An engineering approach to an integrated value proposition design framework

by
Carmen van der Merwe

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

Supervisor: Dr ACJ van Rensburg
Co-supervisor: Prof CSL Schutte

March 2015

DECLARATION

By submitting this thesis electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

Date: November 2014

ABSTRACT

Numerous problems with product quality and time-to-market launches can be traced back to the management of the product lifecycle. This research assignment provides insight into how an integrated value proposition design framework can address these issues by shifting the focus of product lifecycle management from being product-centric to being customer-centric. This framework combines tools, methods and processes from a variety of disciplines such as Systems Engineering, Marketing, Project Management, and Financial Management. The application of the framework during the product lifecycle management process is that of a planning and communication tool to ensure integration between multifunctional teams to increase customer value proposition quality and decrease product time to market. This research assignment was implemented in a new product development case study within a leading Telecommunications company in South Africa.

Key words

Customer segmentation, Refined Kano's model, Blue Ocean strategy, Quality Function Deployment, Bass model, Generalised Bass model, Customer Lifetime Value, Net Present Value, and Goodwill.

OPSOMMING

Die bestuur van ‘n produk se lewensiklus veroorsaak verskeie probleme wat gepaard gaan met die kwaliteit van produkte en die verlengde tydperk wat dit neem om produkte aan die mark bekend te stel. Hierdie navorsingswerk verduidelik hoe die geïntegreerde waarde-stelling raamwerk die probleme met betrekking tot die bestuur van produkte se lewensiklusse aanspreek. Die raamwerk verskuif die fokus van die bestuur van ‘n produk se lewensiklus, wat produk-gesentreerd is, na ‘n kliënt-gesentreerde fokus. Die raamwerk maak gebruik van tegnieke, metodes en prosesse verkry uit die dissiplines van Sisteem Ingenieurswese, Bemarking, Projek bestuur en Finansiële bestuur. Die toepassing van die raamwerk verbeter die bestuur van ‘n produk se lewensiklus deur beplanning en kommunikasie te fassiliteer tussen multi-funksionele spanne. Genoemde raamwerk bevorder die samewerking tussen multi-funksionele spanne, verbeter die waarde-stellings aan kliënte, verhoog die kwaliteit van produkte en verkort die tydperk van produk bekendstelling aan die mark. Bogenoemde navorsingswerk is geïmplementeer in ‘n vooraanstaande Telekommunikasie maatskapy in Suid-Afrika, op ‘n nuwe produkontwikkeling gevallestudie.

ACKNOWLEDGEMENTS

I would like to thank my supervisor Dr Antonie van Rensburg for the continuous support, constructive criticism, and motivation. You guided me to become the best scholar I can be - for which I am sincerely grateful. I would also like to take this opportunity to thank my family who supported me emotionally throughout this journey.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

PLM	Product Lifecycle Management
CLV	Customer Lifetime Value
QFD	Quality Function Deployment
NPV	Net Present Value
VAS	Value Added Services
CVP	Customer Value Proposition
KPI	Key Performance Indicators
SOM	Self-Organising Maps

1 CHAPTER ONE: INTRODUCTION

The custom of value exchange between two or more parties is an age-old tradition. Organisations spend hours preparing and strategising different value offerings because a customer value proposition offers a strategic advantage; it is the golden apple that offers differentiation. Bringing a successful customer value proposition to the market offers significant advantages to the organisation, as it guarantees future survival.

In an ever-competing world where breakthrough innovations are harder to obtain, and where it is even more difficult to differentiate product and service offerings from those of one's competitors, organisations have to start competing on management practices (Straub & Kirby, 2014). This research is based on the principle that formal practices on value proposition design add economic growth by combining contributions from Systems Engineering, Marketing, Project Management, and Financial management disciplines.

A product is a value offering to a customer that consists of a combination of tangible and intangible components. Product Lifecycle Management (PLM) entails the process of managing the entire lifecycle of the product from initiation to product withdrawal and replacement. New product development efforts are managed by the implementation of PLM, which forms a knowledge management process inside the organisation, integrating resources, stakeholders, data, and business processes in order to provide an information outline of the product. Traditionally PLM is used as a business strategy to establish a product-centric organisational focus through which the organisation effectively and continually delivers products to its customer base over time to guarantee organisational growth.

The research assignment introduces an approach to the implementation of PLM by shifting the predominately product-centric focus to a customer-centric focus. The shift towards customer centricity within PLM is done by creating an engineering framework of processes, principles, and methods that introduces key concepts such as multi-functional team integration and business process parallelisation into PLM. The framework is used as a planning and communication tool to extend PLM. The purpose of the integrated value proposition design framework is to reduce variation in process schedules, and to align design specifications around the voice of the customer whilst maintaining flexibility among stakeholders in the process, with the intended effect of reduced time to market and increased product quality.

The research assignment is established in a case study that was conducted during a seven-month period within the marketing division of a leading telecommunications company in South Africa. The case study involves an explanatory analysis of the integrated value proposition design framework on a new product development initiative.

This chapter provides an introduction to the research assignment. It consists of a statement of the research problem, a formulation of the aim, nature, and scope of the research, a brief review of the existing literature, the research design and methodology, a list of key concepts and definitions, and a chapter outline.

1.1 RESEARCH PROBLEM

PLM as a business strategy plays a particularly important role in managing new product development initiatives. Several product failures can be traced to inadequate implementation of PLM. Examples of such failures are that creative ideas fail to be invented; products are not launched on time; critical milestones are missed; once the products are launched, they do not sell in the market; poor capacity planning; and misleading returns on investments. The most common problems that hinder the successful implementation of PLM are due to the level of complexity and the lack of strong leadership between multifunctional teams in PLM implementation.

Numerous research studies have been conducted on the central problems in PLM. The researchers' findings on the central problems in PLM points to five main causes:

a. Management's misperception about PLM
b. Universal product lifecycle management issues
c. Integration and communication issues within the PLM
d. PLM complexity, and
e. Product-centric versus customer-centric PLM focus.

During the seven-month period in which the case study was conducted, similar causes of problems in PLM were found while closely monitoring the way-of-work of the product development teams. The most prominent problems were that over 80 percent of new product launches were late, incomplete products were launched; many products were unsuccessful; the improvements in management processes were small and followed an eighteen-month cycle; and lengthy decision-making processes.

The problem statement is the result of a comparison analysis between the five main causes of problems in PLM found in the literature and the specific problems experienced within the case study. The relationships between the five causes of problems in PLM and the specific problems identified in the case study are compared and listed below.

1.1.1 Management's misperception about PLM

PLM is often not considered by management as a strategic business tool but as an engineering tool associated with large IT investments. This statement forms the first cause of problems in PLM. In an attempt to improve PLM, organisations tend to implement IT software as a PLM solution to control product engineering efficiency, instead of implementing PLM as a business strategy. Senior management transfer their responsibility for PLM to a functional engineering level, and are misled by thinking that improvements in product engineering efficiency are similar to improvements in PLM. In contrast, if PLM is implemented as a business strategy, the improvements in the product PLM could apply to the entire organisation. It is found that improvements in a product's business activities are easier to obtain and have a greater impact on the success of the product than do improvements in product engineering efficiency (Johansson, Kazemahvazi, Henriksson, & Johnsson, 2013:56-58).

Within the case study the problem experienced is not that PLM is implemented in the organisation as an IT system, but that there is no formal procedure for PLM implementation to begin with. Senior management does not fully grasp the importance of PLM in new product development initiatives. It is found that they fully transfer their strategic decision-making responsibilities for PLM implementation to a tactical-planning employee; and so, when the product has to be developed, the product development process is held up through lack of senior management involvement within PLM.

1.1.2 Universal product lifecycle management issues

The second cause of problems in PLM consists of four universal problems associated with the management of new product initiatives within PLM, as identified by Van de Ven (1986: 590). The first problem is that of *managing humans*, especially in large and successful organisations, which are generally more focused on protecting their existing products and services than on generating innovative new ideas.

The second problem is the challenge of transforming an idea into a product as a *collective achievement*. It only takes one person to propose an idea, but for the idea to be successfully invented and implemented, it requires the co-operation of various groups of individuals. It is often found that a promising idea will not be successfully invented due to a lack of energy and commitment amongst multifunctional groups.

The third problem involves the structural problem of *managing multiple functions, resources, and disciplines* as a whole. Individuals involved in the product development process can get so tangled up in their own functional responsibilities that they can easily lose sight of the process as a whole.

The fourth problem is a lack of *leadership*. The development of a product has to adapt to current organisational structures and practices. It is often found that the existing management strategies are very rigid and do not allow for flexibility in the process to adapt to the requirements of current product development. There is a lack of strategic leadership to transform the existing management practices to optimise the innovation's go-to-market cycle strategy (Van de Ven, 1986:591).

The universal problems in managing new product initiatives within the early phases of PLM relate to the problems experienced in the case study, where it was observed that the decision-making processes in PLM are drawn out and time-consuming, with average product development initiatives taking one thousand days – three years – to complete. This problem is partly due to the organisation's inability to manage humans effectively, as summarised in the second cause of problems in PLM; and partly due to the first cause – that of senior management transferring their responsibilities to lower-level employees. Senior management are more focused on protecting their existing product portfolios than initiating new and innovative products. Thus the responsibilities of PLM, especially in the early design phases of PLM, are transferred to lower-level employees. PLM issues that require immediate decision-making are often held up because senior management are too occupied with other responsibilities to give immediate attention to the PLM decision at hand, and the employee responsible for PLM implementation does not have the authority to make on-the-spot decisions.

Within the case study it was also observed that the organisation has a lack of strong leadership to overcome the challenges of inflexible business processes. The PLM project leaders are bound by the senior managements' authority. The lack of strong leadership implies that the organisation is not able to transform a product idea into a launch-ready product as a collective achievement, and the organisation does not have the skill to manage the multiple functions, resources, and disciplines as a whole. Many product initiatives are never implemented due to the PLM multifunctional teams' lack of energy and commitment to realise the product initiative, and due to poor leadership.

1.1.3 Integration and communication issues within the PLM

The third cause of problems in PLM arises from the issues associated with the lack of integration and communication within PLM. Kessler, Bierly, and Gopalakrishnan (2001:80) define the "vasa-syndrome", which applies to the failures in projects due to insufficient communication. The "vasa-syndrome" was framed by taking a sixteenth century new product development disaster, the Swedish warship called Vasa, as an example of common managerial failures that can still apply today.

According to Kessler *et al*., the most prominent challenges that an organisation faces during the new product development stage in PLM are the deficiency in learning ability, a poor knowledge and information feedback system, communication barriers, a lack of ability to recall insights from previous products, and the inability of senior management to set clear objectives. To counter the "vasa-syndrome", an organisation needs to emphasise the importance of the knowledge gained from previous experiences and the importance of sharing the knowledge, together with improving the information systems that need to be in place to overcome communication barriers and poor organisational retention capabilities (Ameri & Dutta, 2005:577).

The third comparison between the central problems in PLM and the problems identified in the case study applies to the organisation's lack of integration and communication within PLM. There is a definite lack of integration amongst the individuals in the multifunctional teams responsible for PLM implementation. The individual stakeholders are mostly focused on their own responsibilities, and failed to show enthusiasm for realising the product as a whole.

Generally within the telecommunications industry, the necessary IT infrastructure is in place to capture accurate data on the Key Performance Indicators (KPIs) for PLM downstream activities – but there is a major gap in capturing, storing, and documenting the product during the earlier PLM stages. There is no formal structured methodology to capture and model the product concepts, resulting in a weak information feed-back system.

1.1.4 PLM complexity

The fourth cause of problems in PLM involves its complexity. The implementation of PLM requires the co-operation of various individuals in multifunctional teams. The level of complexity in PLM increases as the number of stakeholders in the decision-making process increases ("Product lifecycle management problems costing operators dear, survey finds", 2013). It is essential to ensure that all the stakeholders involved in the decision-making process are integrated in order to make consolidated decisions.

As observed within the case study, the implementation of PLM within the organisation is very complex. The PLM teams, gathered from multiple disciplines, are too large to be efficient. In the case study it was found that up to 65 individuals were involved in the product design phase of the PLM implementation of a single product, with little formally-managed relating between them. The complexity of the PLM effort grew as the number of individuals in the decision-making process increased. This degree of complexity results in many product delivery date revisions throughout the product lifecycle.

1.1.5 Product-centric versus customer-centric PLM focus

The fifth cause of problems in PLM identifies the challenges that organisations experience with a product-centric focus as opposed to a customer-centric focus. An organisation that is product-centric has a strong focus on increasing engineering efficiency and reducing costs, whereas a customer-centric organisation places strong emphasis on identifying the needs and preferences of the customer. Often a product-centric organisation will disregard the need of the customer in favour of lowering production costs and increasing the efficiency of the products (Sembhi, 2010). This results in a failure to identify potential market opportunities.

The implementation of PLM observed in the case study has a strong product-centric focus, with very little ability to capture and translate the needs of the customer into appropriate product and service specifications. The product design teams rely on copying competitor products for product innovation and product functionality, instead of delivering the required value to the customer.

1.1.6 The problem statement

The main problems associated with the current methodologies of PLM implementation are that PLM has a strong product-centric focus, and that there is a lack of integration between resources, stakeholders, data, and business processes. This leads to prolonged go-to-market lifecycles for new products, poorly-managed product portfolios for existing products, and unsuccessful product launches.

1.1.7 Research assumption

The research assumption is that the integration of resources, stakeholders, data, and business processes within PLM, together with the shift towards customer-centricity within PLM, will improve with the formal design of customer value propositions for new and existing product initiatives.

1.2 RESEARCH AIM

The product development process is a core business process that generates income for an organisation. The PLM is an essential business strategy that ensures that the product development process will be successful. PLM's aim is to capture accurate information about the success of the product development and product portfolio management processes, and to create a knowledge feed-back loop that guides stakeholders to make accurate and informed decisions regarding the product.

The research assignment addresses the research problems by shifting the product-centric focus of PLM to being customer-centric, with the assumption that greater PLM implementation results will be achieved by instituting formal practices for the design of customer value propositions for products. This implies that the success of a product is measured according to the value being added to the customer, and that the information captured within PLM should revolve around the customer. The research assignment intends to address the research problems by combining various best practice principles, tools, and methods to facilitate the shift towards customer-centricity, and by improving the integration of the multifunctional teams within PLM. Given the intention of the research assignment, the formal statements of the research aim and the research objective are given below.

1.2.1 The aim statement

The aim of this research assignment is to reduce complexity in the PLM by aligning product design specifications around the voice of the customer, whilst maintaining flexibility among the stakeholders with the intended effect of reducing time-to-market and increasing product quality.

1.2.2 The research objective

The objectives of this research assignment are to design an engineering framework that is a top-down customer-centric approach of best practice processes, principles, and methods to illustrate a complete process of value creation and value measurement, and to introduce key concepts such as multifunctional team integration and business process parallelisation into PLM. The intention of the framework is to extend the current PLM process to include a comprehensive customer-centric analysis throughout the entire product lifecycle, particularly applicable to the early product design phases of PLM implementation.

1.3 RESEARCH SCOPE

The scope of the research assignment consists of a framework that is particularly applicable to the early design phases within PLM and that covers the entire spectrum of PLM implementation. The framework is a top-down tool that provides a systematic methodology to facilitate a shift towards customer-centricity within PLM, and includes best practice project management principles to ensure multifunctional team integration. The framework ranges from a tactical planning and measurement tool to a strategic planning, communication, forecasting, and decision-making tool. The rationale of the framework is presented in Chapter 3, which provides a comprehensive overview of its scope.

1.4 LITERATURE SUMMARY

PLM is a business strategy that was developed in the early 1960s as organisational capabilities to manage information improved. The initial motivations for PLM implementation were to shorten the go-to-market lifecycles of new products, to lower production costs, to optimise production volumes, and to improve the quality of products by monitoring the production processes (Rudeck, 2014). Since the 1980s, PLM has evolved from being an engineering functional implementation tool to becoming a business strategy, making use of information feed-back capabilities. Executives use the PLM as a strategic advantage (Johansson *et al.*, 2013:56-58). Although the application of PLM is relatively new, much research has been conducted on PLM (cf. Gecevska, Chiabert, Anisic, Lombardi & Cus, 2010:323; Ameri & Dutta, 2005:577; Zeng, Liu, Maletz & Brisson, 2009:3).

PLM is a business strategy used to create a product-centric environment. Little research is available on shifting the PLM process from product-centric to customercentric. Research studies have until now been focused on the design of customer value propositions and the effect of customer value propositions in business markets (cf. Hassan, 2012; Anderson, Narus & van Rossum, 2006:1) as separate entities from PLM.

The framework delivered in this study aims not only to function as a tool to design customer value propositions that will shift the PLM focus towards customer-centricity, but also to trace the value creation process from product quality attributes to marketing objectives, and to promote the integration amongst resources, stakeholders, data, and business processes. Yang and Sung (2010:925) present a value creation process that is the closest research available to what the framework aims to achieve. The value creation process connects best practice methodologies such as the Refined Kano's model, the Blue Ocean strategy, value analysis, and marketing strategy objectives, to illustrate a value-creating path between marketing objectives and product quality attributes. This study expands the value creation process by including quantitative decision-making tools, customer experience designs, stochastic simulation and forecasting modelling, and project management principles.

1.5 RESEARCH DESIGN AND METHODOLOGY

The research design of the study is illustrated in Figure 1. As mentioned in the research objective statement (Section 1.2.2), the objective of the framework is to combine best practice principles, processes, and methods. Therefore the research design is intended to capture the best practices, and to combine the best practices in a framework that will adhere to the research objectives. These best practices include customer concepts such as customer lifetime value (CLV), customer segmentation, and customer experience; a value creation process with methods such as marketing strategy, value analysis, Blue Ocean strategy, and the Refined Kano's model; stochastic simulation and forecasting modelling methods such as the generalised Bass model, Monte Carlo simulation, and customer lifetime value modelling; and, lastly, best practice project management principles.

The research methodology used within the study is a mixed-method one. The study is driven as a qualitative research assignment within the functional decomposition of the integrated value proposition design framework, and the framework is supported by a stochastic simulation and forecasting model that is conducted as a quantitative research assignment.

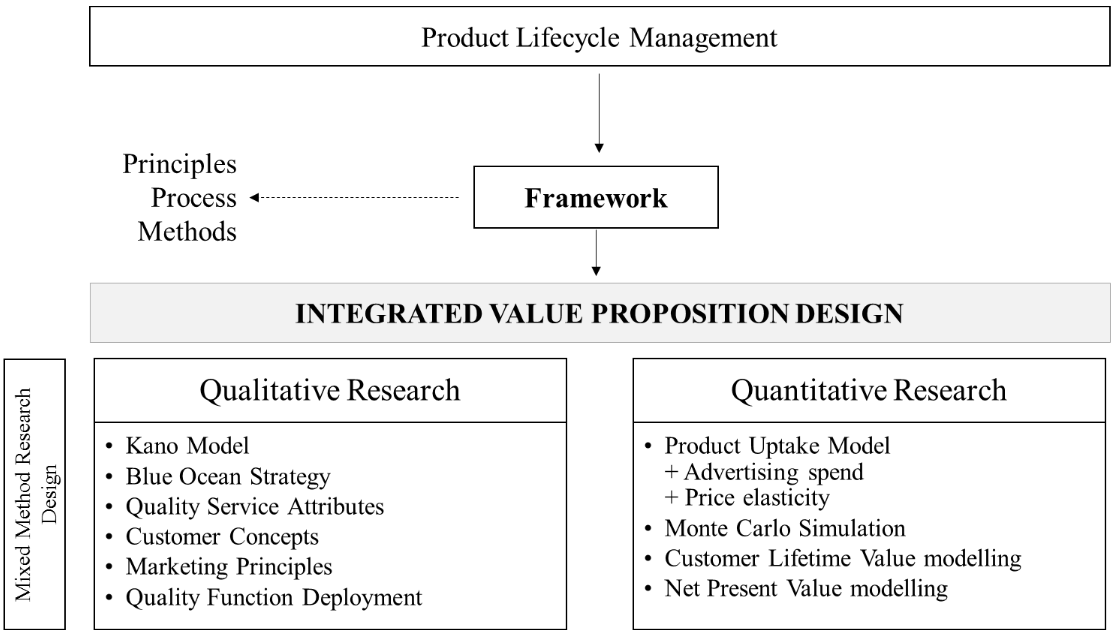


Figure 1: Research design

1.5.1 Research procedure

The research procedure of the assignment is illustrated in Figure 2.

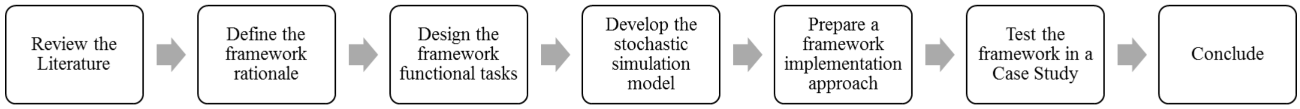


Figure 2: Research procedure

A literature review is prepared, consisting of the best practices identified in Figure 1. The rationale of the framework is discussed. The current way of PLM implementation is compared with the new approach suggested in the research assignment, on which the rationale of the framework is established. Thereafter the theoretical background on the best practice principles, processes, and methods is used to create the integrated value proposition design framework functional tasks decomposition. The stochastic simulation and forecasting model supporting the framework is designed, developed, tested, and applied. An implementation approach for the framework is configured. The framework is descriptively applied to a case study. Lastly, a conclusion is drawn on the success of the framework in respect of the framework objectives, and future research opportunities are recommended. Figure 2 is used throughout the research assignment to indicate the research assignment's progression.

1.6 CONCEPTS AND DEFINITIONS

Product Lifecycle Management (PLM) entails the process of managing the entire lifecycle of a product from initiation to product withdrawal and replacement. It forms a knowledge management process within an organisation that integrates resources, stakeholders, data, and business processes in order to provide an information outline of the product (Gecevska *et al.*, 2010:323).

A *value proposition* is the encapsulation of the expectation of the customer to experience value through the promises of the organisation. Being able to create successful value propositions offers significant strategic advantages to an organisation. The concept of a value proposition can be applied to an entire organisation, business unit, product, or service – as long as the process of value exchange can be defined between a 'supplier' and a 'customer' (Barns, Blake, & Pinder, 2009:21).

A *product-centric* organisation's aim is to introduce leading products into the market, making use of its internal ability to deliver successful high-tech, cutting-edge products. Organisational strategies are defined according to the product and its supporting KPIs, such as product revenue per year, or number of new products realised per year (Sheth, Sisodia, & Sharma, 2000: 55).

A *customer-centric* organisation focuses on delivering the best solution to the customer by designing products and services that are customised for specific customer segment needs. Such organisations typically have KPIs such as customer lifetime value (CLV) and customer satisfaction (Sheth, Sisodia, & Sharma, 2000: 55).

A *multifunctional team* is a group of individuals from various business units who are brought together to achieve an objective. Each individual in a multifunctional team contributes to the objective in a unique manner (Shen, 2002).

A *product* is a tangible or intangible – or a combination of tangible and intangible – offering that is defined in terms of product quality attributes or customer value propositions.

An *innovation* involves the process of translating an idea into an invented product that delivers value to a customer, or for which a customer will pay in return.

The *economics* of an organisation attempt to explain how wealth is created within the organisation.

1.7 CHAPTER OUTLINE

Chapter one: Introduction. The Introduction of the research assignment focuses on the research problems at hand, as well as the research aim, objectives, scope, and methodology to address the problems.

Chapter two: Literature review. The literature review is a succinct study of PLM and the role of industrial engineering within PLM. Thereafter the literature review presents a theoretical background to the processes, methods, and tools used in the integrated value proposition design framework.

Chapter three: Rationale of the integrated value proposition design framework. The rationale of the framework states the reasons behind the approach to PLM implementation suggested by this research assignment. The rationale of the framework also presents the detailed objectives and outline of the integrated value proposition design framework.

Chapter four: Functional decomposition of the integrated value proposition design framework. This chapter is dedicated to the application of the functional tasks within the framework, and the relationships between the tasks within it.

Chapter five: The economics of the integrated value proposition design framework. This chapter describes the detailed analytics that are the most fundamental to apply within a customer-centric organisation. The stochastic simulation and forecasting modelling methods are described, and a stochastic simulation and forecasting model is presented that forecasts an organisation's goodwill firm value from the product lifetime uptake model and CLV predictions.

Chapter six: Implementation approach of the integrated value proposition design framework. This chapter is dedicated to the method of implementing the integrated value proposition design framework via multifunctional teams within an organisation.

Chapter seven: Case study. The integrated value proposition design framework is validated in a case study. In this chapter, an explanatory analysis of the integrated value proposition design framework is presented, and the results of the case study are discussed.

Chapter eight: Conclusion. A conclusion is offered on the integrated value proposition design framework, its application, and the associated advantages of implementation. The limitations of the research assignment are listed, and the future research opportunities are identified.

1.8 INTRODUCTION - CONCLUSION

This introduction to the research assignment emphasises the problems associated with PLM. The most prominent of them concern the complexity of PLM implementation. The introduction states that the research assignment attempts to shift the focus of PLM towards customer-centricity, and aims to improve multifunctional team integration within PLM. This is done by delivering a framework that strengthens the implementation of PLM to capture customer-centric information within PLM.

2 CHAPTER TWO: LITERATURE REVIEW

A literature review is conducted to provide a comprehensive theoretical description of the processes, methods, and tools used to create the integrated value proposition design framework. The literature review is the cornerstone of the research assignment on which the following chapters are built. It follows the four steps listed below:

a. Succinct background on the PLM

The first part of the literature review delivers a brief and clearly-expressed background to PLM, which consists of a summary of the history of PLM, the description of a product as referred to within the research assignment, and a clarification of the meaning of a product lifecycle as used within an organisation and within PLM.

b. Limitations of the existing literature in comparison with the research assignment objectives

The available literature that complies with the objectives of the research assignment is identified, together with its limitations in terms of the existing literature's lack of compliance with the research objectives.

c. Detailed theoretical description of the processes, methods, and tools embedded within the integrated value proposition design framework.

Given that the theoretical concepts form a fundamental part of the integrated value proposition design framework, the following sections within the literature review are exclusively given to providing a detailed theoretical description of the existing literature, and of the methods and tools used to extend the existing literature to create the integrated value proposition design framework.

d. Conclusions on the literature review

A conclusion on the literature review is presented, leading to the following chapter – the rationale of the integrated value proposition design framework.

2.1 PRODUCT LIFECYCLE MANAGEMENT (PLM)

The core principles of PLM emerged in the early 1960s as a strategic management procedure to optimise new product development processes and preserve existing portfolios for an organisation. Early PLM research recognises the importance of keeping a record of a product's performance over time, and how the knowledge of a product's historical performance pattern can be used in new product development processes as a strategic advantage (Levitt, 1965:81). The knowledge of a product's performance over its lifecycle in a market was particularly used to formulate pricing policies for new products (Dean, 1976). Nonetheless, PLM was only established as a formal business strategy in the late 1970s. Seeing that more research progressively became available, and that more institutions and marketing practitioners implemented PLM, Gardener (1986:1) states that PLM is the pivot for all marketing practices; and this statement is just as applicable today.

A product is a value offering to a customer that consists of a combination of tangible and or intangible components. Zeng *et al*. (2009:2) identify that a product consists of three main components: the first is the core product component (which consists of the product's value propositions); the second is the tangible product component; and the third is the strengthened product component (which includes all intangibles associated with the product, such as brand awareness).

Product lifecycle is a marketing concept that describes the stages a product goes through in the product maturity cycle. Figure 3 shows the generally accepted stages of a product's lifecycle, from launching a product in a market to withdrawing the product from a market (Jeong, 2010). There is no prescribed way to define the lifecycle stages of a product. The stages of a product's lifecycle depend on the product, the organisation, and the market environment.

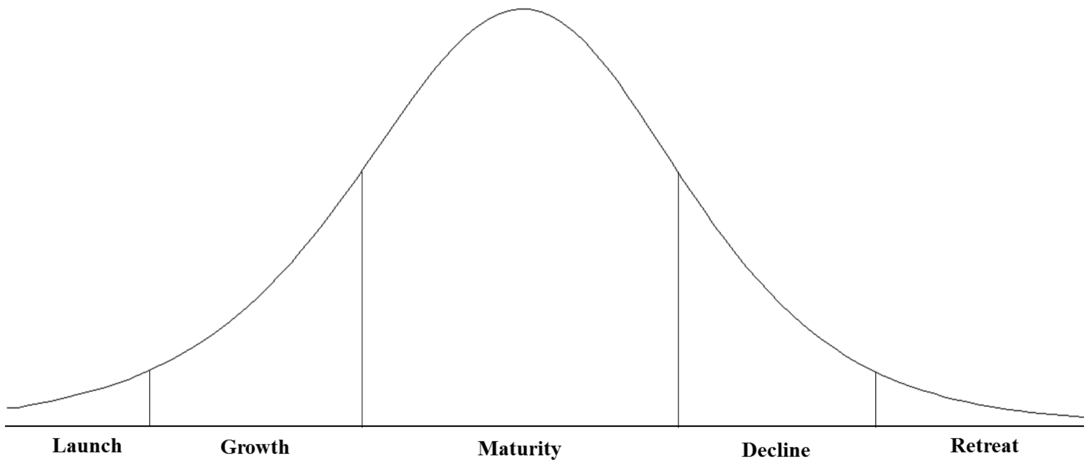


Figure 3: Product Life Cycle (Jeong, 2010)

Data for the product and the customer is captured at every stage in the lifecycle of the product. In PLM the data captured at the numerous product lifecycle stages is transformed into an information knowledge system that is used as a business strategy to rapidly improve the time-to-launch of new products and to improve the management of existing product portfolios (Ameri & Dutta, 2005:577).

2.2 EXISTING LITERATURE, AND ITS LIMITATIONS

The objectives of the research assignment, as stated in Chapter 1, Section 1.2.2, are divided into two distinct parts. The first part is to design an engineering framework that is a top-down customer-centric approach, to illustrate a complete process of value creation and value measurement. This is done by combining various best practice processes and methods in a meticulously-chosen manner to demonstrate a value creation procedure from the organisation's objectives towards the organisation's customer value propositions, and contrariwise, together with a means to measure the impact of the value creation on the firm value of the organisation.

The second part of the research objectives is to introduce key concepts such as multifunctional team integration and business process parallelisation into PLM. This is accomplished by extending the existing PLM processes with a framework that is designed to optimise multifunctional team integration and communication by making use of best practice tools and design principles.

Given that PLM is predominantly product-centric, there is little research available on the attempt to shift the organisational focus within PLM towards customer-centricity. Therefore the scope in which the existing literature was studied ranged over numerous disciplines – in particular, the disciplines of Systems Engineering, Marketing, Project Management, and Financial Management. The primary research work that was identified from the existing literature, and that partially complied with the objectives of this research assignment, was the *value creation process* that Yang and Sung designed and published in 2010. They introduced the notion that it is not sufficient for an organisation only to satisfy their customers: it also has to create value for their customers. They delivered a process that traces product quality attributes through various channels towards the marketing objectives by making use of four methods: the Refined Kano's model, the Blue Ocean strategy, value analysis, and marketing objectives.

The value creation process is used as a foundation for the integrated value proposition design framework. The research assignment extends the value creation process to comply fully with the research objectives by addressing six limitations of the value creation process.

The first limitation of the value creation process is that it is not supplemented by a quantitative measurement tool to perform and implement the process steps within the PLM of a new product development effort, or the management of existing product portfolios.

The second limitation of the value creation process is that it fails to target a specific customer segment for a product. This limitation is addressed with customer segmentation.

In order for the value creation process to be used as a value proposition design procedure in a complete customer-centric approach, the third limitation of the value creation process is that it does not incorporate customer experience designs, such as a customer journey and touch-point analysis.

Yang and Sung mention in their article how an organisation can obtain firm value in return for delivering value to their customers. However, customer lifetime value modelling is not explicitly included within the value creation process – which is the fourth limitation of the value creation process.

The value creation process defines a product according to customer perceptions. However, the value creation process does not include a forecast of the product's uptake by customers in a market. Therefore the fifth limitation of the value creation process is that it does not forecast a product's uptake in a market.

The sixth limitation is that the value creation process does not define the value obtained by the organisation through the value creation process, and does not provide a means to quantitatively measure the firm value obtained.

The next sections of the literature review describe, first, the value creation process and the theoretical methods used within it; then the various theoretical concepts used to extend the value creation process into an integrated value proposition design framework are provided.

2.3 THE VALUE CREATION PROCESS

There are a number of theoretically defined value creation processes (cf. Payne & Frow, 2005; Payne; Yang & Sung 2005). However, for the purpose of this research assignment the value creation process of Yang and Sung (2010:927) was the most accessible process to use in compliance with the research assignment objectives. Yang and Sung designed a model of the value creation process that suggests possible useful actions to enhance customer value, and in return illustrates how the added customer value will be realised in an organisation's marketing objectives. The value creation model, as illustrated in Figure 4, combines the Refined Kano's Model and the

Blue Ocean strategy to identify in which value categories customers will obtain value, and in which marketing strategy it will be realised: in customer acquisition, customer retention, or customer growth.

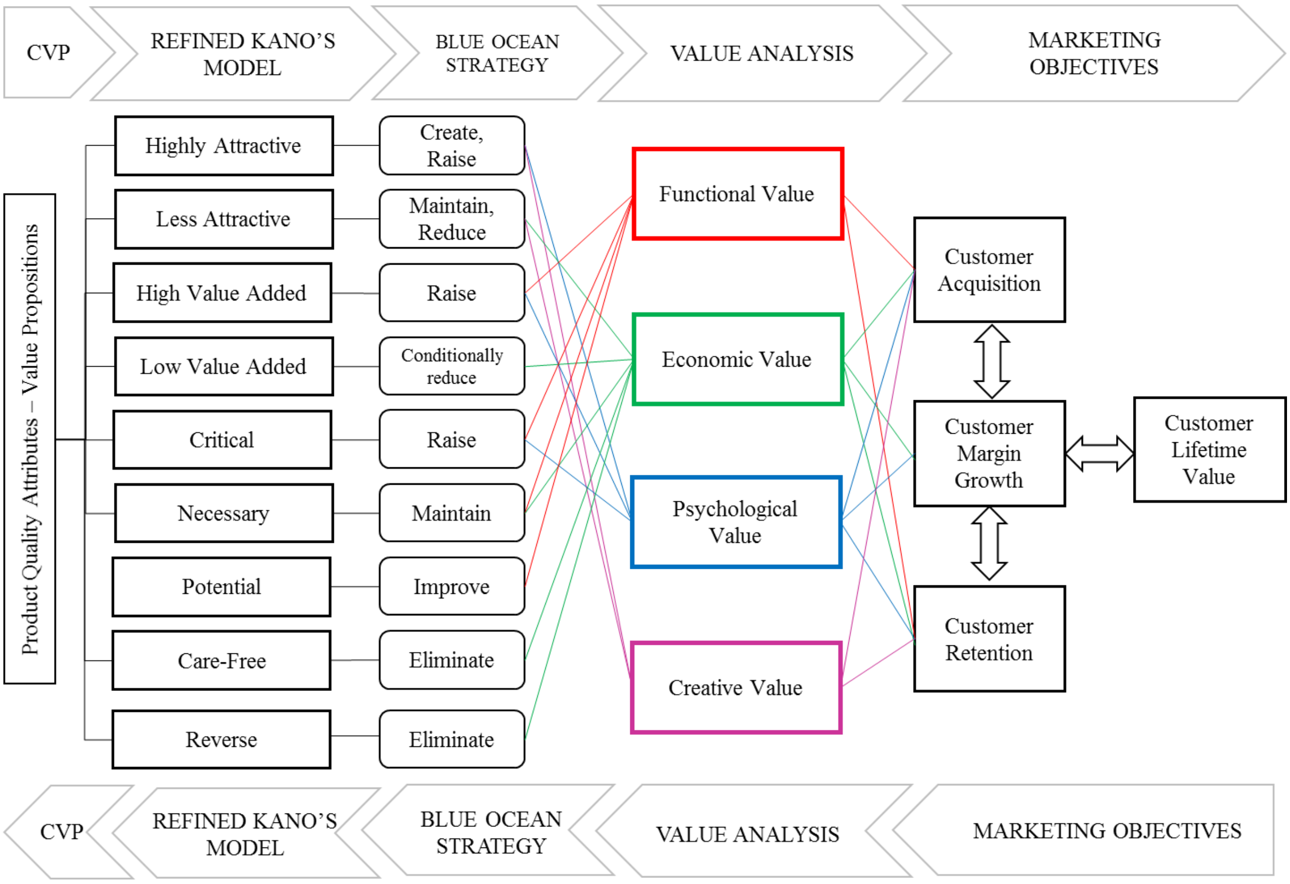


Figure 4: Value Creation Model (Yang & Sung, 2010)

The value creation process can be used in a forward and backward approach. The theoretical description on each entry of the value creation process is discussed; thereafter the analysis of the integrated value proposition design framework is reviewed.

