>Brewery B</i> depot
Depot
Non-exclusive depot
General dealer
Hotel
Household
Kiosk
Nganda
Night club
Restaurant
Street vendor
Supermarket
Take away

8. Outlet storage size

- The surveyor should record an estimation of the storage size.

A.2.3 Product information

For each of the four liquid streams a list of products have been compiled. The price, sales and stock data for each liquid stream must be recorded as per the following units of measure.

- Beer and soft drink product data are recorded per case.
- Spirit product data is recorded per bottle.
- Opaque beer product data is recorded per container, with the exception of sales volume which is recorded per litre.

The products of each liquid stream are selectable from a drop down menu. A maximum of six products can be recorded for each category of product.

9-12. Beer

- Figure A.2 serves to clarify how the survey questions for beer products must be structured.

Product	Sales per week	Price per unit	Stock on floor
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>

Figure A.2: A mock up for beer products data collection.

13-16. Soft drinks

- Figure A.3 serves to clarify how the survey questions for soft drink products must be structured.

Product	Sales per week	Price per unit	Stock on floor
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>

Figure A.3: A mock up for soft drink product data collection.

17-20. *Spirits*

- Figure A.4 serves to clarify how the survey questions for spirit products must be structured.

Product	Sales per week	Price per unit	Stock on floor
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>

Figure A.4: A mock up for spirit product data collection.

21-23. *Opaque beer*

- Figure A.5 serves to clarify how the survey questions for opaque beer products must be structured.

Product	Sales per week	Price per unit
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>
<input type="text"/> ▼	<input type="text"/>	<input type="text"/>

Figure A.5: A mock up for opaque beer product data collection.

24-32. Combined product information

- Figure A.6 serves to clarify how the survey questions for the combined products of each liquid stream must be structured.

Select the categories applicable to you.	Sales per week	Are you ever out of stock?		If you always had stock, how many more units could you sell per week?
<input type="checkbox"/> <i>Beer</i>	<input type="text"/>	<input type="checkbox"/> <i>Yes</i>	<input type="checkbox"/> <i>No</i>	<input type="text"/>
<input type="checkbox"/> <i>Soft drinks</i>	<input type="text"/>	<input type="checkbox"/> <i>Yes</i>	<input type="checkbox"/> <i>No</i>	<input type="text"/>
<input type="checkbox"/> <i>Spirits</i>	<input type="text"/>	<input type="checkbox"/> <i>Yes</i>	<input type="checkbox"/> <i>No</i>	<input type="text"/>

Figure A.6: A mock up for the combined product data collection.

A.2.4 Supply chain information

Figure A.7 indicates how the questions on supply chain information must be structured. The flow chart must be followed for collecting data on beer, soft drinks and spirit products. The section on supply chain information is not relevant to opaque beer products. Additional information is provided for each question to ensure the survey collects both correct and relevant data.

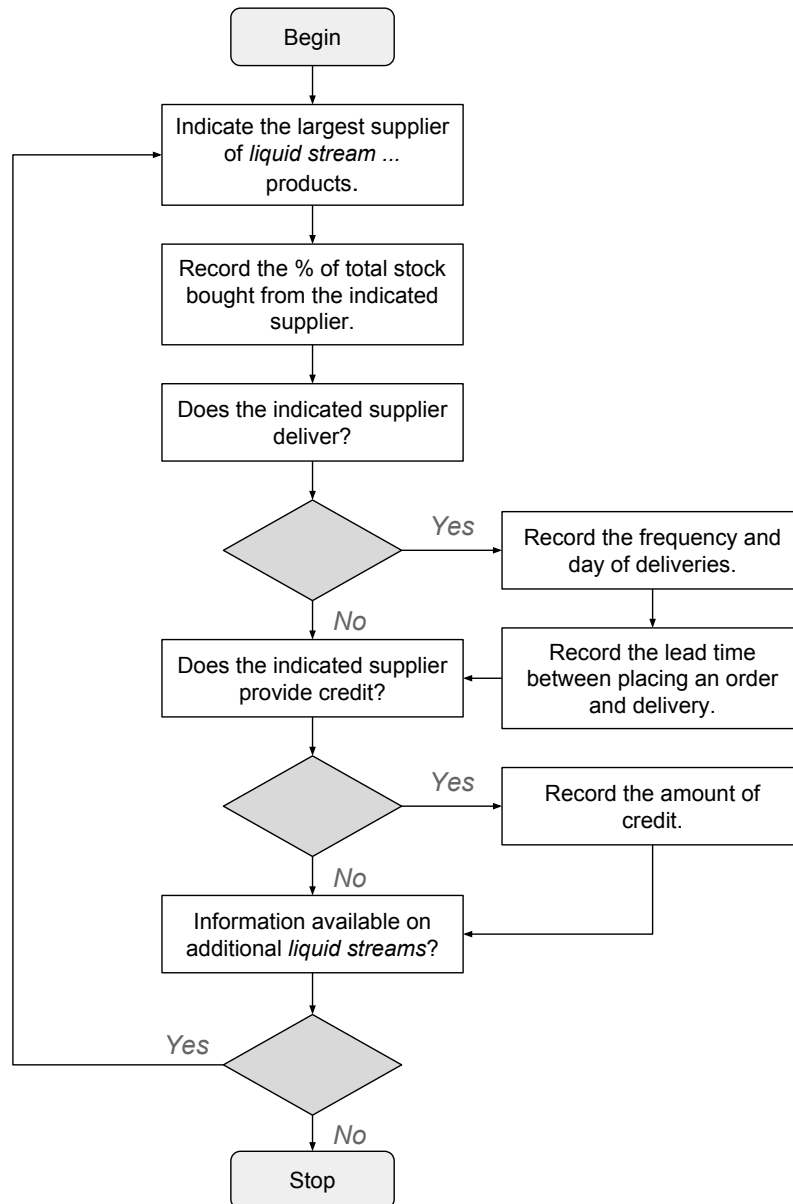


Figure A.7: A logic check for the section on supply chain information.

33-34. Identification of largest supplier

- Figure A.8 serves to clarify how the survey questions on suppliers must be structured.

Select the categories applicable to you.	Supplier name	Percentage of total stock bought
<input type="checkbox"/> <i>Beer</i>	<input type="text"/>	<input type="text"/>
<input type="checkbox"/> <i>Soft drinks</i>	<input type="text"/>	<input type="text"/>
<input type="checkbox"/> <i>Spirits</i>	<input type="text"/>	<input type="text"/>

Figure A.8: Collecting information on the largest supplier for each liquid stream.

35. Supplier delivery status

- It must be recorded whether the supplier delivers to the retail outlet or not.

36. Delivery frequency and receive day

- The categories of answers for the delivery frequency are constrained as detailed in table A.3.

Table A.3: Description of the categories of answers for the field delivery frequency.

Delivery frequency
Daily
Weekly
Every two weeks
Every three weeks
Monthly
<i>Include text box to capture unique delivery frequencies</i>

37. Lead time

Table A.4: Description of the categories of answers for the field lead time.

Lead time category
Same day delivery
Days
Weeks
Months
<i>Include text box to capture unique lead times</i>

- The categories of answers for the lead times are constrained as detailed in table A.4. For each category e.g. days, an accompanying text box is included to specify the numeric number of days.

38-39. Supplier credit

- It must be recorded whether the indicated supplier provides credit or not, and the amount if applicable.

40-53. The fields 33-39 collected supply chain information on beer products. The fields 40-53 follow the same procedure as detailed in figure A.7 for soft drink and spirit products.

A.2.5 Correspondence information

54. Category of information required

- In order to establish future communications, it must be established about which liquid stream the retail outlet requires additional information.

55. Nature of information

- The categories of answers are detailed in table A.5. Each category provides different information about competing retail outlets.

Table A.5: Description of the categories of answers for information on the four liquid streams.

Competitor information
Categories of products sold e.g. Soft drinks
Most popular products
Pricing of products
Largest suppliers
Specials on products

56. Commitment from retail outlet

- Lastly it needs to be determined whether the retail outlet will complete a shorter version of the survey on a monthly basis in return for receiving information on competitors.

Appendix B

Extracts from PowerPivot model

This section is intended to supplement the discussion on the survey information presented in chapter 4. The Excel add-in, PowerPivot, is used to create flexible data models from the processed survey information. Throughout the section extracts from the data model is presented as tables.

B.1 Sample of channel volume flow

B.1.1 Weekly sales volume by category

The data in table B.1 to table B.4 depict the weekly sales volumes recorded by the retail outlet survey. For each of the four liquid streams a separate table is created. Each table details the weekly sales volume per market segment and urbanisation type.

Table B.1: Total weekly beer sales recorded by the retail outlet survey.

Market Segment	Sales volume (hl)			
	Urban	Peri Urban	Rural	Total
Bar/Terrace	2 443,00	399,00	139,00	2 981,00
Boutique	84,00	79,00	11,00	174,00
Brewery A depot	462,00	53,00	22,00	537,00
Brewery B depot	3 340,00	479,00	235,00	4 054,00
Depot	1,00	4,00	0,00	5,00
Depot not exclusive	627,00	319,00	0,00	946,00
General dealer	65,00	38,00	38,00	141,00
Hotel	69,00	26,00	2,00	97,00
Household	24,00	10,00	0,00	34,00
Kiosk	20,00	0,00	0,00	20,00
Nganda	207,00	29,00	1,00	237,00
Night club	244,00	55,00	2,00	301,00
Restaurant	295,00	27,00	10,00	332,00
Street vendor	1,00	0,00	0,00	1,00
Supermarket	22,00	5,00	0,00	27,00
Take away	24,00	3,00	6,00	33,00
Total	7 928,00	1 528,00	468,00	9 920,00

Table B.2: Total weekly opaque beer sales recorded by the retail outlet survey.

Market Segment	Sales volume (hl)			
	Urban	Peri Urban	Rural	Total
Bar/Terrace	164,52	10,02	2,86	177,40
Boutique	6,00	41,39	12,84	60,22
Brewery A depot	0,00	0,00	0,00	0,00
Brewery B depot	0,00	0,00	0,35	0,35
Depot	4,25	3,72	0,00	7,97
Depot not exclusive	0,00	0,00	0,00	0,00
General dealer	2,95	4,64	1,91	9,50
Hotel	0,00	0,00	0,00	0,00
Household	483,58	38,90	61,54	584,01
Kiosk	1,74	3,06	4,25	9,05
Nganda	9,86	23,12	14,55	47,53
Night club	0,00	0,00	0,00	0,00
Restaurant	0,70	2,45	0,70	3,85
Street vendor	19,17	34,03	6,90	60,10
Supermarket	0,00	0,00	0,00	0,00
Take away	0,05	1,05	0,21	1,31
Total	692,82	162,36	106,11	961,28

Table B.3: Total weekly soft drinks sales recorded by the retail outlet survey.

Market Segment	Sales volume (hl)			
	Urban	Peri Urban	Rural	Total
Bar/Terrace	552,78	77,29	21,35	651,42
Boutique	308,15	193,77	32,60	534,51
Brewery A depot	523,19	49,11	6,30	578,60
Brewery B depot	217,68	40,75	7,47	265,89
Depot	239,88	239,04	2,75	481,68
Depot not exclusive	145,52	56,06	0,00	201,57
General dealer	263,25	82,29	19,63	365,18
Hotel	26,48	5,40	0,13	32,01
Household	21,02	1,96	0,12	23,10
Kiosk	60,81	8,11	1,19	70,11
Nganda	57,35	11,54	0,25	69,15
Night club	47,22	9,70	1,32	58,23
Restaurant	101,05	5,44	5,96	112,45
Street vendor	28,07	16,34	0,00	44,42
Supermarket	51,30	3,46	0,00	54,77
Take away	54,71	32,06	1,92	88,69
Total	2 698,45	832,33	100,99	3 631,77

Table B.4: Total weekly spirits sales recorded by the retail outlet survey.

Market Segment	Sales volume (hl)			
	Urban	Peri Urban	Rural	Total
Bar/Terrace	2,99	0,64	0,03	3,65
Boutique	79,52	2,69	0,36	82,57
Brewery A depot	0,00	0,00	0,00	0,00
Brewery B depot	0,00	0,00	0,00	0,00
Depot	0,00	0,00	0,00	0,00
Depot not exclusive	0,36	0,00	0,00	0,36
General dealer	1,74	0,00	0,00	1,74
Hotel	0,41	0,00	0,00	0,41
Household	0,18	0,00	0,00	0,18
Kiosk	16,38	0,26	0,00	16,64
Nganda	0,99	0,20	0,00	1,19
Night club	2,47	0,05	0,00	2,53
Restaurant	0,91	0,00	0,00	0,91
Street vendor	0,00	0,00	0,00	0,00
Supermarket	3,51	0,00	0,00	3,51
Take away	0,00	0,00	0,04	0,04
Total	109,46	3,83	0,43	113,73

B.1.2 Weekly sales volume by product

This subsection illustrates how the channel volume flow can be analysed. In table B.5 the weekly sales for the ten most popular beer products are shown. The data has been filtered to only include recorded sales from urban settings. The data can be further filtered according to geographic areas or income categories. The data model is able to quantitatively illustrate the popularity of different brands, packs and volume sizes. The data model presents a powerful tool whereby marketing profiles can be created.

Table B.5: Total weekly beer sales per product, recorded in urban settings.

Product ID	Sales volume (hl)	% Market share
P33	2 840,89	35,8%
P47	2 265,60	28,6%
P36	868,25	11,0%
P43	586,81	7,4%
P48	406,73	5,1%
P51	245,75	3,1%
P50	241,04	3,0%
P44	117,80	1,5%
P42	71,89	0,9%
P40	57,58	0,7%

B.2 Extrapolated channel volume flow

B.2.1 Sales volume by category

The following subsection details how the sampled data has been extrapolated. Table B.6 to table B.9 shows how the sampled total sales volume has been broken up into redistributed and retail volume. This prevents the analysis from double counting volumes which have been redistributed within the retail market. For each market segment, the retail volume indicates what volume is bought by the ultimate consumer.

Table B.10 to table B.13 details how the weekly sales volume has been extrapolated and calculated to indicate annual figures. This allows the analysis to quantify the potential of the entire market from the sampled data.

Table B.6: Comparison of redistributed and retail volume for beer.

Market segment	Weekly sales volume		
	Total volume (hl)	Redistributed volume (hl)	Retail volume (hl)
Bar/Terrace	2 981,96	149,10	2 832,86
Boutique	173,47	0,00	173,47
Brewery A depot	538,21	484,39	53,82
Brewery B depot	4 054,80	3 649,32	405,48
Depot	4,98	4,48	0,50
Depot not exclusive	946,73	852,05	94,67
General Dealer	141,23	0,00	141,23
Hotel	96,88	0,00	96,88
Household	33,74	0,00	33,74
Kiosk	19,59	0,00	19,59
Nganda	236,51	0,00	236,51
Night club	301,39	0,00	301,39
Restaurant	332,35	0,00	332,35
Street Vendor	1,29	0,00	1,29
Supermarket	27,11	0,54	26,57
Take Away	33,35	0,00	33,35
Total	9 923,58	5 139,89	4 783,70

Table B.7: Comparison of redistributed and retail volume for opaque beer.

Market segment	Weekly sales volume		
	Total volume (hl)	Redistributed volume (hl)	Retail volume (hl)
Bar/Terrace	177,40	8,87	168,53
Boutique	60,22	0,00	60,22
Brewery A depot	0,00	0,00	0,00
Brewery B depot	0,00	0,00	0,00
Depot	7,97	7,17	0,80
Depot not exclusive	0,00	0,00	0,00
General Dealer	9,50	0,00	9,50
Hotel	0,00	0,00	0,00
Household	584,01	0,00	584,01
Kiosk	9,05	0,00	9,05
Nganda	47,53	0,00	47,53
Night club	0,00	0,00	0,00
Restaurant	3,85	0,00	3,85
Street Vendor	60,10	0,00	60,10
Supermarket	0,00	0,00	0,00
Take Away	1,31	0,00	1,31
Total	960,93	16,04	944,89

Table B.8: Comparison of redistributed and retail volume for soft drinks.

