Lead Logistics Provider Business Case, Including Charge Model Selection

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Submitter in partial fulfilment of the requirements for the degree of

BACHELORS OF INDUSTRIAL ENGINEERING

in the

FACULTY OF ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY

UNIVERISTY OF PRETORIA

October 2011

Abstract

IMPERIAL Distribution has introduced a refined service known as a Lead Logistics Provider (LLP) to realise integration, management and optimisation of logistics services. This requires the selection of an appropriate charge model to ensure sustainable results for the client and the LLP. The selection of the most appropriate charge model will result in cost savings for both the client and the LLP. The question arises as to what is the best charge model to implement with the client.

This project answers the question by performing research and case study analysis and finally, developing a solution. The project document commences with a background on the LLP and charge model concepts before detailing company strategies and their impact on supply chain requirements together with the criteria influencing the selection of an appropriate charge model.

Finally, the results of the research and case study analysis conducted are amalgamated in the development of a decision making tool utilising the Analytic Hierarchy Process (AHP) framework, providing a rational approach to selecting the appropriate charge model.

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Chapter 1

Introduction

1.1. Background of IMPERIAL Distribution

IMPERIAL Distribution is a subsidiary company of IMPERIAL Logistics, one of 84 companies operating under the umbrella of IMPERIAL Logistics. IMPERIAL Distribution's primary area of expertise is secondary distribution. This is distribution of products from warehouses to wholesalers and retailers within a supply chain. IMPERIAL Distribution first started as a transport company but has since expanded their line of expertise into areas of logistics optimisation within secondary distribution.

In order to be sustainable in an ever changing business environment, IMPERIAL Distribution has taken the initiative to innovate and maintain their competitive advantage. One way in which IMPERIAL Distribution has done this is through the introduction of a refined service known as a Lead Logistics Provider (LLP).

1.2. Introduction of a Lead Logistics Provider

A Lead Logistics Provider (LLP) is defined as "a client's primary supply chain management provider, defining processes and managing the provision and integration of logistics services through its own organisation and those of its subcontractors" [C.F.Lynch, 2005]. A LLP is one of the operating logistics service providers, within a clients supply chain and logistics network, that functions as part of the client, focusing on the supply chain as a whole and not just a part of it.

The primary roles of the LLP are to co-ordinate and optimise the clients' logistics network to increase service delivery using technology to provide real-time visibility of demand, inventory and other status requirements. This is achieved by 'selecting, monitoring and reporting on the performance of all the logistics service providers as well as maintenance of a single set

of key performance indicators (KPI”S) that provides visibility of the entire supply chain network [J.Sethi,2009].

The benefit of a LLP, for the client, is a reduction of supply chain and logistics costs through optimisation and alignment of the clients’ logistics network to its strategies, profiling and policies. A LLP adds value through synchronisation and integration of systems and processes and establishment of a standardised solution as well as risk management [J, Sethi, 2009]. From my knowledge of the concept of a LLP, an opinionated negative of a LLP is the fact that establishing a LLP requires vast expertise and knowledge and if the LLP does not possess these attributes this could potentially result in the failure of the LLP which would be detrimental, not only to the client’s supply chain and business sustainability, but also to the relations the client has with the service providers of its supply chain. This is substantiated by Sethi, J (2009) who explains that a LLP needs to have a comprehensive set of skills, a large number of trained supply chain professionals, extensive capabilities, reach and resources as well as world-class supply chain strategy formulation and business process redesign capability to be able to deliver an effective supply chain solution. Another negative of a LLP, according to employees of IMPERIAL Distribution, is that the maturity of the client, in terms of the client’s scope of operations and complexity of its supply chain, may not warrant the need of a LLP. Alternatively, if a client already has resources dedicated to performing the tasks of the LLP then employment of a LLP would result in redundancy.

1.3. Problem Statement

No two companies (Clients) will operate in the same manner. Each company will have its own unique strategies, profiling and policies which should all influence the logistical behaviour of the company. It is this logistical behaviour, as a result of consumer needs, that will in turn drive cost. This cost is incurred by the logistics service providers who will then charge the client based on a previously agreed upon charge model or compensation agreement. The risk of the charge model which is implemented is therefore carried by the lead logistics provider. The reason the risk is carried by the LLP is that once the use of a charge model is agreed upon it is the responsibility of the LLP to optimise their operation in order to maximise their profit. If the LLP's operations and management of these operations is flawed the cost of rectification is carried by the LLP and cannot be passed onto the client as the charge model agreement would restrict this. It would therefore behoove the LLP to fit a charge model that would best suit the logistical behaviour of the client

As pointed out, many factors affect the logistical behaviour of a company or client. It therefore becomes implausible to implement one charge model that will suit all clients.

1.4. Project Aim

This project serves to analyse different company strategies and investigate the link between these and the logistical behaviour of the client. Then investigate the relationship between the use of different charge models and the logistical behaviour of different clients and finally to produce a set of systematic procedures to determine the most ideal charge model or hybrid of charge models to be fitted to a client.

1.5. Project Scope

This project is primarily a research project aimed at delivering a decision making tool for the purpose of deciding upon which charge model should be implemented for a particular client of IMPERIAL Distribution. In order to achieve this, the project has been split into three phases.

1.5.1. Phase One

Phase one begins with conducting research on and analysing company strategies, customer profiling and company policy to determine the effect these attributes have on the logistical behaviour of the company. Following this research, an investigation into different charge models will be carried out. This investigation will uncover the advantages and disadvantages of different charge models as they are used in industry today. Phase one will also include the development of a company profile analysis tool which can be used to quickly analyse the company profile of one of IMPERIAL Distribution's clients. The tool will use attributes highlighted by the research conducted to perform the required analysis.

1.5.2. Phase Two

Phase two will consist of analysing different company profiles of IMPERIAL Distribution's clients using the tool developed in Phase One. Next the charge model implemented with each of the client's whose profile was analysed will be investigated. The purpose of this investigation is to determine why that particular charge model was implemented, what are the benefits that have been seen as a result of the implementation of the charge model and what are the shortfalls of the implementation of the particular charge model. This investigation will form the basis of the fitting factor analysis. This fitting factor analysis is what will be used to develop the decision making tool.

1.5.3. Phase Three

Lastly, Phase Three will consist of formulating the decision making tool. Along with the development of the tool a set of recommendations guiding the use of the tool will also be formulated.

Chapter 2

Literature Review

This chapter covers research that was conducted to gain a better understanding of the project. Firstly an analysis of company strategy was conducted. The purpose of this was to gain an understanding of the effect of strategic behaviour of a company on the logistics behaviour of the same company. The effects of the type of industry, the types of product and the practises employed by a company were all investigated to show their effect on the logistical behaviour of the supply chain. Secondly, research was conducted about different charge models used in industry today. The advantages and disadvantages of using each charge model were researched and documented both from a theoretical point of view and IMPERIAL Distributions' experiences as expressed by Mr Stewart Brophy, a director at IMPERIAL Distribution. The purpose of researching the charge models was to gain insight into the usefulness of the charge models and their typical applications.

The understanding gained from the research conducted will be used in the process of identifying factors critical to the selection of a charge model. These critical factors will be used to develop the decision structure of the Analytic Hierarchy Process.

2.1. Company Strategic Analysis

Before taking over the management of a clients supply chain, the LLP needs to asses a few critical factors of the supply chain. These critical factors include:

- the industry in which the supply chain operates,
- the type of products the client supplies,
- how the supply chain is being operated and managed,
- the performance of the supply chain in terms of the level at which the client wants the supply chain to operate and the level at which it currently operates,
- the relationships between client and the parties involved in the supply chain.

The type of industry in which the supply chain operates will give an indication of the size and complexity of the supply chain as well as factors that are most critical to that particular supply chain. For an example, a supply chain operating in the automotive industry will be of a different size and will have different levels of complexity and different factors critical to its success as opposed to one operating in the fast moving consumer goods industry.

The type of product that a client supplies is a very important factor, it will have an influence on the strategy employed and the way the supply chain should be operated. According to Fisher M, L, (1997), managers lack a framework for deciding which new ideas and technologies are best to implement in their companies. He goes on further to explain that the first step in developing an effective supply chain strategy is to consider the nature of the demand of the product being supplied. Although other factors such as product life cycle, demand predictability, product variety etc, are important, Fisher M, L, (1997) found that classification of products based on their demand patterns categorises products into one of two categories, namely primarily functional or primarily innovative. He also states “Each category requires a distinctly different kind of strategy” (Fisher M, L. 1997). Functional products, for example groceries, are those typically bought in retail outlets and are characterised by having stable, predictable demand and long life-cycles, according to Fisher M,L (1997). Fisher M, L (1997) attributes the unpredictability of demand of innovative products to their newness, short life-cycles and variety.

Functional Versus Innovative Products: Differences in Demand

Aspects of Demand	**Functional** (Predictable Demand)	**Innovative** (Unpredictable Demand)
Product life cycle	more than 2 years	3 months to 1 year
Contribution margin*	5% to 20%	20% to 60%
Product variety	low (10 to 20 variants per category)	high (often millions of variants per category)
Average margin of error in the forecast at the time production is committed	10%	40% to 100%
Average stockout rate	1% to 2%	10% to 40%
Average forced end-of-season markdown as percentage of full price	0%	10% to 25%
Lead time required for made-to-order products	6 months to 1 year	1 day to 2 weeks

* The contribution margin equals price minus variable cost divided by price and is expressed as a percentage.

Figure 1. Functional Versus Innovative Products: Differences in Demand (Fisher M,L. 1997)

“A supply chain performs two types of functions: a physical function and a market mediation function” (Fisher M,L. 1997). The physical function consists of converting raw materials to finished goods, transportation, storage, etc. The market mediation functions entails ensuring that the availability of products in the marketplaces meets the requirements of what consumers wish to purchase. Both of these functions will incur costs respectively. Fisher M,L (1997) explains that due to the predictable demand of functional products, it allows managers to focus almost entirely on minimisation of physical costs whilst the unpredictable nature of the demand of innovative products requires more focus on the costs of market mediation. This aspect begins to look into how the supply chain is being operated and managed.