2.3.1 Marketing objectives

There are many definitions of and theories about marketing strategy. For the purpose of this article, the objective of marketing strategy is to increase sales through encouraging customer retention, customer acquisition, or customer growth.

Customer acquisition refers to a new customer making a purchase for the first time (Gupta, Hanssens, Hardie, Kahn, Kumar, Lin, Ravishanker, & Sriram 2006:144). Customer acquisition plays a major role in new markets, when the repeat purchases in a market are infrequent, when an existing market is in a rising phase, and when the costs of transferring between competitors are low (Ang & Buttle, 2006:296).

Customer retention refers to the probability that a customer will repeatedly make a purchase (Gupta *et al.*, 2006:144). Customer retention is an extremely important strategy in a mature market. The costs associated with retaining existing customers are considerably lower than those for acquiring new customers. Customer retention involves having a relationship with a customer with the aim of lengthening customer lifetime (Ang & Buttle, 2006:84).

Customer growth – also known as customer margin expansion – refers to a strategy aimed to grow an individual customer's spending behaviour. Customer growth depends on a customer's past spending behaviour and on the organisation's ability to upsell to the customer (Gupta *et al.*, 2006:144).

2.3.2 Value analysis

Customer value is the trade-off between what a customer knows a product or service costs, and the value that the customer perceives to obtain from it. Customer value depends on how much a product or service contributes to fulfilling customer needs, and how the product or service varies from other competing products or services (Lam, Shankar, Erramilli & Murthy, 2004:295). Value can be added to a customer in four value categories: economic value, functional value, psychological value (Gupta & Lehmann, 2005:7), and creative value (Yang & Sung, 2010:925). Economic value is the financial benefit a customer obtains when using a product or service. Functional value is the practical benefits that a customer receives from the performance or the features of the product or service. Psychological value is the benefits associated with the intangible values of the product or service – for example, brand names. Lastly, creative value is the value added to the customer when they are using the breakthrough idea for the first time.

2.3.3 Blue Ocean strategy

According to Kim & Mauborgne (2004), the business space consists of two types of market environments: 'Red Oceans' and 'Blue Oceans'. Red Oceans represent all the known market environments today. In red ocean environments, organisations know who their competitors are, and there are clear rules for competition. Organisations caught in a Red Ocean aim to overtake the competition and to increase their share of the existing market demand. New products are launched to match or to beat the competition. Blue Oceans represent unknown market environments: in a Blue Ocean the market demand is created rather than battled over between competitors. Blue Oceans can be created in two ways: either by creating a new market environment, or by altering the existing red ocean market in such a way that a new market is created.

The Blue Ocean strategy is a strategic tool set used to exemplify a product or service in a current market. It is known as the 'value innovation', as it differentiates an organisation so that it transforms the market into a new environment, propelling the organisation forward as an industry leader. The Blue Ocean strategy offers four possible strategic actions for the organisation: *Create* new offerings that the industry has never seen before; *Raise* to change existing offerings well beyond the industry norm; *Reduce* to lower existing offerings well below the industry norm; and *Eliminate* offerings that the industry takes for granted (Kim & Mauborgne, 2005).

2.3.4 The Refined Kano's model

Kano's model is a best practice quality measurement tool used in product and service development processes to classify product and service attributes according to how customers perceive them. The Kano's model classifications of quality attributes are key design principles. These classifications measure the effect that a product quality attribute has on customer satisfaction. This provides a logical reasoning to make detailed cost-versus-customer-satisfaction trade-off decisions (Rashid, 2010).

The model classifies product attributes into five categories: *Must-Be* attributes, *One-Dimensional* attributes, *Attractive* attributes, *Indifferent* attributes, and *Reverse* attributes.

Attractive quality attributes lead to utmost customer satisfaction when present in a product. However, customers do not expect to find attractive quality attributes present. The result is no customer dissatisfaction when attractive quality attributes are absent in a product, but extreme customer satisfaction when present. A *One-Dimensional* quality attribute is an attribute that represents a linear relationship between a customer's perception that the quality attribute will satisfy their need and the quality attribute's ability to fulfil it. Better fulfilment in one-dimensional attributes helps to improve customer satisfaction, and contrariwise. *Must-Be* quality attributes are attributes that result in absolute customer dissatisfaction when absent from a product, but that, when present, do not contribute to customer satisfaction. A customer assumes that *Must-Be* quality attributes will be present in a product. *Indifferent* quality attributes do not contribute to either customer satisfaction or dissatisfaction. *Reverse* quality attributes result in absolute customer dissatisfaction when present, and customer satisfaction when absent.

Yang (2005:1129) improved the Kano's model and developed a Refined Kano's model to take into account a customer's perception of the degree of importance of a quality attribute. The model extended the Kano's model to consist of nine quality attributes.

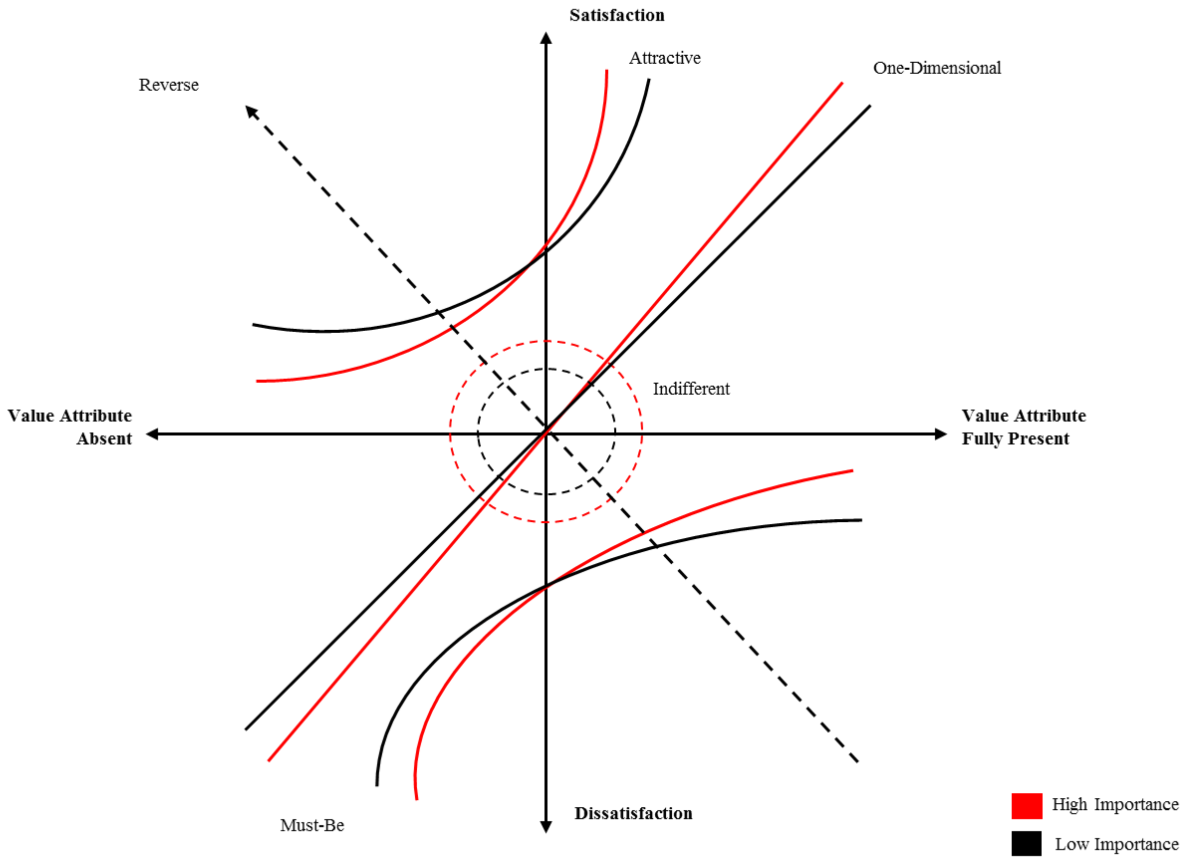


Figure 5: Refined Kano's Model

Attractive attributes with a high importance become *Highly Attractive quality attributes*. These are an organisation's strategic offerings as they, in essence, attract new customers. Attractive attributes with a low importance are *Less Attractive quality attributes*. Less Attractive attributes are attractive quality attributes that customers perceive as less important in a product or service; these quality attributes can be removed in cost-versus-quality trade-offs.

One-Dimensional attributes with a high importance are *High Value-Added quality attributes*. These attributes should be maximised because they generate customer satisfaction to a great extent. One-Dimensional attributes with a low importance are *Low Value-Added quality attributes*. These do not contribute significantly to customer satisfaction; however, organisations cannot avoid these attributes because their absence will cause customer dissatisfaction.

Must-Be attributes with a high importance become *Critical quality attributes*. These are vital in a product, for they represent the core quality attributes a product must have to function successfully. Must-Be attributes with a low importance are *Necessary quality attributes*. Organisations should meet these requirements at a desired level in order to avoid customer dissatisfaction.

Indifferent attributes with a high importance are *Potential quality attributes*. These attributes have the potential to turn into attractive quality attributes if they are improved. Indifferent attributes with a low importance are *Care-Free quality attributes*; these should be completely avoided.

2.3.5 The value creation process analysis

The model allows the decision makers to use a forward and backward analysis to align customer lifetime value through the appropriate strategies of acquisition, retention, and growth to the product quality attributes. The value creation process is analysis in a forward and backward manner.

The forward analysis of the value creation model starts on the left of Figure 4 by classifying product value propositions according to the Kano's refined quality attributes. Thereafter the model recommends which Blue Ocean strategy to use in reaction to a Refined Kano's quality attribute. The effect on customer value that the Blue Ocean strategy has, in conjunction with a Refined Kano's quality attribute, is illustrated in the model. Lastly, the customer value is translated into marketing objectives that result in an optimised customer lifetime value.

The value creation model in a forward analysis can be used as both a tactical and a strategic tool. Tactically the model guides stakeholders to make immediate decisions, to formulate the product value propositions according to the customer, and to realise a value creation process. Strategically, the forward analysis validates whether the product value propositions will realise the organisation's marketing objectives.

A backward analysis can likewise be applied to the value creation model. The backward analysis starts by identifying and prioritising the marketing objectives for a product; thereafter it links the marketing objectives with the customer value categories in order to recognise the customer value categories that need to be fulfilled. The value creation model in a backward analysis can be used as a strategic tool to identify useful actions to optimise the marketing objectives. The value creation model functions as a planning tool to communicate the marketing objectives from senior executives through to marketing managers performing the work.

2.4 QUALITY FUNCTION DEPLOYMENT

To overcome the first limitation of the value creation process, quality function deployment (QFD) is recommended as a quantitative measurement tool to implement the value creation process by prioritising the entries within the process.

The QFD is a very efficient communication and decision-making tool: it takes a subjective attribute and converts it into an objective attribute that can be measured and quantified. Within the QFD the 'House of Quality' enables cross-functional team communication through analytical measurements to ensure accurate and quantifiable results. The QFD's House of Quality brings structure, comparative measurement, and prioritisation into any decision-making process (Hauser & Clausing D. 1988:1).

The integrated value proposition design framework is implemented by using various roll-outs of the House of Quality. The literature review provides an overview of the theoretical application of QFD used in later chapters (Chapters 4 and 7) of this research assignment.

Figure 6 illustrates a House of Quality template.

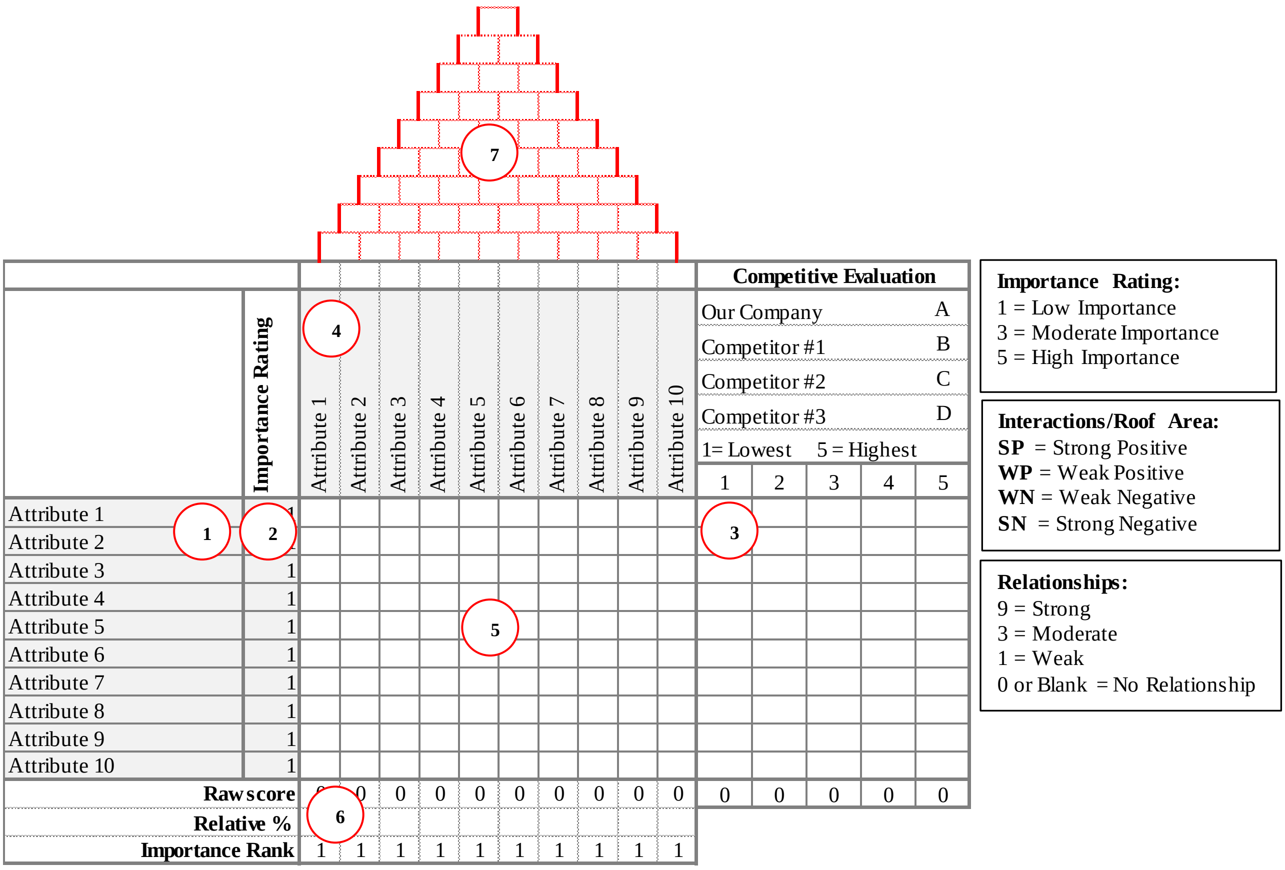


Figure 6: House of Quality Template

The House of Quality is a comparative tool that matches two entries against each other. The order of completing the House of Quality is marked from one to seven in Figure 6. The first step is to fill in the attributes of entry one; thereafter the attributes of entry one are ranked according to their priorities. The third step entails a competitive evaluation of entry one's attributes according to the competitor offerings; this step is optional. The fourth step is to fill in the attributes of entry two into the House of Quality. Step five rates the relationship between the attributes of entry one against the attributes of entry two, varying from robust to weak. Step six prioritises the attributes of entry two relative to the attributes of entry one. Lastly, step seven rates the attributes of entry two according to their correlation against each other. The ultimate objective of the House of Quality is to obtain the importance rating of entry two in step six.

The QFD not only extends the value creation process to overcome its first limitation; it also functions as a communication tool between stakeholders, thus helping the research assignment to comply with the objective of improving integration and communication between PLM stakeholders.

2.5 CUSTOMER SEGMENTATION

The second limitation of the value creation process is that it fails to target the value creation and measurement methods for a specific customer segment. Therefore the theoretical concept of 'customer segmentation' is included within the literature review.

Customer segmentation is the practice of dividing customers into different groups of individuals who have similar needs and characteristics. These target groups, known as customer segments, are alike in specific ways such as gender, age, interests, spending behaviour, and demographics. How the customers are grouped into customer segments varies between organisations and industries. Traditionally it is recommended that customer segmentation should group customers according to their demographic, geographic, and psychological information in order to obtain a subjective presumption about the customer segment. Today customer segmentation is more focused on dividing customers into value bands to obtain an objective presumption about the customer segment. The practice of 'value band customer segmentation' groups customers according to the amount of revenue that individual customers generate for the organisation (Epetimehin, 2011:62-63).

The purpose of value band customer segmentation is to increase customer value or profitability by carefully selecting a specific target group for a product or a campaign. The three key elements to consider when targeting a customer for a product are *what*, *who*, and *how*. The first element for customer segmentation is to identify *what* value will be delivered to the customer. The second element involves identifying the customers *who* will receive the delivered value. The third element identifies *how* the value will be delivered to the customer (Chai & Chan, 2008: 2755). These three elements will determine the customer segment that should be targeted.

One of the most popular methods for grouping customers into segments is a clustering tool (Lien, Ramirez, & Haines, 2006:1). Self-Organising-Maps (SOM) is an artificial neural network clustering tool that aims to find a hidden structure in large amounts of data. The hidden structure is created by converting the data entries into vectors that contain both the magnitude of the data and its position or direction relative to the other data entries. By making use of topology – a graphical description of the arrangements within a network – a direction is provided for each data entry. SOM does not map vectors in a continuous space, but plots the vectors on a two-dimensional map with analogous grid units. Thus SOM has excellent graphical capabilities. The principle of SOM is that if two vectors have similar magnitudes and directions, their positions on a two-dimensional plane are similar, and they are considered to be neighbours. Data attributes are then clustered according to their similarities as presented on a two-dimensional map; in other words, the data entry neighbours with similar attributes are clustered. The cluster values returned are the mean values of the grouped vectors. In order to make the best use of SOM's capabilities, the data assessments have to be relevant. For example, it would be relevant to cluster the spending behaviour of a customer together with the customer geographic locations, while it would not be relevant to map the spending behaviours of customers with their favourite choice of food (Wehrens & Buydens, 2007:2).

2.6 CUSTOMER EXPERIENCE

The third limitation of the value creation process is that it fails to include customer experience designs. The value creation process is extended into an integrated value proposition design framework by customer experience analysis theoretical concepts. 'Customer experience' is a concept that describes the emotions evoked while the customer engages with the organisation's product and service at different touch points. These touch points can be defined as either 'direct' or 'indirect'. A direct interaction with the organisation takes place when a customer purchases and uses a product. An indirect interaction with the organisation encompasses various encounters with the product's brand, including word-of-mouth encounters and criticisms (Meyer & Schwager, 2007:2).

Customer experience consists of every characteristic of the organisation's offerings. The customer experience not only depends on the organisation's customer care services, but also includes the benefits obtained from working with the actual product, the advertisements, the product and organisational brand, and the product's and organisation's reliability. Every current engagement of the customer with the organisation, and every past experience, determines the customer's current experience with the organisation.

The customer's experience of the organisation can be enhanced by designing a product or service to promote customer interaction (Johnston & Kong, 2011). This is done by capturing customer experience information, describing the customer experience in terms of a customer 'journey', and managing the organisation's customer touch points. The customer journey (cf. Bolton, Gustafsson, McColl-Kennedy, Sirianni, & Tse, 2014; Lee, 2009) captures the experience that the customer wishes to have while engaging with the organisation, product, or service throughout the 'cradle-to-grave' lifecycle of the product or service. Within this, customer touch points (Clatworthy, 2011: 16) refer to any point of contact where the customer and the organisation meet to exchange benefits.

The data capturing process of a customer experience analysis entails capturing past, present, and future customer experience data. Meyer and Schwager (2007:6) explain that past customer experience patterns take into account all (or a large number of) the customer transactions completed by individual customers. Present customer experience patterns focus on monitoring and designing a continuous relationship and interaction with the customer. Future customer experience patterns are the exercise of constantly searching for new opportunities to enhance the customer experience.

The data capturing methods for past, present, and future customer experience patterns vary. For past patterns, the data capturing methods should be ongoing, incorporating information feedback loops, and making use of web-based surveys and social networks. The past customer experience patterns are intended constantly to improve the customer experience; they measure and identify trends, and test the implication of new customer value propositions. The data capturing process for present customer experience patterns is periodic: the data should be captured either by directly contacting the customers through phone calls or focus group sessions, or through a detailed customer survey. The present customer experience pattern is aimed at capturing the current relationship and experience issues with the organisation. Future customer experience patterns use once-off data-capturing methods: the data-capturing process is driven by specific objectives, and would use detailed customer interviews. The purpose of future customer experience patterns is to identify and test future opportunities and to resolve major inquiries.

After the data of the customer experience has been captured, the data is transformed into a customer journey map and a customer touch-point management plan. The customer journey is a timeline that illustrates and documents how an organisation will engage with its customers, and what the organisation expects its customers to experience at that point in time, as a response to optimise the customer's experience from their past, present, and future experience endeavours captured in the previous activity. A customer journey is captured to identify how the organisation can uniquely differentiate its products from those of its competitors. A customer journey map stimulates a creative initiative to generate new customer value propositions that will result in customer acquisition, customer retention, and – eventually – increased profits.

The last activity in customer experience analysis is to monitor and manage the customer touch points. The customer's opinions at the various touch points describe the customer's experience of the organisation. Touch points are key design elements, because they create an opportunity for an organisation to use the point of connection to their benefit, and thus to create unique customer value propositions (Clatworthy, 2011:16). In order for an organisation to offer a unique customer experience, it has to deliver unique customer value propositions within the customer touch point engagements.

2.7 CUSTOMER LIFETIME VALUE

The fourth limitation of the value creation process is that it does not explicitly account for customer lifetime value (CLV) modelling. CLV modelling is included in the stochastic simulation and forecasting model that supports the integrated value proposition design framework to facilitate the economics of a customer-centric organisation at a high level.

CLV is a prediction of the present net profit worth of a customer across the period of customer engagement. Various researchers have conducted studies on how organisations should manage customers as investments across their lifetimes (cf. Gupta *et al.*, 2006; Gupta & Lehmann, 2005). A customer-centric organisation aims to maximise its customer spending behaviour on an individual customer level. CLV modelling provides a way to guarantee that an organisation will not overspend on a customer who does not generate a sufficient amount of profit, but rather shifts the organisation's focus to distribute their marketing spend towards those individual customers who will ensure maximised profits.

The basic principle of CLV is that an organisation's marketing efforts have a direct impact on its customer spend, which in turn determines the lifetime value of a customer – or the probability that a customer will generate profits for the organisation in the future, known as 'customer equity'. The CLV, together with customer equity, forms an alternative representation of an organisation's total enterprise value. Figure 7 illustrates the principle of CLV calculations.

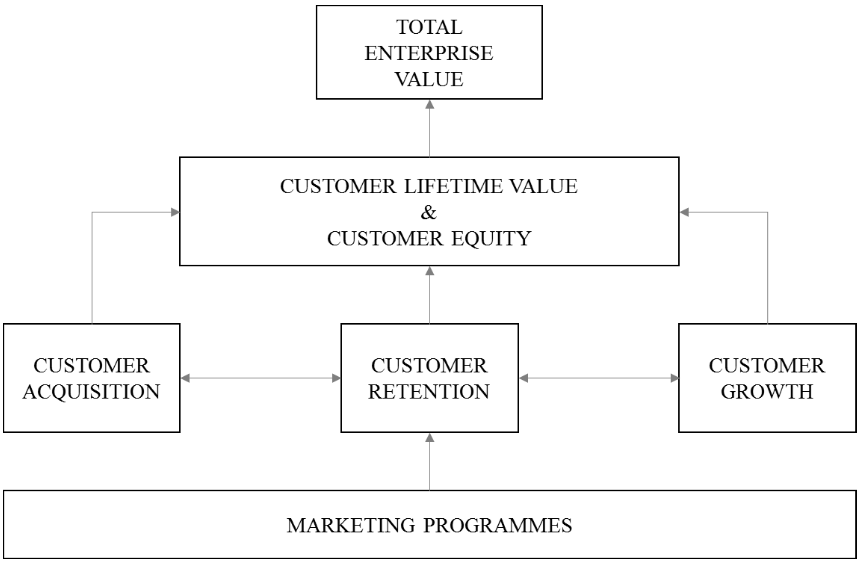


Figure 7: Principle of Customer Lifetime Value Modelling (Gupta et al., 2006:140)

CLV is calculated on an individual customer level. It incorporates the possibility that customers can leave the organisation for competitors, and the marketing cost of acquiring the individual customer. The CLV per customer is calculated as follows (Gupta *et al.*, 2006:141):

$$CLV = \sum_{t=0}^{T} \frac{[P_t - C_t]r_t}{(1+i)^t} - AC$$

Where:

- P_t is the price a customer pays at time t,
- C_t is the direct cost of the product or service at time t,
- i is the discount rate at time t,
- r_t is the probability that a customer will return to the organisation at time t,
- AC is the acquisition cost of the customer, and
- T is the lifetime period of customer engagement.

Various modifications and extensions have been applied to modelling CLV. However, for the purpose of this study, the CLV is based on the discounted cash flow method on an individual customer level. CLV is an accurate metric to validate an organisation's marketing efforts.

2.8 PRODUCT LIFETIME UPTAKE MODELLING

The fifth limitation of the value creation process is that it does not integrate a product lifetime uptake forecasting methodology. A product lifetime uptake model is included in the stochastic simulation and forecasting model of the integrated value proposition design framework to facilitate the economics of a customer-centric organisation at a high level.

The process of adopting a product for a market is one of the most frequently-used tools in marketing. The product lifecycle is a centre for marketing communication and strategic planning. Two of the most widely-known product uptake models are Rogers' (1962) 'diffusion of innovations' model, and the Bass model (Bass, 1969), which overcomes some of the shortcomings of the 'diffusion of innovations' model. Brief background on the diffusion of innovations model will be provided, followed by an in-depth discussion of the Bass model and its extensions.

2.8.1 Diffusion of innovation

The diffusion of a product in a market is subject to four basic factors. The first involves the product offering; the second is the social system in which the product needs to diffuse; the third is the communication channels within the social system; and the fourth involves the timing of the adoption (Rogers, 1983:10).

Rogers (1983:247) defines the diffusion of a new product in a market as a normal distribution with a characteristic bell-shaped curve. The cumulative product uptake results in an S-shaped curve. Rogers' model is known for dividing the process of new product diffusion into adopter category phases. The groups are divided according to their standard deviation position from the mean of a normal distribution curve. Figure 8 shows the adopter classifications and the approximate percentage of adopters in each category. The adopter categories depend on the product offering.

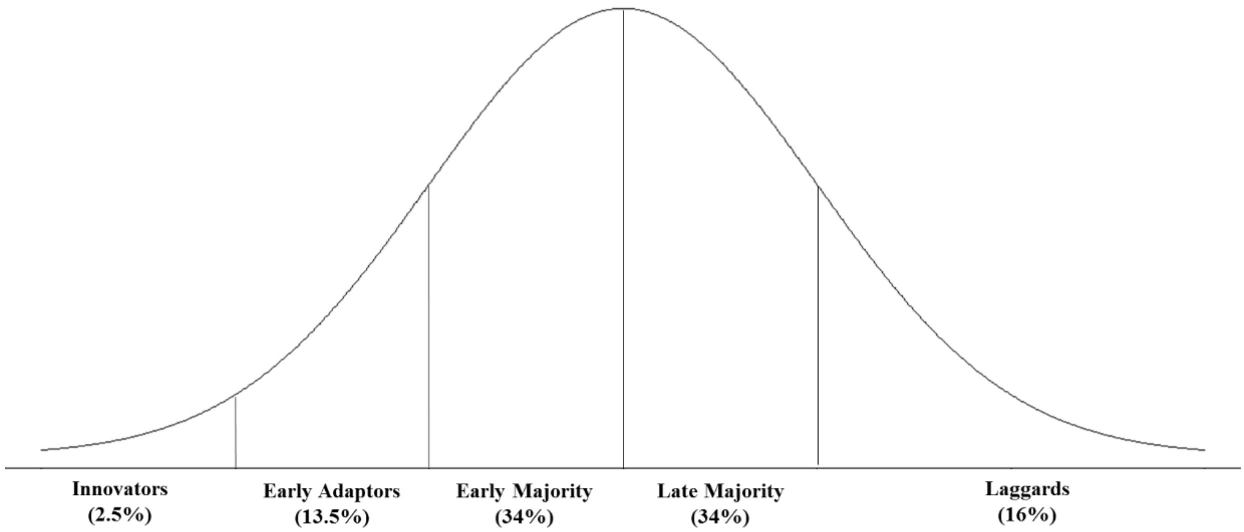


Figure 8: Diffusion of innovation (Rogers, 1983)

The individuals in each adoption category have certain characteristics that differentiate them from the others. *Innovators* can be characterised as eager, venturesome, and bold, generally coupled with being financially strong. *Early adopters* are characterised as successful, respectable role-models; they are the individuals whom the rest of the social system admires and follows: they are not too far behind in adopting to the new product, and they have done their homework thoroughly before adopting to it. The *early majority* individuals are deliberate and willing to adopt to a new product: they deliberately choose to not be leaders in adopting to the new product, but they will not be the last to adopt to a product. The *late majority* can be characterised as sceptical and careful: they will not adopt to a new product unless the larger part of the social system has adopted to it. Lastly, individuals who are *laggards* can be characterised as unaware, traditional, and outdated. These individuals either are not financially strong enough to take the chance to adopt to a product that might fail, so they lag in adoption, making sure the product does work; or they simply do not have an interest in being among the first to adopt to the product (Rogers, 1983:251).

Rogers' model immensely contributed to the diffusion theory of new products. However, Wright and Charlett (1995:35) identified the limitations of the model. The most prominent of these is that the model depends on the standard deviation from the mean of the distribution; and standard deviations cannot be identified until the diffusion process is complete, which is often too late. The Bass model overcomes this limitation by being a new product adoption forecasting model.

2.8.2 The Bass model

Frank Bass developed a new product diffusion model, known as the Bass model, in 1969. It can accurately forecast the life-cycle sales pattern for products under two conditions: either the product was recently introduced into the market, and sales have been observed for a period of time; or the new product is similar to an existing product with known sales figures (Bass, 1969).

The principles of the Bass model are that it determines the probability that a consumer will adopt to a product, given that the consumer has not yet adopted to it. The model describes the product life-cycle as an interaction between consumers and potential consumers. The timing of a consumer's initial purchase of a product depends on the number of previous buyers of the product. Lastly, the model describes the interaction between consumers, in terms of individuals behaving in an innovative and imitative manner.

The Bass model equation is this:

$$n_t = pm + (q - p)N_{t-1} - \frac{q}{m}(N_{t-1})^2$$

where

- m represents the total number of initial buyers over the period of interest,
- p is the coefficient of innovation,
- q is the coefficient of imitation,
- n_t is the number of initial buyers at time period t, and
- N_t is the cumulative number of initial buyers at time period t.

2.8.3 Bass model parameter estimation

The most successful way to determine the Bass model's parameters is to use a nonlinear least squares estimation procedure, as recommended by Srinivasan and Mason (1986:171). The Bass model's cumulative distribution function for the time of adoption is given as follows (cf. Bass, 1969; Srinivasan & Mason, 1986):

$$G_t = cF_t = \frac{c(1 - e^{-bt})}{(1 + ae^{-bt})}$$

Srinivasan and Mason suggest that the parameters $p*$, $q*$, and $m*$ are obtainable through the use of the following function for the number of adopters $X(i)$ in the i^{th} time interval (t_{i-1}, t_i) where u_i is the standard error per time interval (Satoh, 2001:3):

$$X_i = m(F(t_i) - F(t_{i-1}) + u_i \text{ ; or}$$

$$X_i = m\left(\frac{1 - e^{-(p+q)t_i}}{1 + \left(\frac{p}{q}\right)e^{-(p+q)t_i}} - \frac{1 - e^{-(p+q)t_{i-1}}}{1 + \left(\frac{p}{q}\right)e^{-(p+q)t_{i-1}}}\right) + u_i$$

where:

- u_i is the standard error of iteration i.

The Bass model parameters can be predicted from product uptake data. Either the product has been launched in the market, and the product uptake patterns have been observed for a certain period of time; or an existing product's uptake data with similar product features is used. The nonlinear least squares estimation procedure overcomes the gap of the interval time series data, and presents an appropriate continuous time model. The standard error term is due to a combination of sampling errors, external influences (such as economic conditions and marketing mix attributes), and the misspecification of the density function (Srinivasan & Mason, 1986:171).

2.8.4 The Bass model structure

The structure of the Bass model is presented in Figure 9.

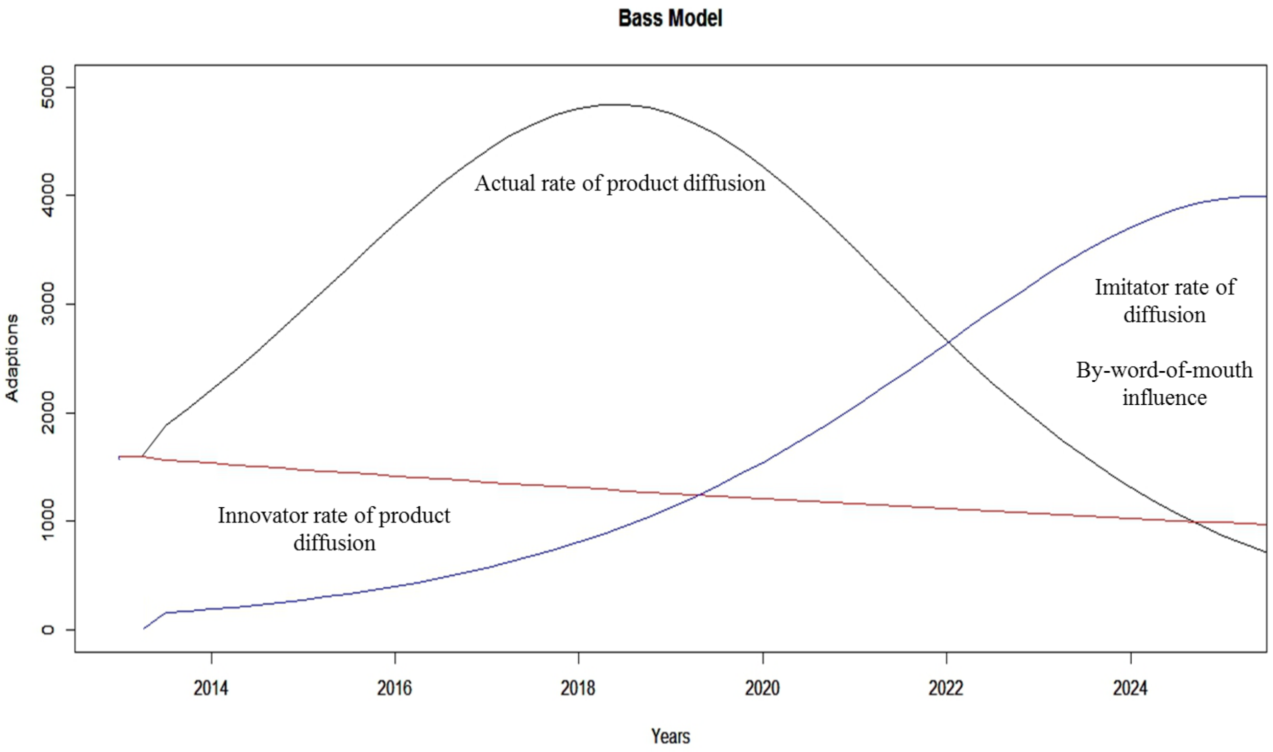


Figure 9: The Bass model structure

The concepts of 'innovators' and 'imitators' are illustrated in Figure 9. The innovator parameter *p* is independent on the diffusion of the product through the market, and does not follow the diffusion pattern of the majority of the social environment. Parameter *q* imitates the behaviour of the greater social environment. The innovators are responsible for speeding up the diffusion process by enhancing the social network's internal influencers, such as by-word-of-mouth exposure to the product.

Bass (1969) extended the work of Rogers' diffusion theory (1962) to incorporate the timing of product adoption. Therefore the characteristics of innovators and imitators closely relate to Rogers' classifications of adopters (see Figure 8).

Innovators are adventuresome and daring. These individuals are inspired by change, and constantly seek to discover new products on their own terms. Innovators decide to adopt to a product or an innovation independently of the decisions of other individuals in a social network, and tend to interact with other innovators. The pressure on an innovator to adopt to a product does not increase with the growth of adoption from other individuals within the social network. Innovators have a greater influence in the early stages of the product lifetime uptake model than when the innovation becomes more widely purchased or used.