Market segment	Weekly sales volume		
	Total volume (hl)	Redistributed volume (hl)	Retail volume (hl)
Bar/Terrace	651,42	32,57	618,85
Boutique	534,51	0,00	534,51
Brewery A depot	578,60	520,74	57,86
Brewery B depot	265,89	239,30	26,59
Depot	481,68	433,51	48,17
Depot not exclusive	201,57	181,42	20,16
General Dealer	365,18	0,00	365,18
Hotel	32,01	0,00	32,01
Household	23,10	0,00	23,10
Kiosk	70,11	0,00	70,11
Nganda	69,15	0,00	69,15
Night club	58,23	0,00	58,23
Restaurant	112,45	0,00	112,45
Street Vendor	44,42	0,00	44,42
Supermarket	54,77	1,10	53,67
Take Away	88,69	0,00	88,69
Total	3 631,77	1 408,63	2 223,14

Table B.9: Comparison of redistributed and retail volume for spirits.

Market segment	Weekly sales volume		
	Total volume (hl)	Redistributed volume (hl)	Retail volume (hl)
Bar/Terrace	3,65	0,18	3,47
Boutique	82,57	0,00	82,57
Brewery A depot	0,00	0,00	0,00
Brewery B depot	0,00	0,00	0,00
Depot	0,00	0,00	0,00
Depot not exclusive	0,36	0,32	0,04
General Dealer	1,74	0,00	1,74
Hotel	0,41	0,00	0,41
Household	0,18	0,00	0,18
Kiosk	16,64	0,00	16,64
Nganda	1,19	0,00	1,19
Night club	2,53	0,00	2,53
Restaurant	0,91	0,00	0,91
Street Vendor	0,00	0,00	0,00
Supermarket	3,51	0,07	3,44
Take Away	0,04	0,00	0,04
Total	113,73	0,57	113,15

Table B.10: Extrapolated redistributed and retail volume for beer.

Market segment	Weekly sales volume per outlet (hl)	Extrapolated weekly sales volume (hl)	Extrapolated annual sales		
			Total volume (hl)	Redistributed volume (hl)	Retail volume (hl)
Bar/Terrace	6,19	15 262,45	793 647,22	39 682,36	753 964,86
Boutique	0,44	1 741,27	90 545,87	0,00	90 545,87
Brewery A depot	8,54	1 905,10	99 065,18	89 158,66	9 906,52
Brewery B depot	40,15	14 573,20	757 806,44	682 025,79	75 780,64
Depot	0,06	17,46	907,96	817,16	90,80
Depot not exclusive	37,87	3 408,21	177 227,03	159 504,33	17 722,70
General Dealer	0,98	403,08	20 960,41	0,00	20 960,41
Hotel	4,61	632,00	32 864,03	0,00	32 864,03
Household	0,13	386,90	20 118,62	0,00	20 118,62
Kiosk	0,31	167,75	8 722,98	0,00	8 722,98
Nganda	2,37	2 270,47	118 064,19	0,00	118 064,19
Night club	8,15	2 231,93	116 060,36	0,00	116 060,36
Restaurant	3,57	979,18	50 917,20	0,00	50 917,20
Street Vendor	0,01	3,33	173,23	0,00	173,23
Supermarket	2,71	371,43	19 314,30	386,29	18 928,02
Take Away	0,79	108,79	5 657,27	0,00	5 657,27
Total		44 462,54	2 312 052,32	971 574,59	1 340 477,72

Table B.11: Extrapolated redistributed and retail volume for opaque beer.

Market segment	Weekly sales	Extrapolated	Extrapolated annual sales		
	volume per outlet (hl)	weekly sales volume (hl)	Total volume (hl)	Redistributed volume (hl)	Retail volume (hl)
Bar/Terrace	0,37	907,95	47 213,57	2 360,68	44 852,89
Boutique	0,15	604,52	31 435,10	0,00	31 435,10
Brewery A depot	0,00	0,00	0,00	0,00	0,00
Brewery B depot	0,00	1,26	65,41	58,87	6,54
Depot	0,10	27,94	1 453,10	1 307,79	145,31
Depot not exclusive	0,00	0,00	0,00	0,00	0,00
General Dealer	0,07	27,12	1 410,11	0,00	1 410,11
Hotel	0,00	0,00	0,00	0,00	0,00
Household	2,22	6 697,22	348 255,30	0,00	348 255,30
Kiosk	0,14	77,45	4 027,29	0,00	4 027,29
Nganda	0,48	456,29	23 726,98	0,00	23 726,98
Night club	0,00	0,00	0,00	0,00	0,00
Restaurant	0,04	11,34	589,84	0,00	589,84
Street Vendor	0,38	155,35	8 078,21	0,00	8 078,21
Supermarket	0,00	0,00	0,00	0,00	0,00
Take Away	0,03	4,27	222,20	0,00	222,20
Total		8 970,71	466 477,10	3 727,34	462 749,76

Table B.12: Extrapolated redistributed and retail volume for soft drinks.

Market segment	Weekly sales	Extrapolated	Extrapolated annual sales		
	volume per outlet (hl)	weekly sales volume (hl)	Total volume (hl)	Redistributed volume (hl)	Retail volume (hl)
Bar/Terrace	1,35	3 334,12	173 374,39	8 668,72	164 705,67
Boutique	1,35	5 365,38	278 999,90	0,00	278 999,90
Brewery A depot	9,18	2 048,06	106 498,99	95 849,09	10 649,90
Brewery B depot	2,63	955,63	49 692,70	44 723,43	4 969,27
Depot	5,95	1 688,84	87 819,72	79 037,75	8 781,97
Depot not exclusive	8,06	725,67	37 734,80	33 961,32	3 773,48
General Dealer	2,54	1 042,28	54 198,68	0,00	54 198,68
Hotel	1,52	208,83	10 859,01	0,00	10 859,01
Household	0,09	264,89	13 774,26	0,00	13 774,26
Kiosk	1,10	600,29	31 214,87	0,00	31 214,87
Nganda	0,69	663,83	34 519,08	0,00	34 519,08
Night club	1,57	431,23	22 423,73	0,00	22 423,73
Restaurant	1,21	331,31	17 228,31	0,00	17 228,31
Street Vendor	0,28	114,81	5 970,13	0,00	5 970,13
Supermarket	5,48	750,29	39 015,01	780,30	38 234,71
Take Away	2,11	289,30	15 043,45	0,00	15 043,45
Total		18 814,75	978 367,04	263 020,60	715 346,43

Table B.13: Extrapolated redistributed and retail volume for spirits.

Market segment	Weekly sales volume per outlet (hl)	Extrapolated weekly sales volume (hl)	Extrapolated annual sales		
			Total volume (hl)	Redistributed volume (hl)	Retail volume (hl)
Bar/Terrace	0,01	18,69	972,11	48,61	923,51
Boutique	0,21	828,86	43 100,86	0,00	43 100,86
Brewery A depot	0,00	0,00	0,00	0,00	0,00
Brewery B depot	0,00	0,00	0,00	0,00	0,00
Depot	0,00	0,00	0,00	0,00	0,00
Depot not exclusive	0,01	1,28	66,69	60,02	6,67
General Dealer	0,01	4,96	257,87	0,00	257,87
Hotel	0,02	2,67	139,09	0,00	139,09
Household	0,00	2,06	107,34	0,00	107,34
Kiosk	0,26	142,49	7 409,41	0,00	7 409,41
Nganda	0,01	11,40	592,55	0,00	592,55
Night club	0,07	18,71	973,10	0,00	973,10
Restaurant	0,01	2,68	139,45	0,00	139,45
Street Vendor	0,00	0,00	0,00	0,00	0,00
Supermarket	0,35	48,12	2 502,31	50,05	2 452,26
Take Away	0,00	0,13	6,78	0,00	6,78
Total		1 082,07	56 267,56	158,67	56 108,89

B.2.2 Missed sales volume by category

The following subsection is used to determine whether the demand for beer, soft drinks and spirits are saturated in the three towns of the Katanga province. Table B.14 to table B.16 indicates what percentage of outlets experience stock outs. Table B.17 to table B.19 details how the weekly missed sales volume has been extrapolated to present annual figures.

Table B.14: Percentage of outlets experiencing stock outs of any beer product.

Market Segment	Outlets experiencing stock outs		
	Total count	Stock out count	% of Outlets
Bar/Terrace	482	180	37,3%
Boutique	396	26	6,6%
Brewery A depot	63	19	30,2%
Brewery B depot	101	59	58,4%
Depot	81	0	0,0%
Depot not exclusive	25	15	60,0%
General dealer	144	5	3,5%
Hotel	21	4	19,0%
Household	263	8	3,0%
Kiosk	64	2	3,1%
Nganda	100	31	31,0%
Night club	37	12	32,4%
Restaurant	93	25	26,9%
Street vendor	159	1	0,6%
Supermarket	10	1	10,0%
Take away	42	3	7,1%
Total	2 081	391	20,6%

Table B.15: Percentage of outlets experiencing stock outs of any soft drink product.

Market Segment	Outlets experiencing stock outs		
	Total count	Stock out count	% of Outlets
Bar/Terrace	482	96	19,9%
Boutique	396	84	21,2%
Brewery A depot	63	20	31,7%
Brewery B depot	101	16	15,8%
Depot	81	26	32,1%
Depot not exclusive	25	11	44,0%
General dealer	144	26	18,1%
Hotel	21	4	19,0%
Household	263	11	4,2%
Kiosk	64	9	14,1%
Nganda	100	22	22,0%
Night club	37	7	18,9%
Restaurant	93	11	11,8%
Street vendor	159	8	5,0%
Supermarket	10	1	10,0%
Take away	42	11	26,2%
Total	2 081	363	19,6%

Table B.16: Percentage of outlets experiencing stock outs of any spirit product.

Market Segment	Outlets experiencing stock outs		
	Total count	Stock out count	% of Outlets
Bar/Terrace	482	6	1,2%
Boutique	396	8	2,0%
Depot not exclusive	25	0	0,0%
General dealer	144	0	0,0%
Hotel	21	0	0,0%
Household	263	0	0,0%
Kiosk	64	4	6,3%
Nganda	100	1	1,0%
Night club	37	1	2,7%
Restaurant	93	2	2,2%
Supermarket	10	0	0,0%
Take away	42	1	2,4%
Total	1 677	23	1,5%

Table B.17: Extrapolated redistributed and retail volume for missed beer sales.

Market segment	Missed sales per outlet (hl)	Extrapolated weekly missed sales volume (hl)	Extrapolated annual missed sales		
			Total volume (hl)	Redistributed volume (hl)	Retail volume (hl)
Bar/Terrace	3,02	7 461,91	388 019,20	19 400,96	368 618,24
Boutique	0,19	771,87	40 137,38	0,00	40 137,38
Brewery A depot	4,64	1 034,88	53 813,72	48 432,35	5 381,37
Brewery B depot	31,53	11 444,83	595 131,41	535 618,26	59 513,14
Depot	0,00	0,00	0,00	0,00	0,00
Depot not exclusive	16,95	1 525,42	79 322,07	71 389,86	7 932,21
General Dealer	0,23	93,28	4 850,38	0,00	4 850,38
Hotel	0,71	96,67	5 027,00	0,00	5 027,00
Household	0,06	191,98	9 982,92	0,00	9 982,92
Kiosk	0,03	17,15	891,61	0,00	891,61
Nganda	1,05	1 010,41	52 541,50	0,00	52 541,50
Night club	4,56	1 248,63	64 928,71	0,00	64 928,71
Restaurant	0,91	248,97	12 946,61	0,00	12 946,61
Street Vendor	0,01	2,07	107,67	0,00	107,67
Supermarket	2,80	384,08	19 972,13	399,44	19 572,69
Take Away	0,20	27,43	1 426,58	0,00	1 426,58
Total		25 559,59	1 329 098,89	675 240,88	653 858,01

Table B.18: Extrapolated redistributed and retail volume for missed soft drinks sales.

Market segment	Missed sales per outlet (hl)	Extrapolated weekly missed sales volume (hl)	Extrapolated annual missed sales		
			Total volume (hl)	Redistributed volume (hl)	Retail volume (hl)
Bar/Terrace	0,32	792,72	41 221,55	2 061,08	39 160,47
Boutique	0,50	1 976,36	102 770,52	0,00	102 770,52
Brewery A depot	3,93	876,80	45 593,58	41 034,22	4 559,36
Brewery B depot	1,68	608,30	31 631,52	28 468,37	3 163,15
Depot	3,78	1 074,50	55 874,05	50 286,64	5 587,40
Depot not exclusive	4,75	427,62	22 236,15	20 012,54	2 223,62
General Dealer	0,55	226,90	11 798,77	0,00	11 798,77
Hotel	0,10	13,23	687,97	0,00	687,97
Household	0,05	138,87	7 221,46	0,00	7 221,46
Kiosk	0,24	131,97	6 862,55	0,00	6 862,55
Nganda	0,27	259,77	13 508,01	0,00	13 508,01
Night club	0,94	257,45	13 387,62	0,00	13 387,62
Restaurant	0,17	46,09	2 396,82	0,00	2 396,82
Street Vendor	0,05	22,02	1 144,89	0,00	1 144,89
Supermarket	3,19	436,60	22 703,17	454,06	22 249,11
Take Away	0,28	38,93	2 024,61	0,00	2 024,61
Total		7 328,14	381 063,25	142 316,91	238 746,34

Table B.19: Extrapolated redistributed and retail volume for missed spirits sales.

Market segment	Missed sales per outlet (hl)	Extrapolated weekly missed sales volume (hl)	Extrapolated annual missed sales		
			Total volume (hl)	Redistributed volume (hl)	Retail volume (hl)
Bar/Terrace	0,00	3,38	175,78	8,79	166,99
Boutique	0,02	72,31	3 760,00	0,00	3 760,00
Brewery A depot	0,00	0,00	0,00	0,00	0,00
Brewery B depot	0,00	0,00	0,00	0,00	0,00
Depot	0,00	0,00	0,00	0,00	0,00
Depot not exclusive	0,00	0,00	0,00	0,00	0,00
General Dealer	0,00	0,00	0,00	0,00	0,00
Hotel	0,00	0,00	0,00	0,00	0,00
Household	0,00	0,00	0,00	0,00	0,00
Kiosk	0,04	24,54	1 275,96	0,00	1 275,96
Nganda	0,00	1,61	83,82	0,00	83,82
Night club	0,00	0,83	43,11	0,00	43,11
Restaurant	0,00	0,16	8,58	0,00	8,58
Street Vendor	0,00	0,00	0,00	0,00	0,00
Supermarket	0,00	0,00	0,00	0,00	0,00
Take Away	0,00	0,55	28,48	0,00	28,48
Total		103,38	5 375,72	8,79	5 366,94

B.3 Route to market strategy

B.3.1 Distribution channel

This subsection details the data used to draw volume flow diagrams. For each liquid stream two tables are documented. The first table details the percentage of the total volume flow collected from upstream supply chain links as illustrated in figure B.1a. The second table details the percentage of the total volume flow delivered to the downstream supply chain links as illustrated in figure B.1b.

Supply chain category	Runner Retail		Supplier			Wholesale		
			Imported	Brewery A	Brewery B	Brewery A	Brewery B	Other
Brewery A depot	0,0%	0,0%	0,0%	0,3%	0,0%	0,7%	0,0%	0,0%
Brewery B depot	0,0%	0,0%	0,0%	0,0%	0,5%	0,0%	13,0%	0,0%
Retail	0,2%	2,3%	0,0%	1,3%	3,5%	0,5%	3,8%	10,8%
Other wholesale	0,0%	0,1%	0,0%	0,0%	0,3%	0,2%	0,1%	0,0%
Collected total	0,2%	2,3%	0,0%	1,6%	4,3%	1,4%	16,9%	10,9%

(a) Volume collected upstream.