Physically Efficient Versus Market-Responsive Supply Chains

	Physically Efficient Process	Market-Responsive Process
Primary purpose	supply predictable demand efficiently at the lowest possible cost	respond quickly to unpredictable demand in order to minimize stockouts, forced markdowns, and obsolete inventory
Manufacturing focus	maintain high average utilization rate	deploy excess buffer capacity
Inventory strategy	generate high turns and minimize inventory throughout the chain	deploy significant buffer stocks of parts or finished goods
Lead-time focus	shorten lead time as long as it doesn't increase cost	invest aggressively in ways to reduce lead time
Approach to choosing suppliers	select primarily for cost and quality	select primarily for speed, flexibility, and quality
Product-design strategy	maximize performance and minimize cost	use modular design in order to postpone product differentiation for as long as possible

Figure 2. Physical Efficient Versus Market-Responsive Supply Chains (Fisher M,L. 1997)

Another aspect of the clients supply chain which should be analysed is the practises implemented in the supply as compared to what would be considered best practises in the industry. One also needs to recognise that these practises drive the performance of the supply chain and so the way the supply chain is operated and how it is managed can be analysed simultaneously with the 'as-is' performance of the clients supply chain. According research conducted by McKinsey & Company et al (2008), six practises that drive supply chain performance have been uncovered. These six practises are:

1. **Supply Chain Strategic Alignment.** This involves aligning the supply chain strategy to that of the corporate strategy and ensuring all parties within the supply chain understand the supply chain strategy and its objectives.
2. **Segmentation to Embrace the Complexity that Matters.** This promotes a competitive advantage by designing multiple supply chains within a network to capitalise on the complexity.
3. **A Balanced and Forward-Looking Design.** This entails developing a top-down and forward looking vision of the overall supply chain network and ensuring that the network balances productivity, flexibility and risk.

4. **A Lean, End-to-End Value Chain.** This consists of optimising end-to-end value chains and instilling collaboration across functions as well as implementing continuous improvement.
5. **World-Class Integrated Planning.** This involves focusing planning efforts where they are need to ensure synchronous running of the organisation.
6. **The Right Talent, Accountable for Performance.** This entails acquiring the right talent in the right supply chain position a priority and once accomplished, holding the talent accountable for their contribution to the performance of the supply chain.

According to McKinsey & Company et al (2008), no one company has managed to excel in all six of the practises but it was found that 10% of the companies analysed during the course of the research did combine the six practises to achieve both a service and cost advantage. By analysing the clients supply chain with respect to these six practises strengths and weaknesses of the supply chain can be uncovered.

According to Lee H,L (2004), high speed and low cost are not the only aspect of supply chain performance that are important. Three other factors are also significant, namely agility, adaptability and alignment. He goes on to explain that agility is the ability of a supply chain to respond to short-term changes in demand, or supply, quickly, adaptability is the ability of a company to adjust it supply chain design to accommodate changes in the market and alignment is the establishment of incentives for all parties of the supply chain to improve the performance of the supply chain as a whole. These three attributes of a supply chain can also be used to establish strengths and weaknesses in the operation, management and the performance of the clients supply chain.

The last aspect of the clients supply chain that needs to be analysed is the type of relations that exist between the client and the partners of their supply chain. As the LLP will operate in the supply chain as a manager of the entire supply chain these relations need to be approached delicately so as to not disturb any relations of trust that may exist.

2.2. Charge Models

Charge models are theoretical models which are used as a basis for the calculation of the cost of providing a service to a client. Different charge models have been developed for different uses within industry. Some of these charge models are introduced below.

2.2.1. Open Book

An open book charge model is a model in which any costs incurred in the supply of a product or service are openly presented to the client to whom the product or service is delivered. These incurred costs are then charged to the client plus a previously negotiated profit margin.

The implementation of this charge model allows the opportunity for the creation of a long term strategic alliance between the supplier and client. The transparency of cost can help a client understand the origins of cost and thus reveal areas in which cost can be reduced.

A relationship of trust is key factor for the successful implementation of such a charge model, which is not always easy to establish. Unfortunately, without this relationship of trust between the client and supplier this charge model could result in conflict. One problem faced by IMPERIAL Distribution with one of their clients was a belief, of the client, that due to the passing on of cost in this charge model no effort was being made by IMPERIAL Distribution to reduce costs. This sort of problem will directly impact the relationship of trust that is so critical to the successful implementation of this charge model. Another problem with this charge model is that due to that fact that all costs must be transparent the process of formulating the cost break downs can be administratively intensive especially when a client demands that a particular format be used.

With unpredictable fluctuations and many customers, it is the preferred costing model to use. It is also the preferred model to use when the business scope is complex or unique (Lee, SH. 2009). At IMPERIAL Distribution this charge model is typically implemented with new clients who are unsure of the costs associated with logistics as it enables the client to understand the origins of cost.

2.2.2. Fixed and Variable

This charge model makes use of a fixed charge as well as a variable cost driver as defined by Mr Stewart Brophy, of IMPERIAL Distribution. For example, a fixed cost which includes insurance and the running of a fleet of vehicles and a charge per kilometre travelled as a variable cost driver which covers maintenance, tyres and fuel for the vehicle used.

From the clients' point of view, this charge model is beneficial because it eases the process of budgeting as the fixed cost remains unchanged or is increased gradually according to a predetermined growth rate and the variable cost can be budgeted against expected activity. This charge model also proves beneficial to the service provider as the fixed cost of running the fleet of vehicles is paid regardless of the usage of the vehicle. This reduces the risk of running the fleet of vehicles for the service provider. Through a collaborative relationship between the client and service provider improvements made to the operation of the fleet of vehicles can result in cost savings for both the client and the service provider. Tracking of the utilisation of the vehicles will help in determining the right number of vehicles needed by the client at the right time. This will reduce the accumulation of unnecessary fixed cost for the client and will also allow the service provider to relocate vehicles which are not being utilised by a client. Optimisation of delivery routes, milk runs and planning of deliveries to be made can result in savings of variable costs which is beneficial to the client. This according to Mr Stewart Brophy.

A relationship of trust, to a degree, needs to exist between the service provider and the client. From IMPERIAL Distributions' experience, according to Mr Stewart Brophy, if this trust does not exist, questions of the formulation of the costs may be questioned by the client. This could, like the open book charge model, result in conflict. If the operation of the vehicles is not managed properly cost could escalate for both the client and the service provider. Not tracking the utilisation of vehicles can result in too many vehicles being allocated to a client by the service provider, raising the fixed cost charged to the client. Using the wrong routes or longer routes than necessary will drive up the variable cost for both the client and the service provider. Incorrect planning of deliveries to be made can result in long waiting periods at delivery sites which results in wasteful utilisation of the vehicle.

Typically this charge model is applied as per request of the client or when there is uncertainty regarding the needs of a new client.

2.2.3. Rate per Drop

Rate per drop is a model in which all costs are distributed among the expected number of drops to be made according to Mr Stewart Brohpy. Time becomes a critical cost driver in this model. IMPERIAL Distribution developed this model further before implementing the model with their clients. They introduced radial zoning of the drop sites. This means that radius limits were set creating zones emitting from the point of distribution. Rates were calculated for each zone using a formula that accounted for the units to be delivered and the distance from the distribution point.

This charge model is beneficial to the client as a cost per delivery can easily be calculated. If a good collaborative relationship exists between the client and the service provider and the operation is managed effectively costs for both the client and the service provider can be reduced, according to Mr Stewart Brophy

To compute a rate per drop, a number of different cost variables need to be taken into account. This makes the calculation of a rate per drop difficult. Co-ordination and planning of deliveries to be made is important to reduce costs for both the client and the service provider. For example, if one vehicle has to deliver 80% of its load in zone one and 20% of the load in zone four then costs can be increased for both the client and the service provider. The cost of delivery per unit for the goods delivered to zone four increases for the client because the rate for the drop is only distributed among a 20% load. If any delay forces the driver of the vehicle to work overtime to deliver the goods to zone four then the cost of the overtime falls on the service provider with no additional revenue earned.

This model is mostly used in the fast moving consumer goods industry in which products are consumed by customers at regular intervals. Therefore product availability at the right time and the right place is critical for the occurrence of sales.

2.2.4. Unit Rate

The unit rate charge model is formulated on a fixed rate per unit of merchandise transported and so all costs including driver wages, maintenance on the vehicle and fuel are included in the unit rate, as defined by Mr Stewart Brophy. IMPERIAL Distribution employed the same radial zoning for the unit rate model that was used for the rate per drop model.

Again if a good collaborative relationship exists between the client and the service provider this charge model can result in cost savings for both the client and the service provider. Good onsite management of the fleet of vehicles and of the co-ordination and planning of deliveries can also reduce cost for both the client and service provider. If a good relationship exists between the client and the service provider and the operation is managed effectively, this model can be the most profitable for the service provider.

Mr Stewart Brophy explains that this charge model carries the most risk for the service provider especially if a good relationship between the client and service provider does not exist or when the operation is not managed effectively. Using the example of the 80% and 20% delivery illustrated in the rate per drop model, the service provider will make money on the delivery in zone one but can possibly lose money when making the delivery to zone four. This is because the revenue earned to make the delivery to zone four is only on a 20% truck load and it may cost more to make the delivery than the revenue that will be earned. Thus, co-ordination and planning of deliveries is critical to the success of the model. Fluctuation of capacity requirements may also be problematic for both the service provider and the client and if it is not managed properly could unnecessarily increase cost for both parties as explained by Mr Stewart Brophy.

This model is typically used when demand is predictable and when there is growth in the volume of unit to be transported.

2.2.5. Gain Sharing

Gain sharing is a concept that was first seen in the 1930's (Masternak, RL. 2009). Primarily it has been a way of sharing savings with the employees of the company. The savings for the company that result from increased performance of the employees is shared with the employees. One common misconception about gain sharing is that it is a kind of incentive tool, the carrot in front of the donkey if you will. This is most definitely not the purpose of gain sharing. Gain sharing would typically be implemented to drive performance of an organisation by promoting awareness, alignment, teamwork, communication and involvement (Masternak, RL. 2009). Gain sharing helps drive improvement initiative, cultural and organisational change and heightens the level of employee awareness and also helps develop the feeling of self worth, building a sense of ownership and identity to the organisation.