Imitators are individuals who are influenced by the timing of adoption, through the pressure caused by the number of previous adopters in the social system. The more individuals that have adopted to a product, the more an imitator feels the pressure also to adopt to the product. An imitator's need for change is driven by what their society and peers tell them to purchase in order to remain relevant.

2.8.5 The generalised Bass model

Bass, Krishnan and Jain (1994:204) developed a generalised Bass model that incorporates the effect that a difference in a product's price and advertising spend has on the likelihood of adoption at time T. This is done by adding a multiplicative factor *x(t)* to the original model.

$$n_t = \left[pm + (q - p)N_{t-1} - \frac{q}{m}(N_{t-1})^2\right] x_t$$

where x_t is:

$$x_t = 1 + \alpha\left(\frac{P_t - P_{t-1}}{P_{t-1}}\right) + \beta\, max\left\{0, \frac{A_t - A_{t-1}}{A_{t-1}}\right\}$$

- α is the coefficient representing the percentage of increased diffusion speed due to a one percent decrease in the price of the product,
- P_t is the price of the product at time period t,
- β is the coefficient representing the percentage of increased diffusion speed due to a one percent increase in advertising spend, and
- A_t is the advertising spend at time period t.

2.8.6 Monte Carlo simulation

Monte Carlo simulation is a method that incorporates sensitivity analysis into equations to account for any uncertainties in model parameters (Metropolis & Ulam, 1949:340-341). Any parameters in a mathematical model with inherent uncertainty are replaced with a probability distribution function. The results are calculated thousands of times, using a different set of variables from the probability distribution function. A product uptake model combined with a Monte Carlo simulation holds numerous advantages, as it gives a probabilistic result and a graphical explanation of the various scenarios that could be realised within the forecasted time, and it simplifies sensitivity and correlation analysis.

The Monte Carlo simulation input parameters are random numbers generated form a distribution function. It is essential to use the right probability distribution function for the particular Monte Carlo simulation. The probability distribution function represents the general distribution process of the scenario. The most often-used distribution functions in a Monte Carlo Simulation are a rectangular distribution function, a normal distribution function, and a triangular distribution function. A rectangular distribution function has a constant probability. The normal distribution function is the closest representation of a natural phenomenon. The normal distribution is a symmetrical bell-shaped curve, and is determined by two parameters: the distribution mean and the standard deviation. A triangular distribution is a distribution function with a lower limit, an upper limit, and a mode with a triangular curve.

The accuracy and the effectiveness of the Monte Carlo simulation increases as the number of runs increases. The optimal number of iterations for a Monte Carlo simulation is calculated as follows:

$$\varepsilon = \frac{Z\sigma}{\sqrt{runs}}$$

where:

- Z is the confidence multiplier of a two tailed normal distribution,
- σ is the standard deviation thereof.

The only two options to decrease the standard error of a Monte Carlo simulation are either to increase the number of runs or to lower the confidence level. Each Monte Carlo simulation should be assessed independently to determine the confidence level, standard error, and the number of runs that are optimal for the unique modelling scenario.

2.9 GOODWILL FIRM VALUE

The sixth limitation of the value creation process is that it does not quantitatively determine the value obtained by the organisation through the value creation process. This limitation is overcome by using the CLV modelling methods and the product lifetime uptake modelling methods to predict an organisation's 'goodwill firm value'.

The firm value obtained from the sum of the customers who accepted the value propositions created in the value creation process is known as 'goodwill firm value'. The chapters that follow will illustrate how the value creation process – in combination with the methods used to extend the value creation process into an integrated value proposition design framework – clearly provides a way to calculate the goodwill firm value.

Goodwill firm value is defined as an intangible asset of an organisation, which attempts to quantify the worth of an organisation's customer base, customer relations, brand, and other intangible organisational elements that contribute to the success of an organisation in a market. An organisation's goodwill firm value usually gets accounted for when an organisation's worth is considered to be much higher than the organisation's book value.

Goodwill firm value is attached to a specific organisation: it cannot be sold without the organisation being sold with it. Goodwill is accounted for in two ways: either the goodwill firm value is determined internally, or it is measured as part of the acquisition of an organisation (Johnson & Tearney, 1993).

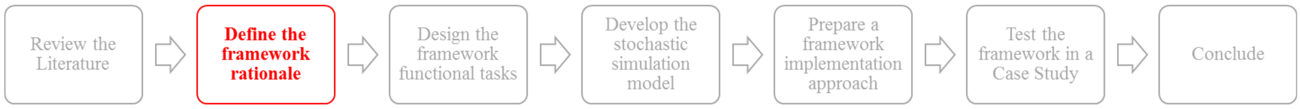
2.10 MODELLING SOFTWARE

The integrated value proposition design framework makes use of two software applications. The software used to build the stochastic simulation and forecasting model is R (CRAN R software, R language reference, version 3.1, available at http://cran.r-project.org/), an open source software environment and language used for statistical computing that can effectively store and handle data, has good graphical capabilities, and can easily be extended with a vast number of CRAN packages covering various research fields of interest. The prioritisation and the implementation of the framework tasks are conducted with SnapSheets XL (SnapSheets XL Software for Microsoft Excel, version 2007, available at http://www.sigmazone.com/snapsheetsxl.htm), an Excel add-in for quality function deployment (QFD).

2.11 LITERATURE REVIEW - CONCLUSION

The literature review provides a detailed theoretical description of the value creation process and of the methods and tools used to extend the value creation process to overcome its limitations in relation to the objectives of the research assignment. The theoretical descriptions of these concepts are the foundation for the implementation of the framework. Given that the literature review thoroughly describes the theoretical background of the framework, the chapters that follow are focused on the formulation, implementation, and validation of the framework.

3 CHAPTER THREE: RATIONALE OF THE INTEGRATED VALUE PROPOSITION DESIGN FRAMEWORK



The rationale of the framework is to move from a traditional product-centric PLM focus to a customer-centric focus. This means that the entire lifecycle, from concept to delivered product, is aligned towards the need and wants of the customer. In order to gain market share and financial benefits from this approach, the framework needs to be able to reduce time-to-market during the product lifecycle, and increase product quality from the perspective of the customer. To do so requires the incorporation of a number of practices into PLM that address the shortcomings and complexities of current PLM systems.

3.1 EXISTING PLM PRACTICES

There are two distinct characteristics of the existing PLM practice that this research assignment attempts to improve. The first characteristic is that it has a strong product-centric focus; the second is that PLM typically follows a serial processing method. These two characteristics, together with the current modus operandi, are described below.

Numerous business processes within an organisation are performed across the product lifecycle. PLM is the business strategy used to manage the various business processes in a collaborative manner. Business processes used within PLM include product planning, customer requirements identification, conceptual and detailed designs, conceptual development and prototyping, manufacturing, outsourcing, inventory management, operations, and waste management.

Liu, Zeng, Maletz and Brisson (2009:3) identify the key role-players in PLM and rate each of the role-player's influence in the PLM phases. The most prominent role-players are customers, developers, suppliers, manufacturers, distributors, and maintainers. For the purpose of this study it is noted that customers only play a major role in the product concept development phase and in the product use phase within PLM. Liu *et al*. (2009:3) also summarise the business processes involved in the various phases of PLM; again it is noted that a key business process in the concept development stage is to identify customer requirements. Therefore the first characteristic of PLM can be described: the existing PLM practice is predominantly product-centric; the only focus on the customer within the existing implementation of PLM is found largely within the initial concept development phase of the product lifecycle, whereas the implementation of PLM is product-centric within the majority of the succeeding phases of the product lifecycle.

Figure 10 illustrates the existing approach to PLM implementation, and the business processes involved within the PLM throughout the product lifecycle stages.

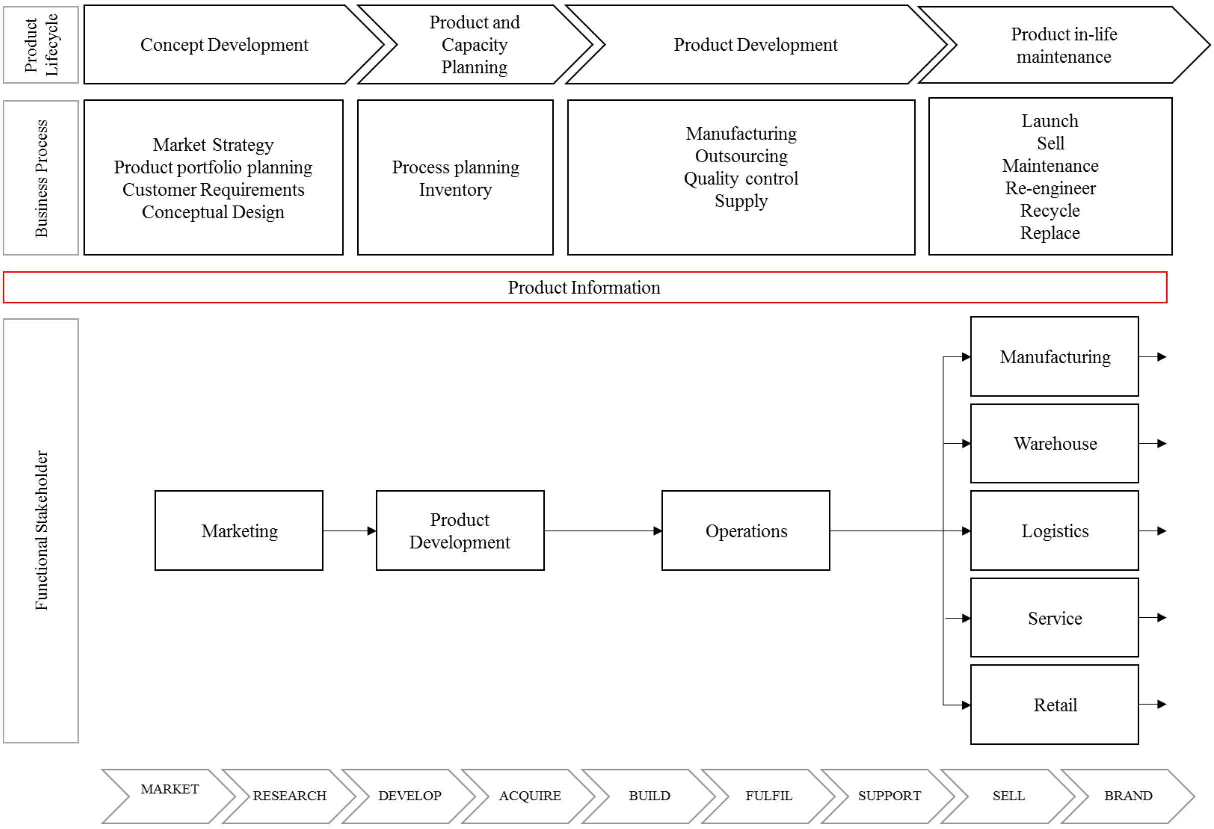


Figure 10: Current approach to PLM

Figure 10 identifies the multifunctional teams that are classically involved within PLM to accomplish the business processes throughout the various stages of the product lifecycle.

The second characteristic of PLM is that it follows a serial processing method. That means that stages follow completed stages within the PLM. For that reason most of the multifunctional teams are not involved throughout the entire implementation of PLM: their expertise is only used to deliver a business process where required. One multifunctional team would hand their work over to the next multifunctional team in a serial manner.

The scope of PLM is immense, and differs between organisations and types of products. Even though the methodologies and procedures within PLM vary between organisations, PLM is generally implemented to reduce the go-to-market time for new products, and to improve the performance of existing products in a market.

3.2 NEW APPROACH TO PLM

The rationale of the integrated value proposition design framework is to promote customer-centricity in the implementation of PLM, and to introduce multifunctional team integration and business process parallelism into PLM.

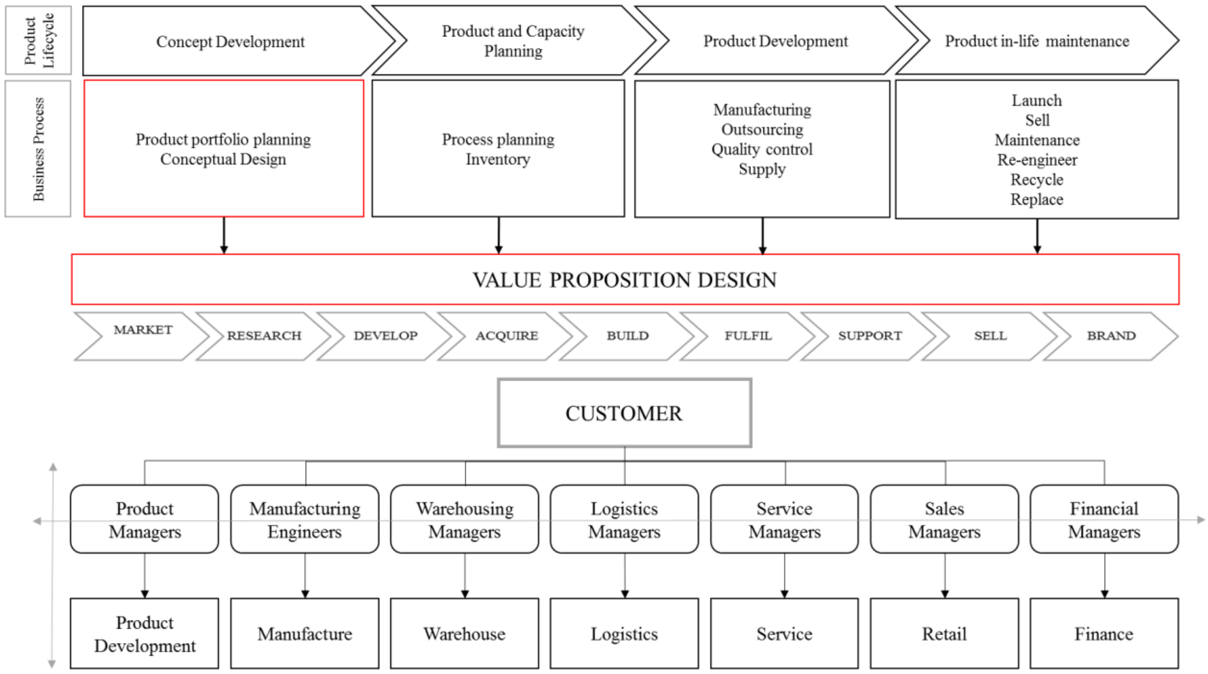


Figure 11: New approach to PLM

The new approach to PLM is shown in Figure 11. The new approach is achieved by adding a universal integrated value proposition design framework to the implementation of PLM.

The first characteristic of the new approach to PLM implementation is that the framework replaces the existing business processes that are focused on defining customer requirements, and extends the entire customer-centric focus in PLM throughout the entire product lifecycle. The focus of data-capturing in PLM will revolve strongly around the customer and the value creation process between the customer and the organisation. The value proposition design process is embedded in the integrated value proposition design framework. The formulation and management of products happens through the design and maintenance of a product's value propositions.

The second characteristic of the new approach to PLM implementation is that the framework uses parallel processing of tasks and cross-functional multifunctional team integration within the value proposition design process.

3.3 DETAILED OBJECTIVES OF THE INTEGRATED VALUE PROPOSITION DESIGN FRAMEWORK

The ultimate purpose of any product development effort is to launch a successful product in a market so that it will generate sufficient profit for the organisation within targeted time frames. Successful implementation of PLM supports organisations in realising increased profits.

In order to ensure that the integrated value proposition design framework extends the PLM system to the optimal extent, a number of key objectives for the integrated value proposition design framework have been defined.

The first objective is to make use of best practices to increase the effectiveness and efficiency of PLM. Effective PLM captures the right information at every stage of the process to create an information system that will productively support the lifecycle management of complex products. An efficient PLM system supports the product development and product portfolio management functions at the right time and in the right manner, providing the multifunctional teams with accurate and informed data to support the decision-making efforts end-to-end in the product lifecycle.

The second objective is to create a deeper understanding of customer requirements, problems, and market opportunities, whilst simultaneously tracking customer value creation. This objective is set to explain and record the procedure of transforming a customer requirement into a marketing objective – and contrariwise, to ensure that a marketing objective will be realised by addressing certain customer requirements.

The third objective is to integrate the members of large multifunctional team across various departments into the value proposition design process. This will be done by making use of best practice design principles and project management methods.

The fourth objective is to simplify all value proposition design elements into a one-page design for communication purposes. This enables the team to simplify communication and integration requirements on a strategic and tactical level, as has been successfully applied in the course of business model design (cf. Osterwalder, 2012).

The fifth objective is to support trade-off analysis and decision-making efforts in the design process by means of a quantitative measurement tool. This tool functions as a communication tool between multifunctional team members so that they can reason together over decisions. It is used as a mechanism to compare different factors quantitatively, to trade off options, and to make the most suitable decision within the framework.

The sixth and last objective is to determine the actual worth of the customer value propositions for the organisation by means of a stochastic simulation and forecasting model. This model has the ability to determine quantitatively the financial benefit that the organisation could obtain from the customer value propositions.

3.4 THE INTEGRATED VALUE PROPOSITION DESIGN FRAMEWORK

Figure 12 presents the outline of the integrated value proposition design framework.

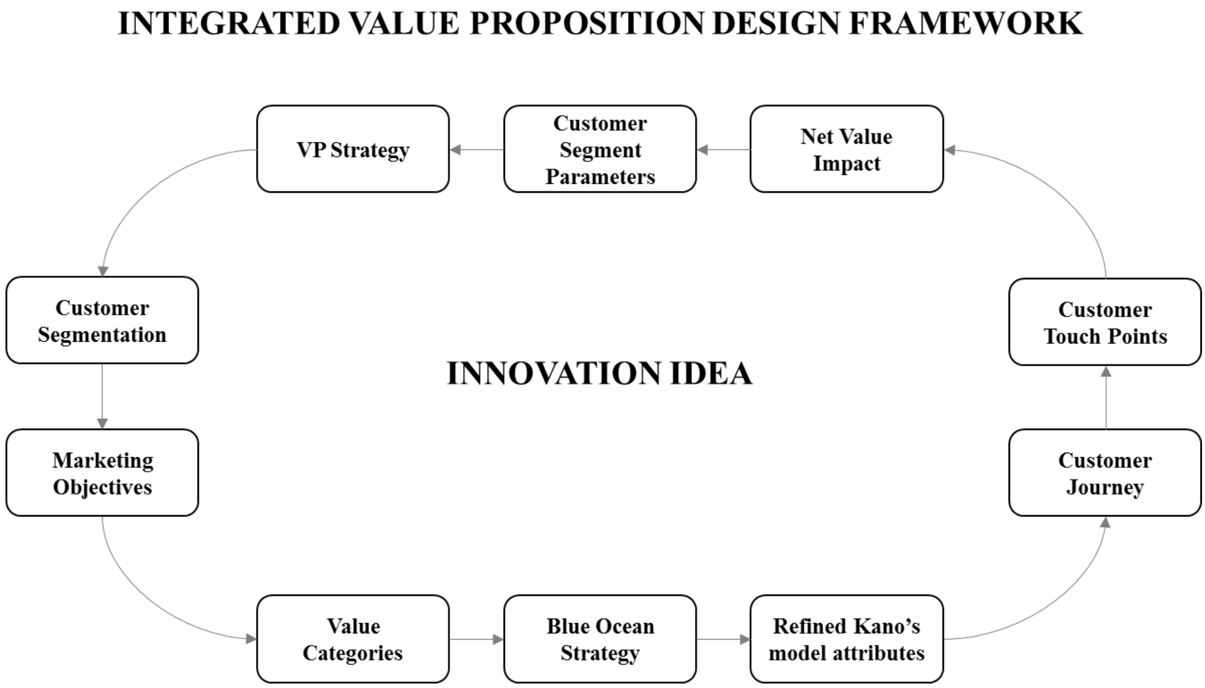


Figure 12: Outline of the integrated value proposition design framework

The integrated value proposition design framework is a top-to-bottom methodology to create a customer-centric focus in PLM. It is an amalgamation of various customer-centric tools, methods, and processes, and functions as a planning and communicating methodology. The framework is implemented by delivering robust and meticulously-chosen process steps at various intervals to bring about a detailed and thorough set of customer value propositions for a product that is in line with the organisational objectives. A stochastic simulation and forecasting model supports the framework that amounts to the economics of a customer-centric organisation at a high level. The economics of the integrated value proposition design framework provide a forecast of the net value impact of the product via the customer lifetime value for the organisation, and deliver an objective presumption of the crucial customer segment parameters – which in turn emphasise the need for new product value proposition design.

The outline presented in Figure 12 extends to the framework illustrated in Figure 13, which graphically shows how the value creation process is extended to overcome the limitations of the existing literature to comply with the objectives of the research assignment.

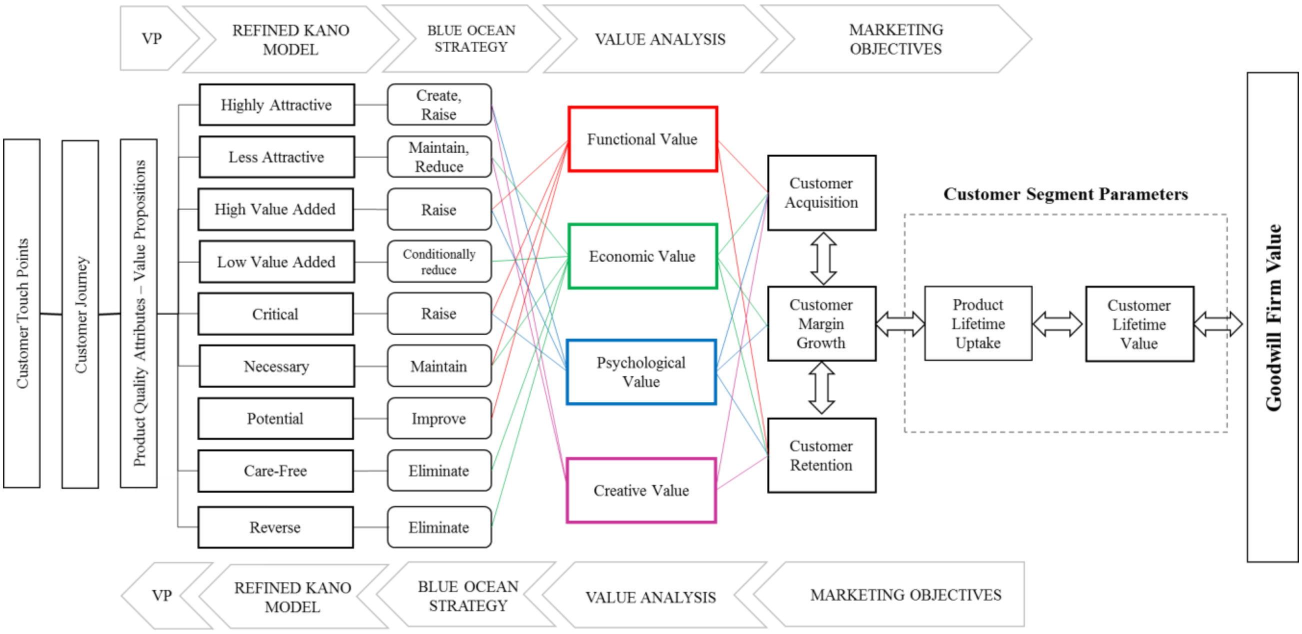


Figure 13: The integrated value proposition design framework

3.5 RATIONALE – CONCLUSION

The rationale of the integrated value proposition design framework is to extend the customer-centric focus within PLM to apply over the entire product lifecycle, and to introduce business process parallelisation into the implementation of PLM. This is achieved by adding an integrated value proposition design framework to the implementation of PLM, incorporating a comprehensive value proposition design methodology into PLM. This methodology reasons that the formulation and management of products happens through the design and maintenance of a product's value propositions, and that the success of a product should be measured in terms of the success of the customer value propositions as the customers perceives them. The chapters that follow explain the formulation, implementation, and application of the framework in greater detail.

4 CHAPTER FOUR: FUNCTIONAL DECOMPOSITION OF THE INTEGRATED VALUE PROPOSITION DESIGN FRAMEWORK

This chapter explains the functional relationship between the constituent activities of the integrated value proposition design framework. The seven-step functional relationship process of the integrated value proposition design framework is illustrated in Figure 14. The aim of the functional decomposition of the integrated value proposition design framework is to describe the purpose of each constituent activity within the framework, and systematically to portray the functional relationships between the activities.

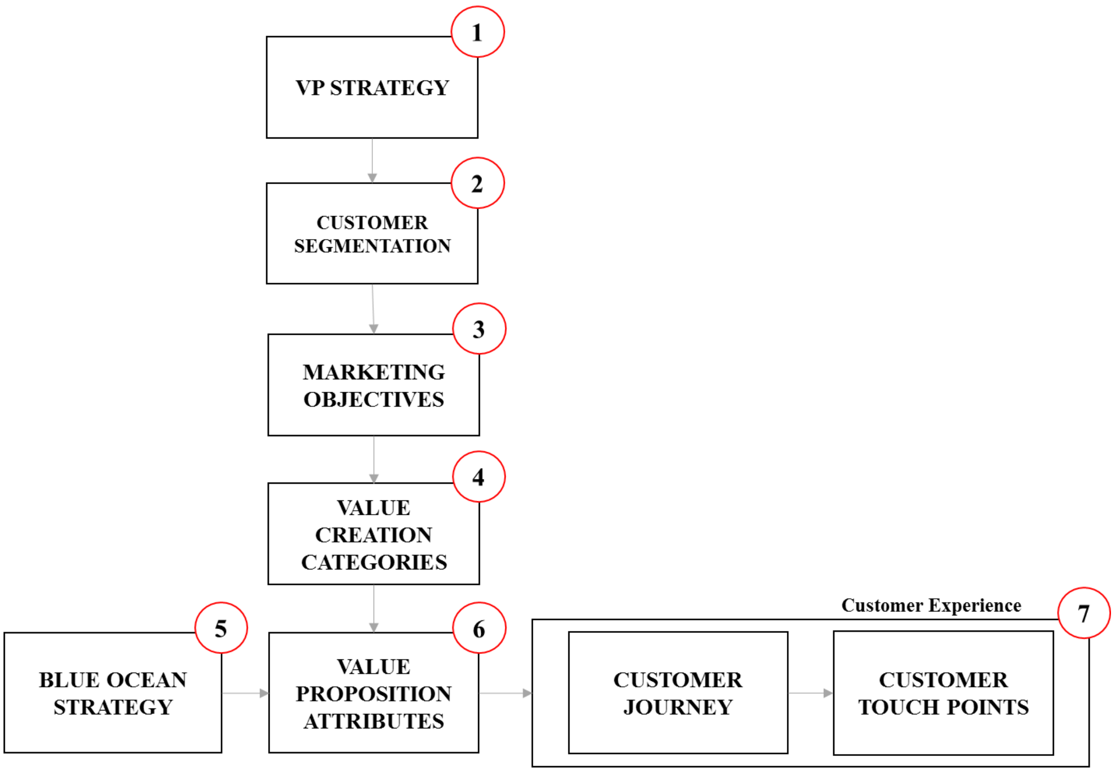


Figure 14: The integrated value proposition design framework process

The process starts with an initial value proposition strategy; thereafter the target customer segment is selected, the framework uses the value creation process to perform tasks three to six, and then it links the customer value proposition elements of the product with the customer experience designs to formulate a complete customer-centric set of customer value propositions for the product. The paragraphs below provide a detailed description of the seven steps: the value proposition strategy, customer segmentation, marketing objectives, value creation categories, Blue Ocean strategy, value proposition attributes, customer journey, and customer touch-points.

4.1 VALUE PROPOSITION STRATEGY

The integrated value proposition design framework opens with a value proposition strategy, which is a combination of four activities: a market analysis, a customer value proposition statement, a business motivation, and a key stakeholder allocation. The value proposition strategy results in a high-level business plan.

The main purpose of the value proposition strategy functional task is to provide the senior executives of the organisation with enough information to make informed decisions about whether the new product development initiative has sufficient potential to be developed into a product, and whether the effort of combining the multiple resources and multifunctional teams to conduct the integrated value proposition design framework will justify the effort.

4.1.1 Market analysis

The market analysis is an evaluation of the market environment in which the organisation aims to launch the new product, and forms the basis of the entire new product development initiative. The definition of a product's market is unique for every new product initiative. It can be defined in terms of its customers' geography, demographics, or spending behaviour. The market analysis, as part of the value proposition strategy functional task, includes a description of the trends in the industry, the characteristics of the target market, and an assessment of the industry competition and of the competition's customer value propositions.

The market analysis can make use of strategic management techniques to evaluate the market. Such techniques include a SWOT analysis, which identifies the internal environmental factors of the organisation (the strengths, weaknesses, opportunities, and threats); and a PEST analysis, which identifies the external environmental factors of the organisation (the political, economic, social, and technological factors of the market) (Cadle, Paul & Turner, 2010:4, 6, & 14).

4.1.2 Customer value proposition statement

A new product idea cannot be developed if the idea does not have a compelling set of customer value propositions. A product is defined in terms of its features – the most basic units that comprise a product. In the integrated value proposition design framework, the core product features are regarded as customer value proposition elements; each basic element of a product is a value offering to the customer, for which the customer in turn is willing to pay. The value proposition strategy functional task brings about a first set of customer value propositions for the new product initiative.

The customer value proposition elements are defined over an organisation's value chain activities, which are the activities of the organisation's business units. The activities of the organisation's business units contribute cohesively to the total value being delivered to the customer.

Figure 15 graphically displays an organisation's typical value chain breakdown.

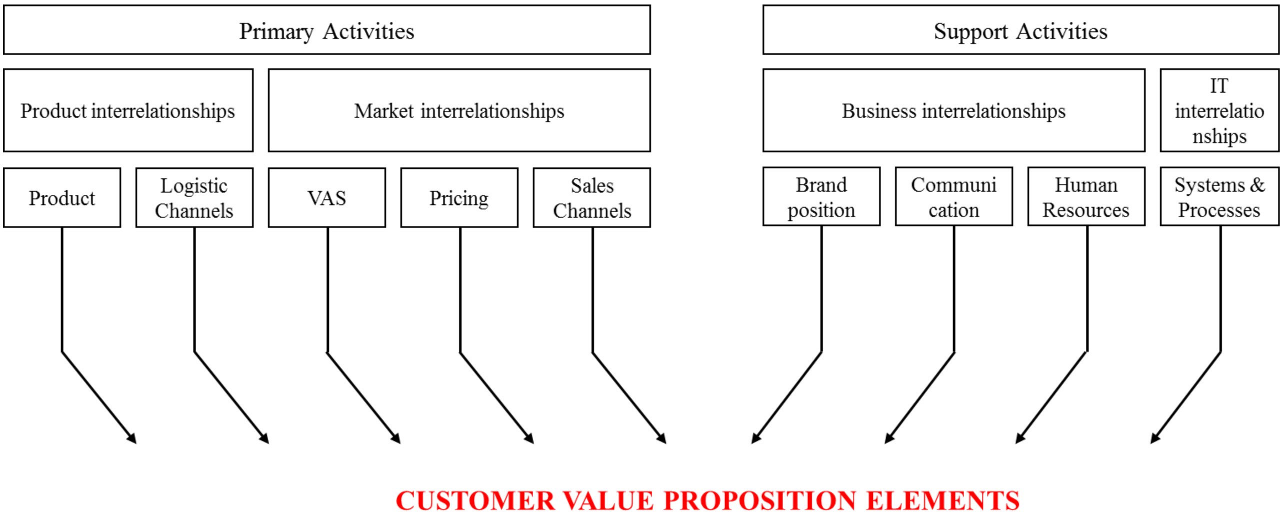


Figure 15: A value chain activity breakdown (VCOR)

The purpose of a value chain is to use effectively the competencies of all the activities in the organisation to add maximum value to the customer. Therefore the product's customer value proposition elements are the basic features of the product, delivering value to the customer as determined by the organisation's value chain activities.

The customer value proposition statement will be a set of customer value propositions consisting, for example, of propositions about the product, value added services, pricing, sales and communication channels, brand awareness, support propositions, and the IT system. The customer value proposition elements are clear, unambiguous, and short statements of the value attributes that constitute the product.

4.1.3 Customer value proposition design motivation

The motivation statement in the value proposition strategy functional task answers the extremely important questions about *why* the organisation has to realise the customer value proposition elements, and *what* advantages lie in the set of customer value proposition elements for the organisation.

The succeeding functional tasks of the integrated value proposition design framework, together with the economics of the framework, follow a detailed methodology to predict the net present worth of the customer value propositions embedded in the product. However, the purpose of this motivation is to provide an initial reason to the senior executives of the organisation about why the customer value propositions should be realised.

4.1.4 Key stakeholders

The fourth activity of the value proposition strategy is to identify the key stakeholders who are responsible for the implementation of the integrated value proposition design framework. The stakeholders in this case are meticulously allocated by the project manager and project sponsor.

Verzuh (2008:38) states that key project stakeholders should be involved for the duration of the entire project. He argues that many projects fail because key stakeholders have not been involved during the project definition and planning phases. This leads to conflicts over the requirements definitions later in the project, resulting in project delays and high project costs. Therefore the key stakeholders are involved from the first functional task of the integrated value proposition design framework.

Making use of a small team is one of the design principles for the integrated value proposition design framework, as mentioned in Section 6.1. The framework implementation team and the product development project team overlap. However, the product development project team consists of individuals responsible for operational deliverables, whereas the integrated value proposition design framework implementation team consists of individuals responsible for strategic and tactical deliverables. The implementation team consists of individuals who are senior representatives of the mandatory business units involved in the PLM, and should not exceed seven individuals.

The four activities of the value proposition functional task – market analysis, the customer value proposition statement, the customer value proposition design motivation, and the key stakeholder allocation – form a high-level business plan for the new product initiative. Once the value proposition strategy function is complete, and the senior executives have approved the value proposition strategy, the integrated value proposition design framework begins with the functional tasks that follow.

4.2 CUSTOMER SEGMENTATION

At this stage in the framework, the implementation team determines the best applicable customer segments to target with their marketing efforts. The purpose of identifying the customer segment is to ensure that the customer value propositions are channelled towards the customers who would most likely adopt to the product.

Figure 16 illustrates how the customer segmentation functional task is accomplished. It has three steps. The first is to execute the customer segmentation model that clusters the customer data into groups; the second is to identify the customer segment most suited to the product; and the third is to sketch a customer profile.

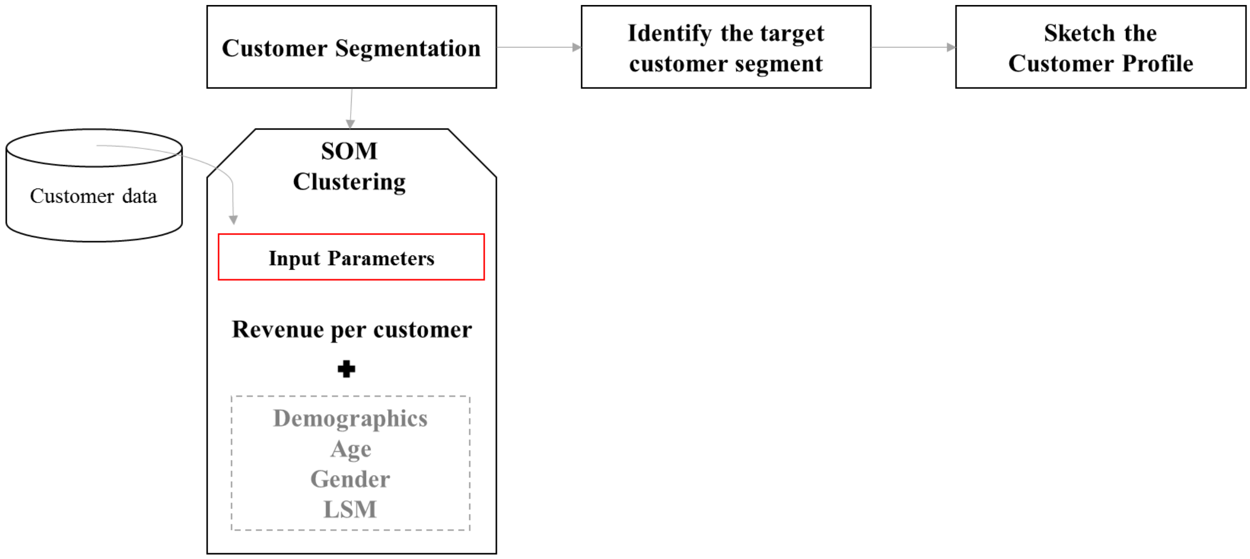


Figure 16: Customer segmentation implementation procedure

The integrated value proposition design framework makes use of value band customer segmentation to cluster the customers into customer segments. Value band customer segmentation is when customers are grouped according to the individual revenues that they generate for the organisation. (The mathematical methodology and code for the customer segmentation model is presented later, in Section 5.7.1.)