Supply chain category	Runner Retail		Supplier			Wholesale		
			Imported	Brewery A	Brewery B	Brewery A	Brewery B	Other
Brewery A depot	0,0%	0,0%	0,0%	2,7%	0,0%	2,4%	0,0%	0,0%
Brewery B depot	0,0%	0,0%	0,0%	0,2%	12,7%	0,2%	15,9%	0,0%
Retail	0,4%	2,5%	0,0%	0,7%	7,6%	0,3%	1,7%	7,8%
Other	0,1%	0,0%	0,0%	1,3%	6,0%	0,0%	0,0%	0,0%
Delivered total	0,5%	2,5%	0,0%	4,9%	26,3%	2,9%	17,5%	7,8%

(b) Volume delivered downstream.

Figure B.1: Simple illustration on how to read volume flow tables.

Table B.20: Percentage of beer volume collected from upstream supply chain link.

Supply chain category	Runner Retail		Supplier			Wholesale		
			Imported	Brewery A	Brewery B	Brewery A	Brewery B	Other
Brewery A depot	0,0%	0,0%	0,0%	0,3%	0,0%	0,7%	0,0%	0,0%
Brewery B depot	0,0%	0,0%	0,0%	0,0%	0,5%	0,0%	13,0%	0,0%
Retail	0,2%	2,3%	0,0%	1,3%	3,5%	0,5%	3,8%	10,8%
Other wholesale	0,0%	0,1%	0,0%	0,0%	0,3%	0,2%	0,1%	0,0%
Collected total	0,2%	2,3%	0,0%	1,6%	4,3%	1,4%	16,9%	10,9%

Table B.21: Percentage of beer volume delivered to downstream supply chain link.

Supply chain category	Runner Retail		Supplier			Wholesale		
			Imported	Brewery A	Brewery B	Brewery A	Brewery B	Other
Brewery A depot	0,0%	0,0%	0,0%	2,7%	0,0%	2,4%	0,0%	0,0%
Brewery B depot	0,0%	0,0%	0,0%	0,2%	12,7%	0,2%	15,9%	0,0%
Retail	0,4%	2,5%	0,0%	0,7%	7,6%	0,3%	1,7%	7,8%
Other wholesale	0,1%	0,0%	0,0%	1,3%	6,0%	0,0%	0,0%	0,0%
Delivered Total	0,5%	2,5%	0,0%	4,9%	26,3%	2,9%	17,5%	7,8%

Table B.22: Percentage of soft drinks volume collected from upstream supply chain link.

Supply chain category	Runner Retail		Supplier				Wholesale		
			Imported	Brewery A	Brewery B	Other	Brewery A	Brewery B	Other
Brewery A depot	0,0%	0,0%	0,0%	1,2%	0,0%	0,0%	0,0%	0,0%	0,0%
Brewery B depot	0,0%	0,0%	0,0%	0,5%	1,7%	0,0%	0,0%	0,1%	0,0%
Retail	0,2%	5,3%	0,3%	2,8%	0,7%	0,2%	3,6%	0,9%	16,1%
Other wholesale	0,0%	0,0%	0,2%	0,3%	0,0%	0,0%	0,1%	0,1%	0,6%
Collected total	0,2%	8,4%	0,5%	4,8%	2,5%	0,2%	3,8%	1,1%	16,8%

Table B.23: Percentage of soft drinks volume delivered to downstream supply chain link.

Supply chain category	Runner Retail		Supplier				Wholesale		
			Imported	Brewery A	Brewery B	Other	Brewery A	Brewery B	Other
Brewery A depot	0,0%	0,0%	0,0%	9,3%	0,3%	0,0%	1,6%	0,0%	0,0%
Brewery B depot	0,0%	0,0%	0,0%	1,8%	3,2%	0,2%	0,3%	0,3%	0,0%
Retail	0,1%	4,5%	0,6%	4,5%	2,3%	2,3%	1,2%	0,4%	11,8%
Other wholesale	0,0%	0,0%	0,7%	11,2%	0,1%	4,2%	0,1%	0,0%	0,8%
Delivered total	0,2%	4,5%	1,2%	26,7%	6,0%	6,7%	3,2%	0,6%	12,6%

Table B.24: Percentage of spirits volume collected from upstream supply chain link.

Supply chain category	Retail	Runner	Supplier	Wholesale
Retail	2,0%	0,1%	3,4%	89,3%
Other wholesale	0,0%	0,0%	0,0%	0,0%
Collected total	2,0%	0,1%	3,4%	89,3%

Table B.25: Percentage of spirits volume delivered to downstream supply chain link.

Supply chain category	Retail	Runner	Supplier	Wholesale
Retail	1,2%	0,0%	0,2%	3,6%
Other wholesale	0,1%	0,0%	0,0%	0,1%
Delivered total	1,4%	0,0%	0,2%	3,7%

Appendix C

Decision support model

C.1 Evaluation of alternatives

Each of the six alternative LSPs was evaluated in terms of the 11 identified strategies. The evaluation was carried out by three consultants at Hunting Dragons Consulting. The purpose of this section is to document the steps and results from the AHP.

C.1.1 Consultant A evaluation

C.1.1.1 Economic development

Table C.1: Consultant A's classification of alternative LSPs in terms of economic development.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	0,1429	0,1429	1,0000	1,0000	0,2000
	B	7,0000	1,0000	1,0000	5,0000	5,0000	3,0000
	C	7,0000	1,0000	1,0000	3,0000	3,0000	1,0000
	D	1,0000	0,2000	0,3333	1,0000	1,0000	0,2000
	E	1,0000	0,2000	0,3333	1,0000	1,0000	0,2000
	F	5,0000	0,3333	1,0000	5,0000	5,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_j
A	0,0455	0,0497	0,0375	0,0625	0,0625	0,0357	0,0489
B	0,3182	0,3477	0,2625	0,3125	0,3125	0,5357	0,3482
C	0,3182	0,3477	0,2625	0,1875	0,1875	0,1786	0,2470
D	0,0455	0,0695	0,0875	0,0625	0,0625	0,0357	0,0605
E	0,0455	0,0695	0,0875	0,0625	0,0625	0,0357	0,0605
F	0,2273	0,1159	0,2625	0,3125	0,3125	0,1786	0,2349

C.1.1.2 Control

Table C.2: Consultant A's classification of alternative LSPs in terms of control.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	1,0000	3,0000	7,0000	7,0000	1,0000
	B	1,0000	1,0000	3,0000	7,0000	7,0000	1,0000
	C	0,3333	0,3333	1,0000	3,0000	3,0000	0,2000
	D	0,1429	0,1429	0,3333	1,0000	1,0000	0,2000
	E	0,1429	0,1429	0,3333	1,0000	1,0000	0,2000
	F	1,0000	1,0000	5,0000	5,0000	5,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_2
A	0,2763	0,2763	0,2368	0,2917	0,2917	0,2778	0,2751
B	0,2763	0,2763	0,2368	0,2917	0,2917	0,2778	0,2751
C	0,0921	0,0921	0,0789	0,1250	0,1250	0,0556	0,0948
D	0,0395	0,0395	0,0263	0,0417	0,0417	0,0556	0,0407
E	0,0395	0,0395	0,0263	0,0417	0,0417	0,0556	0,0407
F	0,2763	0,2763	0,3947	0,2083	0,2083	0,2778	0,2736

C.1.1.3 Core competencies

Table C.3: Consultant A's classification of alternative LSPs in terms of core competencies.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	0,2000	0,2000	0,1429	0,1429	0,2000
	B	5,0000	1,0000	3,0000	0,3333	0,3333	1,0000
	C	5,0000	0,3333	1,0000	0,2000	0,2000	0,3333
	D	7,0000	3,0000	5,0000	1,0000	1,0000	5,0000
	E	7,0000	3,0000	5,0000	1,0000	1,0000	5,0000
	F	5,0000	1,0000	3,0000	0,2000	0,2000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_3
A	0,0333	0,0234	0,0116	0,0497	0,0497	0,0160	0,0306
B	0,1667	0,1172	0,1744	0,1159	0,1159	0,0798	0,1283
C	0,1667	0,0391	0,0581	0,0695	0,0695	0,0266	0,0716
D	0,2333	0,3516	0,2907	0,3477	0,3477	0,3989	0,3283
E	0,2333	0,3516	0,2907	0,3477	0,3477	0,3989	0,3283
F	0,1667	0,1172	0,1744	0,0695	0,0695	0,0798	0,1129

C.1.1.4 Cost

Table C.4: Consultant A's classification of alternative LSPs in terms of cost.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	5,0000	3,0000	3,0000	5,0000	3,0000
	B	0,2000	1,0000	0,3333	0,2000	0,3333	1,0000
	C	0,3333	3,0000	1,0000	0,3333	1,0000	1,0000
	D	0,3333	5,0000	3,0000	1,0000	3,0000	3,0000
	E	0,2000	3,0000	1,0000	0,3333	1,0000	3,0000
	F	0,3333	1,0000	1,0000	0,3333	0,3333	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_4
A	0,4167	0,2778	0,3214	0,5769	0,4688	0,2500	0,3853
B	0,0833	0,0556	0,0357	0,0385	0,0313	0,0833	0,0546
C	0,1389	0,1667	0,1071	0,0641	0,0938	0,0833	0,1090
D	0,1389	0,2778	0,3214	0,1923	0,2813	0,2500	0,2436
E	0,0833	0,1667	0,1071	0,0641	0,0938	0,2500	0,1275
F	0,1389	0,0556	0,1071	0,0641	0,0313	0,0833	0,0800

C.1.1.5 Customer service

Table C.5: Consultant A's classification of alternative LSPs in terms of customer service.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	0,2000	0,3333	3,0000	5,0000	0,2000
	B	5,0000	1,0000	3,0000	5,0000	7,0000	1,0000
	C	3,0000	0,3333	1,0000	3,0000	5,0000	0,3333
	D	0,3333	0,2000	0,3333	1,0000	3,0000	0,2000
	E	0,2000	0,1429	0,2000	0,3333	1,0000	0,1429
	F	5,0000	1,0000	3,0000	5,0000	7,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_5
A	0,0688	0,0695	0,0424	0,1731	0,1786	0,0695	0,1003
B	0,3440	0,3477	0,3814	0,2885	0,2500	0,3477	0,3265
C	0,2064	0,1159	0,1271	0,1731	0,1786	0,1159	0,1528
D	0,0229	0,0695	0,0424	0,0577	0,1071	0,0695	0,0615
E	0,0138	0,0497	0,0254	0,0192	0,0357	0,0497	0,0322
F	0,3440	0,3477	0,3814	0,2885	0,2500	0,3477	0,3265

C.1.1.6 Flexibility

Table C.6: Consultant A's classification of alternative LSPs in terms of flexibility.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	0,2000	0,1111	1,0000	1,0000	0,2000
	B	5,0000	1,0000	0,3333	3,0000	3,0000	1,0000
	C	9,0000	3,0000	1,0000	5,0000	5,0000	3,0000
	D	1,0000	0,3333	0,2000	1,0000	1,0000	0,2000
	E	1,0000	0,3333	0,2000	1,0000	1,0000	0,2000
	F	5,0000	1,0000	0,3333	5,0000	5,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_f
A	0,0455	0,0341	0,0510	0,0625	0,0625	0,0357	0,0485
B	0,2273	0,1705	0,1531	0,1875	0,1875	0,1786	0,1841
C	0,4091	0,5114	0,4592	0,3125	0,3125	0,5357	0,4234
D	0,0455	0,0568	0,0918	0,0625	0,0625	0,0357	0,0591
E	0,0455	0,0568	0,0918	0,0625	0,0625	0,0357	0,0591
F	0,2273	0,1705	0,1531	0,3125	0,3125	0,1786	0,2257

C.1.1.7 Innovation

Table C.7: Consultant A's classification of alternative LSPs in terms of innovation.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	1,0000	1,0000	0,1111	0,1111	0,2000
	B	1,0000	1,0000	1,0000	0,1111	0,1111	0,2000
	C	1,0000	1,0000	1,0000	0,1111	0,1111	0,2000
	D	9,0000	9,0000	9,0000	1,0000	1,0000	3,0000
	E	9,0000	9,0000	9,0000	1,0000	1,0000	3,0000
	F	5,0000	5,0000	5,0000	0,3333	0,3333	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_z
A	0,0385	0,0385	0,0385	0,0417	0,0417	0,0263	0,0375
B	0,0385	0,0385	0,0385	0,0417	0,0417	0,0263	0,0375
C	0,0385	0,0385	0,0385	0,0417	0,0417	0,0263	0,0375
D	0,3462	0,3462	0,3462	0,3750	0,3750	0,3947	0,3639
E	0,3462	0,3462	0,3462	0,3750	0,3750	0,3947	0,3639
F	0,1923	0,1923	0,1923	0,1250	0,1250	0,1316	0,1598

C.1.1.8 Performance

Table C.8: Consultant A's classification of alternative LSPs in terms of performance.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	0,1429	0,3333	0,3333	0,3333	0,2000
	B	7,0000	1,0000	3,0000	3,0000	3,0000	1,0000
	C	3,0000	0,3333	1,0000	0,3333	0,3333	0,2000
	D	3,0000	0,3333	3,0000	1,0000	1,0000	0,3333
	E	3,0000	0,3333	3,0000	1,0000	1,0000	0,3333
	F	5,0000	1,0000	5,0000	3,0000	3,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_g
A	0,0455	0,0455	0,0217	0,0385	0,0385	0,0652	0,0425
B	0,3182	0,3182	0,1957	0,3462	0,3462	0,3261	0,3084
C	0,1364	0,1061	0,0652	0,0385	0,0385	0,0652	0,0750
D	0,1364	0,1061	0,1957	0,1154	0,1154	0,1087	0,1296
E	0,1364	0,1061	0,1957	0,1154	0,1154	0,1087	0,1296
F	0,2273	0,3182	0,3261	0,3462	0,3462	0,3261	0,3150

C.1.1.9 Reliability

Table C.9: Consultant A's classification of alternative LSPs in terms of reliability.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	0,1429	0,3333	1,0000	1,0000	0,2000
	B	7,0000	1,0000	3,0000	3,0000	3,0000	1,0000
	C	3,0000	0,3333	1,0000	1,0000	1,0000	0,3333
	D	1,0000	0,3333	1,0000	1,0000	1,0000	0,3333
	E	1,0000	0,3333	1,0000	1,0000	1,0000	0,3333
	F	5,0000	1,0000	3,0000	3,0000	3,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_g
A	0,0556	0,0455	0,0357	0,1000	0,1000	0,0625	0,0665
B	0,3889	0,3182	0,3214	0,3000	0,3000	0,3125	0,3235
C	0,1667	0,1061	0,1071	0,1000	0,1000	0,1042	0,1140
D	0,0556	0,1061	0,1071	0,1000	0,1000	0,1042	0,0955
E	0,0556	0,1061	0,1071	0,1000	0,1000	0,1042	0,0955
F	0,2778	0,3182	0,3214	0,3000	0,3000	0,3125	0,3050

C.1.1.10 Resources and capabilities

Table C.10: Consultant A's classification of alternative LSPs in terms of resources and capabilities.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	0,3333	0,3333	0,1429	0,1111	0,2000
	B	3,0000	1,0000	1,0000	0,2000	0,2000	1,0000
	C	3,0000	1,0000	1,0000	0,1429	0,1429	0,3333
	D	7,0000	5,0000	7,0000	1,0000	1,0000	5,0000
	E	9,0000	5,0000	7,0000	1,0000	1,0000	5,0000
	F	5,0000	1,0000	3,0000	0,2000	0,2000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_{i0}
A	0,0357	0,0250	0,0172	0,0532	0,0419	0,0160	0,0315
B	0,1071	0,0750	0,0517	0,0745	0,0754	0,0798	0,0772
C	0,1071	0,0750	0,0517	0,0532	0,0538	0,0266	0,0612
D	0,2500	0,3750	0,3621	0,3723	0,3768	0,3989	0,3559
E	0,3214	0,3750	0,3621	0,3723	0,3768	0,3989	0,3678
F	0,1786	0,0750	0,1552	0,0745	0,0754	0,0798	0,1064

C.1.1.11 Risk

Table C.11: Consultant A's classification of alternative LSPs in terms of risk.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	0,3333	0,2000	3,0000	1,0000	1,0000
	B	3,0000	1,0000	0,3333	3,0000	3,0000	1,0000
	C	5,0000	3,0000	1,0000	7,0000	5,0000	3,0000
	D	0,3333	0,3333	0,1429	1,0000	0,3333	1,0000
	E	1,0000	0,3333	0,2000	3,0000	1,0000	0,3333
	F	1,0000	1,0000	0,3333	1,0000	3,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_{i1}
A	0,0882	0,0556	0,0905	0,1667	0,0750	0,1364	0,1021
B	0,2647	0,1667	0,1509	0,1667	0,2250	0,1364	0,1850
C	0,4412	0,5000	0,4526	0,3889	0,3750	0,4091	0,4278
D	0,0294	0,0556	0,0647	0,0556	0,0250	0,1364	0,0611
E	0,0882	0,0556	0,0905	0,1667	0,0750	0,0455	0,0869
F	0,0882	0,1667	0,1509	0,0556	0,2250	0,1364	0,1371

C.1.2 Consultant B evaluation

C.1.2.1 Economic development

Table C.12: Consultant B’s classification of alternative LSPs in terms of economic development.