Gain sharing does not just look at the bottom line figure as profit sharing schemes do, it looks at more directed "line-of-sight" measures and rewards based on increased performance of these measures. Instead of just using one measure, gain sharing models can be developed using a combination of different targeted performance measures. By using different performance measure that employees have the ability to improve, the mere fact of an improvement could instil pride and a sense of workmanship for the employees. By implementing of a gain sharing plan, the organisation can increase its productivity and in turn give itself a better quality employee according to Masternak, RL (2009). Examples of operational measures used within a gain sharing scheme are, according to Masternak, RL (2009), productivity, equipment efficiency, scrap, rework etc.

As opposed to a profit sharing approach in which plan implementation involves minimal employee involvement, gain sharing involves employees from all sectors of the organisation in the design and implementation process. Gain sharing promotes the communication, sharing of ideas, teamwork and collaboration.

2.3. Service Level Agreement (SLA)

A Service Level Agreement is a contract between parties that defines the services provided, the indicators associated with these services, acceptable and unacceptable service levels, liabilities on the part of the service provider and the customer, and actions to be taken in specific circumstances [EuorITX,2004]. The SLA is a good way to manage a service provider and customer relation as both parties become involved in the formulation of the agreement. The agreement stipulates all aspects of the functions and responsibilities of both the service provider and the customer. Every service which is expected of either party is fully defined and documented to avoid any confusion of duties of either party. Service levels are previously agreed upon by the parties. Compensations and repercussions for acceptable and unacceptable service levels, respectively, are to be clearly defined within the agreement.

Other aspects which are also included within the agreement are matters of performance tracking and reporting, problem management, warranties and remedies, security, intellectual property rights and confidential information, legal compliance and resolution of disputes, and termination clauses. The major benefit of a SLA is that it is fully customisable and handles every foreseeable aspect of the customer and service provider relation. Once an agreement has been reached both parties sign the agreement and become legally bound to it. This offers protection against short falls to both parties.

2.4. Methods, Tools and Techniques

This section covers the selection of appropriate methods, tools and techniques to be used in creating the solution of the problem at hand. Also included in the section is the development of the company profile analysis tool to be used in the project.

A vast number of methods, tools and techniques can be employed when developing solutions. It is therefore critical that the most appropriate are selected. For the purpose of this project, the methods and tools considered were sensitivity analysis, trade-off analysis and the analytic hierarchy process (AHP).

Sensitivity analysis is a tool often used within decision making to identify the relationship that exists between variables. Taylor, M (2009) explains that a one-way sensitivity analysis can be used to determine the effect one variable has on a model. Multiple one-way sensitivity analyses may be performed on different parameters which can then be represented on a tornado diagram which will indicate the most sensitive parameter. Alternatively, Taylor, M (2009) explains that a multi-way sensitivity analysis can be performed when the effect of varying multiple parameters simultaneously is necessary. One of the benefits of sensitivity analysis is that the understanding of the relationship of variables can make for better decision making. The problem with sensitivity analysis is that too often it is too simplistic and cannot include multilevel decision making. In the case where multi-way sensitivity is used, Taylor, M (2009) explains that presentation and interpretation of multi-way sensitivity analysis become more difficult as the number of parameters varied increases. Typically sensitivity analysis is applied in the process of risk assessment or decision making. Within this project, sensitivity analysis could be used to analyse the relationship between logistical behaviour and different charge models to provide insight into which charge models are most sensitive to particular logistical behaviour. As seen from research conducted within the literature review, the logistical behaviour of a company is affected by many factors. It would therefore, become difficult to model all the necessary parameters even if a multi-way sensitivity analysis is performed. Furthermore, the charge models investigated show that the model is in most cases only affected by the level of activity for example, the variable charge models such as rate per drop or unit rate are directly affected by the variable cost driver and an open book charge model is directly influenced by the cost of service provision. Thus, it was decided that sensitivity analysis will not be used as the information gained from the analysis will only re-iterate what has already been uncovered and will not lead to the discovery of new information or insight.

Trade-off analysis is a quantitative decision making tool. In the event that all data can be quantified this tool can be used to make an objective decision involving multiple criteria and alternatives. This is the primary advantage of using this particular tool. Unfortunately, trade-off analysis relies on quantifiable inputs and so any aspects of qualitative criteria need to be quantified before a trade-off analysis can be used. This is not always possible to achieve. Typically, trade-off analysis is used to make multi criteria and multi alternative decisions based on quantitative data inputs. As this project contains decision making on both quantitative and qualitative criteria, this tool was not selected.

The analytic hierarchy process is a multi criteria and multi alternative decision making tool. The key benefit of the AHP is that it can handle both quantitative and qualitative inputs. Although advantageous, the qualitative inputs to the decision making process are subjective and this may lead to distortion of the final decision by the person performing the analysis. This tool was selected for use in the project due to its ability to handle both quantitative and qualitative inputs. As the decision process of choosing a charge model involves multiple criteria and alternatives, the AHP allows the alternatives to be evaluated against each other in terms of each criteria and the criteria to be evaluated against each other.

2.4.1. Analytic Hierarchy Process

One of the decision making tools to be used in this project is the Analytic Hierarchy Process (AHP). According to Saaty, TL (2008), to be able to make a decision we must know the problem, the need and purpose of the decision, the criteria and sub-criteria of the decision, the stakeholders affected and alternative actions that can be taken. Once these factors are known priorities for the alternatives are allocated to be able to make a decision on the best alternative. Saaty, TL (2008) explains that not only do priorities have to be set for the alternatives in terms of the criteria by which they will be evaluated, but also for criteria in terms of a higher goal or the alternatives themselves.

Saaty, TL (2008) defines the decision decomposition process in order to generate priorities for the Analytic hierarchy Process in the following steps:

1. Define the problem and determine the kind of knowledge sought.
2. Structure the decision hierarchy from the top with the goal of the decision, then the objectives from a broad perspective, through the intermediate levels (criteria on which subsequent elements depend) to the lowest level (which usually is a set of the alternatives).
3. Construct a set of pair-wise comparison matrices. Each element in an upper level is used to compare the elements in the level immediately below with respect to it.
4. Use the priorities obtained from the comparisons to weigh the priorities in the level immediately below. Do this for every element. Then for each element in the level below add its weight values and obtain its overall or global priority. Continue this process of weighing values and adding until the final priorities of the alternatives in the bottom most level are obtained.

Saaty, TL (2008) explains that in order to perform the comparisons, a comparative scale of numbers is required to indicate relative importance or dominance of one element over another with respect to the criterion or property by which they are being compared. The scale to be used is shown in table one.

Table 1. The Fundamental Scale of Absolute Numbers (Saaty, TL. 2008)

Intensity of Importance	*Definition*	*Explanation*
1	Equal Importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgement slightly favour one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgement strongly favour one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favoured very strongly over another; its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favouring one activity over another is of the highest possible order of affirmation
Reciprocals of above	If activity *i* has one of the above non-zero numbers assigned to it when compared with activity *j*, then *j* has the reciprocal value when compared with *i*	A reasonable assumption
1.1–1.9	If the activities are very close	May be difficult to assign the best value but when compared with other contrasting activities the size of the small numbers would not be too noticeable, yet they can still indicate the relative importance of the activities.

2.4.2. Company Profile Analysis Tool

The next part of the project involves analysing different client company profiles and the particular charge model which was implemented. In order to make the analysis process faster and allow easy comparison of different company profiles, Table 2 was developed. The table offers insight into particular factors of a company profile which would influence the charge model selection. These factors are discussed further below.

Industry refers to the industry in which the supply chain operates. This gives an indication of the type of supply chain being operated and the scale of operations. The scale of operations refers to the size of the supply chain, the levels of complexity and the integration of the logistics network as well as the systems that should be in place. These factors will influence the logistical behaviour of the company and so will have an effect on the decision of charge model selection.

The product or service offering gives information about the products and the demand for the products. Predictability will indicate the accuracy with which the demand for the product may be forecast. High predictability will favour the selection of a unit rate charge model while low predictability might favour an open book or fixed and variable charge model. Variability relates to the variation of the demand for a product over time. Low variability means the demand is almost constant over time hence selection of a unit rate charge model while high variability indicates a strong likelihood of fluctuations in demand, in which case an open book or fixed and variable charge model would be most suitable. The type of product in terms of being functional or innovative will also give insight into the operation of the supply chain. This will sway the selection of a charge model to a unit rate if the product is functional and more toward an open book or fixed and variable in the case were the product is innovative.

The type of customer tells us about the volume and number of deliveries likely to be made. The footprint gives the channels of distribution of the product as well as the nature of those channels of distribution. This has an influence of the volumes of the deliveries and the frequency of deliveries. This in turn drives the logistical behaviour of the company. It also indicates the nature of the deliveries in term of whether one truck load will be delivered to one point or to multiple points. This will affect the charge model selection in terms of whether to use a rate per drop or a unit rate or a fixed and variable charge model.

The current offering gives the current function being performed by IMPERIAL Distribution for the client. This indicates the likely functions the LLP will co-ordinate through its own organisation which forms the basis of earning revenue and range from demand planning, inbound logistics management, outbound logistics management to network optimisation and invoicing.

The supply chain focus gives the objectives of the client. This influences charge model selection because the charge model selected because the charge model implemented will drive logistical behaviour. This drive needs to support the objectives of the client and aid the client in achieving their objectives.

Operational initiatives indicate where pooling of resources or multi-principle warehousing can be implemented. This affects the charge model selection because when sharing resources between clients, IMPERIAL Distribution needs to be able to allocate cost to each client and so a fixed and variable charge model would be favoured.

Annual throughput gives the volume in delivery units used by the client. This indicates the total volume and thus the size of the operation. In terms of charge model selection this will influence the decision by indicating the expected annual revenue to be earned. The turnover given in units also indicates the volume of units to be transported which will indicate the charge model that will generate the most revenue for the service provider.

Complexity gives some of the complexities involved in the operation. It also indicates expected changes in growth. This is important in the charge model selection process as the requirement of visibility of cost or the visibility of activity will affect the selection of a charge model. The accommodation of growth also affects the selection of a charge model.

Systems and people gives the maturity of the client based on a one to five level of maturity as indicated in Figure 3. The maturity of the client indicates the expected efficiency of the clients supply chain. This is important to identify firstly to indicate whether or not the implementation of the LLP concept is warranted and secondly, if the client understands the origins of logistics cost. An immature client will, most likely, lead to the selection of an open book charge model where as a mature client may have a unit rate or fixed and variable charge model implemented.