Once the customers have been grouped into customer segments, the integrated value proposition design implementation team identifies which customer segment to target with the customer value propositions. The pricing customer value proposition is the determining factor: the framework implementation team allocates the customer segment to the product that can most likely afford it.

The third step of the customer segmentation functional task is to summarise the customer segment in a customer segment profile, as shown in Figure 17. This is a one-page summary of a typical customer in the customer segment, understood subjectively.

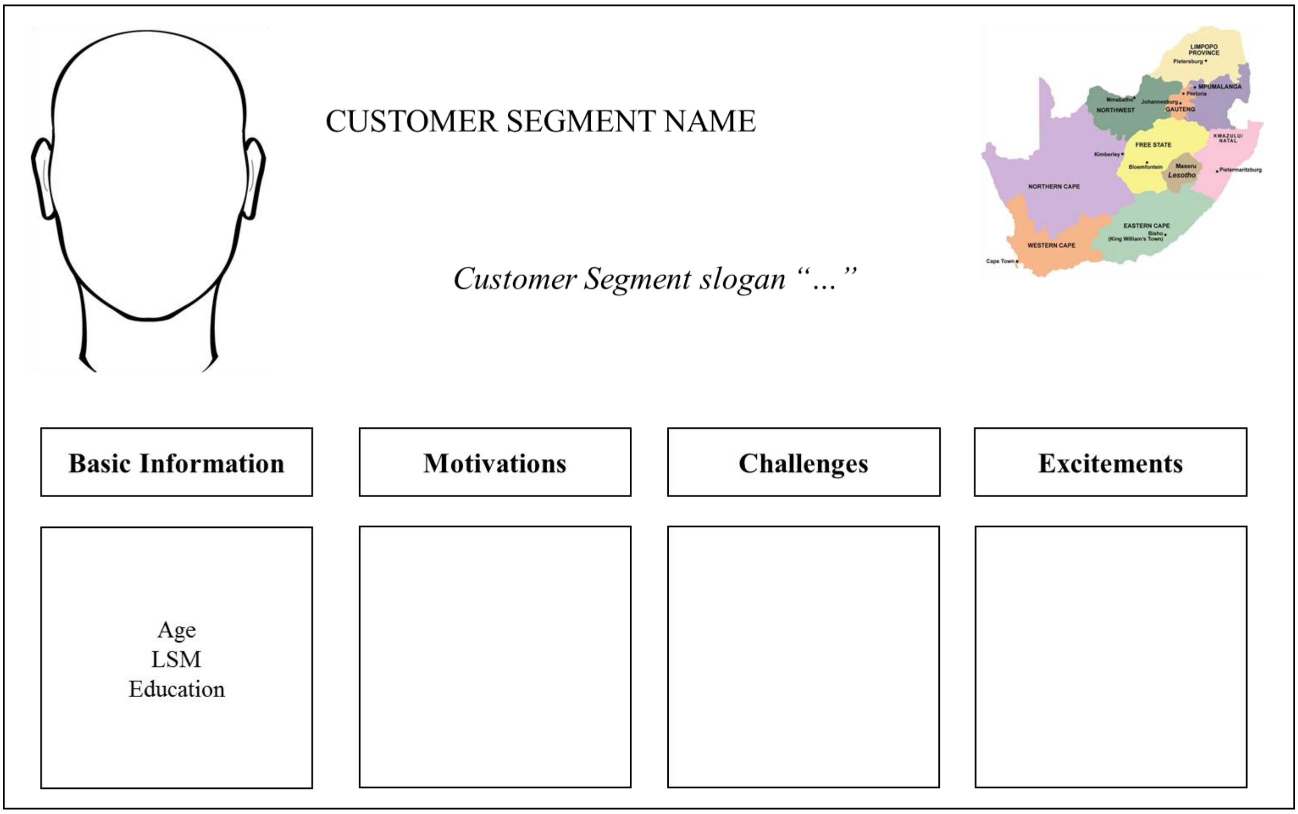


Figure 17: Customer profile template

Figure 17 is a marketing communication tool that enables the integrated value proposition design framework implementation team fully to understand the customer in the targeted customer segment in terms of his or her everyday needs, challenges, motivations, and excitements. The customer profile helps the framework implementation team to perform the tasks that follow by translating the voice of the customer into customer value propositions.

4.3 VALUE CREATION PROCESS

The value creation process is merged into the framework in functional tasks three to six. As mentioned in the literature review (Chapter 2, Section 2.3), the value creation process links the Refined Kano's model and the Blue Ocean strategy to identify the value categories in which customers obtain value, and through which marketing objective it is realised. The value creation process aligns the marketing objectives with the customer value proposition elements. Figure 18 illustrates the value creation process.

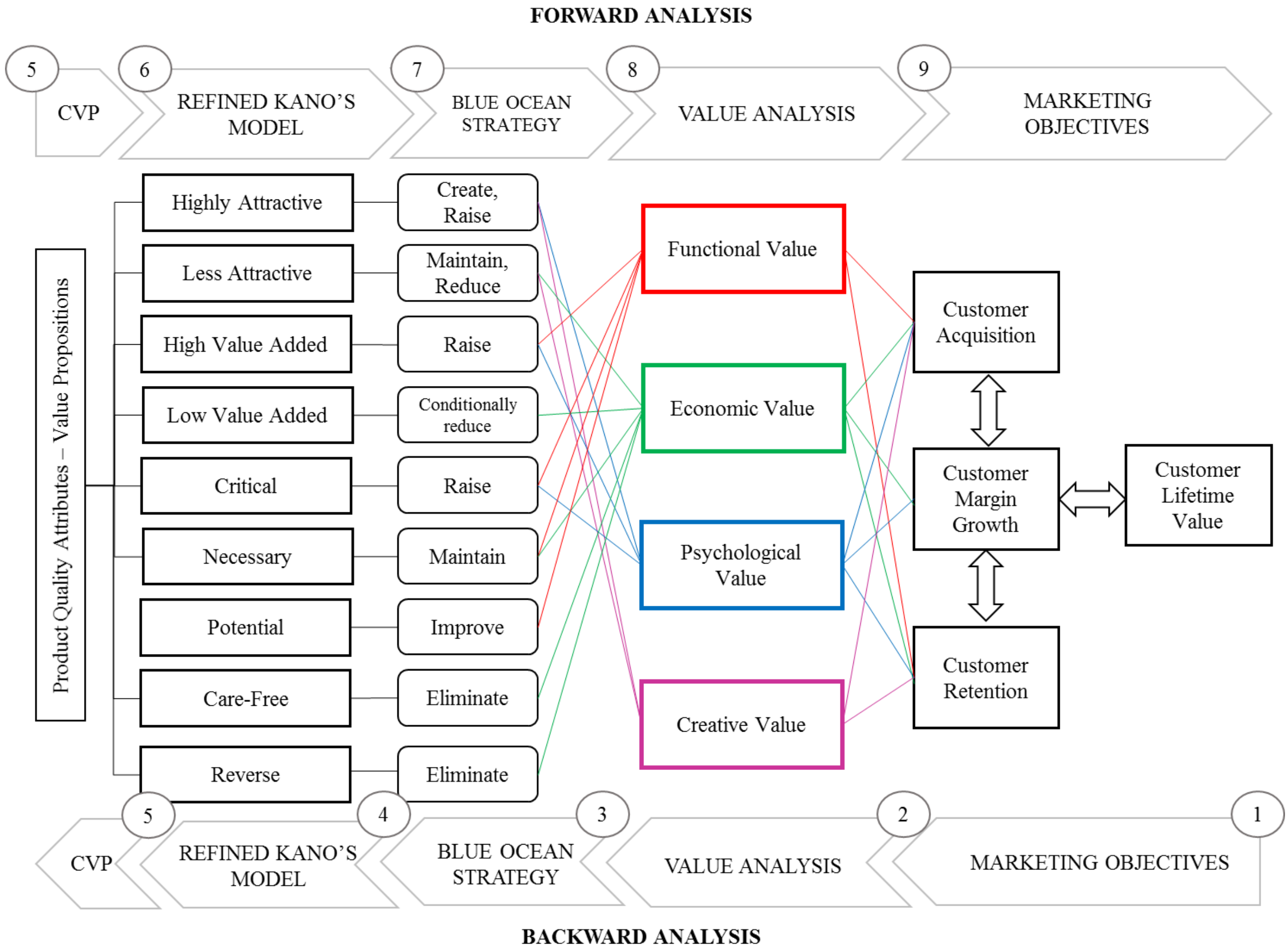


Figure 18: The value creation process analysis

The value creation process is analysed in both a backward and a forward order. The backward analysis order begins with the marketing strategy objectives, through the value categories, towards the Blue Ocean strategy, attached to a refined Kano's quality attribute, which classifies a customer value proposition according to how a customer perceives it.

The value creation process reads backward as follows: In order to realise a customer acquisition marketing objective or a customer retention marketing objective – or both – value has to be delivered to the customer in all four value categories – functional value, economic value, psychological value, and creative value. In order to stimulate market growth, value has to be delivered to the customer in the economic and psychological value categories.

Practical benefits from the product's features are delivered to the customer as functional value if the organisation raises high value-added attributes, raises critical attributes, maintains necessary attributes, and improves potential attributes in the product. Financial benefits are delivered to the customer as economic value if the organisation reduces the less attractive attributes, conditionally reduces low value-added attributes, maintains necessary attributes, and eliminates carefree and reverse attributes in the product. To promote psychological value, which delivers intangible benefits to the customer such as brand appreciation, the organisation has to create or raise highly attractive attributes, raise high value-added attributes, and raise critical attributes in the product. Lastly, to benefit the customers by using a breakthrough idea for the first time that in turn delivers creative value to the customers, the organisation has to create or raise highly attractive attributes, and maintain less attractive attributes in the product. The Refined Kano's attributes are the customer value proposition elements that the organisation offers.

The forward analysis order begins with the customer value proposition elements, defined as Refined Kano's attributes, attached to a Blue Ocean strategy move, through the value categories, towards the marketing strategy objectives.

The value creation process reads forward as follows: Highly attractive attributes are created to attract new customers; in turn, a customer obtains psychological and creative value. Less attractive attributes are reduced if the impact on having them present results in costs that are too high. By reducing less attractive attributes, economic value is added to the customer; and by maintaining less attractive attributes, creative value is delivered to the customer. High value-added attributes are raised to result in psychological and creative customer value. Low value-added attributes are reduced to a level where customer satisfaction is still maintained and costs are as low as possible; this, in turn, delivers economic value to the customer. Critical attributes are essential to customers, and so they are raised to the optimal level of customer satisfaction. Raised critical attributes contribute to the psychological value added. Necessary attributes are maintained at the existing level or reduced; however, before they are reduced, careful consideration is given to ensuring that customer dissatisfaction are not promoted: the maintenance of necessary attributes makes a small contribution to functional customer value. Potential attributes are improved, because they have the potential to become highly attractive attributes, and they potentially increase the functional value added to the customer. Care-free attributes are eliminated in order to improve the associated product or service costs. Reverse attributes are eliminated at all times. Eliminating both care-free and reverse attributes results in added economic value (Yang & Sung, 2010:926).

Functional value and creative value delivered to the customer drive both customer acquisition and customer retention, whereas economic value and psychological value delivered to the customer have the ability to drive customer acquisition, retention, and growth.

The customer value propositions are classified according to the Refined Kano's quality attributes before the value creation analysis begins. The Refined Kano's model classifies the customer value proposition elements into nine categories: Highly Attractive, Less Attractive, High Value-Added, Less Value-Added, Critical, Necessary, Potential, Care-Free, and Reverse. The integrated value proposition design framework makes use of two methods to define the value propositions according to the Refined Kano's model categories. The first is the fast-tracked method of defining the attributes according to the theoretical definitions of the Refined Kano's model, while the second involves making use of a customer questionnaire and customer focus groups.

4.3.1 Theoretical classification of the Refined Kano's attributes

The theoretical classification of the Refined Kano's attributes is done by the integrated value proposition design framework implementation team. Each individual in the team is given a form to fill out, as shown in Table 1, accompanied by a one-page information sheet, as shown in Figure 19, which is a crisp theoretical explanation of the Refined Kano's model.

Theoretical Kano's model classification form for the customer value proposition components of product ______________

CVP* Element	CVP Elements	Kano's Model Attribute					Importance	
		Attractive	OD*	Must-Be	Indifferent	Reverse	High	Low
Product								
VAS*								
Pricing								
Place								
Brand								
Support								
Systems								

Table 1: Theoretical Kano's model classification form

OD* One-Dimensional
VAS* Value Added Services
CVP* Customer Value Proposition

The customer value proposition statement, as defined in the value proposition strategy functional task, describes the customer value proposition elements in terms of the organisation's value chain activities. The customer value proposition elements are entered into the form in advance. Thereafter the integrated value proposition design framework implementation team rates the customer value proposition attributes according to the theoretical definitions of the Kano's model attributes, as provided to them in the information sheet (Figure 19), as well as the importance of the customer value proposition attribute.

KANO'S MODEL

Product Attributes	Definition	Recommendation
Attractive	Attractive attributes leads to greater customer satisfaction, but it is not expected to be present in the product. The result is no dissatisfaction if absent.	Include a decent number of attractive attributes
One-dimensional	A linear relationship between a customers perception of satisfaction and the functionality to fulfil it. Fulfilment help to improve satisfaction and vice versa.	Include a decent number of one-dimensional attributes
Must-be	Attributes whose absence cause absolute dissatisfaction, but absence does not contribute to customer satisfaction	Endure must-be attributes
Indifferent	Indifferent attributes does not contribute to customer satisfaction nor customer dissatisfaction	Avoid indifferent attributes as far as possible
Reverse	A reverse attributes' presence causes customer dissatisfaction, and its absence causes customer satisfaction	Avoid reverse attributes

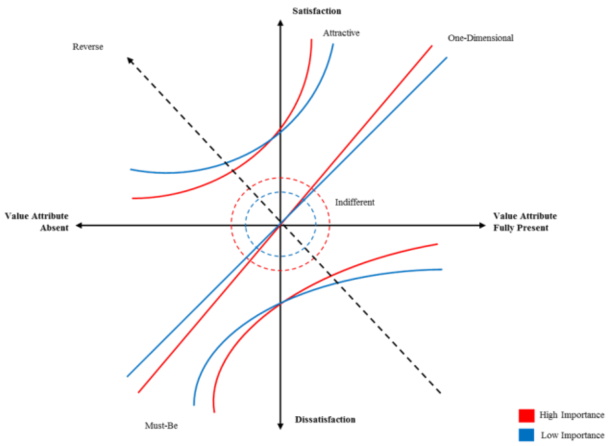


Figure 19: Refined Kano's model information sheet

The customer value proposition elements that are classified into Kano's attributes are compared with the importance ratings in Table 1 to determine the Refined Kano's attributes. The framework implementation team leader takes the responsibility to collect the results from the team members and to classify the customer value proposition components as Refined Kano's attributes. If there is a conflict between the classifications of a Refined Kano's quality attribute for a customer value proposition element, the framework leader leads the team to redefine the customer value proposition element as a Refined Kano's model attribute in a consolidated manner.

4.3.2 Kano questionnaire classification of the Refined Kano's attributes

The second method for determining the Refined Kano's model attribute classifications is by making use of the Kano questionnaire in a customer survey. The Kano questionnaire (Matzler & Hinterhuber, 1998:31) is a unique customer satisfaction measurement instrument that is used to rate the value proposition components according to how the customers perceive them. The questionnaire has three parts: the first part rates the customer's response to the situation if a value proposition element is present in a product; the second part rates the customer's response to the situation if a value proposition element is absent in a product; and the third part rates the customer's response to the degree of importance of the value proposition element being present in a product.

For example, a mobile telecommunications company defines a customer value proposition that they will provide their customers with a loan phone whenever the customer's phone is in for repair.

Using the Kano questionnaire to rate the value proposition, the Refined Kano's quality attribute classification will appear as shown in Figure 20:

Part A

If your phone is handed in for repair, you will receive a loan phone.
How does the proposition make you feel?

- ☐ I like it that way
- ☐ It must be that way
- ☐ I feel neutral
- ☐ I can live without it that way
- ☐ I dislike it that way

Part B

If your phone is handed in for repair, you will not receive a loan phone.
How does the proposition make you feel?

- ☐ I like it that way
- ☐ It must be that way
- ☐ I feel neutral
- ☐ I can live without it that way
- ☐ I dislike it that way

Part C

If your phone is handed in for repair, you will receive a loan phone.
How important is this proposition for you?

- ☐ 5 - Very important
- ☐ 4
- ☐ 3
- ☐ 2
- ☐ 1 – Entirely unimportant

Figure 20: Kano's questionnaire

Part A asks the customer to rate his or her perception of the value proposition being functional in the product offering; Part B asks the customer to rate his or her perception of the value proposition being dysfunctional in the value offering; and Part C asks the customer to rate the importance of the value proposition being present in the product offering.

Once the questionnaires have been completed, the Refined Kano's attributes are determined from the questionnaire, using the matrix illustrated in Table 2.

Functional	**Dysfunctional**				
Functional vs. Dysfunctional	Like	Must-be	Neutral	Live-with	Dislike
Like	Q	A	A	A	O
Must-be	R	I	I	I	M
Neutral	R	I	I	I	M
Live-with	R	I	I	I	M
Dislike	R	R	R	R	Q
A = Attractive; I = Indifferent; M = Must-be; O = One dimensional; Q = Questionable and R = Reverse					

Table 2: Kano's matrix

Part A, which represents the value proposition being functional, is compared with Part B, which represents the value proposition being dysfunctional. The corresponding answers in the questionnaire indicate whether the customer perceives the value proposition as an Attractive offering, a One-Dimensional offering, a Must-be offering, an Indifferent offering, or a Reverse offering. When a questionnaire results in a questionable attribute, it can be assumed that the questionnaire was misunderstood by the customer, and the answer is disregarded.

Thereafter, Part C of the questionnaire is used to calculate the customer satisfaction coefficient and the customer's perception of the importance of the value proposition. Taking the result obtained from Part A and Part B of the questionnaire, the importance rating is summarised according to its respective Kano categories. The percentages of the results in each Kano category is calculated and represented in a table like the example in Table 3.

Product Requirements	**A**	**O**	**M**	**I**	**R**	**Q**	**Total**	**Category**
CVP component 1	28	43	17	7	4	1	100	O
CVP component 2	39	24	13	15	7	2	100	A
CVP component 3	11	23	33	23	10	0	100	M

Table 3: Kano's category summary

The results obtained from Part C of the questionnaire, summarised in Table 3, are used as input to calculate the coefficient of customer satisfaction and customer dissatisfaction.

The coefficient of customer satisfaction:

$$\frac{A + O}{A + O + M + I}$$

The coefficient of customer dissatisfaction:

$$\frac{O + M}{-(A + O + M + I)}$$

The coefficients of customer satisfaction and customer dissatisfaction can be used for various applications. Three of the most common uses of the customer satisfaction coefficients are as KPIs, as inputs to the QFD, or to plot the coefficients in a customer satisfaction diagram to illustrate the level of customer satisfaction, as presented in Figure 21.

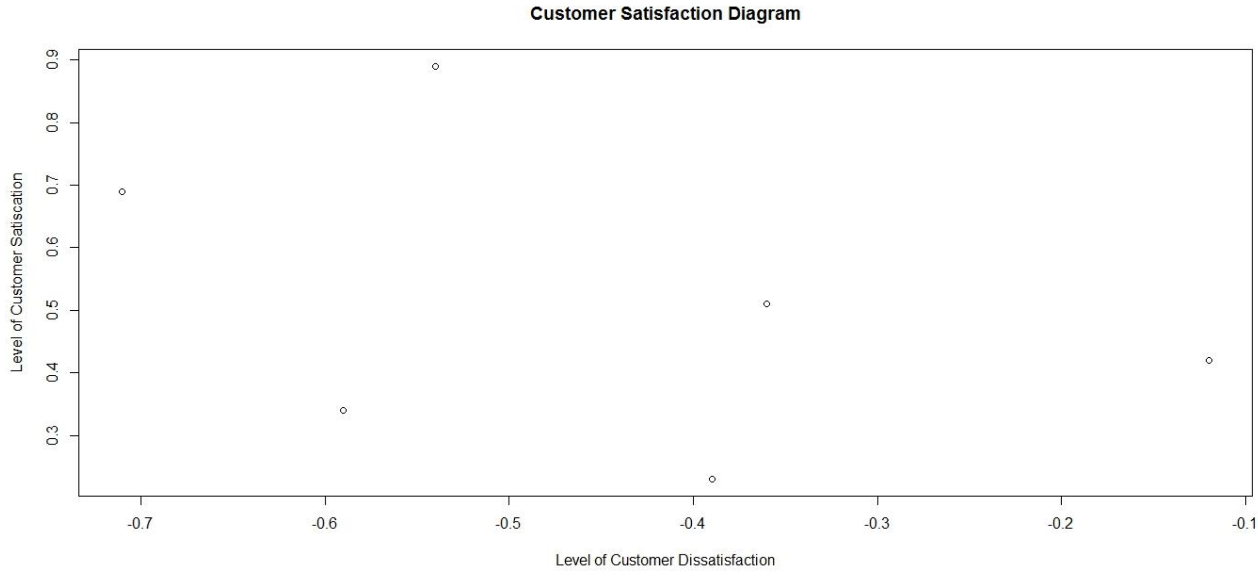


Figure 21: Customer satisfaction diagram

Finally the Refined Kano's model attributes are defined from the questionnaire answers. Parts A, B, and C are used in combination to determine the Refined Kano's model attributes. Parts A and B determine the traditional Kano's model attributes, as illustrated in Table 3; thereafter the importance rating of the value proposition is taken into consideration, as presented in Table 4.

High importance		**Disregarded**	**Low importance**	
5	4	3	2	1

Table 4: Refined Kano's importance rating

If the customer rated the value proposition with an importance of between 4 and 5, the value proposition is regarded as highly important in the Refined Kano's model. If the customer felt neutral about the importance of the value proposition, the questionnaire is disregarded in the attempt to classify the Refined Kano's model attributes. Lastly, if the customer rated the importance of the value proposition between 1 and 2, the value proposition has a low importance.

The responsibility of conducting the customer survey with the Kano questionnaire should be outsourced either to the market research and customer analytics business unit within the organisation, or to a market research consulting company. Conducting a formal customer survey is an intricate process, and the success of the customer survey depends greatly on the analysts conducting it.

If the organisation has the resources to conduct a customer survey, it is recommended that it follow the Kano questionnaire methodology for classifying the Refined Kano's model attributes. The method of theoretically defining the Refined Kano's attributes is the general practice in the integrated value proposition design framework. After the value proposition components have been theoretically classified, it would be beneficial if the organisation outsourced the Kano questionnaire survey to ensure that the actual perspective of the customer is used to classify the customer value proposition elements according to Refined Kano's model attributes.

4.3.3 Quality function deployment

Quality function deployment (QFD) is the tool used to implement the value creation process. Figure 22 illustrates the comparative roll-outs of the value creation process. The QFD allows the integrated value proposition design framework implementation team to quantitatively prioritise the entries within the value creation process.

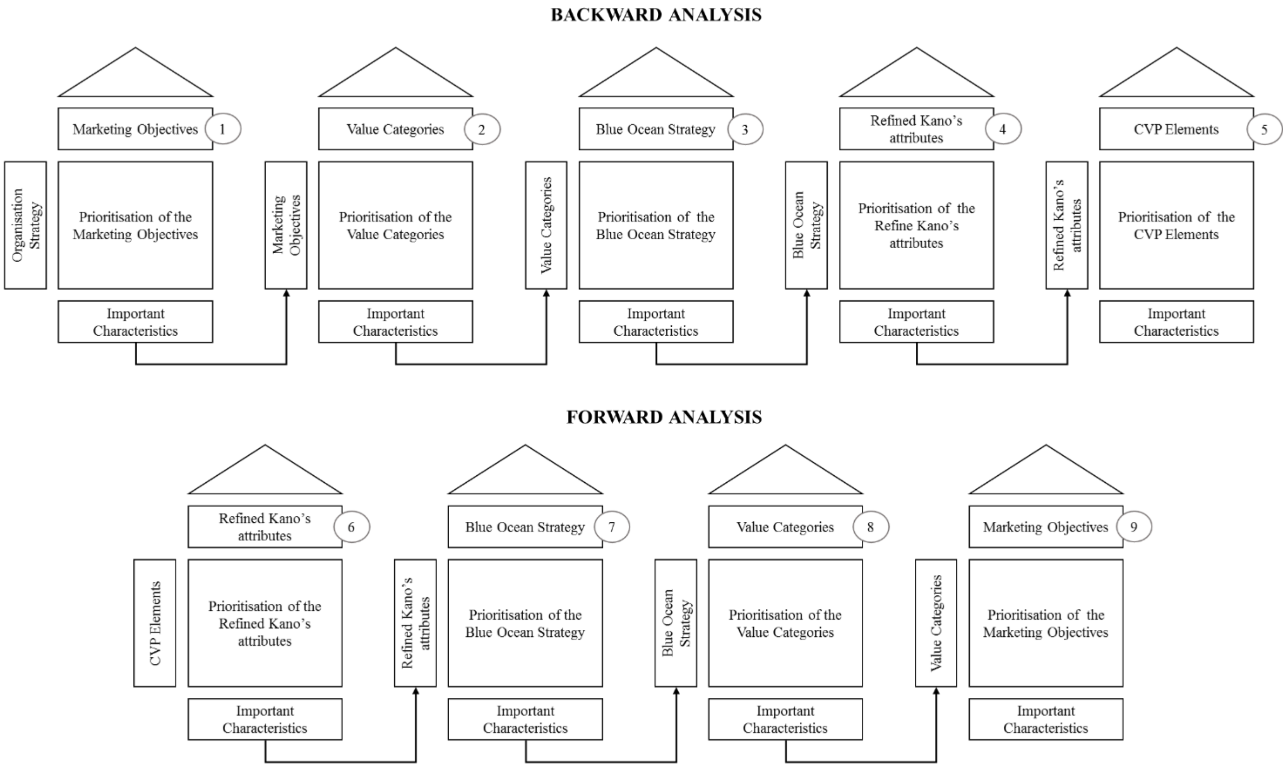


Figure 22: Value creation process QFD roll-out

The first roll-out of the QFD, in the backward analysis, prioritises the marketing strategy objectives for the new product initiative against the organisational objectives. Thereafter the value categories are prioritised in the second roll-out of the QFD against the marketing strategy objectives. The third roll-out of the QFD prioritises the Blue Ocean strategy against the value categories. The fourth roll-out of the QFD prioritises the Refined Kano's model attributes against the Blue Ocean strategy, and the fifth roll-out of the QFD prioritises the customer value proposition elements against the importance ratings of the Refined Kano's attributes of the product.

Once the backward analysis of the value creation process is complete, the framework implementation team knows the composition of the new product initiative's marketing strategy objectives. For example, the product can be 60% acquisition-driven, 30% growth-driven, and 10% retention-driven, and through the marketing strategy objectives, the customer value proposition elements are prioritised. The customer value proposition element importance ratings show the framework implementation team which customer value proposition elements will contribute the most towards the marketing strategy objectives.

The forward analysis of the value creation process validates whether the chosen set of customer value proposition elements will be realised in the marketing strategy objective composition. The sixth roll-out of the QFD begins the forward analysis of the value creation process, and prioritises the Refined Kano's model attributes against the importance ratings of the customer value proposition elements. The seventh roll-out prioritises the Blue Ocean strategy against the Refined Kano's model, the eighth roll-out prioritises the value categories against the Blue Ocean strategy, and the ninth roll-out of the QFD prioritises the marketing strategy objectives against the value categories.

The prioritisation of the comparisons within the forward analysis is kept similar to the backward analysis roll-out; in other words, the prioritisations of the second and ninth, the third and eighth, the fourth and seventh, and the fifth and sixth roll-outs of the QFD are similar. Prioritisation can only occur between the value creation process steps as linked within the value creation process (Figure 17).

The backward analysis and the forward analysis should be coordinated. At any moment in the forward analysis, the framework implementation team can return to the backward analysis to compare the findings of the value creation process analysis. Once the forward analysis and the backward analysis of the value creation process are done, the marketing strategy composition of the forward analysis and the backward analysis should be similar. If there is a difference in the marketing strategy composition between the forward and backward analyses, there is a misunderstanding between the marketing strategy objectives and the customer value proposition elements. Either the customer value proposition elements should be altered to conform to the marketing strategy objectives, or the marketing strategy objectives should be altered to conform to the customer value proposition elements. The value creation process analysis can be repeated forward and backward as many times as necessary to ensure that a desired set of customer value propositions is consistent with the organisation's marketing objectives.

The prioritisation of the value creation process steps should be led by the integrated value proposition design framework implementation team in collaboration with the organisation's senior executives.

Within functional tasks three to six of the integrated value proposition design framework, the implementation team has to make important decisions. The value creation process facilitates the decision-making process, and therefore it is important to collaborate with the senior executives to ensure that the decisions are made properly the first time.

4.4 CUSTOMER EXPERIENCE DESIGNS

The seventh task of the integrated value proposition design framework is to map the customer value proposition elements against the required customer experience designs, in relation to the customer journey and customer touch points. This means that customer value proposition elements contribute towards the customer journey and customer touch points, and are traceable through the design in a forward and backward manner.

The level of a customer's experience with the organisation and its product should be an organisation's first concern. As mentioned in the literature review (Section 2.6), the three foremost activities in customer experience analysis are to obtain the right information, to map the customer experience in a customer journey map, and to manage the customer touch points.

The scope of the integrated value proposition design framework does not include the exercise of capturing the customer experience data. It highlights the importance of such data, and allows the implementation team to integrate with the organisation's market research and customer analysis business unit. Most organisations already have a customer experience analysis methodology that they use to design customer journey maps and manage their customer touch points. If the organisation does not have a standard procedure to capture customer experience data, the integrated value proposition design framework implementation team should outsource the data capturing responsibilities of the customer experience analysis either to the market research, digital marketing, and customer analysis business units inside the organisation, or to a relevant consulting company. There are numerous best-practice methodologies for customer experience analysis (cf. Meyer & Schwager, 2007; Verhoef, Lemon, Parasuraman, Roggeveen, Tsiros & Schlesinger, 2009) that could be used as a platform to establish an ongoing customer experience data capturing procedure.

4.4.1 The customer journey map

The framework is designed to match the customer value proposition elements with the customer journey. It is able to adopt to any product in any organisation. The standard design for the customer journey map is shown in Figure 23. It is a generic design that should be further refined and customised for each unique product.

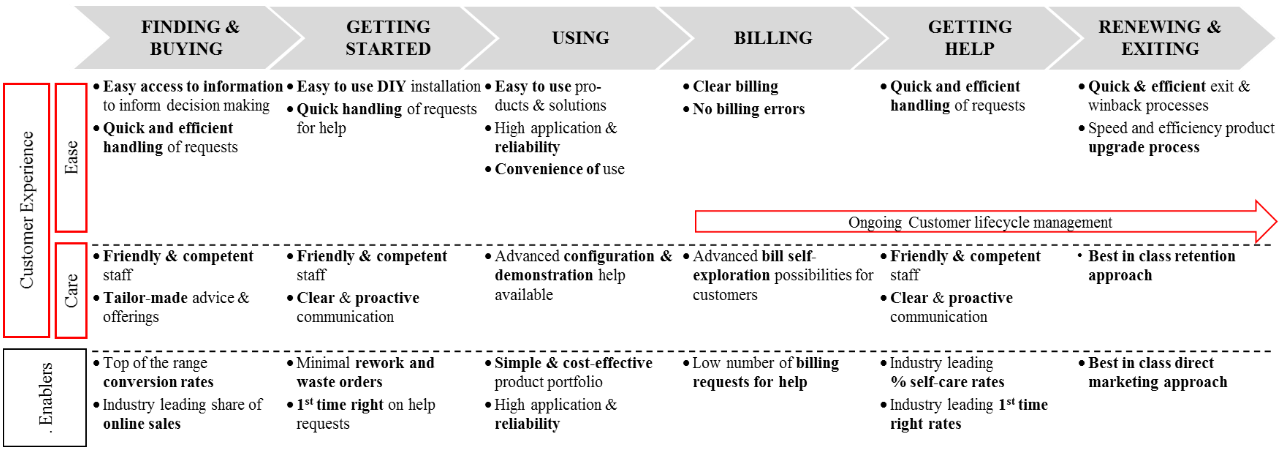


Figure 23: Customer journey map template

The generic customer journey map evaluates the customer journey in three parts. The first two parts represent the customer's experience with the organisation; the first lane includes the elements of the customer's engagement with the product through the *ease* of use over the customer journey. The second lane represents the customer experience where the customer requests customer *care* over the course of the journey. The last lane offers *enablers* on how to achieve the entries in the customer experience ease and care divisions. The generic customer journey map provides a valuable template for the framework implementation team to design the customer experience, and to expand the customer value propositions to ensure that the product lifecycle management process will have a comprehensive customer-centric focus.

In order to ensure that the customer value proposition attributes apply to the customer journey, the QFD is used to prioritise the customer value proposition elements against the customer journey phases. The prioritisation of the customer journey phases shows the organisation where the customer experience in the customer journey is good, and where in the customer journey the organisation has to improve the customer experience to match the customer value proposition elements. This in turn ensures that the customer experience with the product in the customer journey is optimal.

4.4.2 Touch points

Touch points are the points of connection between the organisation and a customer. Many organisations view the touch points as part of the customer journey map. The integrated value proposition design framework makes use of a generic touch point customer experience template (Figure 24) to ensure that the customer value proposition elements apply not only to the customer journey, but also specifically to the customer's experience at each touch point.

The touch point customer experience template in Figure 24 is non-specific, and should be customised for each unique product offering and organisation.

		Online Telesales	Retail Stores	Call Centre	Website	Product
Customer Experience	Ease	• Hassle-free **order processing & reporting** • **Stock availability**	• **Low waiting times** • Intuitive **self-exploration**	• Low **waiting times** • **First time right**	• **User-friendly** website • No **downtimes**	• **Instant access** • **First time right**
	Serve	• Best-in-class **dealer support & retention programs** • **Delivery at customers door step**	• **Friendly & competent** staff • Advanced **con-figuration &** help available • **Tailor-made** advice	• **Friendly & competent** staff • **Tailor-made** advice	• **Tailored web** portal to customer needs • Comprehensive **self-care possibilities**	• **User-friendly** applications • **Tailor made** customer interface
Enablers		• **Share of wallet** • **Handling cost/ transaction**	• Advanced **self-service tools** • Top of the range **conversion rates**	• **% IVR** • **Bad volumes** • **1st time right**	• Industry leading **self-care rates** • Industry leading **online sales** rates	• Industry leading **% usage** • Low # of **requests for help**

Figure 24: Customer touch-points template

To ensure that the greatest customer satisfaction is achieved at each touch point, they are prioritised according to the customer value proposition elements using the QFD, which prioritises the touch-points that should be improved in order to optimise the customer's experience with the product and with the organisation.

4.5 FUNCTIONAL DECOMPOSITION OF THE INTEGRATED VALUE PROPOSITION DESIGN FRAMEWORK – CONCLUSION

The integrated value proposition design framework expresses a customer value proposition statement over an organisation's value chain activities. The customer value proposition elements consist of product, service, pricing, sales and communication channel, brand, support, and IT propositions. This customer value proposition statement embraces the organisation's holistic capabilities to deliver value to customers. Best practice customer-centric tools and methodologies are embedded in the integrated value proposition design framework that translates the voice of the customer into customer value proposition elements. The QFD aligns the marketing strategy objectives with the customer value proposition elements, and with the desired customer experience. The total extent of the functional tasks of the integrated value proposition design framework is that it directs strategy towards an operational customer touch-point level.

The functional decomposition of the tasks inside the integrated value proposition design framework formulates a qualitative investigation into the needs of the customer, and translates that into marketing strategy objectives. The functional tasks within the integrated value proposition framework enable the organisation to take the first step towards a customer-centric focus within PLM. The tasks inside the framework enable the organisation not only to launch products into a market, but also to build efficient on-going relationships with their customers, thus maximising their customer lifetime values.

5 CHAPTER FIVE: THE ECONOMICS OF THE INTEGRATED VALUE PROPOSITION DESIGN FRAMEWORK

The functional decomposition of the tasks within the integrated value proposition design framework provides a holistic view of the value transfer process between the organisation and the customer. It guides the organisation to cultivate loyal customers through designing customer value propositions according to how the customers perceive quality offerings. The ultimate goal of the integrated value proposition design framework is not only to improve customer loyalty by enhancing their experience and the customer value propositions, but also to maximise the organisation's profits. Kumar and Rajan (2009:1) state that a customer-centric organisation should not only be managed to increase customer loyalty: it should also manage its customers for profitability.