(a) Pairwise comparison matrix A .

Alternatives	j					
	A	B	C	D	E	F
A	1,0000	0,3333	0,3333	1,0000	1,0000	0,3333
B	3,0000	1,0000	3,0000	5,0000	5,0000	0,3333
C	3,0000	0,3333	1,0000	3,0000	3,0000	0,3333
D	1,0000	0,2000	0,3333	1,0000	1,0000	0,3333
E	1,0000	0,2000	0,3333	1,0000	1,0000	0,3333
F	3,0000	3,0000	3,0000	3,0000	3,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_i
A	0,0833	0,0658	0,0417	0,0714	0,0714	0,1250	0,0764
B	0,2500	0,1974	0,3750	0,3571	0,3571	0,1250	0,2769
C	0,2500	0,0658	0,1250	0,2143	0,2143	0,1250	0,1657
D	0,0833	0,0395	0,0417	0,0714	0,0714	0,1250	0,0721
E	0,0833	0,0395	0,0417	0,0714	0,0714	0,1250	0,0721
F	0,2500	0,5921	0,3750	0,2143	0,2143	0,3750	0,3368

C.1.2.2 Control

Table C.13: Consultant B’s classification of alternative LSPs in terms of control.

(a) Pairwise comparison matrix A .

Alternatives	j					
	A	B	C	D	E	F
A	1,0000	1,0000	5,0000	5,0000	5,0000	3,0000
B	1,0000	1,0000	5,0000	5,0000	5,0000	3,0000
C	0,2000	0,2000	1,0000	1,0000	1,0000	0,2000
D	0,2000	0,2000	1,0000	1,0000	1,0000	0,3333
E	0,2000	0,2000	1,0000	1,0000	1,0000	0,3333
F	0,3333	0,3333	5,0000	3,0000	3,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_i
A	0,3409	0,3409	0,2778	0,3125	0,3125	0,3814	0,3277
B	0,3409	0,3409	0,2778	0,3125	0,3125	0,3814	0,3277
C	0,0682	0,0682	0,0556	0,0625	0,0625	0,0254	0,0571
D	0,0682	0,0682	0,0556	0,0625	0,0625	0,0424	0,0599
E	0,0682	0,0682	0,0556	0,0625	0,0625	0,0424	0,0599
F	0,1136	0,1136	0,2778	0,1875	0,1875	0,1271	0,1679

C.1.2.3 Core competencies

Table C.14: Consultant B's classification of alternative LSPs in terms of core competencies.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	0,3333	1,0000	0,1429	0,1429	0,3333
	B	3,0000	1,0000	1,0000	0,2000	0,2000	1,0000
	C	1,0000	1,0000	1,0000	0,1429	0,1429	0,3333
	D	7,0000	5,0000	7,0000	1,0000	1,0000	7,0000
	E	7,0000	5,0000	7,0000	1,0000	1,0000	7,0000
	F	3,0000	1,0000	3,0000	0,1429	0,1429	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_3
A	0,0455	0,0250	0,0500	0,0543	0,0543	0,0200	0,0415
B	0,1364	0,0750	0,0500	0,0761	0,0761	0,0600	0,0789
C	0,0455	0,0750	0,0500	0,0543	0,0543	0,0200	0,0499
D	0,3182	0,3750	0,3500	0,3804	0,3804	0,4200	0,3707
E	0,3182	0,3750	0,3500	0,3804	0,3804	0,4200	0,3707
F	0,1364	0,0750	0,1500	0,0543	0,0543	0,0600	0,0883

C.1.2.4 Cost

Table C.15: Consultant B's classification of alternative LSPs in terms of cost.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	0,3333	3,0000	5,0000	5,0000	1,0000
	B	3,0000	1,0000	3,0000	3,0000	3,0000	3,0000
	C	0,3333	0,3333	1,0000	1,0000	1,0000	0,3333
	D	0,2000	0,3333	1,0000	1,0000	1,0000	0,3333
	E	0,2000	0,3333	1,0000	1,0000	1,0000	0,3333
	F	1,0000	0,3333	3,0000	3,0000	3,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_4
A	0,1744	0,1250	0,2500	0,3571	0,3571	0,1667	0,2384
B	0,5233	0,3750	0,2500	0,2143	0,2143	0,5000	0,3461
C	0,0581	0,1250	0,0833	0,0714	0,0714	0,0556	0,0775
D	0,0349	0,1250	0,0833	0,0714	0,0714	0,0556	0,0736
E	0,0349	0,1250	0,0833	0,0714	0,0714	0,0556	0,0736
F	0,1744	0,1250	0,2500	0,2143	0,2143	0,1667	0,1908

C.1.2.5 Customer service

Table C.16: Consultant B's classification of alternative LSPs in terms of customer service.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	0,3333	3,0000	5,0000	5,0000	1,0000
	B	3,0000	1,0000	5,0000	7,0000	7,0000	3,0000
	C	0,3333	0,2000	1,0000	1,0000	1,0000	0,2000
	D	0,2000	0,1429	1,0000	1,0000	1,0000	0,2000
	E	0,2000	0,1429	1,0000	1,0000	1,0000	0,2000
	F	1,0000	0,3333	5,0000	5,0000	5,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_{ξ}
A	0,1744	0,1549	0,1875	0,2500	0,2500	0,1786	0,1992
B	0,5233	0,4646	0,3125	0,3500	0,3500	0,5357	0,4227
C	0,0581	0,0929	0,0625	0,0500	0,0500	0,0357	0,0582
D	0,0349	0,0664	0,0625	0,0500	0,0500	0,0357	0,0499
E	0,0349	0,0664	0,0625	0,0500	0,0500	0,0357	0,0499
F	0,1744	0,1549	0,3125	0,2500	0,2500	0,1786	0,2201

C.1.2.6 Flexibility

Table C.17: Consultant B's classification of alternative LSPs in terms of flexibility.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	0,3333	0,2000	0,2000	0,2000	1,0000
	B	3,0000	1,0000	0,3333	0,3333	0,3333	3,0000
	C	5,0000	3,0000	1,0000	1,0000	1,0000	5,0000
	D	5,0000	3,0000	1,0000	1,0000	1,0000	5,0000
	E	5,0000	3,0000	1,0000	1,0000	1,0000	5,0000
	F	1,0000	0,3333	0,2000	0,2000	0,2000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_{ξ}
A	0,0500	0,0313	0,0536	0,0536	0,0536	0,0500	0,0487
B	0,1500	0,0938	0,0893	0,0893	0,0893	0,1500	0,1103
C	0,2500	0,2813	0,2679	0,2679	0,2679	0,2500	0,2641
D	0,2500	0,2813	0,2679	0,2679	0,2679	0,2500	0,2641
E	0,2500	0,2813	0,2679	0,2679	0,2679	0,2500	0,2641
F	0,0500	0,0313	0,0536	0,0536	0,0536	0,0500	0,0487

C.1.2.7 Innovation

Table C.18: Consultant B's classification of alternative LSPs in terms of innovation.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	0,2000	0,2000	0,1429	0,1429	0,3333
	B	5,0000	1,0000	0,2000	0,2000	0,2000	3,0000
	C	5,0000	5,0000	1,0000	1,0000	1,0000	5,0000
	D	7,0000	5,0000	1,0000	1,0000	1,0000	7,0000
	E	7,0000	5,0000	1,0000	1,0000	1,0000	7,0000
	F	3,0000	0,3333	0,2000	0,1429	0,1429	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_z
A	0,0357	0,0121	0,0556	0,0410	0,0410	0,0143	0,0333
B	0,1786	0,0605	0,0556	0,0574	0,0574	0,1286	0,0897
C	0,1786	0,3024	0,2778	0,2869	0,2869	0,2143	0,2578
D	0,2500	0,3024	0,2778	0,2869	0,2869	0,3000	0,2840
E	0,2500	0,3024	0,2778	0,2869	0,2869	0,3000	0,2840
F	0,1071	0,0202	0,0556	0,0410	0,0410	0,0429	0,0513

C.1.2.8 Performance

Table C.19: Consultant B's classification of alternative LSPs in terms of performance.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	0,1429	5,0000	5,0000	5,0000	1,0000
	B	7,0000	1,0000	9,0000	9,0000	9,0000	7,0000
	C	0,2000	0,1111	1,0000	1,0000	1,0000	0,2000
	D	0,2000	0,1111	1,0000	1,0000	1,0000	0,3333
	E	0,2000	0,1111	1,0000	1,0000	1,0000	0,3333
	F	1,0000	0,1429	5,0000	3,0000	3,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_g
A	0,1042	0,0882	0,2273	0,2500	0,2500	0,1014	0,1702
B	0,7292	0,6176	0,4091	0,4500	0,4500	0,7095	0,5609
C	0,0208	0,0686	0,0455	0,0500	0,0500	0,0203	0,0425
D	0,0208	0,0686	0,0455	0,0500	0,0500	0,0338	0,0448
E	0,0208	0,0686	0,0455	0,0500	0,0500	0,0338	0,0448
F	0,1042	0,0882	0,2273	0,1500	0,1500	0,1014	0,1368

C.1.2.9 Reliability

Table C.20: Consultant B's classification of alternative LSPs in terms of reliability.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	0,3333	7,0000	7,0000	7,0000	1,0000
	B	3,0000	1,0000	9,0000	9,0000	9,0000	3,0000
	C	0,1429	0,1111	1,0000	1,0000	1,0000	0,2000
	D	0,1429	0,1111	1,0000	1,0000	1,0000	0,2000
	E	0,1429	0,1111	1,0000	1,0000	1,0000	0,2000
	F	1,0000	0,3333	5,0000	5,0000	5,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_g
A	0,1842	0,1667	0,2917	0,2917	0,2917	0,1786	0,2341
B	0,5526	0,5000	0,3750	0,3750	0,3750	0,5357	0,4522
C	0,0263	0,0556	0,0417	0,0417	0,0417	0,0357	0,0404
D	0,0263	0,0556	0,0417	0,0417	0,0417	0,0357	0,0404
E	0,0263	0,0556	0,0417	0,0417	0,0417	0,0357	0,0404
F	0,1842	0,1667	0,2083	0,2083	0,2083	0,1786	0,1924

C.1.2.10 Resources and capabilities

Table C.21: Consultant B's classification of alternative LSPs in terms of resources and capabilities.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	0,2000	0,3333	0,1429	0,1429	0,3333
	B	5,0000	1,0000	1,0000	0,1429	0,1429	1,0000
	C	3,0000	1,0000	1,0000	0,2000	0,2000	3,0000
	D	7,0000	7,0000	5,0000	1,0000	1,0000	7,0000
	E	7,0000	7,0000	5,0000	1,0000	1,0000	7,0000
	F	3,0000	1,0000	0,3333	0,1429	0,1429	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_{i0}
A	0,0385	0,0116	0,0263	0,0543	0,0543	0,0172	0,0337
B	0,1923	0,0581	0,0789	0,0543	0,0543	0,0517	0,0816
C	0,1154	0,0581	0,0789	0,0761	0,0761	0,1552	0,0933
D	0,2692	0,4070	0,3947	0,3804	0,3804	0,3621	0,3656
E	0,2692	0,4070	0,3947	0,3804	0,3804	0,3621	0,3656
F	0,1154	0,0581	0,0263	0,0543	0,0543	0,0517	0,0600

C.1.2.11 Risk

Table C.22: Consultant B's classification of alternative LSPs in terms of risk.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	0,3333	0,2000	0,2000	0,2000	0,3333
	B	3,0000	1,0000	0,3333	0,3333	0,3333	1,0000
	C	5,0000	3,0000	1,0000	1,0000	1,0000	3,0000
	D	5,0000	3,0000	1,0000	1,0000	1,0000	5,0000
	E	5,0000	3,0000	1,0000	1,0000	1,0000	5,0000
	F	3,0000	1,0000	0,3333	0,2000	0,2000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_j
A	0,0455	0,0294	0,0517	0,0536	0,0536	0,0217	0,0426
B	0,1364	0,0882	0,0862	0,0893	0,0893	0,0652	0,0924
C	0,2273	0,2647	0,2586	0,2679	0,2679	0,1957	0,2470
D	0,2273	0,2647	0,2586	0,2679	0,2679	0,3261	0,2687
E	0,2273	0,2647	0,2586	0,2679	0,2679	0,3261	0,2687
F	0,1364	0,0882	0,0862	0,0536	0,0536	0,0652	0,0805

C.1.3 Consultant C evaluation

C.1.3.1 Economic development

Table C.23: Consultant C's classification of alternative LSPs in terms of economic development.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	0,1111	0,2000	0,2000	0,2000	0,1429
	B	9,0000	1,0000	9,0000	5,0000	3,0000	1,0000
	C	5,0000	0,1111	1,0000	0,3333	0,3333	0,3333
	D	5,0000	0,2000	3,0000	1,0000	0,3333	1,0000
	E	5,0000	0,3333	3,0000	3,0000	1,0000	1,0000
	F	7,0000	1,0000	3,0000	1,0000	1,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_j
A	0,0313	0,0403	0,0104	0,0190	0,0341	0,0319	0,0278
B	0,2813	0,3629	0,4688	0,4747	0,5114	0,2234	0,3871
C	0,1563	0,0403	0,0521	0,0316	0,0568	0,0745	0,0686
D	0,1563	0,0726	0,1563	0,0949	0,0568	0,2234	0,1267
E	0,1563	0,1210	0,1563	0,2848	0,1705	0,2234	0,1854
F	0,2188	0,3629	0,1563	0,0949	0,1705	0,2234	0,2044

C.1.3.2 Control

Table C.24: Consultant C's classification of alternative LSPs in terms of control.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	1,0000	3,0000	7,0000	7,0000	3,0000
	B	1,0000	1,0000	3,0000	7,0000	7,0000	1,0000
	C	0,3333	0,3333	1,0000	3,0000	3,0000	0,2000
	D	0,1429	0,1429	0,3333	1,0000	1,0000	0,2000
	E	0,1429	0,1429	0,3333	1,0000	1,0000	0,2000
	F	0,3333	1,0000	5,0000	5,0000	5,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_2
A	0,3387	0,2763	0,2368	0,2917	0,2917	0,5357	0,3285
B	0,3387	0,2763	0,2368	0,2917	0,2917	0,1786	0,2690
C	0,1129	0,0921	0,0789	0,1250	0,1250	0,0357	0,0949
D	0,0484	0,0395	0,0263	0,0417	0,0417	0,0357	0,0389
E	0,0484	0,0395	0,0263	0,0417	0,0417	0,0357	0,0389
F	0,1129	0,2763	0,3947	0,2083	0,2083	0,1786	0,2299