Figure 3. Levels of Maturity (Berg, P et al. 2002)

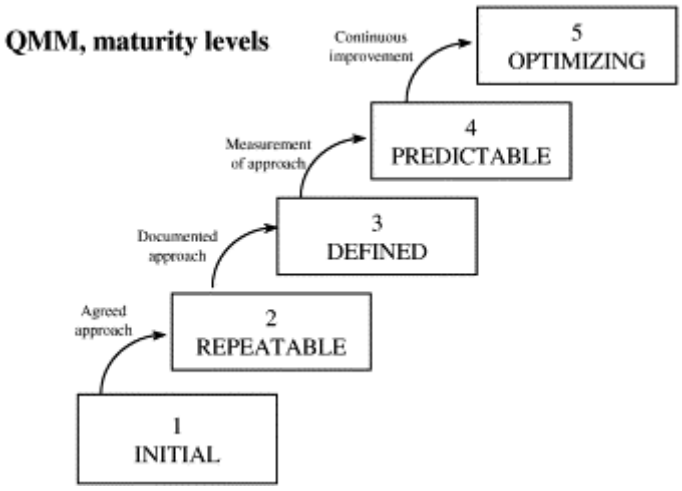

Table 2. Company Profile Analysis Tool

COMPANY	CLIENT A	CLIENT B
Industry:		
Product / Service Offering (including Predictability, variability, functional or innovative):		
Type of customers (including footprint, route to market):		
Current offering (Warehousing / Distribution):		
Supply chain focus areas/issues (growth):		
Operational initiatives (pooling, multi-principle):		
Annual Throughput (Delivery Units):		
Complexity (Range of services):		
Systems and People (effeciency, how paperless can you go, maturity):		

Chapter 3

Case Analysis

This chapter entails performing case analysis of four clients of IMPERIAL Distribution. Firstly, the company profile of the client will be analysed, using the company profile analysis tool developed earlier, in order to gain an understanding of the logistical behaviour of the client. Secondly, the charge model implemented by IMPERIAL Distribution, with the client, will be investigated. The charge model implementation analysis will give insight into why the charge model was implemented, what benefits have been seen from the implementation of the charge model, what shortfalls have been encountered due to the implementation of the charge model and what assumptions, if any, were made when selecting the charge model.

The purpose of this chapter is to form the 'Fitting Factor Analysis' (FFA) of the project. This FFA becomes the basis of understanding for the charge model selection process currently being used by IMPERIAL Distribution. The aim of the FFA is to identify critical factors of a companies' profile and logistical behaviour that most strongly influence the selection of a charge model. These factors identified will form the inputs to the Analytic Hierarchy Process to be used in the solution development.

3.1. Company Profile Analysis

Table 3. Populated Company Profile Analysis Tool

COMPANY	CLIENT A	CLIENT B	CLIENT C	CLIENT D
Industry:	**FMCG - Beverages**	**Packaging**	**FMCG - Food**	**FMCG - Personal care**
Product / Service Offering (including Predictability, variability, functional or innovative):	380 SKUs Predictability: Poor Variability: High Functional: 90% Innovative: 10%	150 SKUs, but 10% of SKUs = 90% of volume Predictability: High Variability: Low Functional: 100%	450 SKUs Predictability: Average Variability: Medium Functional: 70% Innovative: 30%	230 SKUs Predictability: High Variability: Medium Functional: 100% Innovative: 0%
Type of customers (including footprint, route to market):	National Footprint, ± 9000 delivery points, averaging 1 delivery per week Restaurants (on-consumption), retail (off-consumption) and wholesale	SA National & accross border. Only 16 customers. Delivery ranges from daily to once per week.	Gauteng & surrounding areas. 1800 delivery points. Retail & wholesale.	Metro areas. 5500 delivery points. Retail & wholesale. Averaging 1.5 deliveries per week.
Current offering (Warehousing / Distribution):	Primary Distribution Warehousing Secondary Distribution Mix between ID dedicated (metro areas) and sub-contractors (outlying). Client currently manage all sub-contractors	Warehouse Secondary Distribution Both dedicated	Secondary Distribution	Warehouse Secondary Distribution Some warehouse facilities are shared with other clients
Supply chain focus areas/issues (growth):	Focus to reduce logistics cost (for all 3 functions). Primary distribution: changed packaging to increase pallet capacity Warehousing: focus on productivity of workers, with assistance of WMS Secondary: Considering MOV (minimum order value), Saturday deliveries & weekly delivery smoothing (NDD). Expect that the supply chain capacity will double in the next 5 years	Improve on-time delivery to customers Improve stock management	Inflationary growth Focus to smooth eratic vehicle demand during week	Inflationary growth Focus on customer service
Operational initiatives (pooling, multi-principle):	Pooling is a new concept. This is the sharing of vehicles between different contracts/clients, or even i.e. using secondary vehicles for Client A and use that fleet to do primary distribution at night for client A.	None	Multi-principal environment. I.e. share the same vehicles between two different clients.	Re-defining service to be provided to client's customers (in terms of delivery frequency, minimum order quantity & NDD)
Annual Throughput (Delivery Units):	Throughput: network of 45 million cases (delivery unit)	Througput: 45,000 pallets	Throughput: 50,000 tonnes	Throughput: 11.6 million cases
Complexity (Range of services):	Biggest challenge is to balance logistics cost with customer service. Client has aggressive growth projections (in both throughput & number of customers, i.e. footprint).	Stable environment	Secondary distribution only. We are basically a sub-contractor...	Warehouse & secondary efficiency to reduce cost, but maintain or improve customer service
Systems and People (effeciency, how paperless can you go, maturity):	Maturity: 3 out of 5. Implemented WMS (warehouse management system) and TMS (transport management system).	Maturity: 2 out of 5. No systems. Everything run on paper & spreadsheets.	Maturity: 3 out of 5. WMS & TMS	Maturity: 4 out of 5. WMS (client's in-house) & TMS

3.1.1. Client A

Client A operates in the fast moving consumer goods (FMCG) industry distributing 380 stock keeping units (SKU's) or products, namely beverages. Client A's products are primarily functional. As identified in the literature study, functional products are typically characterised by predictable demand. In the case of Client A, the high variability of the demand makes the predictability of demand low. This means that Client A will employ unique logistical behaviour.

The distribution channels of Client A's supply chain follow a national footprint with approximately 9000 delivery points of which on deliver is made to each point per week, on average. Due to the variability of the demand, the deliveries will vary in number and in the volume per delivery.

IMPERIAL Distribution currently provides primary distribution, warehousing and secondary distribution services to Client A. Primary distribution is the distribution of products to distribution centres and to large wholesalers. Secondary distribution is the distribution of products from the distribution centres to the retailers, restaurants and wholesalers. In terms of transportation the unit sizes of the primary and secondary distribution will differ as will the size of deliveries and the number of deliveries.

Client A is focused on reducing logistics cost which means that visibility of cost is necessary to be able to identify where significant cost may be reduced. Client A also expects the supply chain capacity to double within the next five years. This means that the charge model implemented will need to be able to accommodate the growth.

Pooling of resources has been introduced to Client A's supply chain and so visibility of cost is again important for IMPERIAL Distribution to be able to allocate cost to Client A accurately.

The throughput of Client A's supply chain is 45 million delivery units per annum which indicates a high volume of products to be delivered.

The complexities with Client A's supply chain are firstly, the need to balance logistics cost with customer service. This requires the visibility of cost to be able to calculate the logistics cost accurately and to be able to balance cost with customer service. Secondly, the aggressive growth strategy employed by Client A in terms of the throughput of the supply chain and the footprint means that the charge model applied should be able to accommodate the growth of the supply chain. This increase in the number of unit will cause the client to want to renegotiate the rates applied.

Client A has a maturity level of 3 which means that system and procedures are defined. The client has implemented warehouse management systems and transport management systems which indicates that the supply chain should operate efficiently if the systems in place are adequate.

3.1.2. Client B

Client B operates in the packaging industry distributing 150 SKU's. It has been identified that 10% of these SKU's are responsible for 90% of the throughput of the supply chain. All of Client B's products are categorised as functional with the characteristically high predictability of demand and low variation of demand.

Client B distributes its products both around South Africa and outside of South Africa. Client B only has 16 customers to which it delivers. Deliveries vary from daily to weekly. This indicates that the size and number of deliveries to its customers.

IMPERIAL Distribution currently provides warehousing and secondary distribution to the Client B. IMPERIAL Distribution has dedicated resources to Client B thus assignment of cost to the client is not a problem.

Client B is focused on improving on time delivery and stock management. This indicates that visibility of activity is necessary to be able to identify possible areas of improvement.

The throughput of Client B's supply chain is 45 000 pallets per annum. This is relatively low volume throughput.

The supply chain operates in a stable environment with no complexities or drastic growth predicted.

Client B has a maturity level of 2 which means that an approach to running the supply chain is a agreed upon and is repeated. No formal systems are in place and data is recorded on paper or in spreadsheets. It is expected that the clients supply chain will not be efficient and possibility of errors occurring is likely.

3.1.3. Client C

Client C operates in the FMCG market distributing 450 varieties on food products. The products Client C distributes are primarily functional but 30% are innovative. The predictability of demand is average and variability of demand is medium.

Client C distributes its products to 1800 different retailers and wholesalers around Gauteng province and to surrounding areas. This indicates that deliveries will vary in both size and frequency.

IMPERIAL Distribution currently offers only secondary distribution to the client.

The focus of Client C's supply chain is to maintain inflationary growth and to smooth the erratic demand for vehicles during the week. This will in turn increase the predictability of resource requirements.

IMPERIAL Distribution has implemented a multi-principle environment with the client. This is the sharing of vehicles between Client C and one other client. Therefore, the assignment of cost to the client is necessary but as the only service offered is secondary distribution, the assignment of cost can be based on activity.

The throughput of the clients supply chain is 50 000 tonnes per annum which indicates relative low volume.

As IMPERIAL Distribution is a sub-contractor of Client C, the complexity of the operation is minimal.

Client C has a maturity level of 3. The client has implemented warehouse management systems as well as transport management systems. The supply chain is therefore most likely to be efficient.

3.1.4. Client D

Client D operates in the FMCG industry distributing 230 personal care products to 5500 retailers and wholesalers in urban areas. On average, 1.5 deliveries are made per week. The predictability of Client D's demand is high with medium variation in demand. All of the clients' products are categorised as functional.