The economics of the integrated value proposition design framework is the organisation's firm value. The organisation's customer base is the sum of the customers who have and who will potentially adopt the products of the organisation. The integrated value proposition design framework defines a product in terms of its customer value propositions. Therefore the firm value is equal to the sum of the CLVs of the customers who adopt the organisation's customer value propositions.

The stochastic simulation and forecasting model used within the integrated value proposition design framework makes use of two forecasting tools: a product lifetime uptake model, and a customer lifetime value (CLV) model, which add up to a goodwill firm value prediction. The code used to build the model is given in Section 5.5, and the code used to model each figure in Chapter 5 is presented in Appendix B.

5.1 PRODUCT LIFETIME UPTAKE MODEL

The product lifetime uptake model used in this study is a Monte Carlo simulation of the Bass model. A Monte Carlo simulation replaces the input parameters of the Bass model with probability distribution functions to account for any uncertainty within the model. The generalised Bass model is an extension of the Bass model used in the framework to incorporate the effect of price elasticity and advertising elasticity on the uptake demand of the product. Before the product lifetime uptake model is presented, the formulation of the model extends the introductory concepts, as discussed in the literature review (section 2.8), to give a rigorous outline of the product lifetime uptake model.

5.1.1 The Bass model and its parameters

The Bass model is a new product diffusion model that multiplies the rate of product adoption by the potential market size.

The Bass model equation (Bass, 1969):

$$n_t = pm + (q - p)N_{t-1} - \frac{q}{m}(N_{t-1})^2$$

Simplified into a multiplication equation, it is presented as:

$$n_t = [\, p + qN_{t-1}\,][\, m - N_{t-1}]$$

The probability of adoption at time t given that the adoption has not yet occurred
= p + q *cumulative fraction of adopters at time T*

where

- m is the total number of initial buyers over the period of interest,
- p is the coefficient of innovation,
- q is the coefficient of imitation,
- n_t are the number of initial buyers at time period t, and
- N_t are the cumulative number of initial buyers at time period t.

The Bass model parameters are acquired by making use of prior sales data. This is obtainable through observing either the product's actual sales patterns for a period after the product has been launched, or the sales data for an existing product that is similar in product features.

One of the major concerns about using past sales data is that the Bass model is designed to work with the initial purchases of an innovation, and does not apply to customer replacement demand. When sales data is used as an alternative to product uptake data, the period under observation should be carefully selected to ensure that replacement demand is disregarded (Mahajan, Muller & Bass, 1995).

The model parameters are best estimated by using a nonlinear least squares estimation procedure. This fits a set of observations to a model that is nonlinear with unknown parameters. The more data provided for a nonlinear least squares estimation procedure, the more accurate the parameter estimation result will be. However, it is extremely important to ensure that the data provided for the nonlinear least squares estimation procedure represents the product uptake over one life cycle usage of the product, and does not contain any replacement sales data.

A number of research studies have been conducted on real-life scenarios to estimate the most likely values for the innovator (*p*) and imitator (*q*) parameters (cf. Lawrence & Lawton, 1981; Sultan, Farley & Lehmann, 1990). It was found that the average rate of diffusion per year for *p* is 0.03, and the average rate of diffusion per year for *q* yields 0.38, and also that *q* generally lies between 0.3 and 0.5, with the rare exception of outliers. Despite the generic averages that can be calculated from various products, there are no fixed parameters for *p* and *q*. The innovator and imitator parameters vary between products, organisations, and market environments. The Bass model parameters should be individually determined for each product or service being analysed (Mahajan, Muller & Bass, 1995).

To illustrate the Bass model's sensitivity towards the input parameters, three input parameter scenarios are demonstrated together with their values for *p*, *q*, and *m*. The first illustration has a high innovator and imitator rate of diffusion; the second has a medium innovator and imitator rate of diffusion; and the third has a slow innovator and imitator rate of diffusion. The diffusion speed is considered per month.

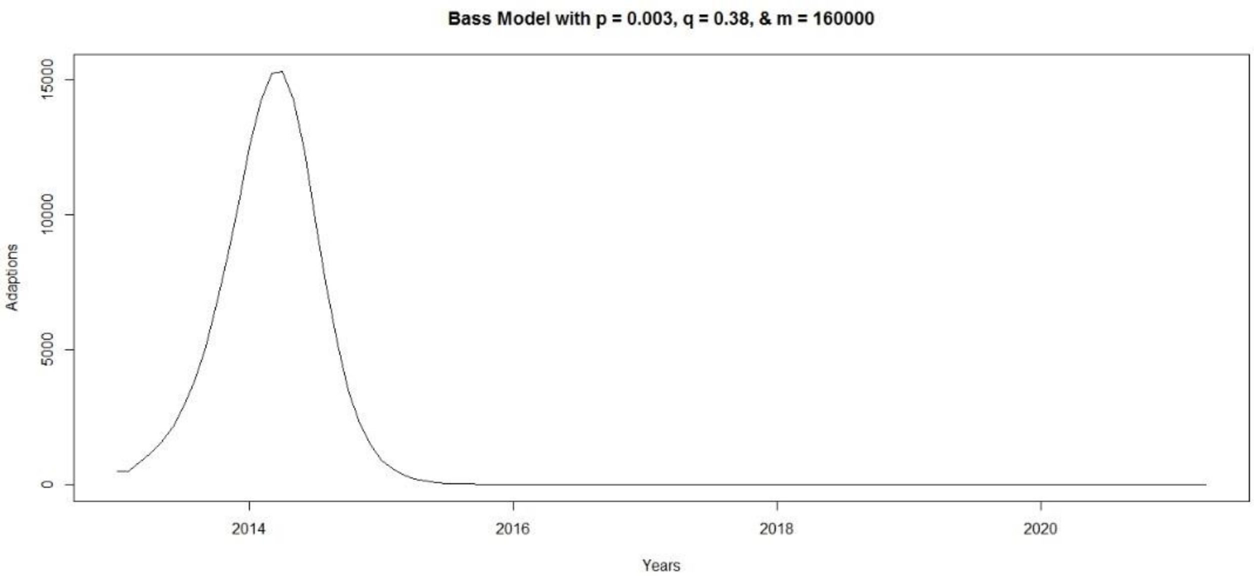


Figure 25: Bass model with a high innovator and imitator rate

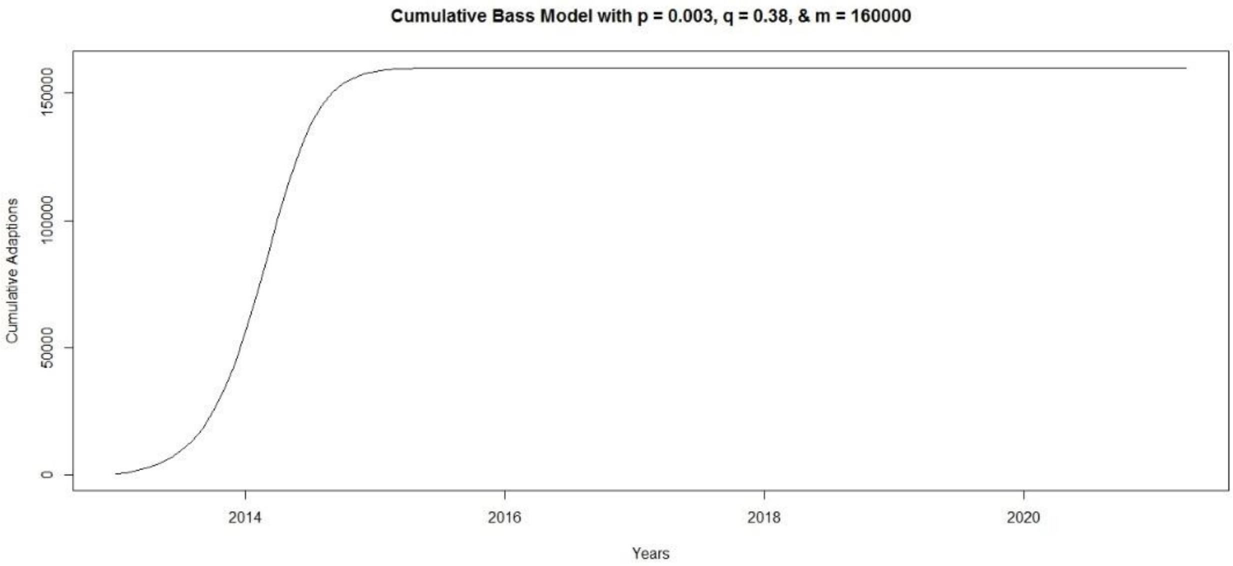


Figure 26: Cumulative Bass model with high innovator and imitator rate

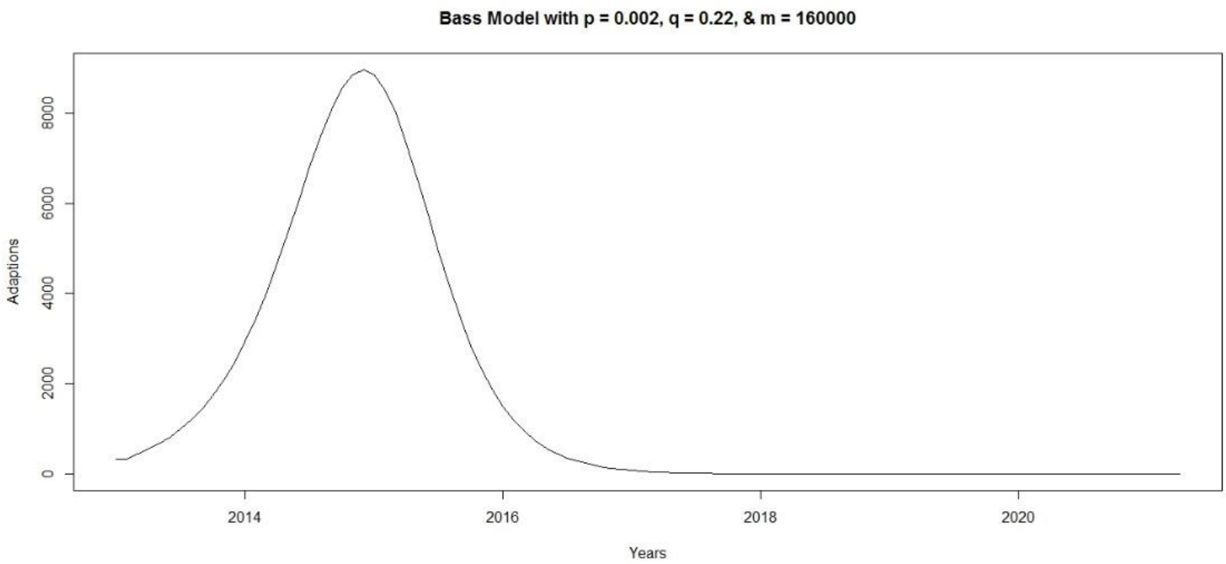


Figure 27: Bass model with medium innovator and imitator rate

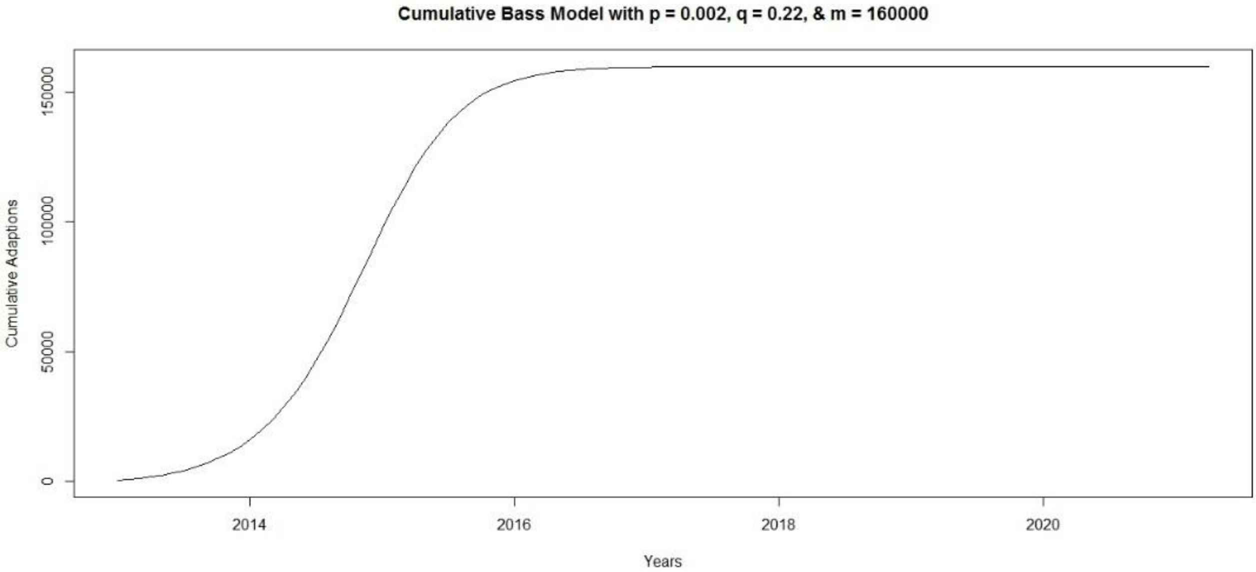


Figure 28: Cumulative Bass model with medium innovator and imitator rate

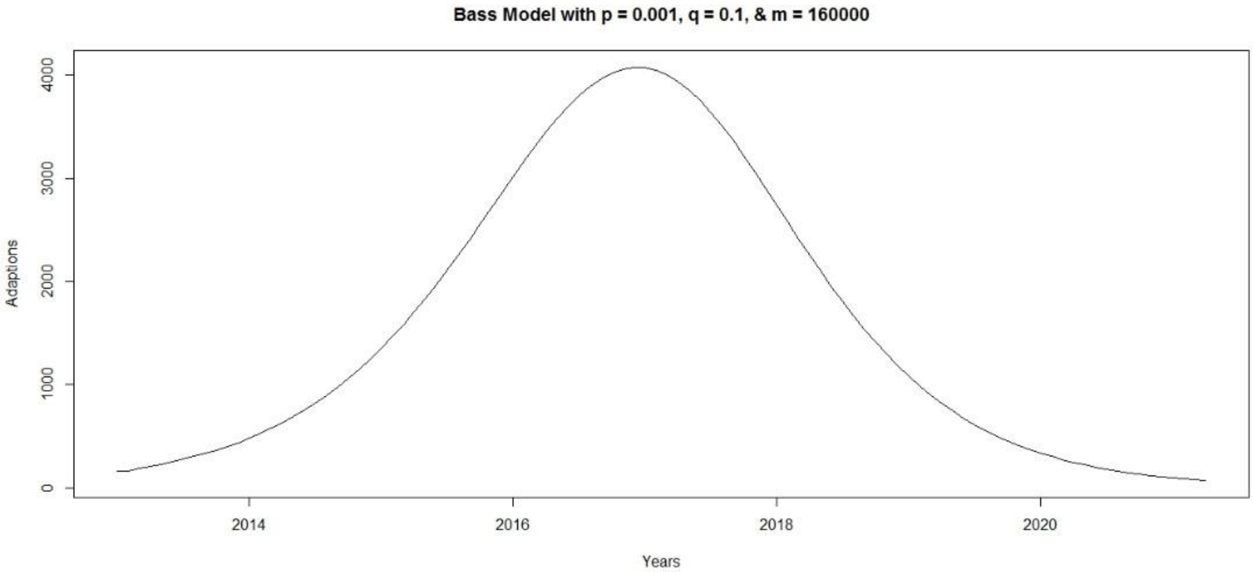


Figure 29: Bass model with low innovator and imitator rate

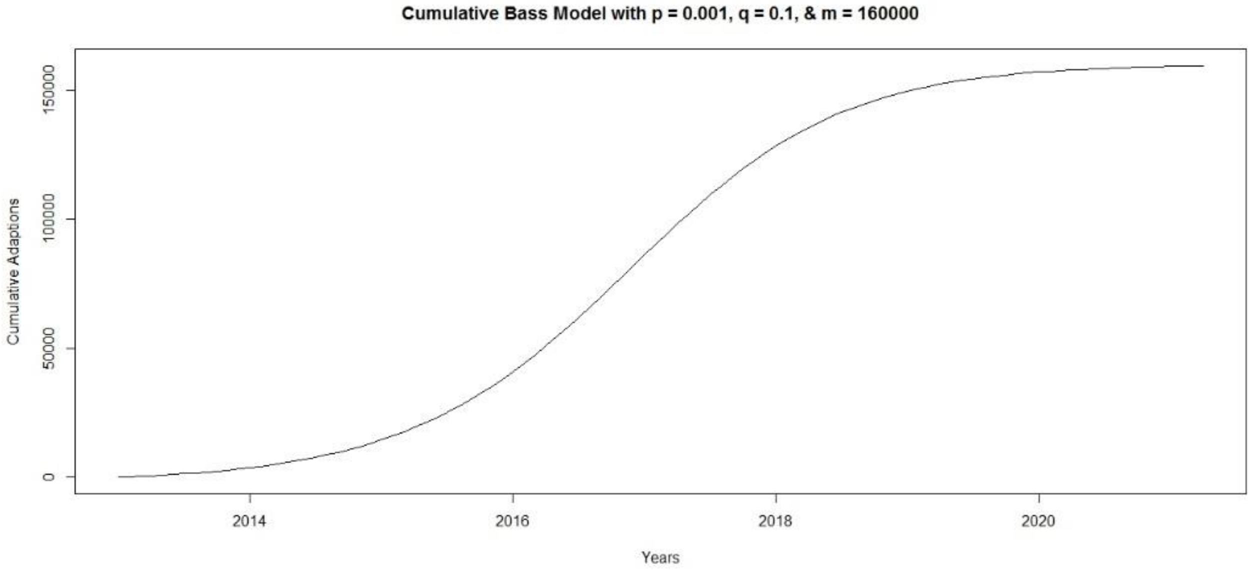


Figure 30: Bass model with low innovator and imitator rate

In Figures 25 to 30, the potential market size is held constant, the innovator and imitator diffusion rates varies, and the diffusion speed is observed on a monthly period. The higher the diffusion rates, the quicker the product will diffuse through the market. The Bass model is highly sensitive to the accuracy of the input parameters. Van den Bulte and Lilien (1997:338) state that the model parameters are more accurately predicted through a nonlinear linear least squares estimation as the number of data points increase. Therefore the Bass model is not a once-off application where an organisation might use it as a forecasting tool to analyse their products' potential performance in a market. It is a tool that should be constantly re-calculated and refined to determine a product's best parameter fit to its natural diffusion in a market.

The basic premise of the Bass model is that the number of potential adopters increases with time. The premise is built on the assumption that the imitator rate is greater than the innovator rate. Figures 31 and 32 illustrate the difference in diffusion curves when the innovator rate is greater than the imitator rate, and contrariwise.

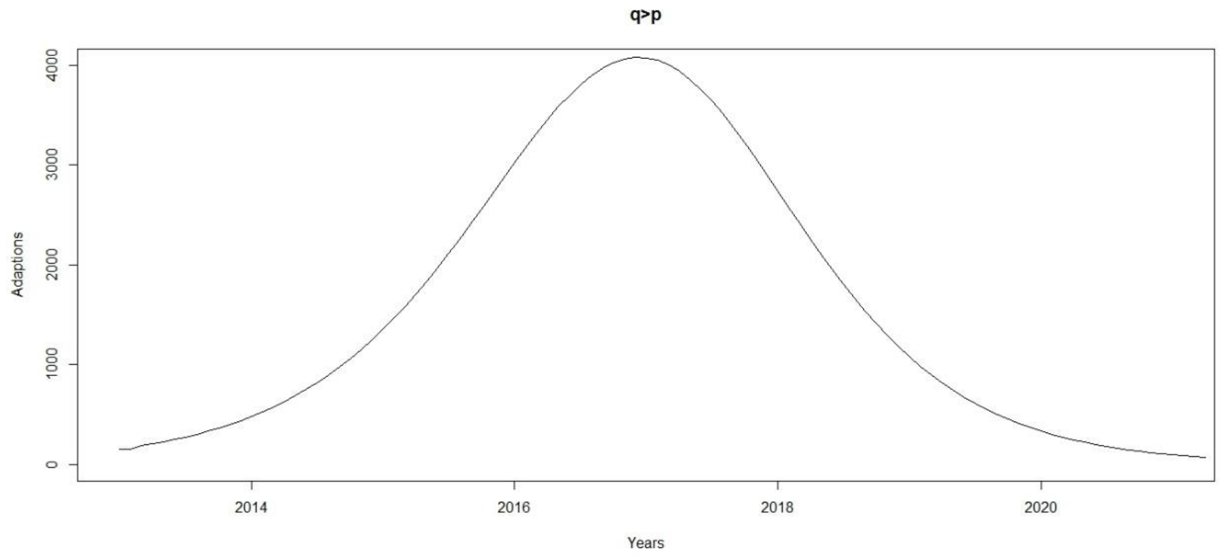


Figure 31: Bass model curve with imitator rate greater than innovator rate

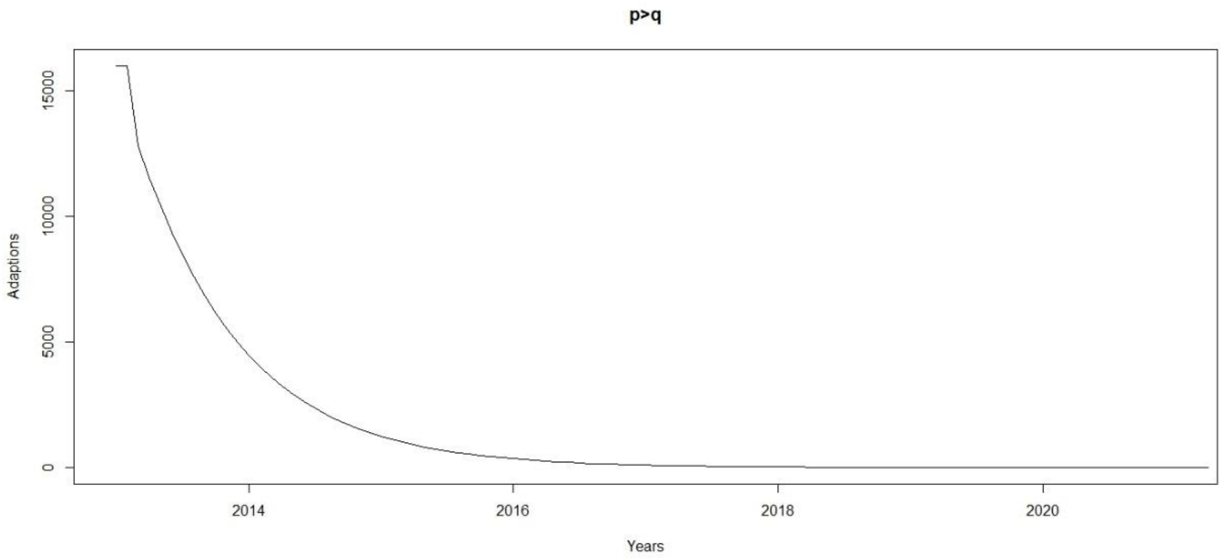


Figure 32: Bass model curve with innovator rate greater than imitator rate

Organisations generally aim to achieve a bell-shaped product lifecycle curve. If a product's lifecycle curve follows a negative exponential shape, it is a definite indication that the product is not performing as desired in the market. A negative exponential product lifecycle curve results from a product that was over-promoted before it was launched, and then failed to meet customers' expectations; or the product was not launched on time and the market had no enthusiasm to purchase the product; or the organisation overestimated the customer need for the product, and it turned out that there was no market for the product to begin with. When the product demonstrates a negative exponential curve, it has to be re-engineered to fulfil the market need.

5.1.2 The Bass model extensions

The Bass model is one of the most frequently-used tools in marketing and management. The diffusion of products through social environments has been a research field of interest since the mid-1900s, and there have been numerous extensions to the Bass model. The most relevant extension of the Bass model is to incorporate the effect of an organisation's marketing mix into the diffusion speed of the product through a market, and to account for the increase in product demand. The extensions of the Bass model were investigated and analysed to ensure that the product lifetime uptake model is the closest representation of the actual product uptake in a market.

Bass, Jain and Krishnan (2000:99) described in the book *New-Product Diffusion Models* that when an extension of the Bass model is used that relates to the decision variables of the model, it is compulsory for the extended model to follow an empirical diffusion process. This implies that the diffusion curve of the extended model should be similar to the Bass model curve.

5.1.2.1 The generalised Bass model

The generalised Bass model incorporates the effect of an organisation's marketing mix on the diffusion rate of a product through a market. An organisation's marketing mix consists of the four P's of marketing: Price, Product, Promotion, and Place. The generalised Bass model only incorporates the effect of price and advertising market elasticity because the product price-decrease rate and the increased advertising-spend are the marketing mix elements most frequently used to increase product demand. Product and place marketing mix efforts are long-term marketing strategies that have longer lead times to influence the product rate of diffusion.

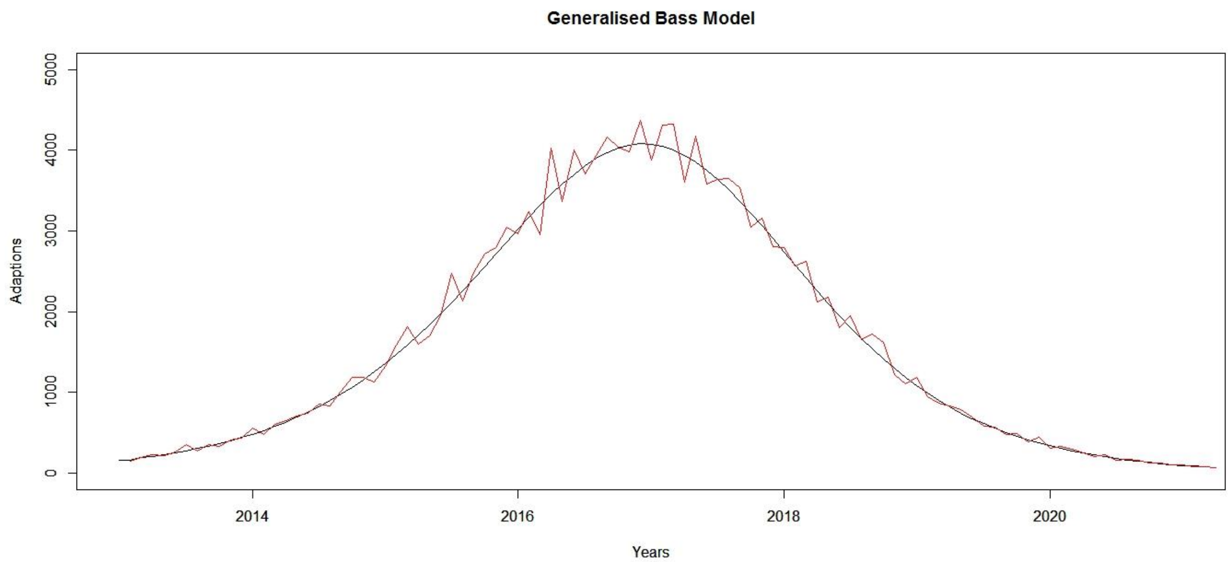


Figure 33: The generalised Bass model

The generalisation of the Bass model can shift the diffusion curve upward or downward, depending on market sensitivity towards the difference in price and advertising spend. The generalised Bass model functions on the premise that the time of adoption depends on both the current marketing effort and the sum of previous marketing efforts. The generalised Bass model has the property that the adoption rate increases as the relative rate of price-decrease increases. If the price difference between time periods is zero, consumers will adjust their adoption behaviour to the normal adoption curve. However if the rate of price-decrease and advertising spend is enlarged throughout the lifecycle of the product, the product adoption rate will increase and the product peak adoption time will be achieved earlier.

The generalised Bass model equation:

$$n_t = \left[pm + (q-p)N_{t-1} - \frac{q}{m}(N_{t-1})^2\right] x_t$$

Where the marketing mix factor, *xt*, is:

$$x_t = 1 + \alpha\left(\frac{P_t - P_{t-1}}{P_{t-1}}\right) + \beta\, max\left\{0, \frac{A_t - A_{t-1}}{A_{t-1}}\right\}$$

- α is the coefficient representing the percentage of increase in diffusion speed due to a one percent decrease in the price of the product,
- P_t is the price of the product at time period t,
- β is the coefficient representing the percentage of increase in diffusion speed due to a one percent increase in advertising spend, and
- A_t is the advertising spend at time period t.

The generalised Bass model includes marketing mix decision variables, has a closed-form solution in the product lifecycle, and adjusts the Bass model under regulated conditions for the decision variables (Bass *et al.*, 1994:204).

If the change in marketing mix over time is constant, the generalised Bass model will reduce to the normal Bass model adoption curve. If the change in marketing mix is constant over time, the change in adoption rate over time will also be constant. The generalisation of the Bass model depends greatly on the accuracy of the marketing mix factor input parameters. Each input parameter of the marketing mix factor is listed and described below.

i. Price elasticity of demand:

Price elasticity of demand (ε) is the percentage change in product demand due to a one percent change in product price. The price elasticity of demand is calculated as follows:

$$\varepsilon = \frac{\left(\frac{Q_t - Q_{t-1}}{Q_{t-1}}\right)}{\left(\frac{P_t - P_{t-1}}{P_{t-1}}\right)}$$

where:

- Q_t is the market demand at time t, and
- P_t is Price at time t.

The premise of price elasticity is that changes in product demand are associated with changes in product price. Price elasticity on product demand can be linked to various external influences, such as similarity of product quality features between competing products, the availability of substitute products, the product use range, and the product price itself.

The average price elasticity of demand for the period under observation is taken as the input parameter for α in the generalised Bass model. The data requirements for the identification of the coefficient representing the percentage increase in diffusion speed due to a one percent decrease in the price of the product is the same as for the resolution of the Bass model parameters. However, the price elasticity of demand parameter requires the product uptake quantities, the replacement quantities, and the product price per period. The price elasticity parameter is obtainable either through observing the recently launched product for a certain period of time, or by using a similar product's sales and price data. Usually price elasticity is calculated on a customer segment. The expected sign of α is negative because it is anticipated that the portion of demand will increase as the proportion of price decreases.

ii. Advertising elasticity of demand:

Advertising elasticity of demand (AED) measures the effect that a change in advertising spend has on the market demand for a product. The advertising elasticity is calculated as follows:

$$AED = \frac{\left(\frac{Q_t - Q_{t-1}}{Q_{t-1}}\right)}{\left(\frac{P_t - P_{t-1}}{P_{t-1}}\right)}$$

The advertising elasticity over the period of observation is regarded as the β input parameter. The expected sign of β is positive because it is fair to assume that an increase in advertising spend will result in an increase in product demand. The advertising elasticity parameter is measured as max {0, ΔA_t}; the argument is that only a positive change in advertising spend has an effect on the increase in product demand.

Bass (2004:1837) commented in one of his most recent papers that the generalised Bass model is the most concrete Bass model extension to incorporate the effect of marketing mix decision variables. The generalised Bass model illustrates the effect that the marketing mix has on the diffusion speed of the product in a market. It is important to note that the generalised Bass model is a closed form solution, and that if the change in product price and advertising spend is constant, the product uptake rate in a market will return to its natural diffusion speed.

5.1.2.2 Market size extensions to the Bass model

Bass, Krishnan, and Jain (1994:209) state that one of the major concerns about the generalised Bass model is that it considers the total market size (*m*), the innovator rate (*p*), and the imitator rate (*q*) as constant over time. Numerous extensions of the Bass model and the generalised Bass model have been designed in an attempt to overcome the shortcomings of the generalised Bass model. Most of the extensions aim to incorporate the change of demand in the market size variable over time, thus converting the *m* variable to m_t.

Lilien, Rangaswamy and Van den Bulte (1999:3) suggest an extension to the generalised Bass model to incorporate the possibility of the eventual adopters varying over time due to external influence, excluding price and advertising elasticity. The external influence may include the increase in product availability through improved and optimised product channels, or through the corresponding influence other technologies may have on the product – for example, the positive effect of improved internet access on online products. They state that the potential market size is related to the price of the product. Their extension to translate the fixed market size parameter is as follows:

$$m_t = m_1(1+r)^{t_{-1}} \left[\frac{P_t}{P_1}\right]^{-\eta}$$

where:

- m_t is the number of eventual adopters in period t,

- r is the market growth rate, excluding the effect of price elasticity,
- P_t is the product price at time t, and
- η is the price elasticity.

However, when put to the test as in Figure 34, it is found that the diffusion rate is extremely sensitive to the change in market size. The input variables for Figure 34 were similar to those for Figure 29, with $p = 0.001$, $q = 0.1$, and $m_1 = 160$. A 'guesstimate' was made for parameters r and η, with both equal to 0.5, and a random price of 35 was generated for the experiment, with a standard deviation of 3. The adoption rates increased unnaturally fast, and even more so when r and η were enlarged. Lilien *et al.*'s extension of a variable market size parameter was disregarded for the purpose of this study for a number of reasons, the most prominent being that (1) the adoption rate increased unnaturally fast, (2) there is no precise way to determine the market growth rate due to external influences, and (3) the product diffusion curve is not similar to the Bass model curve.

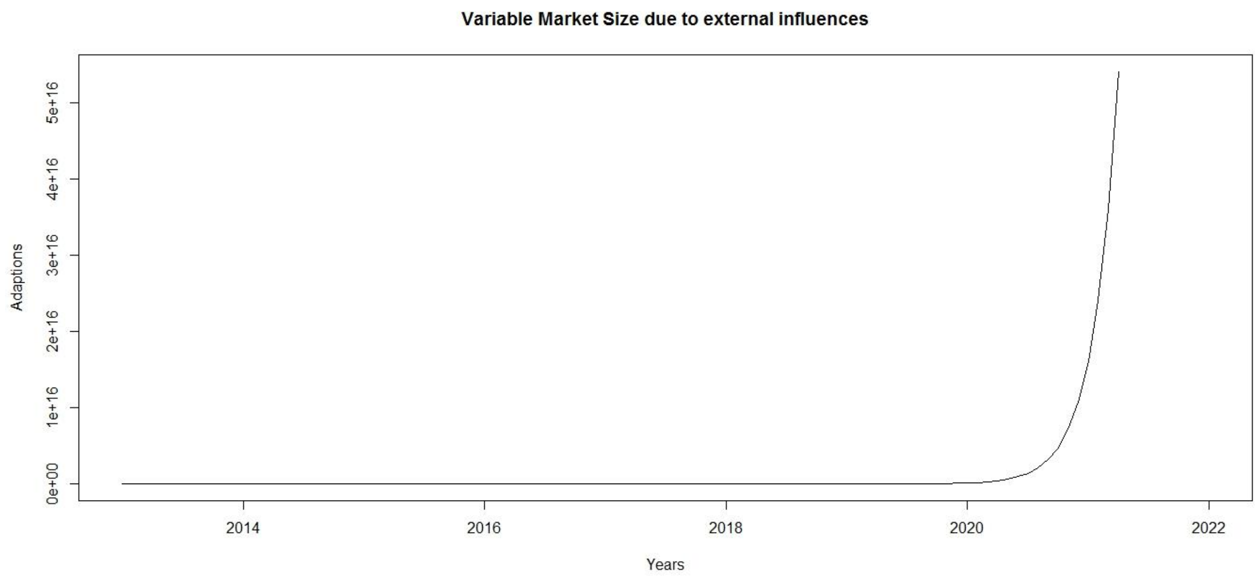


Figure 34: Bass model extension of a variable market size due to external influences

Boehner and Gold (2012:86) argued that the market size cannot be viewed as constant over time due to the influence of the internal marketing mix on the market demand for the product. They change the market size parameter m from an exogenous parameter to an endogenous parameter, and incorporate the value of m as the marketing mix factor of the generalised Bass model. They suggest that the market size parameter m should be determined as follows:

$$m = sP^{-e}A^{f}$$

where:

- m is the market size,
- s is a scaling factor,
- P is the Price of the product,
- A is the advertising expenditure,
- e is the price elasticity, and
- f is the advertising elasticity.

The extension works on the premise that for the time interval t, the advertising expenditure and price per product is fixed. Boehner and Gold incorporate the market size extension directly into the generalised Bass model, altering the equation to:

$$n_t = p(sP^{-e}A^f) + (1 + q - p)N_{t-1} - \left(\frac{q}{sP^{-e}A^f}\right)N_{t-1}{}^2$$

The scaling factor s is set to yield the predefined market size. Boehner and Gold's extension was put to the test with guesstimate parameters p = 0.001, q = 0.1, m = 160000, P = 100, A = 50, e = -1, and f = 0.5. By using the suggested market size equation, the scaling factor s yields s = 226.2742. Figure 35 graphically shows the results obtained from the example of Boehner and Gold's extension.