C.1.3.3 Core competencies

Table C.25: Consultant C's classification of alternative LSPs in terms of core competencies.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	0,1111	0,2000	0,1429	0,1429	0,1429
	B	9,0000	1,0000	1,0000	0,3333	0,3333	0,3333
	C	5,0000	1,0000	1,0000	1,0000	1,0000	1,0000
	D	7,0000	3,0000	1,0000	1,0000	1,0000	1,0000
	E	7,0000	3,0000	1,0000	1,0000	1,0000	1,0000
	F	7,0000	3,0000	1,0000	1,0000	1,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_3
A	0,0278	0,0100	0,0385	0,0319	0,0319	0,0319	0,0287
B	0,2500	0,0900	0,1923	0,0745	0,0745	0,0745	0,1260
C	0,1389	0,0900	0,1923	0,2234	0,2234	0,2234	0,1819
D	0,1944	0,2700	0,1923	0,2234	0,2234	0,2234	0,2212
E	0,1944	0,2700	0,1923	0,2234	0,2234	0,2234	0,2212
F	0,1944	0,2700	0,1923	0,2234	0,2234	0,2234	0,2212

C.1.3.4 Cost

Table C.26: Consultant C's classification of alternative LSPs in terms of cost.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	9,0000	7,0000	5,0000	5,0000	1,0000
	B	0,1111	1,0000	1,0000	1,0000	1,0000	0,2000
	C	0,1429	1,0000	1,0000	0,3333	2,0000	0,1429
	D	0,2000	1,0000	3,0000	1,0000	0,3333	0,3333
	E	0,2000	1,0000	0,5000	3,0000	1,0000	0,2000
	F	1,0000	5,0000	7,0000	3,0000	5,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_4
A	0,3768	0,5000	0,3590	0,3750	0,3488	0,3477	0,3845
B	0,0419	0,0556	0,0513	0,0750	0,0698	0,0695	0,0605
C	0,0538	0,0556	0,0513	0,0250	0,1395	0,0497	0,0625
D	0,0754	0,0556	0,1538	0,0750	0,0233	0,1159	0,0832
E	0,0754	0,0556	0,0256	0,2250	0,0698	0,0695	0,0868
F	0,3768	0,2778	0,3590	0,2250	0,3488	0,3477	0,3225

C.1.3.5 Customer service

Table C.27: Consultant C's classification of alternative LSPs in terms of customer service.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	1,0000	0,3333	0,3333	1,0000	5,0000
	B	1,0000	1,0000	0,3333	0,2000	3,0000	3,0000
	C	3,0000	3,0000	1,0000	3,0000	5,0000	7,0000
	D	3,0000	5,0000	0,3333	1,0000	3,0000	5,0000
	E	1,0000	0,3333	0,2000	0,3333	1,0000	3,0000
	F	0,2000	0,3333	0,1429	0,2000	0,3333	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_5
A	0,1087	0,0938	0,1423	0,0658	0,0750	0,2083	0,1156
B	0,1087	0,0938	0,1423	0,0395	0,2250	0,1250	0,1224
C	0,3261	0,2813	0,4268	0,5921	0,3750	0,2917	0,3822
D	0,3261	0,4688	0,1423	0,1974	0,2250	0,2083	0,2613
E	0,1087	0,0313	0,0854	0,0658	0,0750	0,1250	0,0819
F	0,0217	0,0313	0,0610	0,0395	0,0250	0,0417	0,0367

C.1.3.6 Flexibility

Table C.28: Consultant C's classification of alternative LSPs in terms of flexibility.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	1,0000	0,3333	0,2000	0,2000	0,2000
	B	1,0000	1,0000	0,3333	0,2000	0,2000	0,2000
	C	3,0000	3,0000	1,0000	3,0000	3,0000	3,0000
	D	5,0000	5,0000	0,3333	1,0000	1,0000	1,0000
	E	5,0000	5,0000	0,3333	1,0000	1,0000	1,0000
	F	5,0000	5,0000	0,3333	1,0000	1,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_{ξ}
A	0,0500	0,0500	0,1250	0,0313	0,0313	0,0313	0,0531
B	0,0500	0,0500	0,1250	0,0313	0,0313	0,0313	0,0531
C	0,1500	0,1500	0,3750	0,4688	0,4688	0,4688	0,3469
D	0,2500	0,2500	0,1250	0,1563	0,1563	0,1563	0,1823
E	0,2500	0,2500	0,1250	0,1563	0,1563	0,1563	0,1823
F	0,2500	0,2500	0,1250	0,1563	0,1563	0,1563	0,1823

C.1.3.7 Innovation

Table C.29: Consultant C's classification of alternative LSPs in terms of innovation.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	1,0000	0,3333	0,1111	0,1111	0,1429
	B	1,0000	1,0000	0,3333	0,2000	0,1429	0,1111
	C	3,0000	3,0000	1,0000	0,3333	0,2000	0,1429
	D	9,0000	5,0000	3,0000	1,0000	1,0000	3,0000
	E	9,0000	7,0000	5,0000	1,0000	1,0000	1,0000
	F	7,0000	9,0000	7,0000	0,3333	1,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_{ζ}
A	0,0333	0,0385	0,0200	0,0373	0,0322	0,0265	0,0313
B	0,0333	0,0385	0,0200	0,0672	0,0414	0,0206	0,0368
C	0,1000	0,1154	0,0600	0,1119	0,0579	0,0265	0,0786
D	0,3000	0,1923	0,1800	0,3358	0,2895	0,5559	0,3089
E	0,3000	0,2692	0,3000	0,3358	0,2895	0,1853	0,2800
F	0,2333	0,3462	0,4200	0,1119	0,2895	0,1853	0,2644

C.1.3.8 Performance

Table C.30: Consultant C's classification of alternative LSPs in terms of performance.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	1,0000	9,0000	3,0000	3,0000	1,0000
	B	1,0000	1,0000	7,0000	1,0000	1,0000	1,0000
	C	0,1111	0,1429	1,0000	0,3333	0,3333	0,3333
	D	0,3333	1,0000	3,0000	1,0000	0,3333	0,2000
	E	0,3333	1,0000	3,0000	3,0000	1,0000	0,3333
	F	1,0000	1,0000	3,0000	5,0000	3,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_g
A	0,2647	0,1944	0,3462	0,2250	0,3462	0,2586	0,2725
B	0,2647	0,1944	0,2692	0,0750	0,1154	0,2586	0,1962
C	0,0294	0,0278	0,0385	0,0250	0,0385	0,0862	0,0409
D	0,0882	0,1944	0,1154	0,0750	0,0385	0,0517	0,0939
E	0,0882	0,1944	0,1154	0,2250	0,1154	0,0862	0,1374
F	0,2647	0,1944	0,1154	0,3750	0,3462	0,2586	0,2591

C.1.3.9 Reliability

Table C.31: Consultant C's classification of alternative LSPs in terms of reliability.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	1,0000	1,0000	0,3333	0,3333	0,3333
	B	1,0000	1,0000	3,0000	1,0000	0,3333	0,2000
	C	1,0000	0,3333	1,0000	1,0000	0,3333	0,2000
	D	3,0000	1,0000	1,0000	1,0000	0,3333	0,2000
	E	3,0000	3,0000	3,0000	3,0000	1,0000	0,3333
	F	3,0000	5,0000	5,0000	5,0000	3,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_g
A	0,0833	0,0882	0,0714	0,0294	0,0625	0,1471	0,0803
B	0,0833	0,0882	0,2143	0,0882	0,0625	0,0882	0,1041
C	0,0833	0,0294	0,0714	0,0882	0,0625	0,0882	0,0705
D	0,2500	0,0882	0,0714	0,0882	0,0625	0,0882	0,1081
E	0,2500	0,2647	0,2143	0,2647	0,1875	0,1471	0,2214
F	0,2500	0,4412	0,3571	0,4412	0,5625	0,4412	0,4155

C.1.3.10 Resources and capabilities

Table C.32: Consultant C's classification of alternative LSPs in terms of resources and capabilities.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	5,0000	0,2000	0,3333	0,3333	0,3333
	B	0,2000	1,0000	0,1111	0,1429	0,1429	0,1111
	C	5,0000	9,0000	1,0000	3,0000	3,0000	5,0000
	D	3,0000	7,0000	0,3333	1,0000	3,0000	3,0000
	E	3,0000	7,0000	0,3333	0,3333	1,0000	1,0000
	F	3,0000	9,0000	0,2000	0,3333	1,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_{10}
A	0,0658	0,1316	0,0918	0,0648	0,0393	0,0319	0,0709
B	0,0132	0,0263	0,0510	0,0278	0,0169	0,0106	0,0243
C	0,3289	0,2368	0,4592	0,5833	0,3539	0,4787	0,4068
D	0,1974	0,1842	0,1531	0,1944	0,3539	0,2872	0,2284
E	0,1974	0,1842	0,1531	0,0648	0,1180	0,0957	0,1355
F	0,1974	0,2368	0,0918	0,0648	0,1180	0,0957	0,1341

C.1.3.11 Risk

Table C.33: Consultant C's classification of alternative LSPs in terms of risk.

(a) Pairwise comparison matrix A .

		j					
Alternatives		A	B	C	D	E	F
i	A	1,0000	0,1429	0,3333	1,0000	0,1111	0,1111
	B	7,0000	1,0000	7,0000	5,0000	3,0000	1,0000
	C	3,0000	0,1429	1,0000	1,0000	0,1111	0,1429
	D	1,0000	0,2000	1,0000	1,0000	0,3333	0,1429
	E	9,0000	0,3333	9,0000	3,0000	1,0000	0,3333
	F	9,0000	1,0000	7,0000	7,0000	3,0000	1,0000

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Alternatives	A	B	C	D	E	F	w_{11}
A	0,0333	0,0507	0,0132	0,0556	0,0147	0,0407	0,0347
B	0,2333	0,3547	0,2763	0,2778	0,3971	0,3663	0,3176
C	0,1000	0,0507	0,0395	0,0556	0,0147	0,0523	0,0521
D	0,0333	0,0709	0,0395	0,0556	0,0441	0,0523	0,0493
E	0,3000	0,1182	0,3553	0,1667	0,1324	0,1221	0,1991
F	0,3000	0,3547	0,2763	0,3889	0,3971	0,3663	0,3472

C.1.4 Summary of evaluations

A summary of the evaluations of each consultant is provided. Additionally the consistency of each pairwise comparison matrix is evaluated by calculating the consistency ratio.

Table C.34: Aggregated comparison of weights from consultant A's evaluation.

Alternatives	W ₁	W ₂	W ₃	W ₄	W ₅	W ₆	W ₇	W ₈	W ₉	W ₁₀	W ₁₁
A	0,0489	0,2751	0,0306	0,3853	0,1003	0,0485	0,0375	0,0425	0,0665	0,0315	0,1021
B	0,3482	0,2751	0,1283	0,0546	0,3265	0,1841	0,0375	0,3084	0,3235	0,0772	0,1850
C	0,2470	0,0948	0,0716	0,1090	0,1528	0,4234	0,0375	0,0750	0,1140	0,0612	0,4278
D	0,0605	0,0407	0,3283	0,2436	0,0615	0,0591	0,3639	0,1296	0,0955	0,3559	0,0611
E	0,0605	0,0407	0,3283	0,1275	0,0322	0,0591	0,3639	0,1296	0,0955	0,3678	0,0869
F	0,2349	0,2736	0,1129	0,0800	0,3265	0,2257	0,1598	0,3150	0,3050	0,1064	0,1371

Table C.35: Aggregated comparison of weights from consultant B's evaluation.

Alternatives	W ₁	W ₂	W ₃	W ₄	W ₅	W ₆	W ₇	W ₈	W ₉	W ₁₀	W ₁₁
A	0,0764	0,3277	0,0415	0,2384	0,1992	0,0487	0,0333	0,1702	0,2341	0,0337	0,0426
B	0,2769	0,3277	0,0789	0,3461	0,4227	0,1103	0,0897	0,5609	0,4522	0,0816	0,0924
C	0,1657	0,0571	0,0499	0,0775	0,0582	0,2641	0,2578	0,0425	0,0404	0,0933	0,2470
D	0,0721	0,0599	0,3707	0,0736	0,0499	0,2641	0,2840	0,0448	0,0404	0,3656	0,2687
E	0,0721	0,0599	0,3707	0,0736	0,0499	0,2641	0,2840	0,0448	0,0404	0,3656	0,2687
F	0,3368	0,1679	0,0883	0,1908	0,2201	0,0487	0,0513	0,1368	0,1924	0,0600	0,0805

Table C.36: Aggregated comparison of weights from consultant C's evaluation.

Alternatives	W ₁	W ₂	W ₃	W ₄	W ₅	W ₆	W ₇	W ₈	W ₉	W ₁₀	W ₁₁
A	0,0278	0,3285	0,0287	0,3845	0,1156	0,0531	0,0313	0,2725	0,0803	0,0709	0,0347
B	0,3871	0,2690	0,1260	0,0605	0,1224	0,0531	0,0368	0,1962	0,1041	0,0243	0,3176
C	0,0686	0,0949	0,1819	0,0625	0,3822	0,3469	0,0786	0,0409	0,0705	0,4068	0,0521
D	0,1267	0,0389	0,2212	0,0832	0,2613	0,1823	0,3089	0,0939	0,1081	0,2284	0,0493
E	0,1854	0,0389	0,2212	0,0868	0,0819	0,1823	0,2800	0,1374	0,2214	0,1355	0,1991
F	0,2044	0,2299	0,2212	0,3225	0,0367	0,1823	0,2644	0,2591	0,4155	0,1341	0,3472

Table C.37: Consistency evaluation of each pairwise comparison matrix completed by the consultants.

Matrix	Consultant A		Consultant B		Consultant C	
	λ_{\max}	CR	λ_{\max}	CR	λ_{\max}	CR
A ₁	6,2703	0,0436	6,5619	0,0906	6,6114	0,0986
A ₂	6,1301	0,0210	6,1860	0,0300	6,2989	0,0482
A ₃	6,5478	0,0883	6,3841	0,0620	6,3471	0,0560
A ₄	6,5120	0,0826	6,4252	0,0686	6,6085	0,0981
A ₅	6,5080	0,0819	6,2122	0,0342	6,5602	0,0903
A ₆	6,2264	0,0365	6,0810	0,0131	6,5500	0,0887
A ₇	6,0802	0,0129	6,5184	0,0836	6,5200	0,0839
A ₈	6,2651	0,0428	6,6189	0,0998	6,5462	0,0881
A ₉	6,1641	0,0265	6,1637	0,0264	6,4792	0,0773
A ₁₀	6,3611	0,0582	6,5459	0,0880	6,6103	0,0984
A ₁₁	6,4760	0,0768	6,1806	0,0291	6,5959	0,0961

C.2 Compatibility assessment scoring approach

In the following section, the scoring approach used during the compatibility assessment of transportation arrangements is detailed. The scoring approach consists of two facets. Firstly a weight is assigned to each consideration to illustrate its relative importance. Secondly, a relationship type is assigned to each transportation arrangement to reflect the impact the client score has. A detailed record is presented in table C.38.

Table C.38: Complete record of the scoring approach used during the compatibility assessment.