IMPERIAL Distribution currently offers warehousing and secondary distribution services to the client. Some of the warehouse facilities are shared with other client and so visibility of cost is necessary to be able to accurately assign cost to the client.

The focus of the supply chain is maintain inflationary growth and to improve customer service. This improvement of customer service will need to be balanced with the cost of logistics which will require visibility of cost. Client D has undertaken to re-define the services it offers to its customers. The client aims to increase delivery frequency and implement a minimum order quantity.

The throughput of the supply chain is 11.6 million cases per annum which indicates high volume.

The complexities involved in the operation are increasing warehouse and secondary distribution to reduce cost and to maintain or improve customer service. This requires visibility of cost.

Client D has a maturity level of 4 which means that key performance indicator (KPI's) are recorded and maintained. This in turn will ensure efficiency of the supply chain.

3.2. Charge Model Implementation Analysis

3.2.1. Client A

The charge model IMPERIAL Distribution implemented with Client A was an open book charge model. The primary reason why this charge model was implemented was because the client was a new client and there was uncertainty regarding the supply chain costs. This charge model provides full visibility of all costs associated with the provision of services. Another reason this model fits the client is that with unpredictable demand and high variation in the demand the open book charge model is the preferred model to use.

A number of benefits have been seen from the implementation if this charge model. Firstly the full visibility of cost reduced the risk of the uncertainty of the supply chain costs. Secondly, the visibility of cost shows the actual cost of logistics and so areas of improvement or cost reduction opportunities could be identified. Another key benefit of the open book charge model is that the profit margin applied does not have to be fixed. In the case of its implementation with Client A the profit margin was based on IMPERIAL Distributions' performance on specific key performance indicators. This drives the service provider to improve performance.

The major shortfall of the implementation of this charge model is that fact that the cost of providing the service is passed directly to the client plus a previously agreed upon profit margin. This in some instances leads the service provider to assign a lower priority to cost reduction. In an environment where the client wishes to reduce logistics cost, this behaviour is not conducive to maintaining the relationship of trust that exists between the client and the service provider.

3.2.2. Client B

A unit rate charge model was implemented with Client B as per the request of the client. Due to the dedicated resources and the stable environment the dedicated fixed cost associated with providing services was not a concern.

Due to the high predictability of demand and low variation of the demand the client can easily predict the cost of the services provided and IMPERIAL Distribution can predict the expected earned revenue with relative accuracy. As the unit rate is fixed, any operational

savings translate to an increase in profit for IMPERIAL Distribution. This drives the behaviour of IMPERIAL Distribution to reduce the cost of operations and to collaborate with the client to increase the efficiency of the operation.

Although the variation of demand, for Client B's product, the possibility of high fluctuations in demand, either up or down, still remains. This is problematic for both the client and IMPERIAL Distribution. High upward fluctuations in demand increases the cost of logistics for the client for which they may not have budgeted. Downward fluctuations in demand decreases the revenue earned by IMPERIAL Distribution which may result in a loss as the fixed cost of providing a service still remains.

3.2.3. Client C

As with Client B, a unit rate was implemented with Client C as per the request of the Client. Although the average predictability and medium variability of demand increases the risk of providing the service for IMPERIAL Distribution, the charge model was implemented to satisfy the client.

If the forecasting of demand is accurate the cost of distribution can easily be derived. This is beneficial to both the client and IMPERIAL Distribution. Again, any operational savings translate to an increase in profit for IMPERIAL Distribution.

The average predictability and medium variability of demand makes demand forecasting difficult which will result in inaccurate demand forecasts. This in turn can negatively affect the clients budgeting for cost as well as the IMPERIAL Distributions capacity planning. The capacity planning was also negatively impacted due to the lack of ordering rules set by the client. The ordering behaviour of the customers of the client made planning transportation a difficult process.

An assumption was made with the implementation of this charge model that the unit rate would be based on data given by the client in terms of the geographical footprint, number of deliveries and volume. If any of these attributes change the unit rate would be impacted. Justification of the change and the renegotiation of rates is often a difficult process when changes in assumptions occur.

3.2.4. Client D

IMPERIAL Distribution implemented a fixed and variable charge model with Client D as per the request of the client.

The major benefit of the implementation this charge model for IMPERIAL Distribution is that risk in terms of dedicated capacity, to the client, is reduced. This is because the fixed portion of the charge model covers the capital investment made when capacity is dedicated to the client. From the clients' point of view, this charge model is beneficial as the fixed cost remains constant and the variable component can be linked to throughput. This makes the process of budgeting easier for the client.

Specifically regarding the fixed component, questions may arise as to the efficiency of the service provider in reducing cost. This can create problems in the relationship of trust that exists between the client and the service provider.

An assumption made with the implementation of this, and all charge models, is that the proposal made is base on the distribution activity provided by the client. Should this change, the proposal presented will be impacted and will require review.

Chapter 4

Solution Development

Now that the research and case analysis has been completed, the development of the solution may be completed. Commencing with the identification of critical factors influencing charge model selection that will form the decision points within the decision making tool. The rationale for selecting the critical factors, the measurement of the criteria and the impact of the identified factors will be discussed in the next section.

The next step involves developing the Analytic Hierarchy Process (AHP) with the criteria previously defined. The pair-wise comparison scales to be used with the AHP will be defined in this section.

Lastly the recommended system of procedures to be followed in the charge model selection process will be defined.

4.1. Critical Factor Identification

From the literature review and case study analysis completed, six critical factors influencing charge model selection where determined, namely predictability, variability, throughput, resource allocation, cost visibility and complexity.

4.1.1. Predictability

Predictability is defined as the accuracy with which demand can be forecast. This is important because forecasting of demand is the starting point of all planning. The forecast will be used to determine the logistical activity needed to be performed, the resource requirement to complete the deliveries, the planning of transportation and the volume of goods to be transported. All of these aspects that stem from the forecast will accumulate cost for both the client and the service provider. The recovery of that cost becomes a risk to either party if the forecast of the demand is inaccurate.

The predictability will be measured against three sub-criteria namely, low, medium and high. High Predictability means that the demand can be predicted with a high degree of accuracy. Medium predictability means that the forecast of demand is only accurate to an extent but fluctuation of demand around the forecast value should be expected. Low predictability means that the forecast value of demand is most likely not a reflection of the true demand and high differences between forecast and true demand should be expected.

High predictability reduces the risk, to the service provider, of allocating more resources than required to a client. Allocation of resources costs the service provider money and depending on the charge model implemented, this cost may or may not be recovered. High Predictability enables the service provider to apply a more risky charge model, such as a unit rate charge model. With the high predictability, initiatives can be undertaken to reduce operational cost which will result in higher profit, for the service provider, if a unit rate is applied. When predictability is medium or low the risk becomes whether or not the service provider will be able to recover their cost of providing the service. When a unit rate is used with low or medium predictability, revenue is only earned based on activity. If there is insufficient activity the service provider will be at great risk of not covering the cost. Hence, an open book or fixed and variable charge model would be more appropriate to reduce the risk of making a loss.

4.1.2. Variability

Variability is defined as the fluctuation of demand over time. This will have an effect on the resource planning and allocation. Fluctuations of demand will in turn create fluctuations in the capacity requirement of the client. Both the client and the LLP need to plan for the fluctuations to be able to plan the allocation of resources accordingly. As cost is accumulated with allocating resources to a client this factor is important to the decision making involving charge model selection.

Like with predictability, variability can be high, medium or low. Low variability means that demand stays relatively constant with minimal fluctuations over time. Medium variability means that demand does vary over time fitting a pattern of seasonal demand. High variability means that the demand fluctuates erratically making the demand difficult to predict.

Low variability creates a stable environment which reduces the risk of cost recovery for the service provider thus allowing the service provider to use a more risky unit rate charge model. The risk of cost recovery increases proportionally with variability which will favour the selection of a fixed and variable or open book charge model.

4.1.3. Throughput

Throughput is defined as the annual volume of merchandise expected to be distributed. This is an important factor in charge model selection as the volume will determine the resource requirements of the client which accumulates cost for the service provider.

Throughput, like variability and predictability can be low, medium or high. High throughput is in line with the throughput of Client A which is 45 million cases. Medium throughput would be the throughput of Client D which is 11.6 million cases. Low throughput is in the range of the throughput of Clients B and C.

High volume offers the possibility of reducing operational cost by increasing operational efficiency. This cost reduction will translate into increased profit if a unit rate is implemented. As with high throughout, medium throughput may also benefit from increased operational efficiency.

4.1.4. Resource Allocation

Resource allocation is defined as the method by which IMPERIAL Distribution allocates resources to its clients. Allocation of resources to a client accumulates cost for the service provider. This cost is the cost of insuring and licensing the vehicle as well as the capital investment made to purchase the vehicle. These costs need to be recovered by the service provider in order to make a profit and the recovery of this cost is dependent on the charge model implemented.

At IMPERIAL Distribution resources are allocated in one of two ways namely, dedicated or multi-principle. Dedicated resource allocation means that IMPERIAL Distribution allocates resources solely for use by one client. Alternatively, multi-principle resource allocation means that resources of IMPERIAL Distribution are shared between two or more clients based on the different clients' resource requirements.

When resources are shared between clients, it can become difficult to establish what portion of the total cost should be attributed to each client. In such a case an aspect of cost visibility will benefit the process of costing per client thus fixed and variable or open book charge model implementation would be advantageous. When resources are dedicated to a client, cost apportionment is not necessary.

4.1.5. Cost Visibility

Cost visibility is defined as the transparency of costs incurred in the provision of a service. Cost visibility is a matter of whether or not the client wants to know how the cost of service is calculated. The reason the client may want cost visibility could be one of many. The client might want to validate that the service provider is not charging more than they ought to be, they may just want to gain a better understanding of the cost of logistics or they may want to know details of the cost to be able to undertake reducing the costs.

The requirement of cost visibility will affect the selection of a charge model. An open book charge model has full visibility of cost. Within a fixed and variable charge model, visibility of cost can be incorporated. With a unit rate charge model, the calculation of the unit rate can be complex thus visibility of the cost involved in the calculation may be difficult.