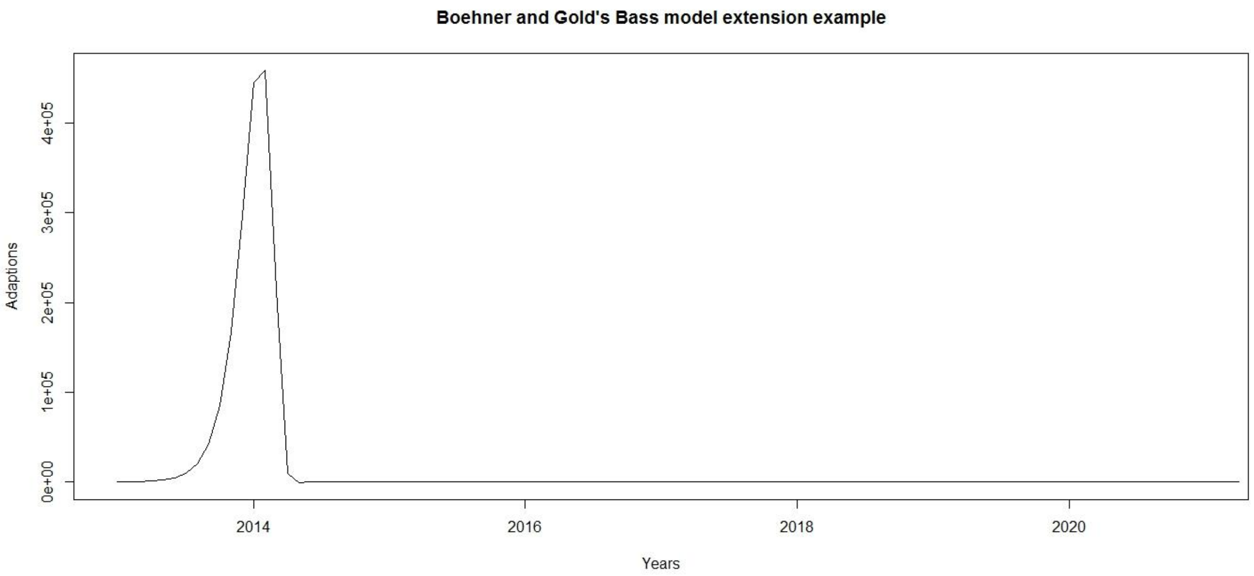


Figure 35: Generalised Bass model extension of a variable market size due to internal influences

Although the product diffusion curve of Boehner and Gold's Bass model extension did follow the normal Bass model curve assumptions, the extension to the Bass model is fairly new, and there is a lack of empirical proof that the forecast diffusion pattern of an existing product through the Bass model extension is similar to the product's actual uptake in the market.

After analysing the two foremost options to extend the Bass model to incorporate a changing market size variable over time, it was decided not to include the extension of a variable market size parameter in the product lifetime uptake model, due to the result of unnatural product diffusion curves and the uncertainties in parameter estimations. The bass model is only extended to the generalised Bass model within the product lifetime uptake model. The market size variable is held constant over time in the product lifetime uptake model, as suggested by Bass, Krishnan and Jain (1994). The generalised Bass model is particularly applicable to products with constantly varying prices over time, and to products that are very price and advertising elastic.

5.1.3 Accounting for risk

Using the Bass model and the generalised Bass model to forecast and model product uptake involves an inherent uncertainty. The Bass model and the generalised Bass model are extremely sensitive towards the input parameters. A wrong estimate for any of the input parameters could give an incorrect impression of the product's performance in a market. Van den Bulte and Lilien ('Why Bass model estimates may be biased') mention that the two major concerns about estimating the Bass model parameters are that the market size is generally underestimated, and the contagion rate or imitation rate is overestimated. This could ultimately lead to misunderstood market demands.

In order to account for the inherent uncertainties in the Bass model and the generalised Bass model, a Monte Carlo simulation is used. This is a widely-used technique to model the impact of risk and uncertainty in forecasting models.

A Monte Carlo simulation replaces the decision variables within the Bass model with a random variable with a probability distribution function covering the most likely, worst, and best outcomes. The results are repeated a number of times, each time using a different random number within the probability distribution range. This range should be carefully selected to ensure an accurate representation of the decision variables. The selection and calculation of the probability distribution functions for each variable in the product lifetime uptake model are discussed in detail to ensure that there is a systematic methodology to determine the decision variable probability distribution functions.

The *market size* decision variable is the most important variable to replace with a probability distribution function. In this manner the product lifetime uptake model accounts for the concerns associated with the constant market size variable within the generalised Bass model. There are numerous reasons why the demand for a product affects the number of eventual adopters. As

Boehner and Gold (2012:86) argued that the internal influence of an organisation's marketing mix efforts does affect the market size, so it can be expected that, as the product price drops or the advertising spend increases, the organisation's market share will increase. However, external factors also play a major role in the fluctuations of market size. The economic state of a market at a certain time, competitor offerings and their level of marketing efforts, fluctuations in currencies, the price of petrol, and even the weather – all of these can influence the product demand. In order to account for all potential factors that could influence the market size, the best suitable option is to provide a range within which the market share might fall, which functions as a platform on which to conduct what-if scenario analysis.

The market size parameter *m* is replaced by a random variable that follows a normal distribution or a triangular distribution with a mean value as obtained from the nonlinear least squares parameter estimation procedure. The standard deviation of the market size parameter can be obtained either by calculating the observed data's standard deviation, or as a managerial input parameter capturing management's perception of the most likely standard deviation of the market size.

The new product can often be a combination of several products. The Bass model estimation procedure is then more complicated, because a range of options is available. When this situation occurs, the average *innovator rate* and the average *imitator rate* can be calculated, together with the corresponding standard deviations, and replaced as probability distribution parameters within a Monte Carlo simulation – as long as the existing products have similar uptake assumptions and configurations.

The result of the Monte Carlo simulation of the Bass model is shown in Figure 36, which is the final product lifetime uptake model of the integrated value proposition design framework.

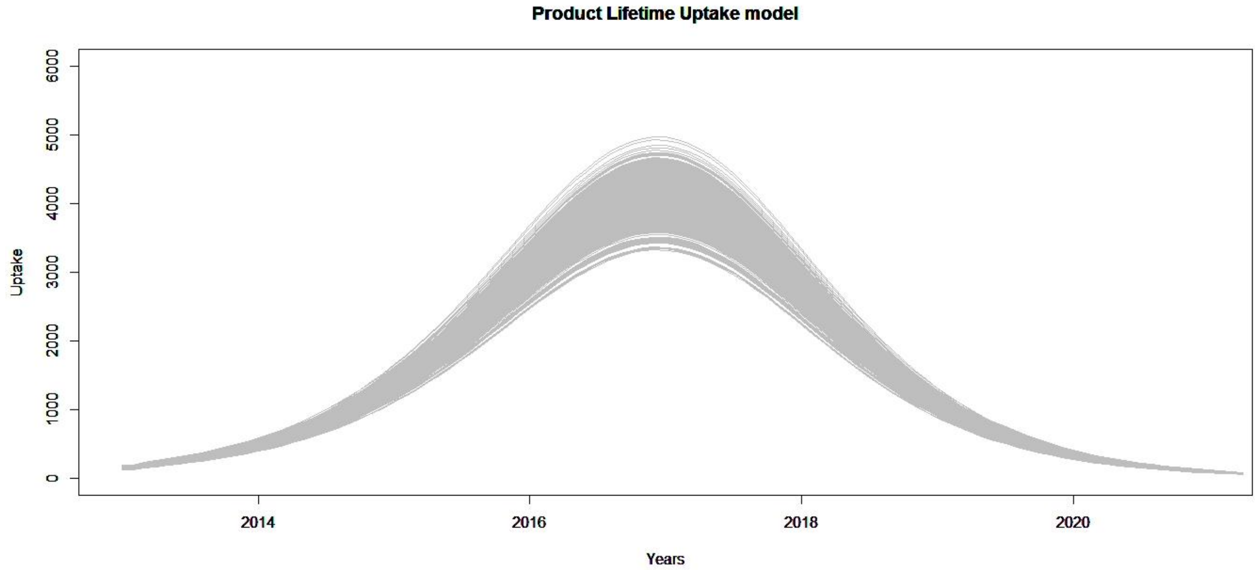


Figure 36: Product lifetime uptake model

The product lifetime uptake model facilitates what-if scenario analysis, which allows analysts to model and evaluate different scenarios – for example, what the product uptake will look like in a 'hot market' and in a 'cold market', and what the 'most likely' product uptake will look like. Figure 37 demonstrates this example of different scenario analyses on market environments.

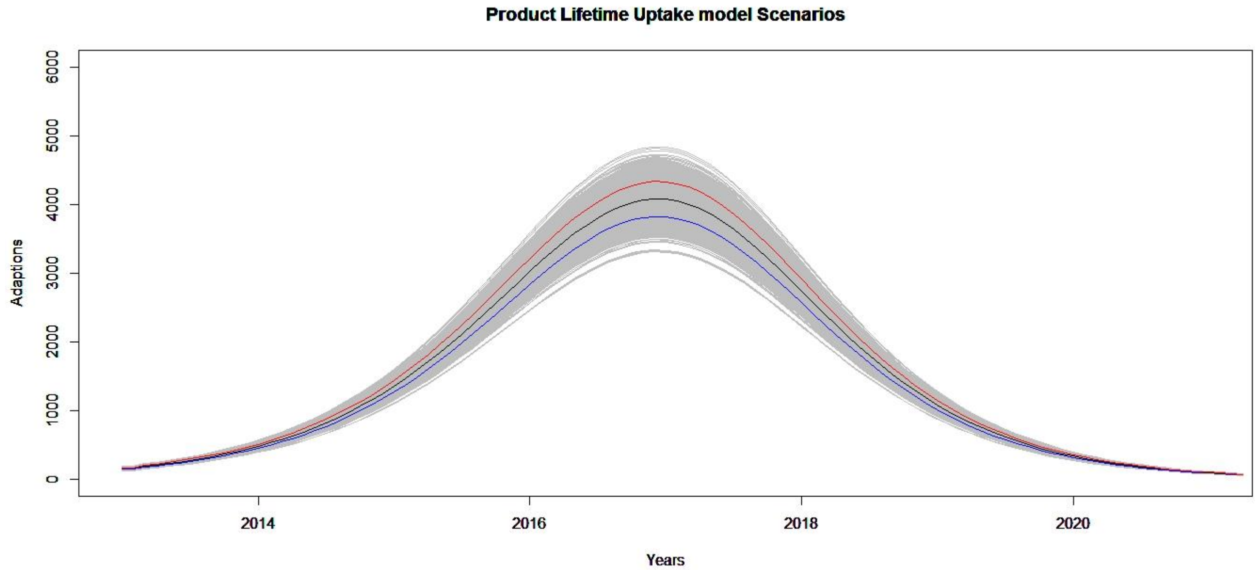


Figure 37: Product lifetime uptake model scenario analysis

The blue product uptake represents a 'cold market', the red product uptake a 'hot market', and the black product uptake the 'most likely' product diffusion. The product lifetime uptake model provides a foundation on which to model various types of scenarios to ensure that all risks and opportunities are accounted for.

5.1.4 Conclusion on the product lifetime uptake model

A leading customer-centric organisation knows its market and the diffusion rate of its products in it. This can only be obtained by effectively managing product portfolios. The advantages of modelling the product lifetime uptake are numerous. It allows for timely execution of strategic moves, and it enhances the effectiveness of product portfolio management and ongoing product strategy validation.

Product uptake modelling is not a once-off exercise to forecast a new product's performance in a market: it is an on-going exercise. The more frequently a product is tested through the product lifetime uptake model, the better the prediction of a product's diffusion rate will be. It is a widely-known fact that the Bass model is more accurate as the amount of data increases through which the model parameters are estimated. Therefore if the product lifetime uptake modelling process is on-going, the organisation will thoroughly understand its customers, their sensitivity towards price and advertising spend, and their eagerness to purchase new products.

The integrated value proposition design framework creates the opportunity for an organisation to build a product quality attribute archive according to how customers perceive the product offerings. Products are classified according to the Refined Kano's attributes, thus making it easier for an organisation to recognise similar products. Together with the archive of product quality attributes, the products' performance in the market needs to be analysed against the product lifetime uptake model to determine the product type's model parameters.

5.2 CUSTOMER LIFETIME VALUE

A customer-centric organisational focus aims to maximise the profits gained on an individual customer level. Such organisations manage their customers as investments. Customer value ultimately drives shareholder value, and therefore not only should the customer value be translated into organisational value in a qualitative manner, but the customer value should also be measured.

Customer lifetime value (CLV) enables an organisation to channel its customer value propositions towards those customers who will in turn generate profit for the organisation. It works on the premise that marketing is held accountable for the efforts and spend to acquire, retain, and grow the organisation's market, by empowering the marketing business unit to focus their efforts on those customers who are not just loyal, but who also generate profit for the organisation.

CLV is similar to the discounted cash flow method, as it calculates a customer's net present value (NPV). The principle of CLV is that it amounts to the NPV of the future revenues obtained from the customer minus the customer acquisition cost. Success in the execution of CLV modelling lies in accurately defining the model input parameters.

5.2.1 Customer lifetime value model input parameters

The CLV per customer is calculated as follows (Gupta *et al.*, 2006:141):

$$CLV = \sum_{t=0}^{T} \frac{[P_t - C_t]r_t}{(1+i)^t} - AC$$

where:

- P_t is the price a customer pay at time t,
- C_t is the direct cost of the product or service at time t,
- i is the discount rate at time t,
- r_t is the probability that a customer will return to the organisation at time t,
- AC is the acquisition cost of the customer, and
- T is the lifetime period of customer engagement.

Each input parameter within the CLV model should be carefully examined and calculated to give an accurate representation of the market environment. The CLV model can be disaggregated into five parts: how much return the organisation makes from each customer per product, how long the customer uses the product, the organisation's discounted rate, the probability that the customer will return to the organisation after using the product, and how much it costs the organisation to acquire the customer. The CLV input requirements are briefly reviewed below; thereafter the methodology for obtaining the input parameters from the product lifetime uptake model is explained in detail.

5.2.1.1 Profit per product

Pricing forms an integral part of the product's customer value proposition statement. Pricing is one of the fundamental Ps of marketing, and it should be in line with the customer value propositions. The integrated value proposition design framework will suggest a pricing strategy that is aligned with the organisation's objectives. The price should either be maintained at the industry standard or reduced below the industry standard. Either way, the pricing strategy identifies the optimal price of the product and the cost of the product, which in turn is used as input parameters in CLV calculations.

5.2.1.2 Time period

This refers to the time period that a customer is classified as being actively involved with the organisation. The regularity of customer purchases depends on the type of product and its billing arrangement. Products associated with contract subscription payment agreements are generally easier to use in CLV calculations, as such agreements guarantee regulated cash flow. The data obtained from subscription agreements has short feedback loops, and therefore offers a good premise for customer behaviour analysis. For transaction-based product payment agreements, the retention rate is used to calculate the time period of customer engagement.

5.2.1.3 Discounted rate

The discounted rate is the net present value interest rate that compares the organisation's current expenses with all future income streams. The discounted rate is used to compare the desirability of the organisation's investments. A customer-centric organisation manages customers as investments; therefore the discounted rate is an indication of the attractiveness of having that customer active in the organisation. Making use of a discounted rate, the CLV calculation shows an organisation whose customers will generate profits in the future; and in that way the organisation can channel its marketing spend.

An organisation's discounted rate is determined by a weighted average cost of capital (WACC) methodology. The WACC is a combination of the cost of equity and the after-tax cost of debt. Cost of equity (*Re*) is what it costs an organisation to maintain a share price at an acceptable level. The cost of debt (*Rd*) is the effective rate an organisation pays on its current debt (McClure).

The cost of equity is calculated as follows:

$$Re = Rf + \beta(Rm - Rf)$$

where:

- Rf is the risk free rate;
- β is the rate of how the organisation's share price performs in comparison with the market as a whole; and
- *(Rm – Rf)* are the equity market risk premiums.

The risk free rate *Rf* represents the amount of equity the organisation obtains from risk free investments such as government bonds. A β rate of 1 indicates that the performance of the organisation is in line with the other competitors in the market; if β is greater than 1, it indicates that the organisation's share price performance is better than the competitors; and contrariwise if β is less than 1. Equity market risk premiums are the rate on returns expected above the risk-free investment rates.

The final input parameters to calculate the discounted rate are the total equity over total organisation value (*equity + debt*) ratio, and the total debt over total organisation value ratio. From these, an organisation's discounted rate is calculated as follows:

$$WACC = Re\frac{E}{V} + Rd(1 - corporate\ tax\ rate)\frac{D}{V}$$

5.2.1.4 Customer retention rate

Customer retention rate is the ratio of the number of retained customers from one period of time to another. In other words, it represents the probability that a customer will be an active customer at a certain time, given that he or she was an active customer at a previous time. The customer retention rate is calculated as follows:

$$RR = \frac{C_T - C_n}{C_s}$$

where:

- C_T is the total number of customers at the end of the period,
- C_n is the total number of new customers at the end of the period, and
- C_s is the total number of customers at the start of the period.

5.2.1.5 Acquisition cost

Customer acquisition cost is the cost associated with acquiring a new customer. The modelling approach within the integrated value proposition design framework uses a high-level calculation of customer acquisition cost, which can be calculated either by adding all the marketing expenditure of a period of time, divided by the number of customers over that period of time, or by multiplying the direct marketing cost aimed at a customer by the probability of the response rate of the customer.

$$CAC = \frac{Marketing\ spend}{Cn}$$

or

$$CAC = Marketing\ Spend\ \times response\ rate$$

The marketing spend used in the customer acquisition cost calculation is the direct marketing cost aimed at acquiring new customers – for example, call centre costs or direct messaging costs.

5.2.2 Customer lifetime value (CLV) modelling

CLV is the net present value of all the future income generated by a customer engaging with an organisation. The CLV calculation depends significantly on the type of product. For subscription types of products, the CLV calculation over time is relatively less complex than for non-subscription types of products.

The CLV modelling method employed within the integrated value proposition design framework uses the product lifecycle as a platform for the CLV input parameter estimation. There are numerous approaches to computing the input parameters over the product lifecycle that could be argued to be mathematically correct. Therefore the methodology used to model CLV within the framework stipulates three assumptions. The assumptions, and the reasoning behind them, are listed below.

Retention rate: Depending on the type of product, the retention rate trend will differ. Retention rates are subjected to the type of product and industry. For example, for a subscription product in the telecommunications industry, the retention rate is subject to the churn rate: it is expected to be high at the beginning of the subscription period and to decrease as the time period increases. By contrast, in the life insurance industry, which also sells subscription-type products, the likelihood of a customer being active increases with time. For example, if the customer has paid life insurance cover premiums for a long time, the likelihood that he or she will opt out is far lower than for a customer who has paid only a few premiums. Therefore *the first assumption is that the customer retention rate of a product fluctuates over the product lifecycle, subject to the type of product and industry*. The retention rate is empirically defined for each CLV modelling exercise, depending on the type of product and industry.

Acquisition cost: Numerous marketing campaigns are associated with a new product launch. The premise of this assumption is to divide acquisition cost into two distinct parameters. The first is the once-off *product acquisition cost*. The product acquisition cost is not directed at a specific customer, but rather towards the product target market; typically it includes acquisition expenditure such as large advertising campaigns, digital marketing campaigns, brand exposure campaigns, and so forth. The second type of acquisition cost is direct *customer acquisition cost*. A customer acquisition cost is the direct cost of acquiring a new customer. For example, an agency is hired to phone clients, and for each client that the agency acquires, a commission charge is transferred. Or it costs an organisation a certain amount to message a customer directly; that, multiplied by the response rate, is the direct customer acquisition cost. *The second assumption for CLV modelling is that only the direct customer acquisition cost is considered*. The product acquisition cost is accounted for later on in the stochastic simulation and forecasting model of the integrated value proposition design framework.

Discounted rate: The discounted rate of an organisation is a parameter that should frequently be re-examined in the light of the organisation's performance in relation to the market. *The third assumption is that the discounted rate for an organisation is fixed*. Incorporating a variable discounted rate would be beneficial in optimising the accuracy of the forecast. The CLV modelling is conducted on a high level within the integrated value proposition design framework, and therefore the discounted rate is held constant.

The CLV formula used within the framework is as follows:

$$CLV_i = \sum_{t=1}^{T} \frac{(p_t - c_t)r_t}{(1+i)^t} - CAC$$

where:

- CLV_i is the CLV per customer purchasing product *i*, and
- CAC is the customer acquisition cost.

It is important to note that the customer acquisition cost in the equation within the CLV model equation occurs at time zero. If the customer acquisition cost will only occur in the future, it should be discounted.

5.3 PRODUCT NET PRESENT VALUE

A new product development effort would ultimately attempt to forecast the amount of profit a product generates – in other words, the net present value (NPV) of the product. This is determined by combining the product lifetime uptake model and the CLV model, as presented in Figure 38.

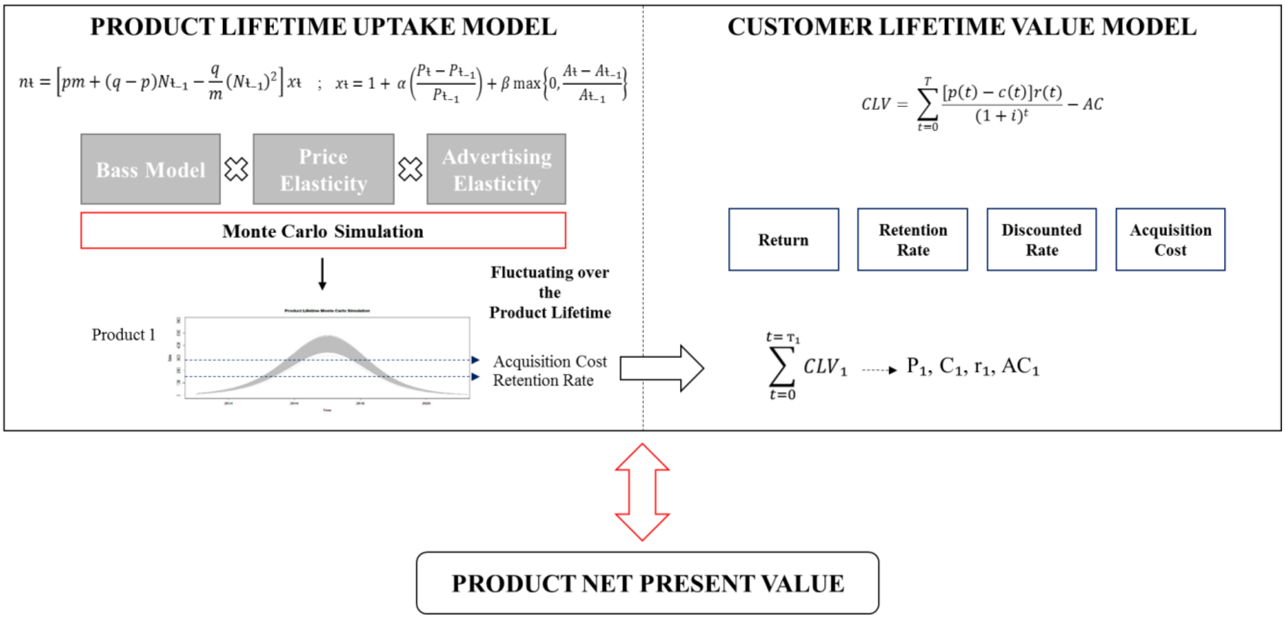


Figure 38: Product NPV calculation

The product NPV formula is as follows:

$$NPV(P_i) = \sum_{t=1}^{L} \frac{(n_t \times CLV_i) - FE_t}{(1+i)^t} - (PAC + OC)$$

where:

- $NPV(P_i)$ is the net present value of product i,
- n_t is the number of initial adopters at time period t,
- FE_t is the fixed expenses at time t,
- PAC is the product acquisition cost,
- OC is the sum of any additional once-off expenditures, and
- L is the product lifetime periods.

The number of initial adopters used in the NPV calculation is obtained from the product lifetime uptake model. The fixed expenses are the overhead expenses that could not be directly linked to the cost of the product per customer, but that are still traceable to the product. Examples of fixed expenses for a product include rent for facilities, indirect labour, outsourcing, and so forth, as long as they directly apply to the product. The product acquisition cost is the initial marketing expenditure to acquire new customers in a market, as described in section 5.2.2. Thereafter, the formula can be personalised for any product and organisation, taking several additional once-off expenses into consideration that are associated with the product, such as major infrastructure expenses, staff training expenses, and more.

The NPV for a product gives the organisation a good idea of what the actual profit generated from the product could be, taking the time value of money into consideration. It gives a good indication of whether the expenses are worth the effort. The product NPV model generated from CLV and the product lifetime uptake model plays a major role in the pricing process of the product, as it provides a platform for studying the diffusion speed, market response, and profit increase or decrease due to a change in product price.

5.4 GOODWILL FIRM VALUE

A ‘customer’ is the primary asset of a customer-centric organisation, yet this is often not mentioned in financial statements and annual reports. Goodwill firm value is the intangible value of an organisation’s attractiveness. It is a combination of the organisation’s ability to sustain durable relationships with its customers and suppliers, and it is an indication of the quality of value delivery to its customers through its products. It is an indication of the organisation’s corporate worth.

The research assignment introduces a new approach to modelling an organisation’s goodwill firm value. Within the integrated value proposition design framework, goodwill firm value is the sum of all the lifetime values of customers purchasing the organisation’s products in the future. It is an indication of the organisation’s customer base worth and the organisation’s ability to maintain an on-going relationship with its customers. Ultimately the sum of the CLVs of the customers using the organisation’s customer value propositions, which is obtainable through products, is the organisation’s goodwill firm value. Figure 39 illustrates the concept of goodwill firm value in the context of the integrated value proposition design framework.

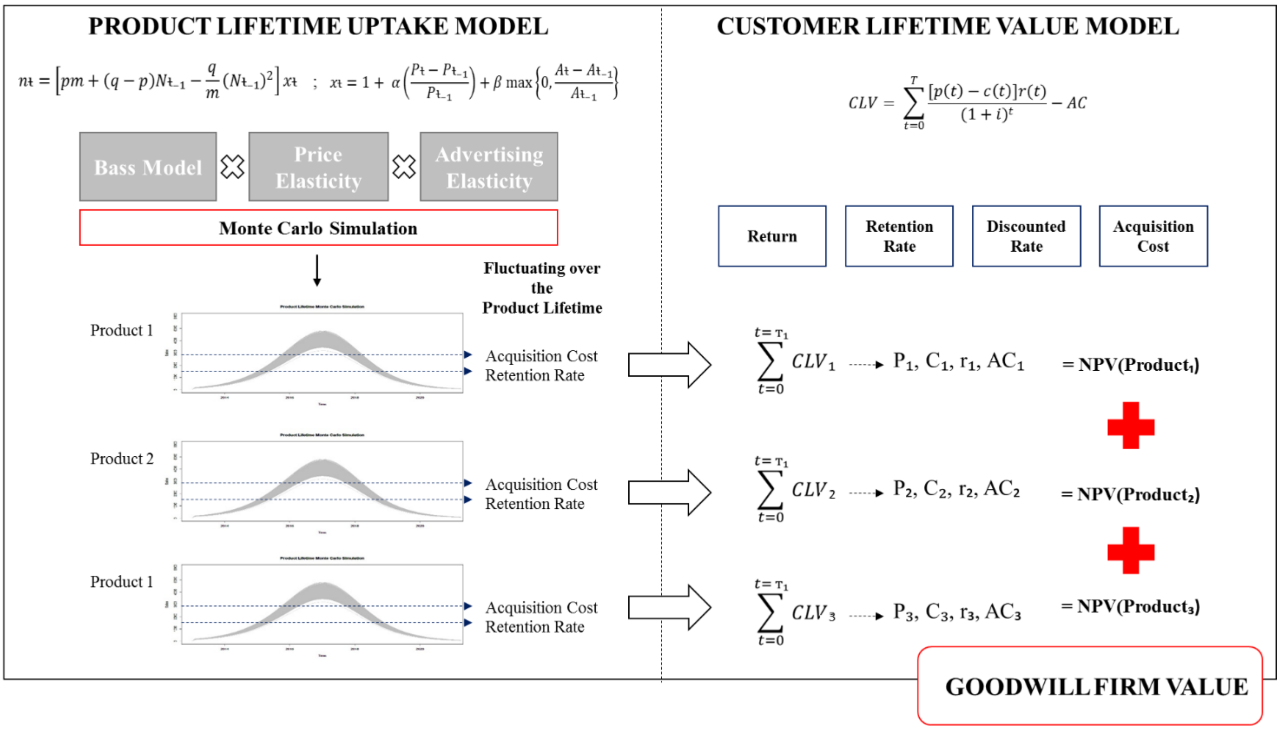


Figure 39: Goodwill firm value calculation outline

The goodwill firm value is calculated as follows:

$$NFV = \sum_{i=1}^{m} NPV(P_i)$$

where:

- m is the number of products.

Expanded:

$$NFV = \sum_{i=1}^{m} \sum_{r=1}^{L} \frac{\left[n_r \times \left(\sum_{t=1}^{T} \frac{(p_t - c_t) r_t}{(1+i)^t} - CAC \right) \right] - FE_r}{(1+i)^r} - (PAC + OC)$$

where:

- r is the time periods of the product lifecycle.
- t is the time period of customer engagement with the product.

The goodwill firm value, in combination with the integrated value proposition design framework, is a depiction of the economics of a customer-centric organisation. The goodwill firm value model can be applied to any organisation and any product.

5.5 CUSTOMER SEGMENT RATE CARD

In order to promote the knowledge feed-back capability of the integrated value proposition design framework used within PLM, the customer segmentation template (Chapter 4, Section 2.5), and the one-page design (Section 5.6) are coupled with an objective customer segment rate card, which is a summary of the key metrics that define the customer segment. Figure 40 demonstrates a template of a customer segment rate card.

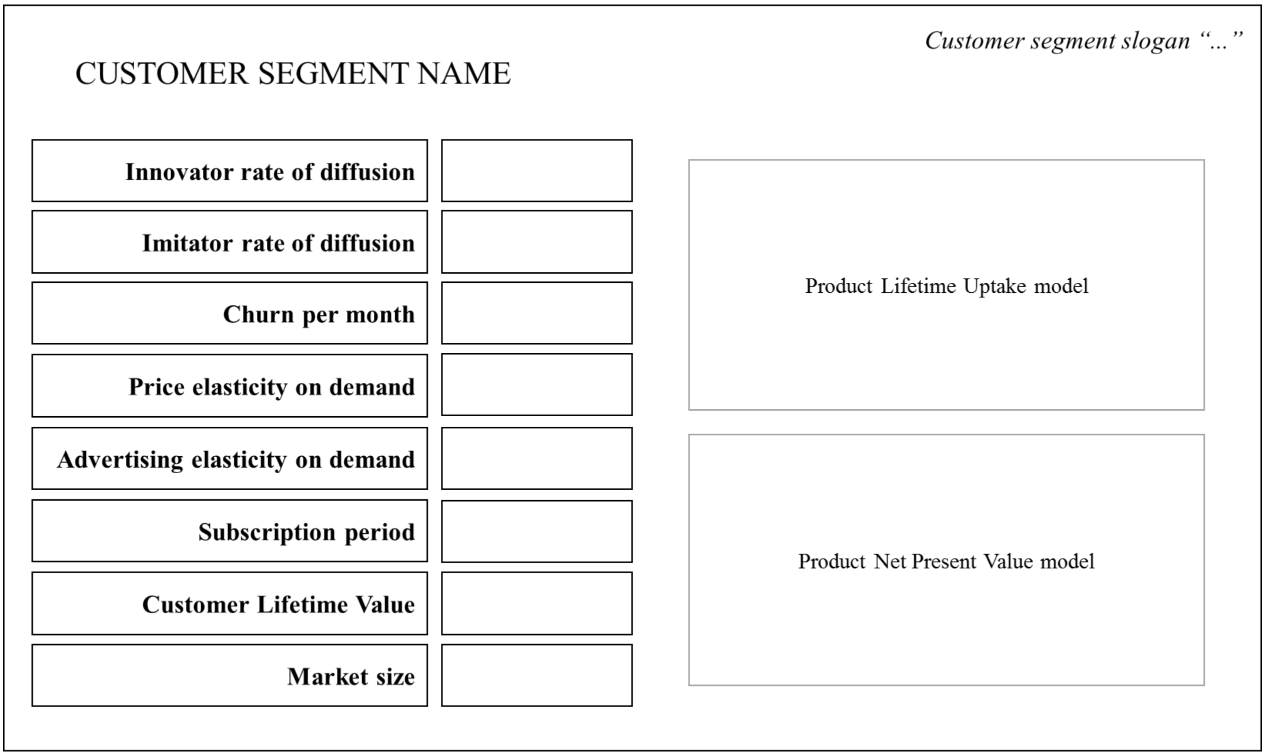


Figure 40: Customer segment rate card template

The left-hand side of the rate card present the key customer segment metrics that are obtainable through the stochastic simulation and forecasting model, and the right-hand side of the customer rate card provides a space where the stochastic simulation and forecasting model output graphs can be inserted. The purpose of the customer segment rate card is to form an archive of the key customer segment metrics. It supports the PLM implementation for present and future new product developments, and encourages the organisation to design new customer value propositions.

5.6 ONE-PAGE DESIGN

One of the objectives of the integrated value proposition design framework is to present the framework on a one-page design for communication purposes. This enables the team to simplify communication and integration requirements on a strategic and tactical level.

The one-page summary starts with the various CLV options available for the product, as well as the target customer segments and the composition thereof; for example the product could be 20 per cent focused on segment one, 65 percent focused on segment two, and 15 percent focused on segment three. Thereafter the one-page summary indicates the marketing strategy objectives, and the value category composition as prioritised within the QFD. Lastly the one-page summary lists the customer value proposition elements , and indicates which Blue Ocean strategic action, customer journey phase, and customer touch point apply to the customer value proposition elements. The case study contains an example of a one-page summary for a product (Chapter 7, Figure 79).

The one-page product summary, as presented in Figure 41, in conjunction with the customer profile summary (Figure 17), and the customer rate card (Figure 40) forms an information feed-back archive within PLM that defines the product and the customer segment in a customer-centric approach. This in turn promotes product portfolio management, and new product development efforts.

Integrated value proposition design framework: One-page design

Customer Lifetime Value						
Price 1	Price 2	Price 3	Price 4	Price 5	Price 6	**Monthly ARPU**
Subscription Period	Subscription Period	Subscription Period	Subscription Period	Subscription Period	Subscription Period	**Subscription Period**
CLV 1	CLV 2	CLV 3	CLV 4	CLV 5	CLV 6	**CLV**

Segment			
Segment 1	Segment 2	Segment 3	**Segments**
			LSM Levels
			Customer Composition

Marketing Objectives		
Customer Acquisition	Customer Growth	Customer Retention

Value Creation Categories			
Functional Value	Economic Value	Psychological Value	Creative Value

Customer value proposition elements		Blue Ocean Strategy against Competitors					
		Create	Raise	Reduce	Eliminate	Maintain	Improve
Product							
VAS							
Pricing							
Place							
Position							
People							
Systems							
RELATIVE %							

Customer Journey					
Finding & Buying	Getting started	Using	Billing	Getting help	Renewing and Exiting

Customer Touch Points				
Online Sales	Retail stores	Call centre	Website	Product

Figure 41: One-page design

5.7 CODE

The customer segmentation model, the product lifetime uptake model, the CLV model, and the goodwill firm value model were coded in the language R (CRAN R software, R language reference, version 3.1, available at http://cran.r-project.org). The code to build the above-mentioned models in R is listed below, together with guidelines for application. Figure 42 illustrates the steps of the stochastic simulation and forecasting model within the integrated value proposition design framework.

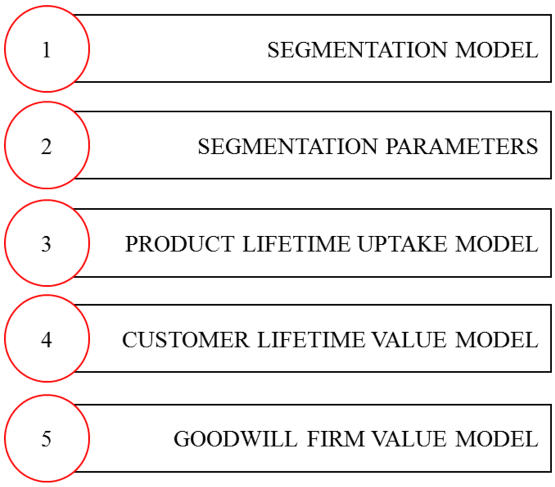


Figure 42: Integrated value proposition design framework modelling steps

The execution of the stochastic simulation and forecasting model is conducted in five steps. The first step clusters the customers into segments. Thereafter the input parameters are determined and stated. The third step is to model the uptake of the product throughout the product lifecycle. Subsequently the CLV for a customer purchasing the product is determined. Lastly, the product lifetime uptake model, in combination with the CLV model, delivers a goodwill firm value.