Consideration	Weight (/10)	Relationship type					
		Own fleet	Owner driver	Crowd sourced	3PL	4PL	Distributor
Industrial relations							
1.	10	α	α	=	=	=	=
2.	5	=	=	α	α	α	α
3.	10	=	=	α	α	α	α
4.	8	=	=	α	α	α	α
Human resource management							
5.	10	=	=	α	α	α	α
6.	10	=	=	α	α	α	α
7.	6	=	=	α	α	α	α
8.	6	=	=	α	α	α	α
Transaction cost economics							
9.	10	α	α	=	=	=	=
10.	4	α	α	≈	=	=	=
11.	4	α	α	≈	=	=	=
12.	5	α	α	≈	=	=	≈
13.	5	α	α	α	=	=	=
14.	10						
14.a.		=	=	α	α	α	α
14.b.		=	=	≈	α	α	≈
14.c.		=	≈	≈	α	α	≈
Resource based considerations							
15.	5	α	≈	α	=	=	=
16.	5	α	≈	α	=	=	=
17.	10	=	=	≈	≈	≈	≈
18.	10	=	=	α	=	=	=
Country economics and politics							
19.	10	α	α	=	=	=	α
20.	10	α	α	=	=	=	α
21.	10	α	α	=	=	=	α
22.	10	α	=	=	=	=	α
23.	5	α	α	=	=	=	α
Competitive advantage							
24.	5	=	=	α	=	α	=
25.	10	=	=	α	α	α	=
26.	5	=	α	α	α	α	=
Management practises							
27.	10	=	=	≈	α	α	=
28.	10	α	=	=	α	α	=
29.	10	α	α	α	=	=	α
30.	10	α	α	α	=	=	α

C.3 Scenario testing

This section outlines the results produced by the strategic and compatibility assessment during the scenario testing. For each scenario excluding the distributor scenario, the pairwise comparison matrices produced by the strategic assessment are detailed. The relative closeness of each transportation arrangement is also tabulated. Additionally, the compatibility assessment and its results are recorded. Lastly, the consistency ratio of the client pairwise comparison matrices is affirmed.

C.3.1 Own fleet scenario

Table C.39: Pairwise comparison of attributes favouring an own fleet.

(a) Pairwise comparison matrix A .

Attribute	1	2	3	4	5	6	7	8	9	10	11
1	1	0,1111	3,0000	0,2000	0,3333	0,3333	3,0000	0,3333	0,2000	1,0000	0,1111
2	9,0000	1	9,0000	3,0000	5,0000	9,0000	9,0000	5,0000	5,0000	7,0000	1,0000
3	0,3333	0,1111	1	0,1429	0,3333	0,3333	1,0000	0,2000	0,2000	0,3333	0,1111
4	5,0000	0,3333	7,0000	1	3,0000	3,0000	5,0000	3,0000	3,0000	5,0000	0,3333
5	3,0000	0,2000	3,0000	0,3333	1	3,0000	5,0000	1,0000	0,3333	3,0000	0,1111
6	3,0000	0,1111	3,0000	0,3333	0,3333	1	3,0000	0,3333	0,3333	1,0000	0,1111
7	0,3333	0,1111	1,0000	0,2000	0,2000	0,3333	1	0,2000	0,1429	1,0000	0,1111
8	3,0000	0,2000	5,0000	0,3333	1,0000	3,0000	5,0000	1	0,3333	3,0000	0,2000
9	5,0000	0,2000	5,0000	0,3333	3,0000	3,0000	7,0000	3,0000	1	3,0000	0,1111
10	1,0000	0,1429	3,0000	0,2000	0,3333	1,0000	1,0000	0,3333	0,3333	1	0,1111
11	9,0000	1,0000	9,0000	3,0000	9,0000	9,0000	9,0000	5,0000	9,0000	9	1

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Attribute	1	2	3	4	5	6	7	8	9	10	11	w
1	0,0252	0,0316	0,0612	0,0220	0,0142	0,0101	0,0612	0,0172	0,0101	0,0291	0,0336	0,0287
2	0,2269	0,2840	0,1837	0,3305	0,2125	0,2727	0,1837	0,2577	0,2516	0,2039	0,3020	0,2463
3	0,0084	0,0316	0,0204	0,0157	0,0142	0,0101	0,0204	0,0103	0,0101	0,0097	0,0336	0,0168
4	0,1261	0,0947	0,1429	0,1102	0,1275	0,0909	0,1020	0,1546	0,1509	0,1456	0,1007	0,1224
5	0,0756	0,0568	0,0612	0,0367	0,0425	0,0909	0,1020	0,0515	0,0168	0,0874	0,0336	0,0596
6	0,0756	0,0316	0,0612	0,0367	0,0142	0,0303	0,0612	0,0172	0,0168	0,0291	0,0336	0,0370
7	0,0084	0,0316	0,0204	0,0220	0,0085	0,0101	0,0204	0,0103	0,0072	0,0291	0,0336	0,0183
8	0,0756	0,0568	0,1020	0,0367	0,0425	0,0909	0,1020	0,0515	0,0168	0,0874	0,0604	0,0657
9	0,1261	0,0568	0,1020	0,0367	0,1275	0,0909	0,1429	0,1546	0,0503	0,0874	0,0336	0,0917
10	0,0252	0,0406	0,0612	0,0220	0,0142	0,0303	0,0204	0,0172	0,0168	0,0291	0,0336	0,0282
11	0,2269	0,2840	0,1837	0,3305	0,3824	0,2727	0,1837	0,2577	0,4528	0,2621	0,3020	0,2853

Table C.40: Ranking of transportation alternatives according to TOPSIS for an own fleet scenario.

Alternative	Relative closeness	Rank
Own fleet	0,6159	1
Owner driver	0,5986	2
Distributor	0,5431	3
3PL	0,3888	4
4PL	0,3247	5
Crowd sourced	0,3167	6

Table C.41: Summary of the compatibility assessment favouring an own fleet.

Consideration	Score	Weight (/10)	Normalised weight	Impact calculation											
				A		B		C		D		E		F	
				R	WS	R	WS	R	WS	R	WS	R	WS	R	WS
Industrial relations															
1.	10	10	0,3030	α 0,00	α 0,00	= 3,03	= 3,03	= 3,03	= 3,03	α 0,15	α 0,15	α 0,15	α 0,15	α 0,30	α 0,30
2.	9	5	0,1515	= 1,36	= 1,36	α 0,15	α 0,15	α 0,15	α 0,15	α 0,30	α 0,30	α 0,30	α 0,30	α 0,00	α 0,00
3.	9	10	0,3030	= 2,73	= 2,73	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00
4.	10	8	0,2424	= 2,42	= 2,42	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00
Sub total				6,52	6,52	3,48	3,48	3,48	3,48	3,48	3,48	3,48	3,48	3,48	3,48
Human resource management															
5.	1	10	0,3125	= 0,31	= 0,31	α 2,81	α 2,81	α 2,81	α 2,81	α 2,81	α 2,81	α 2,81	α 2,81	α 2,81	α 2,81
6.	3	10	0,3125	= 0,94	= 0,94	α 2,19	α 2,19	α 2,19	α 2,19	α 2,19	α 2,19	α 2,19	α 2,19	α 2,19	α 2,19
7.	8	6	0,1875	= 1,50	= 1,50	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38
8.	8	6	0,1875	= 1,50	= 1,50	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38
Sub total				4,25	4,25	5,75	5,75	5,75	5,75	5,75	5,75	5,75	5,75	5,75	5,75
Transaction cost economics															
9.		10	0,2632	α 0,19	α 0,19	= 0,00	= 1,32	= 1,32	= 0,79	α 0,63	α 0,63	\approx 0,74	= 0,42	= 0,42	= 0,42
10.	4	4	0,1053	α 0,63	α 0,63	\approx 0,74	= 0,42	= 0,42	= 0,42	α 0,84	α 0,84	\approx 0,63	= 0,21	= 0,21	= 0,21
11.	2	4	0,1053	α 0,84	α 0,84	\approx 0,63	= 0,21	= 0,21	= 0,21	α 0,99	α 0,99	\approx 0,82	= 0,33	= 0,33	\approx 0,82
12.	2,5	5	0,1316	α 0,99	α 0,99	\approx 0,82	= 0,33	= 0,33	\approx 0,82	α 1,18	α 1,18	α 1,18	= 0,13	= 0,13	= 0,13
13.	1	5	0,1316	α 1,18	α 1,18	α 1,18	= 0,13	= 0,13	= 0,13	2,11	1,75	0,88	0,53	0,53	0,88
14.		10	0,2632	2,11	1,75	0,88	0,53	0,53	0,88						
14.a.	2			=	=	α	α	α	α						
14.b.	2			=	=	\approx	α	α	\approx						
14.c.	2			=	\approx	\approx	α	α	\approx						
Sub total				5,94	5,59	4,25	2,93	2,93	3,25	5,94	5,59	4,25	2,93	2,93	3,25
Resource based considerations															
15.	5	5	0,1667	α 0,83	\approx 1,25	α 0,83	= 0,83	= 0,83	= 0,83	α 1,33	\approx 1,00	α 1,33	= 0,33	= 0,33	= 0,33
16.	2	5	0,1667	α 1,33	\approx 1,00	α 1,33	= 0,33	= 0,33	= 0,33	α 0,83	\approx 1,25	α 0,83	= 0,83	= 0,83	= 0,83
17.	8	10	0,3333	= 2,67	= 2,67	\approx 3,00	\approx 3,00	\approx 3,00	\approx 3,00	α 0,00	α 0,00	α 0,00	= 3,33	= 3,33	= 3,33
18.	10	10	0,3333	= 3,33	= 3,33	α 0,00	= 3,33	= 3,33	= 3,33	α 0,00	α 0,00	α 0,00	= 3,33	= 3,33	= 3,33
Sub total				8,17	8,25	5,17	7,50	7,50	7,50	8,17	8,25	5,17	7,50	7,50	7,50
Country economics and politics															
19.	2	10	0,2222	α 1,78	α 1,78	= 0,44	= 0,44	= 0,44	α 1,78	α 1,78	α 1,78	α 1,78	= 0,44	= 0,44	α 1,78
20.	2	10	0,2222	α 1,78	α 1,78	= 0,44	= 0,44	= 0,44	α 1,78	α 1,78	α 1,78	α 1,78	= 0,44	= 0,44	α 1,78
21.	8	10	0,2222	α 0,44	α 0,44	= 1,78	= 1,78	= 1,78	α 0,44	α 0,44	α 0,44	α 0,44	= 1,78	= 1,78	α 0,44
22.	1	10	0,2222	α 2,00	= 0,22	= 0,22	= 0,22	= 0,22	α 2,00	= 0,22	= 0,22	= 0,22	= 0,22	= 0,22	α 2,00
23.	10	5	0,1111	α 0,00	α 0,00	= 1,11	= 1,11	= 1,11	α 0,00	α 0,00	α 0,00	α 0,00	= 1,11	= 1,11	α 0,00
Sub total				6,00	4,22	4,00	4,00	4,00	6,00	6,00	4,22	4,00	4,00	4,00	6,00
Competitive advantage															
24.	8	5	0,2500	= 2,00	= 2,00	α 0,50	= 2,00	α 0,50	= 2,00	α 0,50	α 0,50	α 0,50	= 2,00	α 0,50	= 2,00
25.	10	10	0,5000	= 5,00	= 5,00	α 0,00	α 0,00	α 0,00	= 5,00	α 0,00	α 0,00	α 0,00	= 5,00	α 0,00	= 5,00
26.	10	5	0,2500	= 2,50	α 0,00	α 0,00	α 0,00	α 0,00	= 2,50	α 0,00	α 0,00	α 0,00	= 2,50	α 0,00	= 2,50
Sub total				9,50	7,00	0,50	2,00	0,50	9,50	9,50	7,00	0,50	2,00	0,50	9,50
Management practises															
27.	10	10	0,2500	= 2,50	= 2,50	\approx 2,50	α 0,00	α 0,00	= 2,50	α 0,00	α 0,00	α 0,00	= 2,50	α 0,00	= 2,50
28.	2	10	0,2500	α 2,00	= 0,50	= 0,50	α 2,00	α 2,00	= 0,50	α 2,00	α 2,00	α 2,00	= 0,50	= 0,50	α 2,00
29.	2	10	0,2500	α 2,00	α 2,00	α 2,00	= 0,50	= 0,50	α 2,00	α 2,00	α 2,00	α 2,00	= 0,50	= 0,50	α 2,00
30.	1	10	0,2500	α 2,25	α 2,25	α 2,25	= 0,25	= 0,25	α 2,25	α 2,25	α 2,25	α 2,25	= 0,25	= 0,25	α 2,25
Sub total				8,75	7,25	7,25	2,75	2,75	8,75	8,75	7,25	7,25	2,75	2,75	8,75

Table C.42: Summary of results produced by the compatibility assessment favouring an own fleet.

Consideration	Weight (/10)	Normalised weight	Weighted transportation arrangement score					
			Own fleet	Owner driver	Crowd sourced	3PL	4PL	Distributor
Industrial relations	4	0,1333	0,8687	0,8687	0,4646	0,4646	0,4646	0,4646
Human resource management	4	0,1333	0,5667	0,5667	0,7667	0,7667	0,7667	0,7667
Transaction cost economics	6	0,2000	1,1873	1,1171	0,8504	0,5868	0,5868	0,6504
Resource based considerations	4	0,1333	1,0889	1,1000	0,6889	1,0000	1,0000	1,0000
Country economics and politics	5	0,1667	1,0000	0,7037	0,6667	0,6667	0,6667	1,0000
Competitive advantage	3	0,1000	0,9500	0,7000	0,0500	0,2000	0,0500	0,9500
Management practises	4	0,1333	1,1667	0,9667	0,9667	0,3667	0,3667	0,9667
Compatibility %			68,28%	60,23%	44,54%	40,51%	39,01%	57,98%

C.3.2 Owner driver scenario

Table C.43: Pairwise comparison of attributes favouring an owner driver.

(a) Pairwise comparison matrix A .

Attribute	1	2	3	4	5	6	7	8	9	10	11
1	1	3,0000	5,0000	3,0000	1,0000	3,0000	9,0000	1,0000	3,0000	5,0000	5,0000
2	0,3333	1	3,0000	1,0000	0,3333	1,0000	5,0000	0,2000	1,0000	3,0000	3,0000
3	0,2000	0,3333	1	0,3333	0,1429	0,3333	3,0000	0,1429	0,3333	1,0000	0,3333
4	0,3333	1,0000	3,0000	1	0,3333	3,0000	9,0000	0,3333	1,0000	3,0000	3,0000
5	1,0000	3,0000	7,0000	3,0000	1	3,0000	7,0000	1,0000	3,0000	7,0000	5,0000
6	0,3333	1,0000	3,0000	0,3333	0,3333	1	5,0000	0,2000	0,3333	3,0000	1,0000
7	0,1111	0,2000	0,3333	0,1111	0,1429	0,2000	1	0,1111	0,1429	0,3333	0,3333
8	1,0000	5,0000	7,0000	3,0000	1,0000	5,0000	9,0000	1	3,0000	5,0000	5,0000
9	0,3333	1,0000	3,0000	1,0000	0,3333	3,0000	7,0000	0,3333	1	3,0000	3,0000
10	0,2000	0,3333	1,0000	0,3333	0,1429	0,3333	3,0000	0,2000	0,3333	1	0,3333
11	0,2000	0,3333	3,0000	0,3333	0,2000	1,0000	3,0000	0,2000	0,3333	3	1

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Attribute	1	2	3	4	5	6	7	8	9	10	11	w
1	0,1982	0,1852	0,1376	0,2231	0,2015	0,1438	0,1475	0,2118	0,2226	0,1456	0,1852	0,1820
2	0,0661	0,0617	0,0826	0,0744	0,0672	0,0479	0,0820	0,0424	0,0742	0,0874	0,1111	0,0724
3	0,0396	0,0206	0,0275	0,0248	0,0288	0,0160	0,0492	0,0303	0,0247	0,0291	0,0123	0,0275
4	0,0661	0,0617	0,0826	0,0744	0,0672	0,1438	0,1475	0,0706	0,0742	0,0874	0,1111	0,0897
5	0,1982	0,1852	0,1927	0,2231	0,2015	0,1438	0,1148	0,2118	0,2226	0,2039	0,1852	0,1893
6	0,0661	0,0617	0,0826	0,0248	0,0672	0,0479	0,0820	0,0424	0,0247	0,0874	0,0370	0,0567
7	0,0220	0,0123	0,0092	0,0083	0,0288	0,0096	0,0164	0,0235	0,0106	0,0097	0,0123	0,0148
8	0,1982	0,3086	0,1927	0,2231	0,2015	0,2396	0,1475	0,2118	0,2226	0,1456	0,1852	0,2070
9	0,0661	0,0617	0,0826	0,0744	0,0672	0,1438	0,1148	0,0706	0,0742	0,0874	0,1111	0,0867
10	0,0396	0,0206	0,0275	0,0248	0,0288	0,0160	0,0492	0,0424	0,0247	0,0291	0,0123	0,0286
11	0,0396	0,0206	0,0826	0,0248	0,0403	0,0479	0,0492	0,0424	0,0247	0,0874	0,0370	0,0451

Table C.44: Ranking of transportation alternatives according to TOPSIS for an owner driver scenario.