4.1.6. Complexity

Complexity is defined as the uniqueness of the operation of a clients' supply chain and the service to be provided. Complexity can complicate the calculation of rates. This will have an effect on the selection of a charge model. Complexity of operation may also introduce risks to the service provider thus affecting the selection of a charge model. For example, if a client offers specialised delivery services to its customer the service provider may find a situation where a delivery of one unit has to be made to each of ten customers. If a service provider has applied a unit rate to the client, the service provider will receive revenue for the delivery of ten units but actual cost of making those ten deliveries may exceed the earned revenue.

Complexity can be described as high, medium or low. High complexity refers to an operation were the calculation of a rate, for example a unit rate, may be infeasible. This could be because the units of different products vary in size and because of a wide range of products, the calculation of individual rates will require too much time and too many resources to be sustainable. Medium complexity is where there are some aspects of the operation that are complex while other aspects are simple thus rate calculation is difficult but not infeasible. Low complexity is an environment where the operation and the service requirement is simple and thus implementation of a charge model for consistent application.

In a highly complex environment, operations are often unique thus an open book charge model is a more appropriate charge model to use than a fixed and variable or unit rate. As complexity decreases so does the difficulty of implementing a charge model. Therefore, a unit rate charge model may be suitable for a medium complexity or low complexity operation. A fixed and variable may be applied in any level of complexity but may not be as appropriate as the open book or unit rate charge model in certain situations.

4.2. Analytic Hierarchy Process

Form the critical factors identified the Analytic Hierarchy Process was developed starting with the development of the decision hierarchy structure, next the pair-wise comparison matrices were developed and concludes with the calculation of the global weights for each alternative.

4.2.1. Decision Hierarchy Structure

The decision hierarchy was developed into a three tier structure as shown in Figure 4.

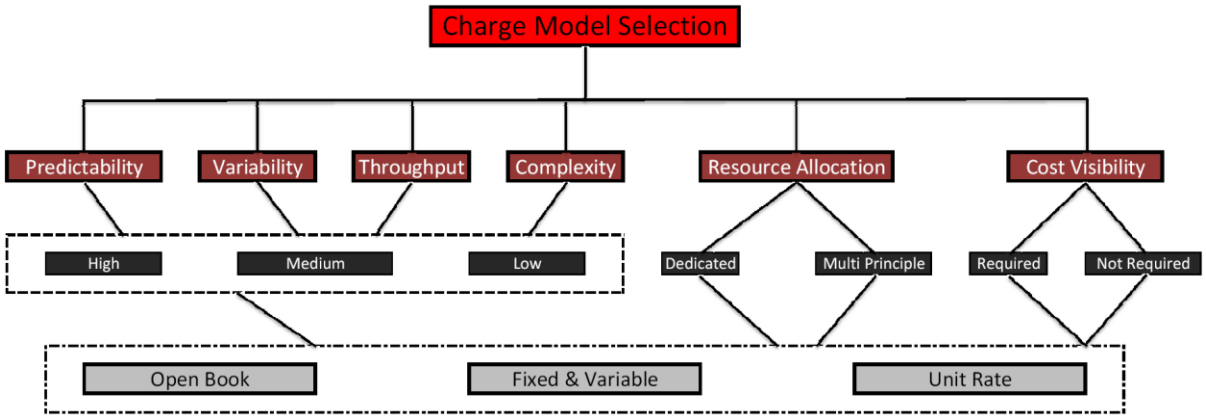

Figure 4. Decision Hierarchy Structure

The first tier of the structure contains the six critical factors identified in section 4.1. Each of the six critical factors has sub-criteria. These sub-criteria form the second tier of the structure. Predictability, variability, throughput and complexity all have the sub-criteria of high, medium or low. Resource allocation has sub-criteria of dedicated or multi-principle and cost visibility has sub-criteria of required or not required. The third tier of the structure is made up of the alternative charge models, namely open book, fixed and variable and unit rate. These three charge models were the only charge models selected as they are the preferred charge models of use by IMPERIAL Distribution. These alternatives will be evaluated via a pair-wise comparison against each sub-criterion.

4.2.2. Pair-wise Comparison

Pair-wise comparison matrices were developed for each tier. Each tier has a uniquely defined scale for use with the pair-wise comparison matrices. For every pair-wise comparison matrix only the upper triangle of the matrix is filled. Formulae input into MS Excel calculate the elements of the lower triangle of the matrix.

The pair-wise matrix of the first tier is as shown in Figure 5.

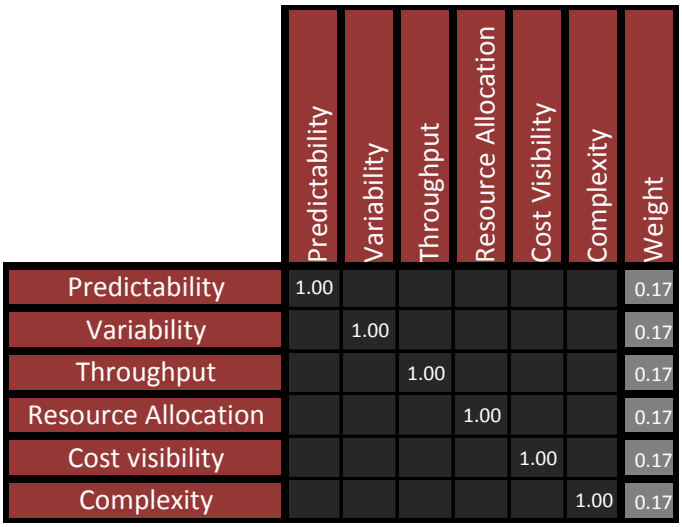

Figure 5. Critical Factor Pair-Wise Comparison Matrix

The scale to be used for this matrix is as follows in Table 4:

Table 4. Critical Factor Pair-Wise Comparison Scale

Intensity of Importance	*Definition*
1/5	Strongly less important
1/3	Moderately less important
1	Equally Important
3	Moderately more important
5	Strongly more important

This comparison will be conducted by IMPERIAL Distribution upon completion of the company profile analysis of the new client. The aim of the comparison is to determine weights of importance of each of the critical factors.

Similarly pair-wise comparison matrices where developed for the sub-criteria of the critical factors. The scale to be used for the pair-wise comparison of the sub-criteria is as indicated in Table 5.

Table 5. Sub-Criteria Pair-Wise Comparison Scale

Intensity of Importance	*Definition*
10	Object *i* selected over object *j*
1	Object *i* not selected over object *j*

This scale enables a weight of one to be calculated for the sub-criteria that fits the description of the critical factor. For example, if the predictability is high the pair-wise comparison matrix will look as shown in Figure 6. This pair-wise comparison will completed by IMPERIAL Distribution upon completion of the company profile analysis of the new client.

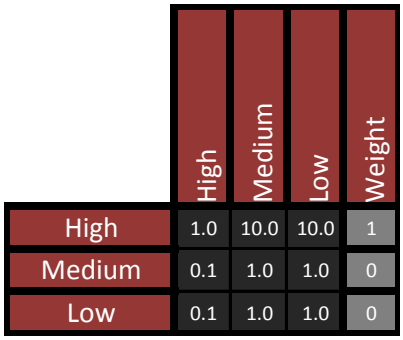

Figure 6. Sub-Criterion Pair-Wise Comparison Matrix Example

The pair-wise comparison matrices for the comparison of the alternatives against each sub-criterion was then developed. The scaled used for the comparison is shown in Table 6. The comparison matrices of the alternatives against each sub-criterion is predefined based on research conducted and the case analysis performed.

Table 6. Alternatives Pair-Wise Comparison Scale

Intensity of Importance	*Definition*
1/5	Strongly less preferable
1/3	Moderately less preferable
1	Equally preferable
3	Moderately more preferable
5	Strongly more preferable

The predetermined alternative pair-wise comparison matrices are displayed in figures 7 through12. The reason why only these matrices are predefined is that the matrix comparisons will not change with different clients. This is because each predefined comparison matrix is formulated based on the comparison of the charge models against the specific sub-criteria, regardless of the client. For example, the predefined matrix for High Predictability compares the three charge models solely against the sub-criteria of High Predictability of demand. The comparison matrices of the first and second tier depend entirely on the company profile of the client for which a charge model is being selected. The reasoning behind the specific comparisons made within the predefined matrices follows that which is discussed in the critical factor identification.