5.7.1 Customer segmentation modelling

Customer segmentation is an exercise unique to each organisation and product offering, as mentioned in the literature review (Chapter 2, Section 2.5). The most often-used approach to grouping the customer segments is to make use of a clustering tool. Various types of customer data can be grouped together to define customer segments.

The framework uses the CRAN 'kohonen' package for customer segment clustering. Kohonen is an easy-to-use package, built on Teuvo Kohonen's method for SOM, which returns different clusters according to the data provided. The data clusters are the centre points of a specified typology. The size of the topology determines the number of customer segment clusters. The code used for SOM within the 'kohonen' package is given below (Wehrens & Buydens, 2007:5; Lynn, 2014):

```
library("kohonen")                          # Open the kohonen package in R
data <- read.csv(file.choose())             # Load the data file
data$Gender <- as.numeric(data$Gender)      # Convert any non-numeric entries
                                            as numeric

# At this point the data sets used for clustering the customer are converted to numeric
entries

data.input <- data$Revenue                  # For the purpose of this excersie
                                            only cluster the arpu

# Specify the size and type of topology either hexagonal or circular – the size of the
topology equals to the amount of customer segment clusters

somgrid <- somgrid(, , "hexagonal")
data.som <- som(data = data.input, grid = somgrid)
plot(data.som, main = "Customer Segmentation")


data.clusters <- data.som$codes
data.clusters                               # Clusters, Customer segment mean

# Count the number of entries between the clusters

clusters <- sort(data.clusters)
segment_size <- c()

for (i in 2:length(clusters)) {
segment_size[1] <- sum(data.input < clusters[1])
segment_size[i] <- sum(data.input < clusters[i] & data.input > clusters[i-1])
}
segment_size                                # Amount of entries between
                                            clusters
```

The customer segmentation model returns various clusters of related customer information. These clusters are the customer segments. The customer segmentation model is linked to the customer segmentation functional tasks inside the framework, as discussed in Chapter 4, Section 4.2.

5.7.2 Customer segmentation parameters

The product lifetime uptake model, the CLV model, and the goodwill firm value model are calculated by a set of parameters that are unique to each customer segment. The code for calculating and stating the parameters for the rest of the model is given below:

```
## PARAMETER ESTIMATION AND ESTABLISHMENT

# Determine the Bass Model parameters with a non-linear least square built in function

Uptake <- c()                    # Product uptake data per time period, either define
                                 the data in a list, or import the data from a csv file
Time <- 1:length(Uptake)         # Vector with equal length to the uptake data


Bass.nls <- nls(Uptake ~ M * (((P+Q)^2 / P) * exp(-(P+Q) * Time))/(1+(Q/P)*exp(-
(P+Q)*Time))^2,
start = list(M=, P=, Q=))
summary(Bass.nls)

# Customer Segmentat parameters

Bcoef <- coef(Bass.nls)
m <- Bcoef[1]                    # Market size parameter m
p <- Bcoef[2]                    # Innovator rate of diffusion
q <- Bcoef[3]                    # Imitator rate of diffusion
Alpha <-                         # Price Elasticity
Betha <-                         # Advertising elasticity
Price <- c()                     # Forecasted product price over the time period
Advert <- c()                    # Forecasted advertising spend over the time period
churn <-                         # The customer segment churn rate
t <- c(1:24)                     # Subscription time period
Subscription_Fee <- c()          # Subscription fee over the time period - this entry
                                 is the price entry at the point where the customer
                                 adapts to the product
Cost <- c()                      # Product cost
Revenue <- Subscription_Fee - Cost
AC <-                            # Acquisition cost per customer at time t = 0
t_final <- tail(t, n=1)          # Last time period of the subscription contract
c <- (churn/12)                  # The organisation's churn rate per year divided by
                                 the time period breakdown, monthly = 12, quarterly = 4

# Product parameters

E <- c()                         # Fixed Expenses per time period of the product
                                 lifecycle or product being active
Product_AC <-                    # Initial product acquisition cost at time 0
Product_OC <-                    # Product Overhead costs
Period <-                        # Product lifetime length under observation
n <- 1:Period                    # Product lifetime length in time periods, depending
                                 on when the organisation decides to replace product

# Organisation parameters

d <-                             # The organisation's discounted rate per year
```

5.7.3 The product lifetime uptake model

The first step in the product lifetime uptake model is to calculate the Bass model, without any extensions, from the parameters estimated in step 1. The normal Bass model is coded as follows:

```
## NORMAL BASS MODEL

Uptake <- c()                   # Create empty entries for the for-loop
CumUptake <- c()
Uptake[1] <- p*m                # Define the uptake at time t = 1
CumUptake[1] <- 0               # Define the cumulative uptake at time t = 1

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

# Convert vectors into time series

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)
CumUptakeseries <- ts(CumUptake, start = c(2014, 1), frequency = 12)

# Plot the product uptake and cumulative uptake

plot(Uptakeseries, main="Bass Model", xlim = c(), ylim = c(), xlab="Years",
ylab="Adaptions")

plot(CumUptakeseries, main="Bass Model", xlim = c(), ylim = c(), xlab="Years",
ylab="Cumulative Adaptions")
```

The second step in the product lifetime uptake model is to extend the Bass model towards a generalised Bass model.

```
## GENERALISED BASS MODEL

# Convert Marketing Mix into time series

PriceSeries <- ts(Price, start = c(2014, 1), frequency = 12)
AdvSeries <- ts(Advert, start = c(2014, 1), frequency = 12)

# Calculate the difference in price and advertising between time periods

DeltaPrice <- diff(PriceSeries, lag=1, difference=1)
DeltaAdv <- diff(AdvSeries, lag=1, difference=1)
DeltaAdv[DeltaAdv<0] <- 0       #Only account for a positive change in advertising spend

# Calculate the Generalised Bass model factor for incorporating Marketing Mix

MarketingFactor <- 1 + Alpha*(DeltaPrice/PriceSeries) + Betha*(DeltaAdv/AdvSeries)

GeneralisedBass <- MarketingFactor*Uptakeseries

# Plot Generalised Bass model

plot(GeneralisedBass, col="red", xlim=c(), ylim=c(), xlab = “Years”, ylab = "Uptake",
main = "Generalised Bass Model")
```

The third and last step in the product lifetime uptake model is to generate a Monte Carlo simulation. A Monte Carlo simulation from the generalised Bass model is coded as follows:

```
## MONTE CARLO SIMULATION

DensityFunc <- c()
Uptake <- c()
CumUptake <- c()
p_mean <- p
q_mean <- q
m_mean <- m
p_sd <-             # Predefine the standard deviation of the innovator parameter
q_sd <-             # Predefine the standard deviation of the imitator parameter
m_sd <-             # Predefine the standard deviation of the market size parameter

runs <-             # Number of Monte Carlo Simulation runs


output <- matrix(NA, Period, runs)     #Storage matrix

plot(0, col="grey", xlim=c(2014,2018), ylim=c(0, 1000), xlab = "Years", ylab =
"Uptake", main = "Product Lifetime Uptake model")

for(run in 1:runs)
{
p <- rnorm(n = 1, mean = p_mean, sd = p_sd)   # coefficient of innovation
q <- rnorm(n = 1, mean = q_mean, sd = q_sd)   # coefficient of imitation
m <- rnorm(n = 1, mean = m_mean, sd = m_sd)   # the number of eventual adaptors

Uptake <- c()                                 # Create empty entries for variables
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

output[, run] = Uptake
Uptakeseries <- ts(Uptake, start = c(2013, 1), frequency = 12)
par(new=T)
plot(Uptakeseries, xlim=c(2014,2018), ylim=c(0, 1000), xlab = "Years", ylab = "Uptake",
main = "Product Lifetime Uptake model")
}

#Summary Statistics
min(output)
mean(output)
max(output)
```

5.7.4 CLV modelling

CLV modelling was conducted on the assumptions mentioned in Section 5.2.2. The code for CLV modelling for a subscription customer is as follows:

```
# CLV PER SUBSCRIPTION PRODUCT CUSTOMER

# Probability of a customer being active at time t

r <- c()
r[1] <- 1
for (i in 2:t_final) {
r[i] = r[i-1]*(1-c)
}

CLV <- sum((Revenue*r)/((1+(d/12))^t)) – AC
CLV
```

5.7.5 The goodwill firm value

The goodwill firm value is the sum of the organisation's NPV product portfolio. The NPV of a product is coded as follows:

```
## PRODUCT NPV

Product_NPV <- sum((Uptakeseries*CLV - E)/((1+(d/12))^n)) – (Product_AC + Product_OC)
```

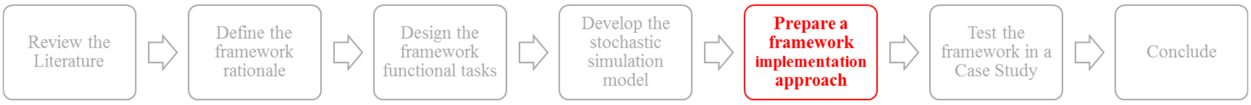
From which the Goodwill Firm Value for an organisation's product portfolio are then coded as follows:

```
## GOODWILL FIRM VALUE

n = time estimation of product 1 from the present
m = time estimation of product 2 from the present
z = time estimation of product 3 from the present

Goodwill_Firm_Value <- Product_1_NPV/(1+(d/12))^n) + Product_2_NPV/(1+(d/12))^m) +
Product_3_NPV/(1+(d/12))^z)
```

5.8 ECONOMICS OF THE INTEGRATED VALUE PROPOSITION DESIGN FRAMEWORK – CONCLUSION

The stochastic simulation and forecasting model of the integrated value proposition design framework provides a way to support the functional tasks inside the integrated value proposition design framework by extending the customer-centric focus within PLM from a qualitative value creation method towards a quantitative value measurement method. The stochastic simulation and forecasting model is a generic and relatively simple tool to implement on any new or existing product initiative, in any organisation.

6 CHAPTER SIX: IMPLEMENTATION APPROACH



The shift towards a customer-centric focus within PLM will not be implemented without several organisational complications. The integrated value proposition design framework could make an immense contribution towards the organisation's strategic efficiency if implemented correctly. This chapter is focused on the approach to implementing the integrated value proposition design framework.

The approach to implementation of the integrated value proposition design framework is a guideline that is made up of project design principles and critical success factors, a methodology to scope the implementation, and a detailed implementation plan. The implementation approach guides the project team leader in adhering to the framework objectives.

6.1 DESIGN PRINCIPLES

Four design principles are defined for the implementation of the integrated value proposition design framework.

The first design principle of the integrated value proposition design framework is the parallelisation of work activities. *Parallel processing* is when two or more activities are conducted simultaneously without affecting each other. Serial processing of activities is when an activity can only start once the previous activity is finished. Tasks performed in parallel shorten the project schedule. A reduced framework project schedule fast-tracks the organisation's ability to benefit from the product, and it reduces the influence of competitors as organisations are under less pressure to match existing offerings as rapidly as possible.

The second design principle is that of *backward scheduling*. This means that the committed product launch date is used as a target date for the framework project, and all the deliverables are scheduled backwards from that date. Backward scheduling is a very effective control tool that enables the organisation to predetermine the exact time requirements for functional tasks within the integrated value proposition design framework.

The third design principle is *milestones*. These define major events on the critical path of the framework project, and allow the project team to measure the state of the project deliverables – for example, whether the project deliverables are still on time. Milestones are a motivation tool to prompt the project stakeholders to deliver the tasks and ultimately the project on time.

The fourth design principle is to make use of *small teams* of the right individuals. Based on project size research studies, the appropriate team size is seven individuals (cf. Lalsing, Kishnah & Pudaruth, 2012:117; Bustamante & Sawhney, 2011:1). The individual team members should be senior representatives from various multifunctional groups. Communication time is directly equivalent to the number of individuals in a team: as the number increases, the channel of communication gets more complex and the time to communicate decisions and findings escalates. There are several advantages to making use of small project teams: administration is simplified, the team members are generally more focused, and the cohesion of and co-operation between individual members is enhanced. The most prominent benefit of small teams is that communication within smaller project teams is more efficient than in larger project teams.

6.2 CRITICAL SUCCESS FACTORS

The implementation of the design principles mentioned in Section 6.1 brings with it certain necessary factors to guarantee the successful implementation of the integrated value proposition design framework. Accurate implementation depends on two critical success factors. The first is that the framework depends upon excellent project management leadership, and the second is that the framework should be implemented in a multi-disciplinary organisation.

The role of a project manager is to ensure that a project is delivered on time and within budget, and that it meets the pre-set project objectives. The general responsibilities of a project manager include the mitigation of risks, detailed planning and control, monitoring progress, and managing stakeholders. The success of the integrated value proposition design framework not only depends on the general project management practices, but it also requires a strong project leader who should have the ability to align the stakeholders and the deliverables towards the project objectives. The project leader should have a clear understanding of the customer, and should fully comprehend the organisation's objectives. He or she must have the ability to cultivate a positive attitude among the stakeholders and to urge them to deliver the tasks with enthusiasm. The success of the framework depends greatly on constructive communication between the project stakeholders and on the ability of the project leader to facilitate the communication requirements.

The framework has the ability to translate organisational objectives into customer requirements through various channels, from the top executives to marketing, financial, and product managers. Multi-disciplinary teams magnify a project team's creative, technical, and analytical expertise. The framework makes use of the input and knowledge of various multifunctional teams to deliver an integrated customer-centric set of validated customer value propositions for a product.

6.3 THE SCOPE OF IMPLEMENTATION

The implementation of the integrated value proposition design framework considers two aspects of scoping: a product scope and a project scope.

6.3.1 The scope of the product

The scope of the product depends on the complexity of the product's value propositions as it applies to the organisation's value chain activities. As described in Chapter 4, Section 4.1.2, the customer value propositions of a product are applicable to the organisation's entire value chain.

The integrated value proposition design framework defines a product in terms of its customer value proposition elements. Thus the scope of a product is determined by a combination of the number of customer value proposition elements embedded within the product and the complexity of realising the value propositions. The scope of a product is classified in a product implementation scope scale, Figure 43 shows the product scope sizes.

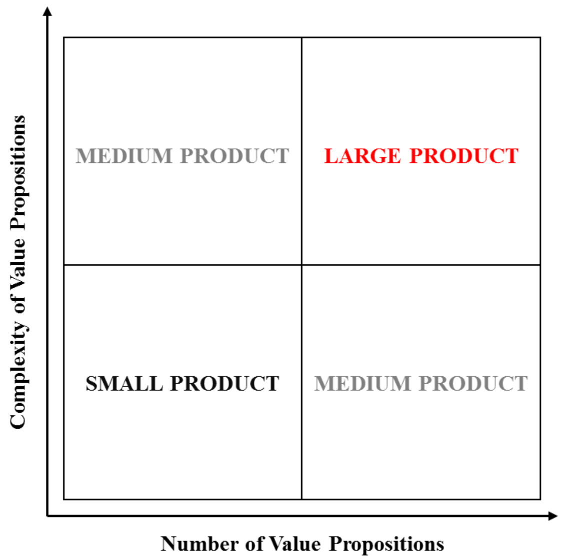


Figure 43: Product scope sizes

A small product is classified as one with a small number of customer value propositions that are uncomplicated to implement. A medium product is classified either as a product with a large number of customer value propositions that are uncomplicated to implement; or as a product with a small number of customer value propositions whose implementation is relatively more complex. A large product is classified as a product with a large number of customer value propositions, most which are difficult to implement.

It is crucial to scope the initial product idea, as determined in the value strategy functional task, in terms of the product sizes. The *initial product scope* is determined both in terms of the number of customer value propositions and the complexity of the value propositions predicted over the organisation's value chain. This plays a major role in the degree of intricacy in the decision-making process within the integrated value proposition design framework. If the complexities of the customer value propositions are relatively easy, the decision-making process and the number of enablers, risks, and barriers in the implementation of the integrated value proposition design framework will also be uncomplicated, and contrariwise. The initial product scope defines the amount of time and number of resources allocated to implement the integrated value proposition design framework.

The scope of the product is greatly dependent on the business requirements and on the organisation's ability to implement the product in terms of budget, time, and technology requirements. The integrated value proposition design framework assists the strategic and tactical team within PLM to scope the final size of the product by delivering a validated set of customer value propositions for the product. Therefore the initial product scope can only be refined into a *final product scope* after the implementation of the integrated value proposition design framework has been completed. In turn, the final product scope supports the PLM team in scoping the product development process.

6.3.2 The scope of the project

The *scope of the project* to implement the integrated value proposition design framework is defined by the functional decomposition of the tasks inside the framework, which are the value proposition functional task, the customer segmentation functional task, the value creation process functional tasks, and the customer experience analysis functional task, in conjunction with the stochastic simulation and forecasting model. The functional tasks within the integrated value proposition design framework are fixed and cannot be altered, replaced, or removed. Chapters 4 and 5 discuss the scope of the integrated value proposition design framework in detail.

6.4 IMPLEMENTATION PLAN

The implementation plan of the integrated value proposition design framework is a detailed plan that encompasses an implementation roadmap, the implementation phases and key milestones, a resource and stakeholder allocation plan, and a means to measure the performance of the implementation of the framework.

6.4.1 Implementation roadmap

The order of the functional tasks in the framework is essential to illustrate a complete process of value creation. The functional tasks within the integrated value proposition design framework are conducted in series. However, the responsibility for the deliverables of each functional task must be divided between the multifunctional team members, and they are conducted in parallel.

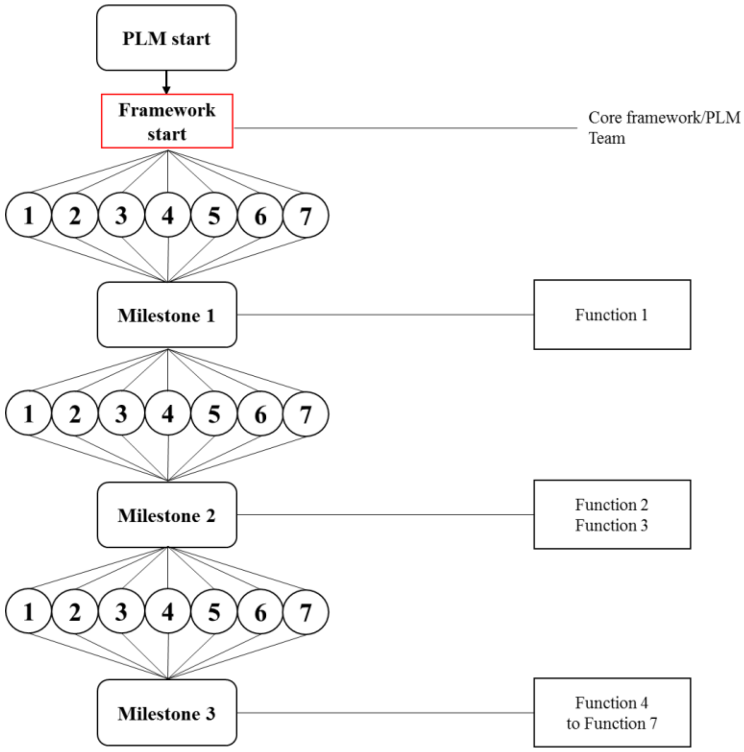


Figure 44: Implementation roadmap structure

The implementation roadmap for the integrated value proposition design framework is presented in Figure 44. The roadmap is a tool to enhance communication between the multifunctional team members, and to conduct as many deliverables as possible in parallel.

The working of the implementation roadmap is as follows. The framework begins with an initial product idea, and the identification of a core framework implementation team and the framework implementation team leader. The initial idea is communicated to the team at the start of the project, each team member takes responsibility to contribute towards the high-level business plan, and goes back to their multifunctional teams where the deliverables for the first functional task of the integrated value proposition design framework are conducted in parallel. After a predefined period, the core implementation team converges at the first milestone. The deliverables of the first functional task are combined, the findings are discussed, and decisions are debated. Again, the core team splits and the high-level business plan is finalised and approved.

Between milestones 1 and 2, the team leader defines the implementation plan, clearly stating the milestone dates, deliverables, resource allocations, and responsibilities. At the second milestone meeting the team leader communicates the implementation approach to the project team. Thereafter the implementation roadmap, the regularity of milestone meetings, and the implementation time requirements depend on the implementation approach defined by the team leader, as long as the implementation roadmap follows a concertina-like movement, with the core multifunction team meeting at a milestone, dividing the work, and meeting again to combine the work.

It is recommended that the roadmap be designed according to a formal functional design approach such as the integrated definition language (KBSI Software, IDEF Method, available at http://www.idef.com/), or a Microsoft Project software model (Microsoft Software, version 2013, available at http://office.microsoft.com/en-za/project/)

6.4.2 Implementation phases and key milestones

The critical path is the longest sequence of activities in a project that need to be completed on time for the project plan to succeed. The critical path of the integrated value proposition design framework consists of the functional tasks inside the framework that need to be completed in a serial manner. Although the multifunctional teams are assigned to complete tasks in parallel between these milestones, the execution of the framework follows a sequential procedure. Figure 45 recalls the implementation phases inside the framework.

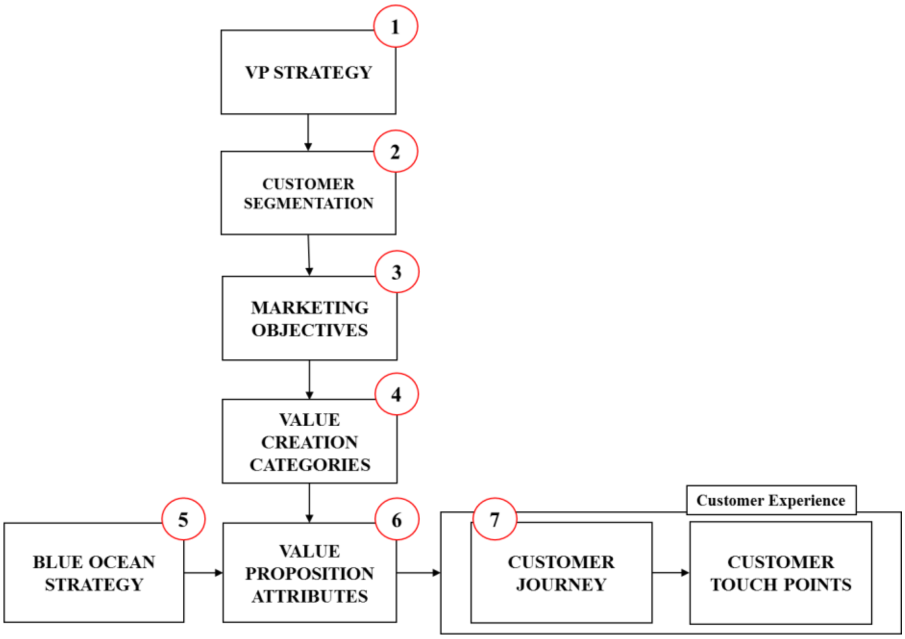


Figure 45: Framework implementation phases

The seven main implementation phases are indicated in Figure 45. Depending on the size of the scope of the product, together with the implementation of the stochastic simulation and forecasting model of the integrated value proposition design framework, the team leader can subjectively decide on the number of milestone meetings and the regularity of deliverables between the implementation phases; however, the critical path is marked as moving from function one to function seven. Strong leadership is required in the core framework team to ensure that targets at the milestones are met.

6.4.3 Resource allocation

The integrated value proposition design framework uses the organisation's employees as the main resources to implement the framework. The other resources on which the implementation of the framework depends are modelling tools such as SnapSheets XL, R, KBSI, or MS Project.

The value chain, over which the customer value propositions apply, disaggregates an organisation into its relevant strategic units. Value chain units are the basic activities from which an organisation builds its human resources in the form of multifunctional teams.

The main resources for the implementation of the integrated value proposition design framework are multifunctional team members. Each business unit influenced by the customer value proposition statement is involved in the implementation of the integrated value proposition design framework. The framework core implementation team consists of the senior representatives of the organisation's value chain business units that are responsible for realising customer value propositions.

Figure 46 shows the value chain activities, and which multifunctional teams would typically be involved in the implementation of the integrated value proposition design framework. The multifunctional teams might vary, depending on the organisational setup.

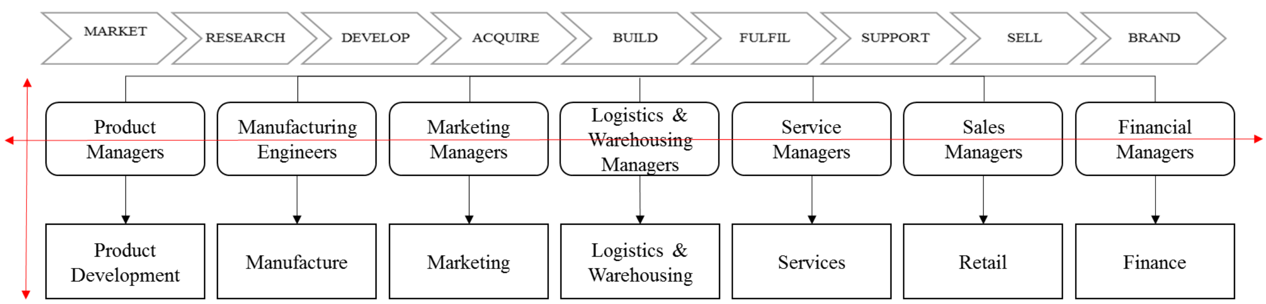


Figure 46: Multifunctional teams within the framework

The software resources mostly used within the implementation of the integrated value proposition design framework are SnapSheets XL (SnapSheets XL Software for Microsoft Excel, version 2007, available at http://www.sigmazone.com/snapsheetsxl.htm), a Microsoft Excel add-in, and the statistical computing software R (CRAN R software, R language reference, version 3.1, available at http://cran.r-project.org/)

As a good project management practice, the implementation of the framework could be improved by making use of formal modelling applications such as the integrated definition language, KBSI, and Microsoft MS Project.

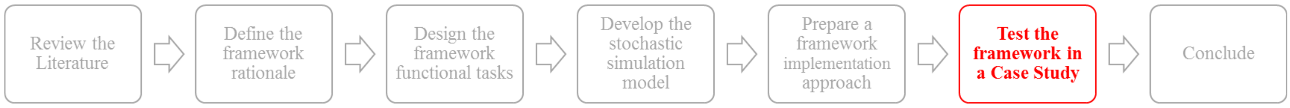
6.4.4 Performance measurement

The two main performance measurements of the integrated value proposition design framework are whether the tasks of the framework are delivered within the predefined *time* periods, and whether the *quality* of the tasks delivered is as desired. The third best practice design principle typically used is whether the tasks are delivered within budget. Given that the framework mostly uses employees as resources, if the tasks are delivered within the right time and according to the desired quality, the organisation inherently saves money because it prevents the employees from having to repeat work.

6.5 IMPLEMENTATION APPROACH – CONCLUSION

The implementation approach of the integrated value proposition design framework is a tool to guide the integrated value proposition design team leader to enhance communication and integration between the multifunctional team members, and to incorporate the parallelisation of work activities. This is achieved by making use of good project design principles and a thorough implementation plan. The implementation approach is a guideline; thus the successful implementation of the framework is to a very large extent dependent on the leadership style of the project manager.

7 CHAPTER SEVEN: CASE STUDY OF A POST-PAID PRICE PLAN PRODUCT



The concept of the integrated value proposition design framework was developed and validated during the course of a seven-month case study conducted at a leading telecommunications company in South Africa, covering the initial design phases of the lifecycle management of a post-paid price plan product. Extensive time was spent on-site interacting regularly with the product development stakeholders. The case study is a descriptive and explanatory analysis of the integrated value proposition design framework. This chapter is focused on providing a detailed application of the integrated value proposition design framework in a real-life scenario.

In the telecommunications industry, a post-paid price plan product is a subscription-type product for a predefined period that includes a phone handset. A telecommunications company offers a combination of services included in the product such as voice talking minutes, SMSes, and data bundles. The organisation's way of working was critically observed and analysed, and as a result the integrated value proposition design framework was structured. The framework is an amalgamation of the elements that proved to be successful in the implementation of PLM at the organisation, an extension to include missing elements, and an improvement on those elements that were inadequate.

The most intricate part of this product in particular was found within the initial design phases of the product, because the organisation already had adequate infrastructure to support the development of the new product. Figure 47 graphically illustrates the involvement with the case study in the PLM over the product lifecycle.

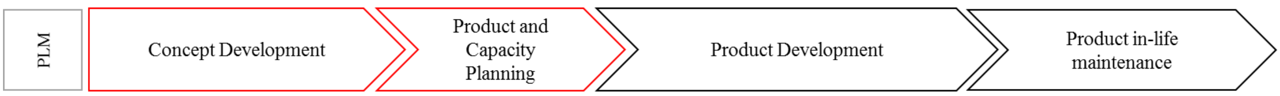


Figure 47: Case study involvement within PLM

In what follows, a brief background to the product is given, and the problem the organisation experienced at that time that pointed to the need to develop a new product is explained. Thereafter the working of the functional tasks of the integrated value proposition design framework is explained in terms of the case study, the economics of the framework are demonstrated, and the final framework deliverables are presented in a one page design. Lastly the success of the case study is discussed.

7.1 BACKGROUND TO THE POST-PAID PRICE PLAN PRODUCT

There are four major telecommunications companies in the South African cellular market, which has reached up to 96 per cent saturation – of which the post-paid market forms about 10 per cent of the overall cellular market. Although the size of the post-paid market remains stable, the configuration of the post-paid market share between the major companies is constantly changing. Thus the post-paid price plan market in South Africa is significantly competitive, as the companies constantly compete to retain their existing post-paid customer base and to acquire new customers from the already-saturated market.

Since mid-2012, the post-paid price plan market environment has drastically transformed: consumers demand newly-proposed price-plan products that complement smartphone capabilities. Given the new market opportunity, the competing telecommunications companies introduced post-paid price plan products that were aggressively-priced. These products provide customers with a converged product where voice talking minutes, SMSes, and data bundles are joined into a one-price plan product for simplicity and consumer convenience. Further enhancing the simplicity and the convenience of these products, the products are priced with a single and predictable tariff, irrespective of the time of day that the call, SMS, or data consumption is made. Peak and off-peak rates therefore do not apply: a flat rate eliminates the inconvenience associated with fluctuating price rates during the day.

The problem that the organisation in the case study experienced was that its competitors launched products that provided high-end consumers in the cellular market with unlimited talking minutes and SMSes for a fixed monthly subscription fee. The organisation was under immense pressure to counter the competitors' value proposition: if it failed to launch a successful high-end post-paid price plan customer value proposition, the organisation's competitors could gain traction in the potential gap in the affluent customer base market.

The new product development effort of the organisation was aimed to match their competitors' product offerings, and to exceed the offerings in value-added services. This in turn would ensure that the organisation remained competitive, and that it stood a chance to retain its existing elite customers, to acquire new elite customers, and to stimulate market growth by increasing the average spend per user behaviour.

7.2 THE FUNCTIONAL TASKS WITHIN THE FRAMEWORK

The working of the functional tasks inside the framework are explained in terms of the implementation process. This process is comprehensively described in Chapter 4. The framework begins with a value proposition design strategy summarised in a high-level business plan. Subsequently the customer segment is decided upon. Thereafter the value creation process begins, and is repeated between functional tasks three to six. Lastly, the set of customer value proposition elements is compared with the customer experience designs.

7.2.1 Function 1: Value proposition strategy

As recalled from Chapter 4, Section 4.1, the value proposition strategy consists of a market analysis, a customer value proposition statement, a business motivation for the product, and a stakeholder allocation, summarised in a high-level business plan.

7.2.1.1 Market analysis

The organisation has approximately 1 million post-paid price plan customers, segmented as high-value customers, whose subscription fees range between R250 and R1,500+ per month.

Smartphones are changing the way in which consumers interact with their mobile hand-sets. In the United States, the United Kingdom, and Italy, consumers spend on average as much as 34 hours, 41 hours, and 37 hours a month respectively on their smartphones. Not only are consumers spending an increased amount of time on their smartphone handsets, they are simultaneously accessing their hand-sets more often – on average, nine times a day (Nielsen, 2014). The ever-increasing spending behaviour of consumers using smartphones, with South Africa not trailing far behind, creates an exclusive opportunity for extreme market growth in the telecommunications industry. The market size for post-paid price plan customers in South Africa is relatively constant; but with the new hype surrounding smart phones, there is an opportunity to increase the average spend per user in the post-paid price plan market.

The organisation recently re-engineered its entire post-paid price plan product portfolio, modified towards the new trend of converged voice, SMS, and data products. The re-engineered products were configured at a competitive network level, and were not aimed to compete on a price level but on a value-added services level. Although the organisation revamped its post-paid price plan product portfolio, there remained a market opportunity to address more effectively the customer requirements of the very top tier of the high-value customer segment – those who consistently spend more than R1,500 a month on average.

The organisation realised that, to address directly the top tier of the high-value customer segment, it would have to design a product with a value proposition statement that is appealingly differentiated, with sufficient value-added services, complemented by the most contemporary hand-sets, in order for the product to compete successfully with both the organisation's existing product offerings and those of its competitors.

In early 2013, the organisation's competitors launched new and innovative post-paid price plan products, offering high-end spending customers unlimited voice minutes, unlimited SMSes, and a compelling monthly data bundle. The launch of the unlimited price plans by the competing telecommunications companies created an opportunity for them to acquire the customers who were not addressed by the organisation being studied. Thus the organisation stood to lose some of its top-tier high-value customers. Table 5 summarises the competitors' products and their corresponding customer value propositions.

CVP Elements	Competitor A	Competitor B
Monthly subscription fee	R 1 999.00	R 1 999.00
Handset	Included	Handset dependent
Voice	Unlimited	Unlimited
SMS	Unlimited	None
Data	1.5 GB	None
VAS	LTE/4G Trade in old phones Applications 24/7 expert support – call centre Multiple SIM depletion	None

Table 5: Case study, competitive analysis: Unlimited offers

Although the organisation's top tier of the high value customer segment comprise only 7 per cent of their total post-paid price plan customer base, these customers are accountable for approximately 19 per cent of the revenue generated from the post-paid price plan customer base.

7.2.1.2 Customer value proposition statement

The organisation aims to introduce an unlimited post-paid price plan product into the market, specifically targeted at the high-end spending user base. The product value proposition allows customers to make unlimited calls to any network at any time. The new price plan product is bundled with an appealing internet bundle, unlimited SMSes, and lifestyle value-added benefits. The unlimited price plan product extends the newly re-engineered post-paid product portfolio of the organisation.

The customer value proposition statement of the unlimited price plan product is summarised in Table 6, as it applies to the organisation's value chain activities.

Customer value proposition element	Customer value proposition details	Customer benefits
Product	Unlimited voice talking minutes	Simple to interpret price plan
	Unlimited SMSes	User can consume as much as desired
	2 Gigabytes inclusive data bundle with the ability to add on another recurring bundle	A price plan that address the user's lifestyle
	Simple and unambiguous price plan	
VAS	Airport lounge access	VAS that complements the user's lifestyle
	Top-of–the-range smartphone handset	A world class network coupled with the most efficient network coverage
	LTE/4G internet coverage	
	Priority calling – call centre service	Viewed as a prestige customer
	The organisation's app inclusive	
	Dual SIM depletion	
Pricing	Monthly subscription fee of R1,999.	Simple transparent pricing with no hidden terms of use
	Transparent and simple	Simple to interpret
Place	Physical channels: Branded stores	Enable sales and support channels to ensure visibility of the product through effective branding
	Online & telesales.	
	Digital channels	Ensure the unlimited product is available and visible in the organisation's online touch points
Position	Integrated communications strategy	Integrated communications strategy that resembles the target market
	Advertising campaigns: radio, print, TV	Positioned as a first-class price plan product
	Digital channels and website	
	Prestige customers' newsletter emails	
People	Efficient training	Informed staff to ensure best experience for elite and prestige customers
	Product accompanied by an information package	
	Effective call centre services	
Systems and processes	Effective network processes	Excellent coverage

Table 6: Unlimited price plan product - customer value propositions

The customer value proposition statement for the unlimited price plan product is a comprehensive offer that applies to the organisation's value chain activities and includes appealing voice, data, price, device, and VAS value propositions. Together with the propositions of unlimited voice minutes and SMSes, the pricing of the product is simple and unambiguous. The price-plan product is coupled with a top-of–the-range smartphone. High-end smartphone users have relatively high data usage, so the product is supported with the most efficient network coverage and an adequate amount of data. The VAS complements the user's lifestyle, and enables a hassle-free experience with the organisation.