Alternative	Relative closeness	Rank
Owner driver	0,8140	1
Distributor	0,7457	2
Crowd sourced	0,3384	3
Own fleet	0,2561	4
4PL	0,2265	5
3PL	0,2212	6

APPENDIX C. DECISION SUPPORT MODEL

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Table C.45: Summary of the compatibility assessment favouring an owner driver.

Consideration	Score	Weight (/10)	Normalised weight	Impact calculation											
				A		B		C		D		E		F	
				R	WS	R	WS	R	WS	R	WS	R	WS	R	WS
Industrial relations															
1.	8	10	0,3030	α 0,61	α 0,61	= 2,42	= 2,42	= 2,42	= 2,42	= 2,42	= 2,42	= 2,42	= 2,42	= 2,42	= 2,42
2.	9	5	0,1515	= 1,36	= 1,36	α 0,15	α 0,15	α 0,15	α 0,15	α 0,15	α 0,15	α 0,15	α 0,15	α 0,15	α 0,15
3.	5	10	0,3030	= 1,52	= 1,52	α 1,52	α 1,52	α 1,52	α 1,52	α 1,52	α 1,52	α 1,52	α 1,52	α 1,52	α 1,52
4.	9	8	0,2424	= 2,18	= 2,18	α 0,24	α 0,24	α 0,24	α 0,24	α 0,24	α 0,24	α 0,24	α 0,24	α 0,24	α 0,24
Sub total				5,67	5,67	4,33	4,33	4,33	4,33	4,33	4,33	4,33	4,33	4,33	4,33
Human resource management															
5.	10	10	0,3125	= 3,13	= 3,13	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00
6.	10	10	0,3125	= 3,13	= 3,13	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00
7.	10	6	0,1875	= 1,88	= 1,88	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00
8.	8	6	0,1875	= 1,50	= 1,50	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38	α 0,38
Sub total				9,63	9,63	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38
Transaction cost economics															
9.		10	0,2632	α 0,17	α 0,17	= 0,00	= 1,32	= 1,32	= 1,32	= 1,32	= 1,32	= 1,32	= 1,32	= 1,32	= 1,32
10.	7	4	0,1053	α 0,32	α 0,32	\approx 0,89	= 0,74	= 0,74	= 0,74	= 0,74	= 0,74	= 0,74	= 0,74	= 0,74	= 0,74
11.	8	4	0,1053	α 0,21	α 0,21	\approx 0,95	= 0,84	= 0,84	= 0,84	= 0,84	= 0,84	= 0,84	= 0,84	= 0,84	= 0,84
12.	7,5	5	0,1316	α 0,33	α 0,33	\approx 1,15	= 0,99	= 0,99	= 0,99	= 0,99	= 0,99	= 0,99	= 0,99	= 0,99	= 0,99
13.	4	5	0,1316	α 0,79	α 0,79	α 0,79	= 0,53	= 0,53	= 0,53	= 0,53	= 0,53	= 0,53	= 0,53	= 0,53	= 0,53
14.		10	0,2632	1,49	1,23	1,10	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,14	1,10
14.a.	6			=	=	α	α	α	α	α	α	α	α	α	α
14.b.	3			=	=	\approx	α	α	α	α	α	α	α	α	\approx
14.c.	4			=	\approx	\approx	α	α	α	α	α	α	α	α	\approx
Sub total				3,31	3,05	4,88	5,55	5,55	5,55	5,55	5,55	5,55	5,55	5,55	5,67
Resource based considerations															
15.	8	5	0,1667	α 0,33	\approx 1,50	α 0,33	= 1,33	= 1,33	= 1,33	= 1,33	= 1,33	= 1,33	= 1,33	= 1,33	= 1,33
16.	8	5	0,1667	α 0,33	\approx 1,50	α 0,33	= 1,33	= 1,33	= 1,33	= 1,33	= 1,33	= 1,33	= 1,33	= 1,33	= 1,33
17.	2	10	0,3333	= 0,67	= 0,67	\approx 2,00	\approx 2,00	\approx 2,00	\approx 2,00	\approx 2,00	\approx 2,00	\approx 2,00	\approx 2,00	\approx 2,00	\approx 2,00
18.	1	10	0,3333	= 0,33	= 0,33	α 3,00	= 0,33	= 0,33	= 0,33	= 0,33	= 0,33	= 0,33	= 0,33	= 0,33	= 0,33
Sub total				1,67	4,00	5,67	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00
Country economics and politics															
19.	2	10	0,2222	α 1,78	α 1,78	= 0,44	= 0,44	= 0,44	= 0,44	= 0,44	= 0,44	= 0,44	= 0,44	α 1,78	α 1,78
20.	2	10	0,2222	α 1,78	α 1,78	= 0,44	= 0,44	= 0,44	= 0,44	= 0,44	= 0,44	= 0,44	= 0,44	α 1,78	α 1,78
21.	8	10	0,2222	α 0,44	α 0,44	= 1,78	= 1,78	= 1,78	= 1,78	= 1,78	= 1,78	= 1,78	= 1,78	α 0,44	α 0,44
22.	10	10	0,2222	α 0,00	= 2,22	= 2,22	= 2,22	= 2,22	= 2,22	= 2,22	= 2,22	= 2,22	= 2,22	α 0,00	α 0,00
23.	10	5	0,1111	α 0,00	α 0,00	= 1,11	= 1,11	= 1,11	= 1,11	= 1,11	= 1,11	= 1,11	= 1,11	α 0,00	α 0,00
Sub total				4,00	6,22	6,00	6,00	6,00	6,00	6,00	6,00	6,00	6,00	4,00	4,00
Competitive advantage															
24.	8	5	0,2500	= 2,00	= 2,00	α 0,50	= 2,00	α 0,50	= 2,00	α 0,50	= 2,00	α 0,50	= 2,00	= 2,00	= 2,00
25.	5	10	0,5000	= 2,50	= 2,50	α 2,50	α 2,50	α 2,50	α 2,50	α 2,50	α 2,50	α 2,50	α 2,50	α 2,50	α 2,50
26.	1	5	0,2500	= 0,25	α 2,25	α 2,25	α 2,25	α 2,25	α 2,25	α 2,25	α 2,25	α 2,25	α 2,25	= 0,25	= 0,25
Sub total				4,75	6,75	5,25	6,75	5,25	6,75	5,25	6,75	5,25	6,75	4,75	4,75
Management practises															
27.	5	10	0,2500	= 1,25	= 1,25	\approx 1,88	α 1,25	α 1,25	= 1,25	= 1,25	= 1,25	= 1,25	= 1,25	= 1,25	= 1,25
28.	8	10	0,2500	α 0,50	= 2,00	= 2,00	α 0,50	α 0,50	= 2,00	= 2,00	= 2,00	= 2,00	= 2,00	= 2,00	= 2,00
29.	8	10	0,2500	α 0,50	α 0,50	α 0,50	= 2,00	= 2,00	= 2,00	= 2,00	= 2,00	= 2,00	= 2,00	α 0,50	α 0,50
30.	2	10	0,2500	α 2,00	α 2,00	α 2,00	= 0,50	= 0,50	= 0,50	= 0,50	= 0,50	= 0,50	= 0,50	α 2,00	α 2,00
Sub total				4,25	5,75	6,38	4,25	4,25	4,25	4,25	4,25	4,25	4,25	5,75	5,75

Table C.46: Summary of results produced by the compatibility assessment favouring an owner driver.

Consideration	Weight (/10)	Normalised weight	Weighted transportation arrangement score					
			Own fleet	Owner driver	Crowd sourced	3PL	4PL	Distributor
Industrial relations	4	0,1333	0,7556	0,7556	0,5778	0,5778	0,5778	0,5778
Human resource management	4	0,1333	1,2833	1,2833	0,0500	0,0500	0,0500	0,0500
Transaction cost economics	6	0,2000	0,6617	0,6091	0,9759	1,1096	1,1096	1,1338
Resource based considerations	4	0,1333	0,2222	0,5333	0,7556	0,6667	0,6667	0,6667
Country economics and politics	5	0,1667	0,6667	1,0370	1,0000	1,0000	1,0000	0,6667
Competitive advantage	3	0,1000	0,4750	0,6750	0,5250	0,6750	0,5250	0,4750
Management practises	4	0,1333	0,5667	0,7667	0,8500	0,5667	0,5667	0,7667
Compatibility %			46,31%	56,60%	47,34%	46,46%	44,96%	43,37%

C.3.3 Crowd sourced

Table C.47: Pairwise comparison of attributes favouring a crowd sourced arrangement.

(a) Pairwise comparison matrix A .

Attribute	1	2	3	4	5	6	7	8	9	10	11
1	1	9,0000	7,0000	1,0000	3,0000	0,2000	3,0000	1,0000	1,0000	0,3333	7,0000
2	0,1111	1	0,3333	0,1111	0,1429	0,1111	0,2000	0,1111	0,1111	0,1111	0,3333
3	0,1429	3,0000	1	0,1429	0,2000	0,1111	0,2000	0,1429	0,1429	0,1111	1,0000
4	1,0000	9,0000	7,0000	1	3,0000	0,3333	3,0000	1,0000	1,0000	0,3333	7,0000
5	0,3333	7,0000	5,0000	0,3333	1	0,2000	3,0000	0,3333	0,3333	0,2000	7,0000
6	5,0000	9,0000	9,0000	3,0000	5,0000	1	7,0000	3,0000	5,0000	1,0000	9,0000
7	0,3333	5,0000	5,0000	0,3333	0,3333	0,1429	1	0,3333	0,3333	0,2000	5,0000
8	1,0000	9,0000	7,0000	1,0000	3,0000	0,3333	3,0000	1	1,0000	0,3333	7,0000
9	1,0000	9,0000	7,0000	1,0000	3,0000	0,2000	3,0000	1,0000	1	0,3333	9,0000
10	3,0000	9,0000	9,0000	3,0000	5,0000	1,0000	5,0000	3,0000	3,0000	1	9,0000
11	0,1429	3,0000	1,0000	0,1429	0,1429	0,1111	0,2000	0,1429	0,1111	0,1111	1

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Attribute	1	2	3	4	5	6	7	8	9	10	11	w
1	0,0765	0,1233	0,1200	0,0904	0,1259	0,0534	0,1049	0,0904	0,0767	0,0820	0,1123	0,0960
2	0,0085	0,0137	0,0057	0,0100	0,0060	0,0297	0,0070	0,0100	0,0085	0,0273	0,0053	0,0120
3	0,0109	0,0411	0,0171	0,0129	0,0084	0,0297	0,0070	0,0129	0,0110	0,0273	0,0160	0,0177
4	0,0765	0,1233	0,1200	0,0904	0,1259	0,0891	0,1049	0,0904	0,0767	0,0820	0,1123	0,0992
5	0,0255	0,0959	0,0857	0,0301	0,0420	0,0534	0,1049	0,0301	0,0256	0,0492	0,1123	0,0595
6	0,3827	0,1233	0,1543	0,2712	0,2099	0,2672	0,2448	0,2712	0,3837	0,2459	0,1444	0,2453
7	0,0255	0,0685	0,0857	0,0301	0,0140	0,0382	0,0350	0,0301	0,0256	0,0492	0,0802	0,0438
8	0,0765	0,1233	0,1200	0,0904	0,1259	0,0891	0,1049	0,0904	0,0767	0,0820	0,1123	0,0992
9	0,0765	0,1233	0,1200	0,0904	0,1259	0,0534	0,1049	0,0904	0,0767	0,0820	0,1444	0,0989
10	0,2296	0,1233	0,1543	0,2712	0,2099	0,2672	0,1748	0,2712	0,2302	0,2459	0,1444	0,2111
11	0,0109	0,0411	0,0171	0,0129	0,0060	0,0297	0,0070	0,0129	0,0085	0,0273	0,0160	0,0172

Table C.48: Ranking of transportation alternatives according to TOPSIS for a crowd sourced scenario.

Alternative	Relative closeness	Rank
Crowd sourced	0,5762	1
3PL	0,5214	2
4PL	0,4950	3
Distributor	0,3901	4
Owner driver	0,3551	5
Own fleet	0,0821	6

Table C.50: Summary of results produced by the compatibility assessment favouring a crowd sourced arrangement.

Consideration	Weight (/10)	Normalised weight	Weighted transportation arrangement score					
			Own fleet	Owner driver	Crowd sourced	3PL	4PL	Distributor
Industrial relations	4	0,1333	0,7556	0,7556	0,5778	0,5778	0,5778	0,5778
Human resource management	4	0,1333	0,7500	0,7500	0,5833	0,5833	0,5833	0,5833
Transaction cost economics	6	0,2000	0,5470	0,4944	1,6491	1,2105	1,2105	1,2281
Resource based considerations	4	0,1333	0,1778	0,5556	0,7111	0,7111	0,7111	0,7111
Country economics and politics	5	0,1667	1,1481	0,8519	0,5185	0,5185	0,5185	1,1481
Competitive advantage	3	0,1000	0,2750	0,4750	0,7250	0,8750	0,7250	0,2750
Management practises	4	0,1333	0,8667	1,0667	1,1000	0,2667	0,2667	1,0667
Compatibility %			45,20%	49,49%	58,65%	47,43%	45,93%	55,90%

C.3.4 3PL

Table C.51: Pairwise comparison of attributes favouring a 3PL arrangement.

(a) Pairwise comparison matrix A .