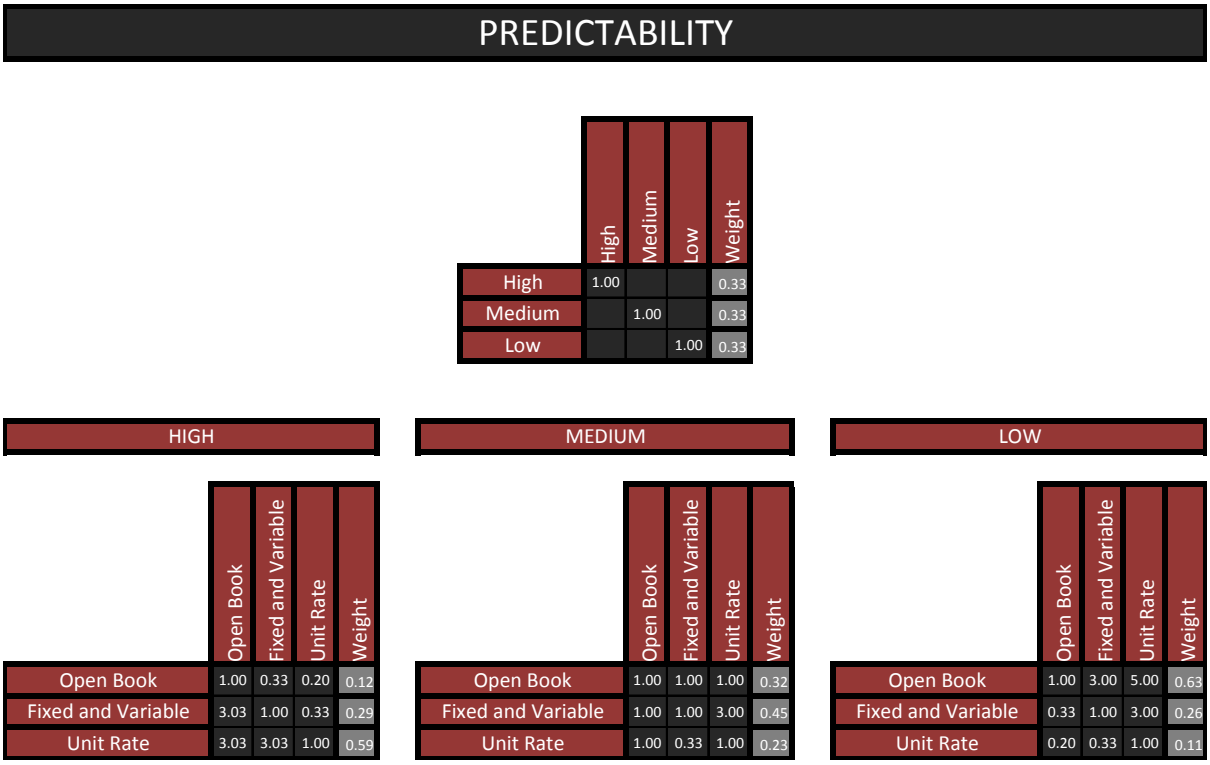

Figure 7. Alternative Predictability Predefined Matrices

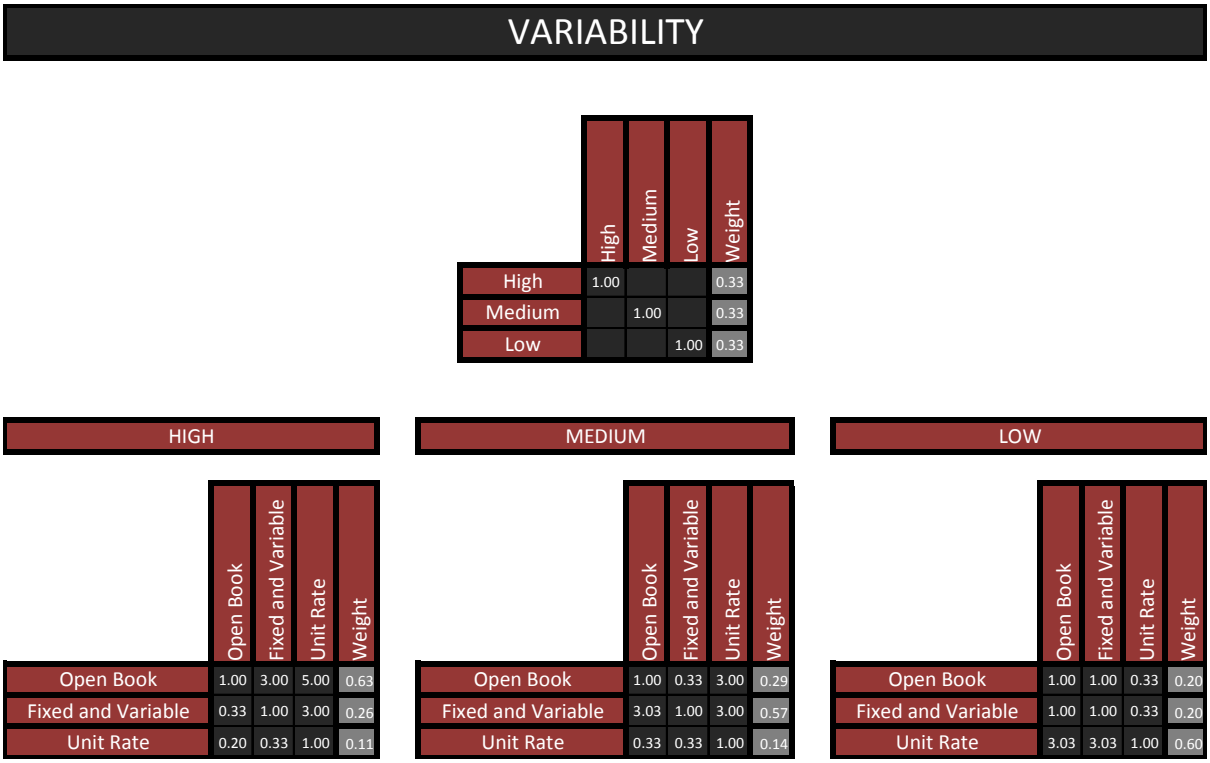

Figure 8. Alternative Variability Predefined Matrices

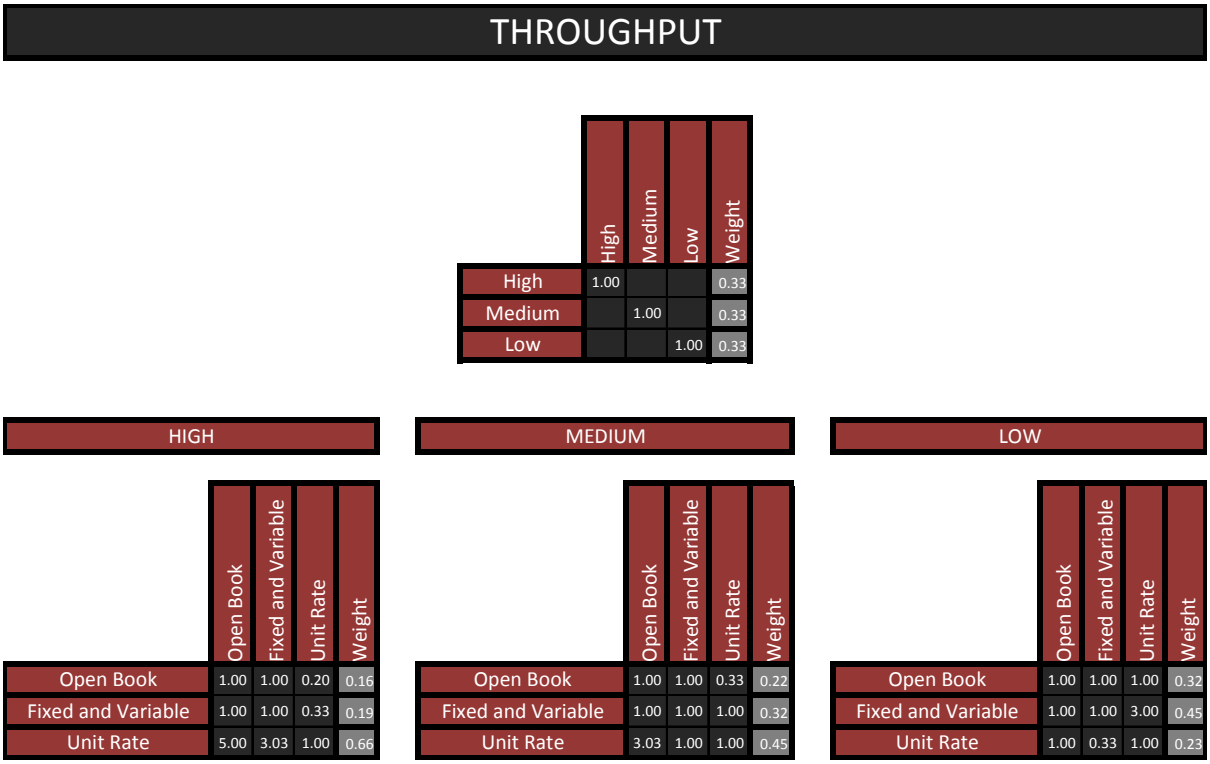

Figure 9. Alternative Throughput Predefined Matrices

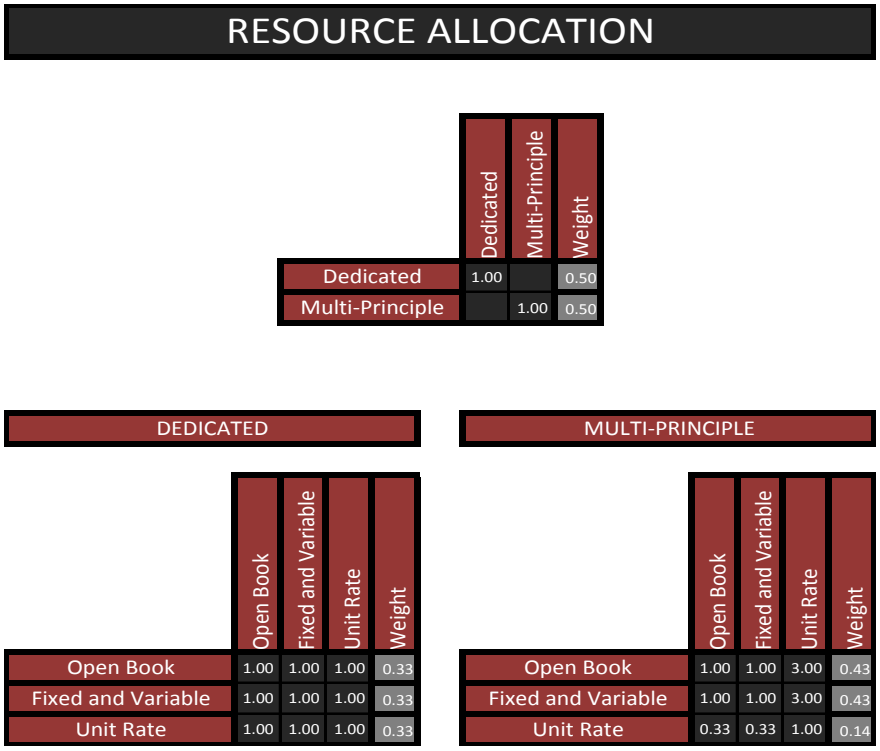

Figure 10. Alternative Resource Allocation Predefined Matrices

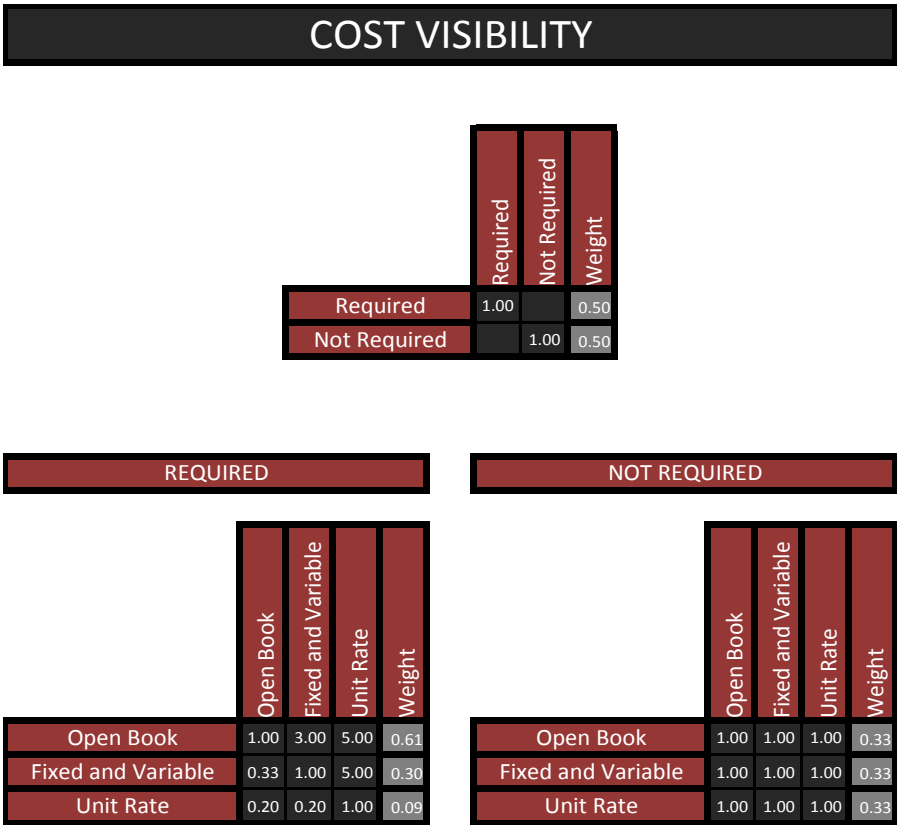

Figure 11. Alternative Cost Visibility Predefined Matrices

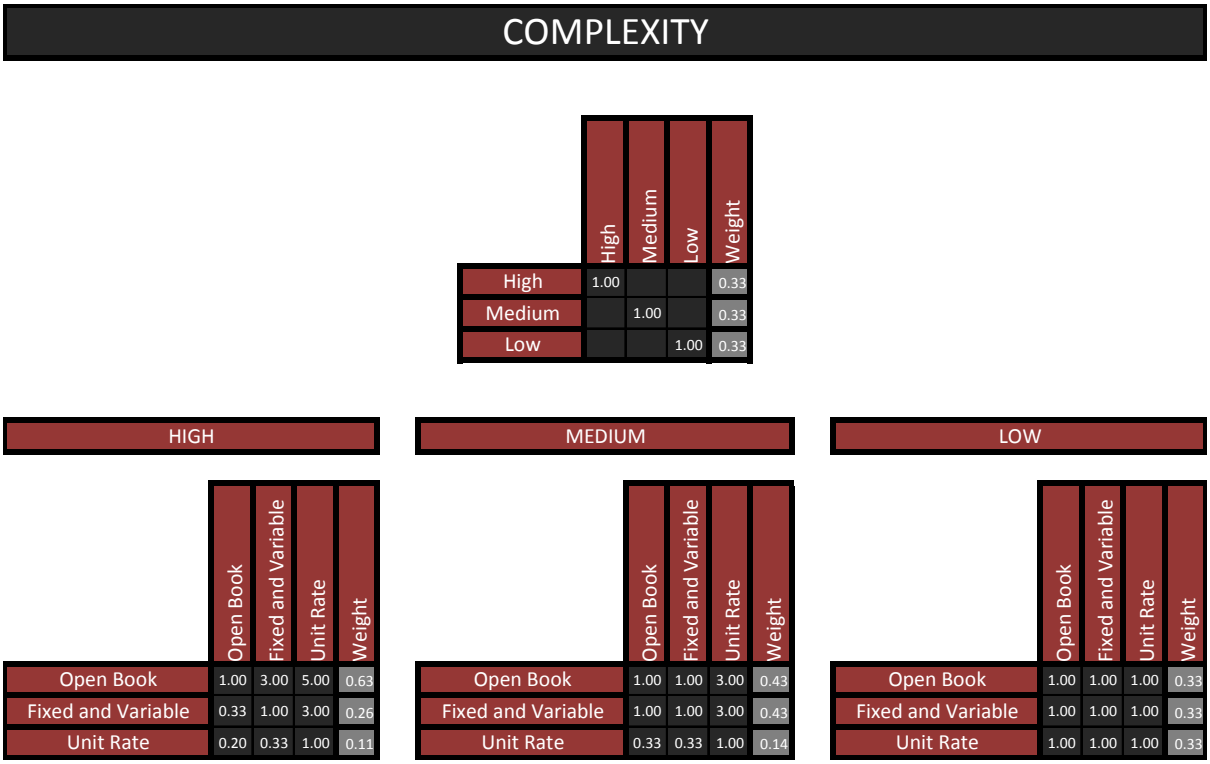

Figure 12. Alternative Complexity Predefined Matrices

4.2.3. Global Weight Calculation

Once the pair-wise comparison matrices of the first and second tier have been populated the MS Excel spreadsheet will automatically calculate the local and global weights.

The local weight are calculated by first calculating an intermediary matrix then the local weight. An example of a pair-wise comparison matrix with the intermediary matrix and weight are shown in Figure 13.

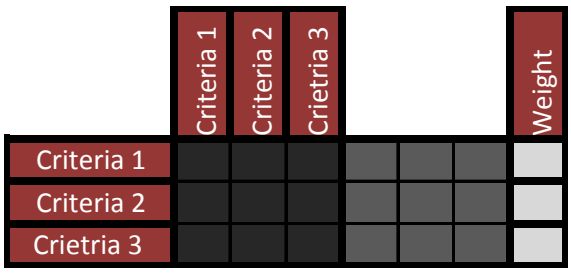

Figure 13. Example of a Pair-Wise Comparison Matrix Including intermediary Matrix

To calculate the intermediary matrix the sum of each column of the pair-wise comparison matrix is found. Element (i,j) of the intermediary matrix is equal to element (i,j) of the pair-wise comparison matrix divided by the sum of the j^{th} column. This calculation is done for each element in the intermediary matrix. The local weight is calculated by finding the average of each row of the intermediary matrix respectfully.

Once all the local weights are calculated the global weight is calculated. This calculation is performed by multiplying the weight of each alternative through and up the decision hierarchy structure and summing the weights. For example the global weight of the open book charge model would be calculated by multiplying the open book weight by the high weight by the predictability weight plus the open book weight by the medium weight by the predictability weight etc until all sixteen of the open book weights have been multiplied up and through the decision hierarchy structure and summed.

The global weights are then represented in the MS Excel spreadsheet as shown in Figure 14.

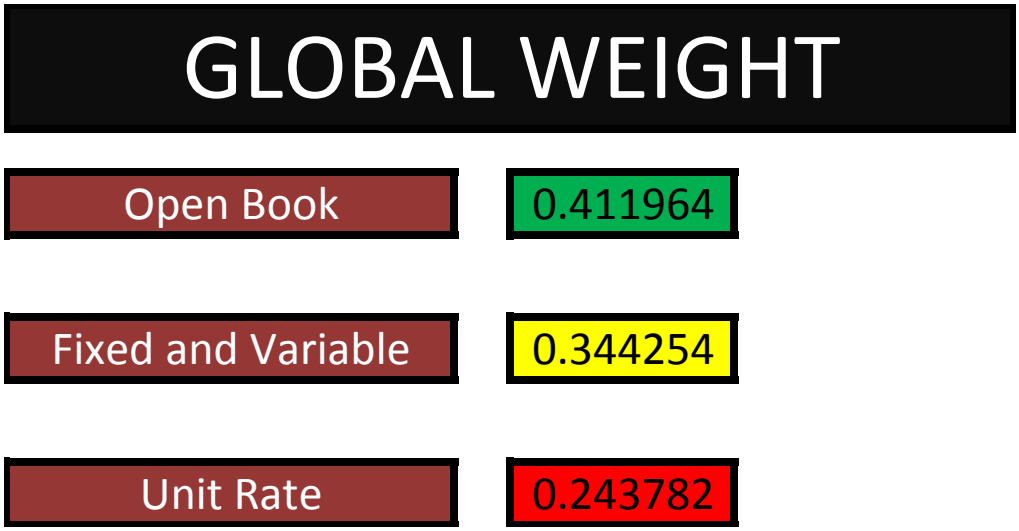

Figure 14. Global Weight Example

The charge model with the highest weight is the model deemed the best fit for the client by the AHP. The weight of this charge model will be highlighted green. The second best fitting charge model will be highlighted yellow and the worst fitting charge model will be highlighted red.

4.3. Recommendations

The first step in the process of determining the most suitable charge model for a client should be determining whether the LLP concept is going to be implemented or not. Two major factors will play a role in this decision. Firstly, the maturity of the clients' supply chain will need to be assessed in terms of the maturity of the systems in place within the supply chain and the whether the LLP can add sustainable value to the client. Secondly, if the client already has resources in place to perform the functions of the LLP then implementation of the LLP will create redundancy and thus should not be implemented unless the client is willing to restructure the resources dedicated to the supply chain management.

Then next step of the process of selecting a charge model for the client is to ensure the client is not requesting a particular charge model to be applied. If the client is requesting a particular charge model which does not suit its logistical behaviour, the AHP can be used to help convince the client to reconsider the request for the particular charge model.

Once the first two steps of the process are completed, an analysis of the clients' company profile should be conducted using the company profile analysis tool developed within this project. This analysis will become the inputs into the next step of the process, the AHP.

Having conducted the company profile analysis of the clients' company, the information from company profile analysis tool should be input into the AHP spreadsheet that was developed. This will result in the selection of the most suitable charge model for the client. This model should then be proposed and negotiated with the client to determine the respective profit margins or rates to be applied. Once negotiation have been conducted and completed the model should be implemented.

Chapter 5

Conclusion

The research and case analysis conducted during the course of this project re-iterate the problem statement. No two companies will operate their supply chain in the same manner and many factors influence the way in which a supply chain is operated. The way in which the supply chain is operated determines the supply chain activities which, in turn drives cost. It is these cost drivers that influence the charge model selection.

The meshing together of the research and case analysis enabled the identification of factors critical to determining the way in which a supply chain is operated. This, in the end, determines the cost drivers. It is these critical factors that formed the basis of the developed of the tools used in the creation of the solution.

The decision making tool developed in this project will aid IMPERIAL Distribution in identifying the most appropriate charge model to implement with new clients and question charge models currently implemented with existing clients.

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