Attribute	1	2	3	4	5	6	7	8	9	10	11
1	1	0,2000	0,1111	0,3333	0,1429	0,1111	0,1111	0,1111	0,1111	0,1111	0,1429
2	5,0000	1	0,3333	3,0000	1,0000	0,2000	0,2000	0,2000	0,2000	0,1111	1,0000
3	9,0000	3,0000	1	5,0000	3,0000	1,0000	1,0000	1,0000	1,0000	0,3333	5,0000
4	3,0000	0,3333	0,2000	1	0,3333	0,1429	0,2000	0,2000	0,2000	0,1111	1,0000
5	7,0000	1,0000	0,3333	3,0000	1	0,3333	0,3333	0,3333	0,3333	0,1429	3,0000
6	9,0000	5,0000	1,0000	7,0000	3,0000	1	3,0000	3,0000	3,0000	0,2000	3,0000
7	9,0000	5,0000	1,0000	5,0000	3,0000	0,3333	1	1,0000	1,0000	0,2000	3,0000
8	9,0000	5,0000	1,0000	5,0000	3,0000	0,3333	1,0000	1	1,0000	0,3333	7,0000
9	9,0000	5,0000	1,0000	5,0000	3,0000	0,3333	1,0000	1,0000	1	0,3333	5,0000
10	9,0000	9,0000	3,0000	9,0000	7,0000	5,0000	5,0000	3,0000	3,0000	1	9,0000
11	7,0000	1,0000	0,2000	1,0000	0,3333	0,3333	0,3333	0,1429	0,2000	0,1111	1

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Attribute	1	2	3	4	5	6	7	8	9	10	11	w
1	0,0130	0,0056	0,0121	0,0075	0,0058	0,0122	0,0084	0,0101	0,0101	0,0372	0,0037	0,0114
2	0,0649	0,0281	0,0363	0,0677	0,0403	0,0219	0,0152	0,0182	0,0181	0,0372	0,0262	0,0340
3	0,1169	0,0844	0,1090	0,1128	0,1209	0,1096	0,0759	0,0910	0,0905	0,1116	0,1311	0,1049
4	0,0390	0,0094	0,0218	0,0226	0,0134	0,0157	0,0152	0,0182	0,0181	0,0372	0,0262	0,0215
5	0,0909	0,0281	0,0363	0,0677	0,0403	0,0365	0,0253	0,0303	0,0302	0,0478	0,0787	0,0466
6	0,1169	0,1407	0,1090	0,1579	0,1209	0,1096	0,2277	0,2730	0,2716	0,0670	0,0787	0,1521
7	0,1169	0,1407	0,1090	0,1128	0,1209	0,0365	0,0759	0,0910	0,0905	0,0670	0,0787	0,0945
8	0,1169	0,1407	0,1090	0,1128	0,1209	0,0365	0,0759	0,0910	0,0905	0,1116	0,1835	0,1081
9	0,1169	0,1407	0,1090	0,1128	0,1209	0,0365	0,0759	0,0910	0,0905	0,1116	0,1311	0,1034
10	0,1169	0,2533	0,3269	0,2030	0,2821	0,5482	0,3794	0,2730	0,2716	0,3348	0,2360	0,2932
11	0,0909	0,0281	0,0218	0,0226	0,0134	0,0365	0,0253	0,0130	0,0181	0,0372	0,0262	0,0303

Table C.52: Ranking of transportation alternatives according to TOPSIS for a 3PL scenario.

Alternative	Relative closeness	Rank
3PL	0,6521	1
4PL	0,6141	2
Crowd sourced	0,4361	3
Distributor	0,3595	4
Owner driver	0,3021	5
Own fleet	0,1131	6

Table C.54: Summary of results produced by the compatibility assessment favouring a 3PL.

Consideration	Weight (/10)	Normalised weight	Weighted transportation arrangement score					
			Own fleet	Owner driver	Crowd sourced	3PL	4PL	Distributor
Industrial relations	4	0,1333	0,3879	0,3879	0,9455	0,9455	0,9455	0,9455
Human resource management	4	0,1333	1,1583	1,1583	0,1750	0,1750	0,1750	0,1750
Transaction cost economics	6	0,2000	0,0733	0,0733	0,8860	1,9474	1,9474	1,4123
Resource based considerations	4	0,1333	0,0889	0,5333	0,6444	0,7333	0,7333	0,7333
Country economics and politics	5	0,1667	1,1111	0,8889	0,5556	0,5556	0,5556	1,1111
Competitive advantage	3	0,1000	0,7750	0,9750	0,2250	0,4750	0,2250	0,7750
Management practises	4	0,1333	0,2000	0,2000	0,3500	1,1333	1,1333	0,2000
Compatibility %			37,95%	42,17%	37,81%	59,65%	57,15%	53,52%

C.3.5 4PL

Table C.55: Pairwise comparison of attributes favouring a 4PL arrangement.

(a) Pairwise comparison matrix A .

Attribute	1	2	3	4	5	6	7	8	9	10	11
1	1	0,3333	0,1111	0,3333	0,1429	0,1429	0,1111	0,1429	0,1429	0,1111	1,0000
2	3,0000	1	0,1429	3,0000	0,3333	0,1429	0,1429	0,2000	0,2000	0,1429	3,0000
3	9,0000	7,0000	1	7,0000	5,0000	3,0000	3,0000	3,0000	3,0000	1,0000	9,0000
4	3,0000	0,3333	0,1429	1	0,2000	0,1429	0,1429	0,1429	0,1429	0,1111	1,0000
5	7,0000	3,0000	0,2000	5,0000	1	0,3333	0,2000	0,3333	0,3333	0,2000	5,0000
6	7,0000	7,0000	0,3333	7,0000	3,0000	1	0,3333	3,0000	3,0000	0,3333	7,0000
7	9,0000	7,0000	0,3333	7,0000	5,0000	3,0000	1	3,0000	3,0000	0,3333	9,0000
8	7,0000	5,0000	0,3333	7,0000	3,0000	0,3333	0,3333	1	1,0000	0,3333	7,0000
9	7,0000	5,0000	0,3333	7,0000	3,0000	0,3333	0,3333	1,0000	1	0,3333	7,0000
10	9,0000	7,0000	1,0000	9,0000	5,0000	3,0000	3,0000	3,0000	3,0000	1	9,0000
11	1,0000	0,3333	0,1111	1,0000	0,2000	0,1429	0,1111	0,1429	0,1429	0,1111	1

(b) Normalised pairwise comparison matrix A_{norm} with attribute weight vector w .

Attribute	1	2	3	4	5	6	7	8	9	10	11	w
1	0,0159	0,0078	0,0275	0,0061	0,0055	0,0123	0,0128	0,0095	0,0095	0,0277	0,0169	0,0138
2	0,0476	0,0233	0,0353	0,0552	0,0129	0,0123	0,0164	0,0134	0,0134	0,0356	0,0508	0,0288
3	0,1429	0,1628	0,2474	0,1288	0,1932	0,2593	0,3445	0,2005	0,2005	0,2494	0,1525	0,2074
4	0,0476	0,0078	0,0353	0,0184	0,0077	0,0123	0,0164	0,0095	0,0095	0,0277	0,0169	0,0190
5	0,1111	0,0698	0,0495	0,0920	0,0386	0,0288	0,0230	0,0223	0,0223	0,0499	0,0847	0,0538
6	0,1111	0,1628	0,0825	0,1288	0,1159	0,0864	0,0383	0,2005	0,2005	0,0831	0,1186	0,1208
7	0,1429	0,1628	0,0825	0,1288	0,1932	0,2593	0,1148	0,2005	0,2005	0,0831	0,1525	0,1565
8	0,1111	0,1163	0,0825	0,1288	0,1159	0,0288	0,0383	0,0668	0,0668	0,0831	0,1186	0,0870
9	0,1111	0,1163	0,0825	0,1288	0,1159	0,0288	0,0383	0,0668	0,0668	0,0831	0,1186	0,0870
10	0,1429	0,1628	0,2474	0,1656	0,1932	0,2593	0,3445	0,2005	0,2005	0,2494	0,1525	0,2108
11	0,0159	0,0078	0,0275	0,0184	0,0077	0,0123	0,0128	0,0095	0,0095	0,0277	0,0169	0,0151

Table C.56: Ranking of transportation alternatives according to TOPSIS for a 4PL scenario.

Alternative	Relative closeness	Rank
3PL	0,6845	1
4PL	0,6644	2
Distributor	0,4452	3
Crowd sourced	0,4450	4
Owner driver	0,3151	5
Own fleet	0,1010	6

Table C.57: Summary of the compatibility assessment favouring a 4PL.

Consideration	Score	Weight (/10)	Normalised weight	Impact calculation											
				A		B		C		D		E		F	
				R	WS	R	WS	R	WS	R	WS	R	WS	R	WS
Industrial relations															
1.	8	10	0,3030	α 0,61	α 0,61	= 2,42	= 2,42	= 2,42	= 2,42	α 0,00	α 0,00	α 0,00	α 0,00		
2.	10	5	0,1515	= 1,52	= 1,52	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00		
3.	1	10	0,3030	= 0,30	= 0,30	α 2,73	α 2,73	α 2,73	α 2,73	α 2,73	α 2,73	α 2,73	α 2,73		
4.	2	8	0,2424	= 0,48	= 0,48	α 1,94	α 1,94	α 1,94	α 1,94	α 1,94	α 1,94	α 1,94	α 1,94		
Sub total				2,91	2,91	7,09	7,09	7,09	7,09	7,09	7,09	7,09	7,09		
Human resource management															
5.	10	10	0,3125	= 3,13	= 3,13	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00		
6.	10	10	0,3125	= 3,13	= 3,13	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00		
7.	10	6	0,1875	= 1,88	= 1,88	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00		
8.	3	6	0,1875	= 0,56	= 0,56	α 1,31	α 1,31	α 1,31	α 1,31	α 1,31	α 1,31	α 1,31	α 1,31		
Sub total				8,69	8,69	1,31	1,31	1,31	1,31	1,31	1,31	1,31	1,31		
Transaction cost economics															
9.		10	0,2632	α 0,10	α 0,10	= 0,00	= 2,63	= 2,63	= 2,63	α 0,00	α 0,00	α 0,00	α 0,00		
10.	10	4	0,1053	α 0,00	α 0,00	\approx 1,05	= 1,05	= 1,05	= 1,05	α 0,00	α 0,00	α 0,00	α 0,00		
11.	10	4	0,1053	α 0,00	α 0,00	\approx 1,05	= 1,05	= 1,05	= 1,05	α 0,00	α 0,00	α 0,00	α 0,00		
12.	10	5	0,1316	α 0,00	α 0,00	\approx 1,32	= 1,32	= 1,32	= 1,32	α 0,00	α 0,00	α 0,00	α 0,00		
13.	10	5	0,1316	α 0,00	α 0,00	α 0,00	= 1,32	= 1,32	= 1,32	α 0,00	α 0,00	α 0,00	α 0,00		
14.		10	0,2632	0,26	0,26	1,01	2,37	2,37	1,01	α 0,00	α 0,00	α 0,00	α 0,00		
14.a.	10			=	=	α	α	α	α	α	α	α	α		
14.b.	7			=	=	\approx	α	α	\approx	α	α	α	α		
14.c.	10			=	\approx	\approx	α	α	\approx	α	α	α	α		
Sub total				0,37	0,37	4,43	9,74	9,74	7,06	9,74	9,74	7,06	7,06		
Resource based considerations															
15.	10	5	0,1667	α 0,00	\approx 1,67	α 0,00	= 1,67	= 1,67	= 1,67	α 0,00	α 0,00	α 0,00	α 0,00		
16.	10	5	0,1667	α 0,00	\approx 1,67	α 0,00	= 1,67	= 1,67	= 1,67	α 0,00	α 0,00	α 0,00	α 0,00		
17.	1	10	0,3333	= 0,33	= 0,33	\approx 1,83	\approx 1,83	\approx 1,83	\approx 1,83	α 0,00	α 0,00	α 0,00	α 0,00		
18.	1	10	0,3333	= 0,33	= 0,33	α 3,00	= 0,33	= 0,33	= 0,33	α 0,00	α 0,00	α 0,00	α 0,00		
Sub total				0,67	4,00	4,83	5,50	5,50	5,50	5,50	5,50	5,50	5,50		
Country economics and politics															
19.	2	10	0,2222	α 1,78	α 1,78	= 0,44	= 0,44	= 0,44	α 1,78	α 1,78	α 1,78	α 1,78	α 1,78		
20.	2	10	0,2222	α 1,78	α 1,78	= 0,44	= 0,44	= 0,44	α 1,78	α 1,78	α 1,78	α 1,78	α 1,78		
21.	4	10	0,2222	α 1,33	α 1,33	= 0,89	= 0,89	= 0,89	α 1,33	α 1,33	α 1,33	α 1,33	α 1,33		
22.	2	10	0,2222	α 1,78	= 0,44	= 0,44	= 0,44	= 0,44	α 1,78	α 1,78	α 1,78	α 1,78	α 1,78		
23.	10	5	0,1111	α 0,00	α 0,00	= 1,11	= 1,11	= 1,11	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00		
Sub total				6,67	5,33	3,33	3,33	3,33	6,67	6,67	6,67	6,67	6,67		
Competitive advantage															
24.	2	5	0,2500	= 0,50	= 0,50	α 2,00	= 0,50	α 2,00	= 0,50	α 2,00	α 2,00	α 2,00	= 0,50		
25.	10	10	0,5000	= 5,00	= 5,00	α 0,00	α 0,00	α 0,00	= 5,00	α 0,00	α 0,00	α 0,00	= 5,00		
26.	1	5	0,2500	= 0,25	α 2,25	α 2,25	α 2,25	α 2,25	= 0,25	α 2,25	α 2,25	α 2,25	= 0,25		
Sub total				5,75	7,75	4,25	2,75	4,25	5,75	4,25	4,25	5,75	5,75		
Management practises															
27.	1	10	0,2500	= 0,25	= 0,25	\approx 1,38	α 2,25	α 2,25	= 0,25	α 2,25	α 2,25	α 2,25	= 0,25		
28.	5	10	0,2500	α 1,25	= 1,25	= 1,25	α 1,25	α 1,25	= 1,25	α 1,25	α 1,25	α 1,25	= 1,25		
29.	10	10	0,2500	α 0,00	α 0,00	α 0,00	= 2,50	= 2,50	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00		
30.	10	10	0,2500	α 0,00	α 0,00	α 0,00	= 2,50	= 2,50	α 0,00	α 0,00	α 0,00	α 0,00	α 0,00		
Sub total				1,50	1,50	2,63	8,50	8,50	1,50	8,50	8,50	1,50	1,50		

Table C.58: Summary of results produced by the compatibility assessment favouring a 4PL.

Consideration	Weight (/10)	Normalised weight	Weighted transportation arrangement score					
			Own fleet	Owner driver	Crowd sourced	3PL	4PL	Distributor
Industrial relations	4	0,1333	0,3879	0,3879	0,9455	0,9455	0,9455	0,9455
Human resource management	4	0,1333	1,1583	1,1583	0,1750	0,1750	0,1750	0,1750
Transaction cost economics	6	0,2000	0,0733	0,0733	0,8860	1,9474	1,9474	1,4123
Resource based considerations	4	0,1333	0,0889	0,5333	0,6444	0,7333	0,7333	0,7333
Country economics and politics	5	0,1667	1,1111	0,8889	0,5556	0,5556	0,5556	1,1111
Competitive advantage	3	0,1000	0,5750	0,7750	0,4250	0,2750	0,4250	0,5750
Management practises	4	0,1333	0,2000	0,2000	0,3500	1,1333	1,1333	0,2000
Compatibility %			35,95%	40,17%	39,81%	57,65%	59,15%	51,52%

C.3.6 Consistency analysis

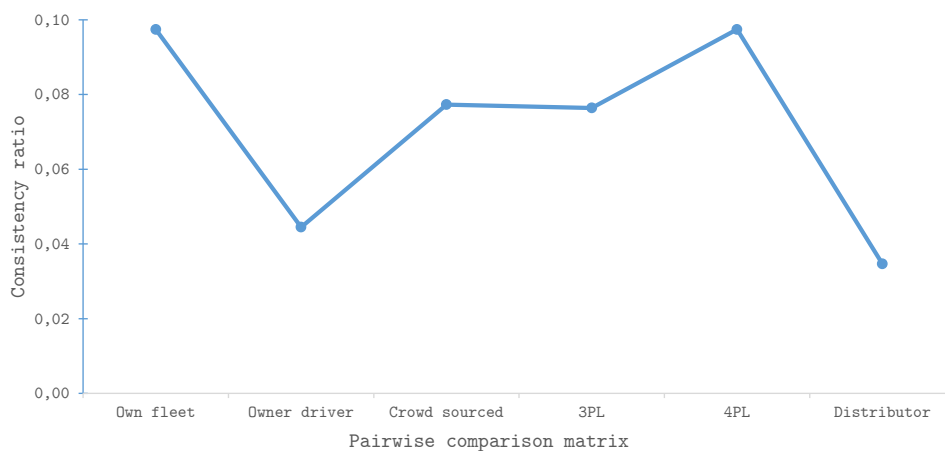


Figure C.1: An evaluation of the quality of the individual ratio assessments for each scenario.