7.2.1.3 Business motivation

The business motivation for the launch of the unlimited price plan product is to satisfy the need in the high-end post-paid price plan market. The organisation's competitors have already addressed the need in the market, and in order for the organisation to remain relevant, it has to launch a product that is appealingly differentiated from those of its competitors. In that way, the organisation retains its top tier high-value customers, stimulates market growth in the customer segment, and potentially acquires top tier high-value customers from competitors and other markets.

7.2.1.4 Stakeholder allocation

The allocation of stakeholders in the design stages of the unlimited price plan product was extremely unproductive. At one point in the process, the project team consisted of 65 individuals. This led to organisational conflict among the stakeholders and to a prolonged decision-making process. The core implementation team of the integrated value proposition design framework should have consisted of the following individuals:

A *high-value consumer segment senior manager* responsible for the design and maintenance of customer value propositions that apply to that segment, and for strategic planning and decision-making about any activity affecting the high-value customer segment.

A *high-value consumer segment manager* responsible for tactical and operational deliverables for the design and maintenance of customer value propositions that apply to the high-value customer segment. The segment manager, with the project manager, is responsible for the operational deliverables of the integrated value proposition design framework.

A *product senior manager* responsible for the design, launch, and in-life maintenance of products. Responsibility for PLM implementation lies with the product manager, who must measure the performance of the product in the market, and develop the stochastic simulation and forecasting model of the integrated value proposition design framework.

A *customer management senior manager* responsible for the development and maintenance of on-going relationships with the customers, and able to conduct customer surveys. This manager also delivers valuable inputs into the integrated value proposition design framework by assessing the customer value propositions in terms of customer perceptions.

A *branded channel senior manager* responsible for managing the customer touch points and providing training to the relevant touch point employees.

A *legal and regulatory senior manager*: the telecommunications industry in South Africa has strong regulatory rules; so this manager ensures that the unlimited price plan product falls within those rules and other legal requirements. It is recommended that a representative from the legal team is present as a framework implementation team member from the start, to ensure that there will be no re-work requirements after the customer value propositions have been defined.

An *integrated value proposition design framework project manager* responsible for the implementation of the framework within a pre-set time frame and at a desired quality level.

7.2.2 Function 2: Customer segmentation

The unlimited price plan product is targeted at the high-value customer segment tier with an average spend of more than R1,500 per month – referred to as 'elite' customers. Customers who spend less than R1,500 will most likely not migrate to the unlimited price plan: it is expected that such customers will not benefit financially from the plan. The elite customer profile for the unlimited product is presented in Figure 48.

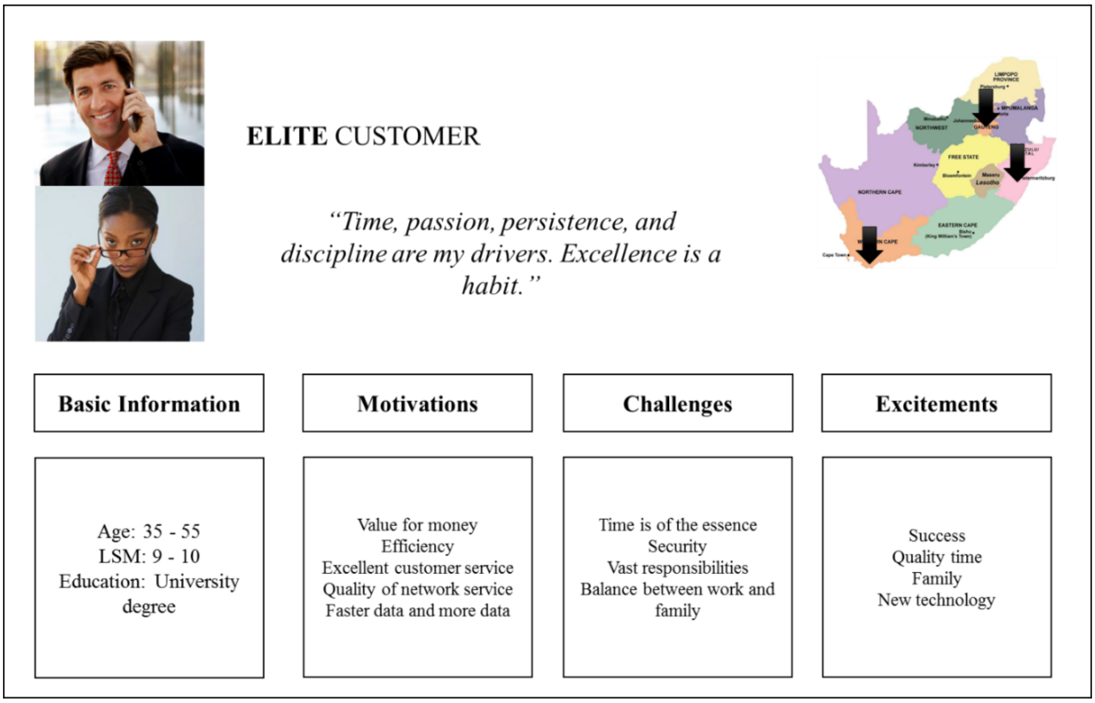


Figure 48: Elite customer segment profile

The elite customer profile in Figure 48 is a subjective representation of a customer in the top tier of the high-value customer segment; it gives the framework implementation team a better understanding of the typical everyday motivations, challenges, and excitements of these customers. As a result of the integrated value proposition design framework and the stochastic simulation and forecasting model, a rigorous and objective estimation of the customer segment is delivered later in the case study in terms of the elite customer segment's CLV, price and advertising sensitivity, churn rate, and product lifetime.

7.2.3 Function 3 – 6: Value creation process

As described in Chapter 4, Section 4.3, before the value creation process can begin, the customer value propositions have to be defined in terms of Refined Kano's quality attributes, either by means of a theoretical definition procedure (Chapter 4, Section 4.3.1) or a Kano Questionnaire (Chapter 4, Section 4.3.2). Thereafter the value creation process is performed in a forward and backward analysis.

7.2.3.1 Refined Kano's model attributes classification

The theoretical classification methodology was used to classify the customer value propositions according to the Refined Kano's model. The basic premise is that the customer value proposition elements are classified by assessing the value proposition against the theoretical definition of a Kano's attribute and its corresponding importance rating. At this point in the framework, the framework implementation team can outsource the Kano survey methodology to obtain a more accurate representation of the value propositions as the customers perceive them. Table 7 illustrates the Refined Kano's attribute classification of the customer value proposition elements as obtained from the theoretical classification technique.

CVP* Element	CVP Components	Kano's Model Attribute					Importance	
		Attractive	OD*	Must-Be	Indifferent	Reverse	High	Low
Product	Unlimited voice	X						X
	Unlimited SMSes	X						X
	2 GB inclusive data	X					X	
	Unambiguous product			X			X	
VAS	Airport lounge access	X					X	
	Superb smartphone handset		X				X	
	LTE/4G internet coverage		X				X	
	Priority calling – call centre		X				X	
	The organisation's app inclusive			X			X	
	Dual SIM depletion			X				X
Pricing	R1,999 p/m			X				X
	Transparent and simple	X					X	
Place	Branded stores				X		X	
	Online & telesales			X			X	
	Digital channels			X			X	
Position	Communications strategy		X				X	
	Radio, print, TV	X					X	
	Digital channels & website			X			X	
	Newsletter emails	X					X	
People	Efficient training			X			X	
	Information package			X			X	
	Effective call centre		X				X	

Systems	Effective network processes				X		X	

Table 7: Case study, theoretical classification of the case study CVPs

The findings of the theoretical Refined Kano's model attribute classification of the value propositions yielded the results in Table 8.

CVP* Element	CVP Components	Refined Kano's model attribute
Product	Unlimited voice talking minutes	Less Attractive
	Unlimited SMSes	Less Attractive
	2 Gigabytes inclusive data bundle with the ability to add on another recurring bundle	Highly Attractive
	Simple and unambiguous price plan	Critical
VAS	Airport lounge access	Highly Attractive
	Top of the range smartphone handset	High Value Added
	LTE/4G internet coverage	High Value Added
	Priority calling – call centre service	High Value Added
	The organisation's app inclusive	Critical
	Dual SIM depletion	Necessary
Pricing	Monthly subscription fee of R1,999 p/m	Necessary
	Transparent and simple	Highly Attractive
Place	Physical channels: Branded stores	Potential
	Online & telesales	Critical
	Digital channels	Critical
Position	Integrated communications strategy	Highly Attractive
	Advertising campaigns: Radio, print, TV	Highly Attractive
	Digital channels and website	Critical
	Prestige customer's newsletter emails	Highly Attractive
People	Efficient training	Critical
	Product accompanied with an information package	Critical
	Effective call centre services	Critical
Systems	Effective network processes	Potential

Table 8: Case study, Refined Kano's attributes

Table 8 returned thought-provoking results. The first notable observation is that the unlimited voice and unlimited SMS propositions are classified as Less Attractive attributes, whereas one would have expected those two attributes to be the main attractions of the product. Although these attributes are attractive, these value propositions are not differentiated from the competitors' offerings, and therefore were perceived as Less Attractive. The data bundle bring forth a Highly Attractive value proposition because the data bundle exceeded the competitors' propositions at that time. The second observation is that the monthly subscription fee is classified as a Necessary attribute. A customer within the target segment will perceive the payment of this product as a must-be value proposition. The price of the product is less important to the targeted segment than the value associated with the product. The brand positioning value propositions that have the ability to distinguish the product from similar products in the market are perceived as Highly Attractive. The third observation is that the organisation had the opportunity to expand and optimise their current network processes to enhance customer satisfaction, and therefore this was perceived as a potential quality attribute.

7.2.3.2 The value creation process analysis: Backward analysis

The backward analysis of the value creation process is shown in Figure 49. It begins with the marketing strategy objectives, through the value category channels, towards the Blue Ocean strategy, and is attached to a Refined Kano's quality attribute, which prioritises the customer value proposition elements according to the marketing strategy objectives.

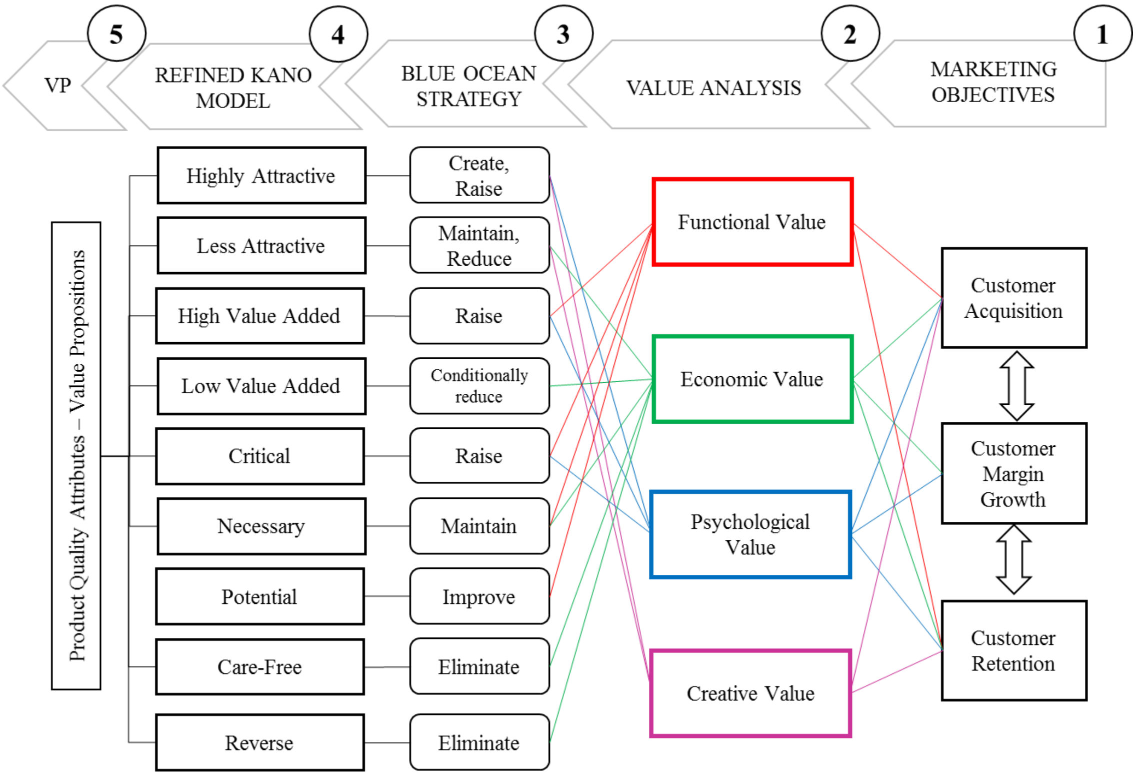


Figure 49: Case study, Value creation process backward analysis

As mentioned in Chapter 4, Section 4.3.3, the QFD is used to implement the analysis of the value creation process, and to prioritise the entries within the value creation model by making use of various roll-outs of the House of Quality.

The backward analysis results in the first five roll-outs of the QFD. This section of the case study illustrates how the QFD roll-out phases of the backward value creation analysis are implemented on the unlimited price plan product.

Backward analysis, QFD roll-out phase 1: Marketing strategy objectives

The organisation has distinct marketing objectives for the unlimited price-plan product. The product is intended to drive new post-paid customer acquisition from within the organisation's customer base, and to acquire new customers from competitor networks. The product is expected to grow the elite customer base with increased post-paid average spend per user. It is aimed to narrow the gap between the organisation and its competitors. The product has to build brand affinity with elite customers, and it has to improve the organisation's position in the post-paid customer market. The product is clearly designed to strengthen the organisation's competitiveness in the elite segment and to defend the organisation's post-paid market share. The product has to increase the retention of current post-paid customers, reduce potential churn (migration to competitors), and it has to ensure relevance in the elite customer post-paid market. Ultimately the product is intended to increase the organisation's revenue.

The marketing objectives within the framework are classified as customer acquisition-driven marketing objectives, customer retention-driven marketing objective, or customer growth-driven marketing objectives. Figure 50 illustrates how the QFD is used to classify the detailed marketing objectives into the marketing strategy objective drivers (acquisition, growth, or retention), and how to prioritise the relationship between the detailed marketing objectives and the marketing objectives.

		WP							
		SP	SP						
		Marketing Drivers			**Competitive Evaluation**				
					Organisation A				
					Competitor #1 B				
					Competitor #2 C				
					Competitor #3 D				
					1= Lowest 5 = Highest				
Detailed Marketing Objectives	**Importance Rating**	Customer Acquisition	Customer Growth	Customer Retention	1	2	3	4	5
Drive new post-paid acquisition.	3	9	0	0	D		A	C	B
Acquire customer from competitor networks.	2	9	0	0	D		A	C	B
Drive the high voice post-paid base.	4	3	7	4	D		C	A	B
Reduce the gap between the organisation and competitors.	3	4	8	4	B	D		C	A
Build brand affinity with elite customers.	3	5	5	5	D		C	A	B
Improve the organisation's position amongst the post-paid market.	4	3	5	7	D		C	A	B
Strengthen the organisation's competitiveness in the elite customer segment.	4	3	5	7	D	C		A	B
Defend the organisation's post-paid market share.	4	2	3	9	D	C	A		B
Increased retention of current post-paid customers.	5	0	0	9	D		A	C	B
Reduce potential churn or migration to competitor networks.	4	0	5	9	D		A	C	B
Ensure relevance in the elite post-paid market.	3	6	6	6	D		C	A	B
Increase the organisation's revenue.	3	2	8	8	D	C		A	B
Grow the high voice post-paid base.	5	2	7	5	D	C	A		B
Raw score		150	216	283					
Relative %		23%	33%	44%					
Importance Rank		1	3	5					

Figure 50: Case study, Marketing objectives OFD, backward analysis

According to the execution of the first roll-out of the QFD, the unlimited price plan product is 23 per cent customer acquisition-driven, 33 per cent customer growth-driven, and 44 per cent customer retention-driven. The right hand side of Figure 50 rates the organisation's ability to realise the detailed marketing objectives in relation to its competitors' ability to realise the detailed marketing objectives. Lastly, the QFD compares the relationship between the various marketing objectives. For example, the efforts associated with acquiring or retaining customers have a strong positive relationship with the efforts associated with encouraging market growth. However, there is a weak positive relationship between customer acquisition and customer retention-driven efforts. The roof area and the competitor analysis of the House of Quality are optional within the implementation of the framework.

Once the marketing objectives have been prioritised and a marketing strategy objective composition has been generated, the framework progresses into the 'value category analysis' phase (Figure 49).

Backward analysis, QFD roll-out phase 2: Value analysis

As mentioned in the literature review (Chapter 2, Section 2.3.2), value can be added to a customer as functional value, economic value, psychological value, and creative value. At this stage in the framework, the marketing objectives are prioritised in relation to the value categories. The value creation process (Figure 49) illustrates the relationship between the marketing objectives and the value categories. Within the QFD the relationships between the value categories and the marketing objectives are marked in light yellow (Figure 51). The prioritisation of the value categories only occurs in the entries that are marked in yellow; the white entries are kept blank.

WP
WP WN
SP SP SP

		Value Categories				Competitive Evaluation				
						Organisation A; Competitor #1 B; Competitor #2 C; Competitor #3 D; 1= Lowest 5 = Highest				
Marketing Drivers	**Importance Rating**	Functional Value	Economic Value	Psychological Value	Creative Value	1	2	3	4	5
Customer Acquisition	1	5	7	9	9	D		A	C	B
Customer Growth	3		9	8		D	C		A	B
Customer Retention	5	8	9	5	9	D		C	A	B
Raw score		45	79	58	54					
Relative %		**19%**	**33%**	**25%**	**23%**					
Importance Rank		1	5	3	2					

Figure 51: Case study, Value categories QFD, backward analysis

The entries are rated according to the theoretical definitions of the value categories. For example, the functional value of the product will not have a strong relationship with the acquisition of new customers because the product is not differentiated on a functional value level; the product will contribute relatively the same functional value to the customers as the other competing products will. Rather, the product is intended to drive customer acquisition by delivering psychological and creative value to the customers.

Every entry within the QFD is reasoned in the same way by the framework implementation team. Figure 51 returns a composition of the value being added to the customer and prioritises the value categories accordingly. The unlimited product will not attempt to deliver more functional value to the customers than already offered by competing products. Rather, the product is mainly aimed at delivering economic value, and the product will be differentiated by delivering psychological and creative value to the customers.

The right-hand side of Figure 51 prioritises the organisation's ability to drive customer acquisition, retention, and growth in relation to the competitors' ability to realise the marketing objectives. The roof area evaluates the relationships between the different value categories. The competitor analysis and the roof area of the House of Quality are not compulsory for the implementation of the framework.

After identifying the value creation channels through which the organisation aims to deliver value to their customers, driven by their chosen marketing objective strategy, a strategic action is identified to realise the value creation category.

Backward analysis, QFD roll-out phase 3: Blue Ocean strategy

Value is delivered to the customer by taking a strategic action. The third phase of the value creation process is to prioritise the strategic actions that the organisation should take in relation to the various value categories. Figure 52 illustrates the relationship between the value categories and the Blue Ocean strategy, according to the value creation process, with the entries marked in light yellow. Only the yellow entries are ranked; the white entries are kept blank.

		Blue Ocean strategy					
Value Categories	**Importance Rating**	Create	Raise	Maintain	Reduce	Improve	Eliminate
Functional Value	1		8	5		5	
Economic Value	5			9	3		1
Psychological Value	3	9	7				
Creative Value	2	9	7	3	3		
Raw score		45	43	56	21	5	5
Relative %		**26%**	**25%**	**32%**	**12%**	**3%**	**3%**
Importance Rank		4	4	5	2	1	1

Figure 52: Case study, Blue Ocean strategy QFD, backward analysis

The prioritisation within the entries of the QFD depends on the theoretical definition of the Blue Ocean strategy. For example, the organisation will deliver functional value by raising its product customer value propositions well above the industry norm, by improving on the industry norm with its customer value proposition, or by maintaining the industry customer value proposition norm. The relationship ranking value between the value categories and the Blue Ocean strategy moves is reasoned over in every entry of the QFD.

Figure 52 shows a Blue Ocean strategy composition for the unlimited price plan product that is 32 per cent focused on maintaining or matching the customer value propositions industry norm, 26 per cent focused on creating customer value propositions that the industry has never seen before, 25 per cent focused on raising the customer value propositions above the industry norm, 12 per cent focused on reducing the customer value propositions below the industry norm, 3 per cent focused on improving the customer value propositions that lead to neither customer satisfaction nor customer dissatisfaction, and 3 per cent focused on eliminating the customer value propositions that do not contribute to customer satisfaction.

After the composition of the Blue Ocean strategy has been obtained, the product quality attributes that should be embedded within the product are prioritised.

Backward analysis, QFD roll-out phase 4: The Refined Kano's model classifications

Figure 53 illustrates the relationship between the Blue Ocean strategy and the Refined Kano's model attributes according to the value creation process, marked in light yellow; only the yellow entries are ranked.

		Refined Kano's model classifications								
Blue Ocean strategy	**Importance Rating**	Highly Attractive	Less Attractive	High Value Added	Low Value Added	Critical	Necessary	Potential	Care-Free	Reverse
Create	4	9								
Raise	4	9		9		7				
Reduce	2		5		3					
Eliminate	1								9	9
Improve	1							7		
Maintain	5		5		5		9			
Raw score		72	35	36	31	28	45	7	9	9
Relative %		**26%**	**13%**	**13%**	**11%**	**10%**	**17%**	**3%**	**3%**	**3%**
Importance Rank		5	3	3	2	2	3	1	1	1

Figure 53: Case study, Refined Kano's attributes QFD, backward analysis

The relationship rank values in the yellow entries are defined by the framework implementation team. These values should be argued over for every new product initiative, taking the market environment and the competitors' product offerings into consideration.

For the unlimited price plan product it is essential to create and raise highly attractive and high value-added quality attributes. It is also vital to eliminate care-free and reverse quality attributes due to strong competition between the telecommunications companies. It is slightly less important to raise critical quality attributes, because they do not contribute greatly to customer satisfaction. Lastly, it is less important to reduce and maintain less attractive and low value-added attributes.

Until this point in the value creation process, the framework implementation team can conclude that, in order to realise the organisation's detailed marketing objectives, a product must be developed with customer value proposition elements that mostly consist of highly attractive, less attractive, high value-added, and necessary quality attributes.

The last phase of the QFD roll-out in the backward analysis of the value creation process prioritises the customer value proposition elements, as defined in the customer value proposition statement in the value proposition strategy functional task, according to the Refined Kano's model importance ratings obtained in the fourth roll-out of the QFD. The customer value proposition elements were ranked according to the Refined Kano's model attributes within the theoretical classification exercise (Section 7.2.3.1). The light yellow entries in Figure 54 show the Refined Kano's attribute classification of the customer value proposition elements; only the yellow entries are ranked.

The prioritisation of the customer value proposition elements shows the integrated value proposition design framework implementation team which customer value proposition elements contribute the most towards the detailed marketing objectives of the organisation. Figure 54 shows how the customer value proposition elements are prioritised; these importance ratings initiate the forward analysis of the value creation process.

Backward analysis, QFD roll-out phase 5: Customer value proposition elements

		Product				VAS						Price		Place			Position				People			
	Importance Rating	Unlimited Voice	Unlimited SMSes	2 GB inclusive data	Unambiguous product	Airport lounge access	Superb smart phone handset	LTE/4G internet coverage	Priority calling – call centre	The organisation's app inclusive	Dual SIM depletion	Monthly subscription: R1999 p/m	Transparent and simple	Branded stores	Online & Telesales	Digital channels	Communications strategy	Radio, Print, TV	Digital channels & website	Newsletter emails	Efficient training	Information package	Effective call centre	Effective network processes
Highly Attractive	5			9		9							9				9	9		9				
Less Attractive	3	9	9																					
High Value Added	3						9	9	9															
Low Value Added	2																							
Critical	2				9					9					9	9			9		9	9	9	
Necessary	3										9	9												
Potential	1													9										9
Care-Free	1																							
Reverse	1																							
Raw score		27	27	45	18	45	27	27	27	18	27	27	45	9	18	18	45	45	18	45	18	18	18	9
Relative %		**4%**	**4%**	**7%**	**3%**	**7%**	**4%**	**4%**	**4%**	**3%**	**4%**	**4%**	**7%**	**1%**	**3%**	**3%**	**7%**	**7%**	**3%**	**7%**	**3%**	**3%**	**3%**	**1%**
Importance Rank		3	3	5	2	5	3	3	3	2	3	3	5	1	2	2	5	5	2	5	2	2	2	1

Figure 54: Case study, CVP QFD, backward analysis

7.2.3.3 The value creation process analysis: Forward analysis

The forward analysis of the value creation process is used to confirm whether or not the chosen value proposition elements will realise the marketing strategy objectives. The forward analysis starts with the customer value proposition elements, defined as Refined Kano's attributes, attached to a Blue Ocean strategy, moving through the value categories towards the marketing strategy objectives.

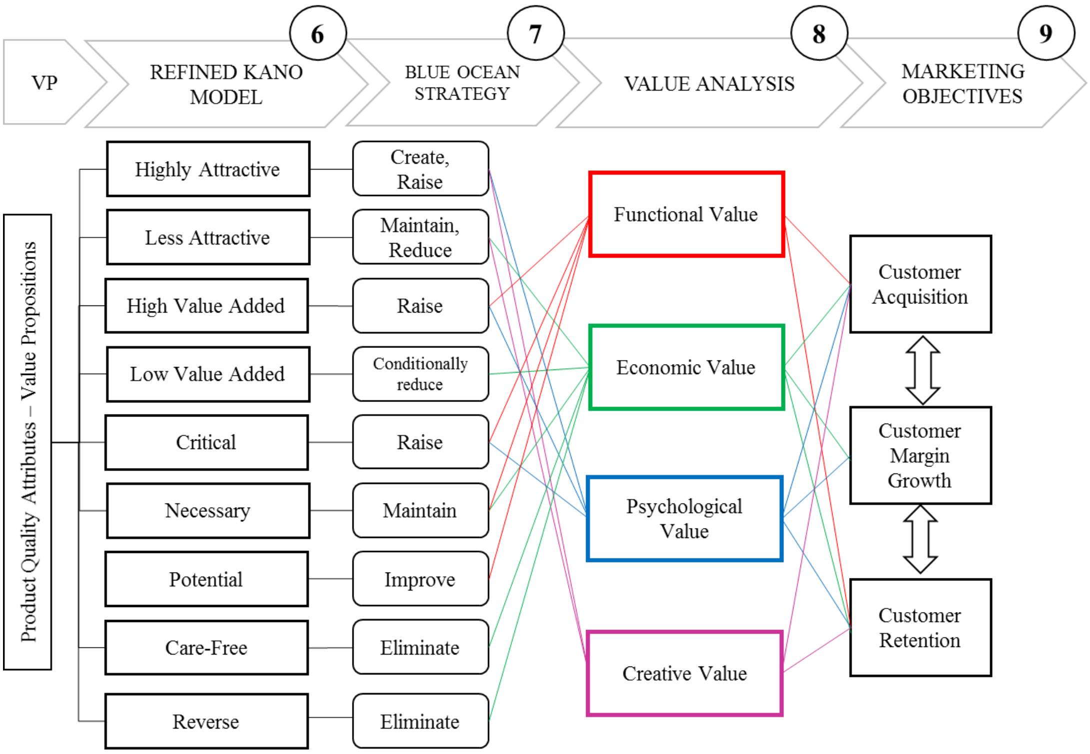


Figure 55: Case study, Value creation process, forward analysis

The forward analysis results in the QFD roll-out of phases six to nine. This section of the case study illustrates how the QFD roll-out phases of the forward value creation analysis are implemented on the unlimited price plan product. At any phase in the forward analysis, the process can be stopped and referred back towards the findings in the backward analysis. The relationship rankings within the QFD roll-outs of the entries in the forward analysis are kept similar to the entries in the backward analysis to ensure consistency.

Forward analysis, QFD roll-out phase 6: The Refined Kano's model

The importance ratings of the customer value proposition elements were obtained from the backward analysis (Figure 54). The actual Refined Kano's model quality attribute composition that the product consists of is represented in Figure 56.

			Refined Kano's model classifications									Competitive Evaluation				
												Organisation A; Competitor #1 B; Competitor #2 C; Competitor #3 D; 1= Lowest 5 = Highest				
	Customer value propositions	Importance Rating	Highly Attractive	Less Attractive	High Value Added	Low Value Added	Critical	Necessary	Potential	Care Free	Reverse	1	2	3	4	5
Product	Unlimited Voice	3		9								C		A	D	B
	Unlimited SMSes	3		9								C		A	D	B
	2 GB inclusive data	5	9										D	C	B	A
	Unambiguous product	2					9						D	C	B	A
VAS	Airport lounge access	5	9									D	C	B		A
	Superb smart phone handset	3			9								D	A	C	B
	LTE/4G internet coverage	3			9								D	C	A	B
	Priority calling – call centre	3			9								D	C	A	B
	The organisation's app inclusive	2					9						D	C	A	B
	Dual SIM depletion	3						9				D		A	C	B
Pricing	Monthly subscription: R1999 p/m	3						9				C		D	A	B
	Transparent and simple	5	9										D	C	B	A
Place	Branded stores	1							9			D		C	A	B
	Online & Telesales	2					9						D	C	A	B
	Digital channels	2					9					D	C		A	B
Position	Communications strategy	5	9									D		C	A	B
	Radio, Print, TV	5	9									D		A	C	B
	Digital channels & website	2					9						B	D	C	A
	Newsletter emails	5	9									D	C	B		A
People	Efficient training	2					9					D	C	B	A	
	Information package	2					9						D	B	C	A
	Effective call centre	2					9					D	C	A	B	
Process	Effective network processes	1							9							
	Raw score		270	54	81	0	144	54	18	0	0	0	0	0	0	0
	Relative %		43%	9%	13%	0%	23%	9%	3%	0%	0%					
	Importance Rank		5	2	2	1	3	2	1	1	1					

Figure 56: Case study, Refined Kano's attributes QFD, forward analysis

On the right-hand side of Figure 56, a competitor analysis was conducted on the ability of the organisation to fulfil the value proposition elements in the market, in relation to the competitors' ability to fulfil the same value proposition elements. The organisation can now thoroughly evaluate its ability to realise the customer value position elements in the market, and select the customer value proposition elements that the organisation should emphasise to be the industry leaders.

Forward analysis, QFD roll-out phase 7: Blue Ocean strategy

The relationships between the Blue Ocean strategy and the Refined Kano's model classifications in the forward analysis are similar to the relationships that the framework implementation team decided upon in the backward analysis. Highly attractive, high value-added, necessary, and reverse attributes had the highest importance rating because these attributes contribute the most towards customer satisfaction. Care-free attributes were also considered to be an important rating because they add to neither customer satisfaction nor customer dissatisfaction. However, necessary and potential attributes had a minor importance rating, because necessary attributes do not contribute greatly towards customer satisfaction, and potential attributes usually involve a complex procedure to improve relative to their contribution to customer satisfaction. The findings of the forward analysis between the Refined Kano's model and the Blue Ocean strategy are presented in Figure 57.

Refined Kano's model classifications	Importance Rating	Blue Ocean Strategy: Create	Raise	Maintain	Reduce	Improve	Eliminate
Highly Attractive	5	9	9				
Less Attractive	2			5	5		
High Value Added	2		9				
Low Value Added	1			5	3		
Critical	3		7				
Necessary	2			9			
Potential	1					7	
Care Free	1						9
Reverse	1						9
Raw score		45	84	33	13	7	18
Relative %		23%	42%	17%	7%	4%	9%
Importance Rank		3	5	2	1	1	2

Figure 57: Case study, Blue Ocean strategy QFD, forward analysis

Figure 57 returned a strategic move set composition that indicates that the product is 42 per cent focused on raising customer value proposition well above the industry norm, 23 per cent focused on creating customer value propositions that the industry has never seen before, 17 per cent focused on matching the industry customer value proposition norm, 4 per cent focused on improving the product's potential customer value propositions, 7 per cent focused on reducing the customer value propositions below the industry norm, and 9 per cent focused on eliminating the customer value propositions that lead to customer dissatisfaction.

Forward analysis, QFD roll-out phase 8: Value categories

After the importance rankings of the Blue Ocean strategy have been obtained, the value category compositions are identified. The relationships between the Blue Ocean strategy and the value categories are similar to those originally decided upon in the backward analysis. Figure 58 illustrates the results of the forward analysis composition of the value categories.

The Blue Ocean strategy importance rating delivers value to the customers in the following value category composition: Of the total value delivered to the customer through the unlimited product, 31 per cent of the value propositions are focused on delivering psychological value, another 31 per cent are focused on creative value, 27 per cent are focused on functional value, and 11 per cent are focused on delivering economic value.

		Value Categories			
Blue Ocean strategy	Importance Rating	Functional Value	Economic Value	Psychological Value	Creative Value
Create	3			9	9
Raise	5	8		7	7
Maintain	2	5	9		
Reduce	1		3		
Improve	1	5			
Eliminate	2		1		
Raw score		55	23	62	62
Relative %		27%	11%	31%	31%
Importance Rank		4	1	5	5

Figure 58: Case study, Value categories QFD, forward analysis

Forward analysis, QFD roll-out phase 9: Marketing objectives

Lastly, the importance rating of the value categories obtained from the forward analysis procedure are compared with the marketing strategy objectives to obtain a re-calculated marketing strategy objective combination, as compiled from the customer value proposition elements.

		Marketing drivers		
Value Categories	Importance Rating	Customer Acquisition	Customer Growth	Customer Retention
Functional Value	4	5		8
Economic Value	1	7	9	9
Psychological Value	5	9	8	5
Creative Value	5	9		9
Raw score		117	49	111
Relative %		42%	18%	40%
Importance Rank		5	1	5

Figure 59: Case study, Marketing objectives QFD, forward analysis

Figure 59 shows that the customer value proposition elements of the unlimited product will result in a composition that is 42 per cent customer acquisition-driven, 18 per cent customer growth-driven, and 40 per cent customer retention-driven.

7.2.3.4 Backward and forward analysis comparison

At the end of the value creation process analysis, the forward value creation process phases and the backward value creation process phases have to be in alignment – otherwise there is a mismatch between the marketing objectives and the customer value propositions.

If the forward and backward value creation process analyses are not in alignment, the integrated value proposition design framework implementation team have to re-design either the marketing objectives or the customer value propositions. Figures 60 and 61 illustrate the differences between the marketing objectives of the backward analysis and the forward analysis respectively.

Marketing objectives:

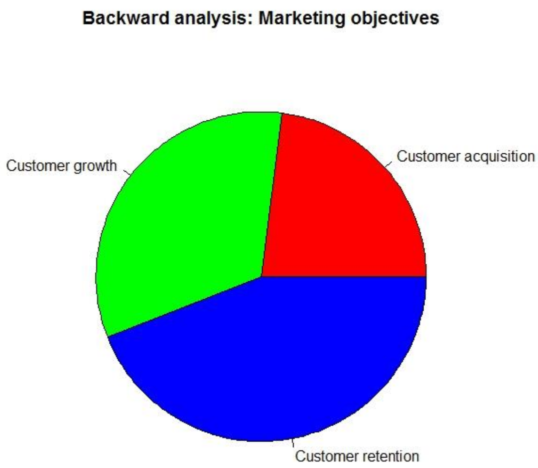


Figure 60: Case study, Backward analysis marketing objectives pie chart

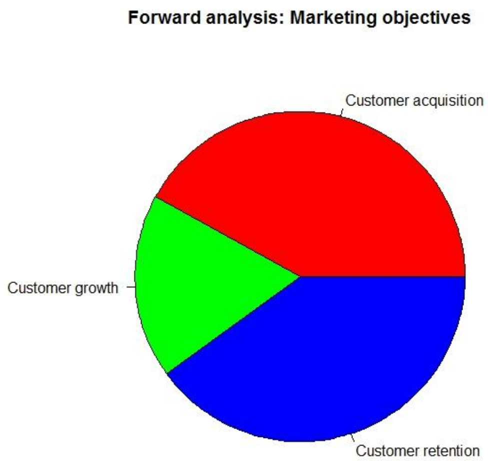


Figure 61: Case study, Forward analysis marketing objectives pie chart

When reflecting back on the detailed marketing objectives listed in Figure 50, the initial projected marketing objectives are intensely focused on growing the elite customer market. Customer growth is aimed at raising an individual customer's spending behaviour. Comparing the marketing objective of customer growth with the value propositions and the product lifetime uptake model (discussed later in this chapter), the product will most likely be adopted by the current customers of the organisation, or new acquired customers, who will benefit financially from the value propositions. The product will not contribute greatly to market growth. It is expected that customers who spend more than R1,999 per month will migrate to the product. This will result in a decreased average spend per customer, but will contribute to customer retention. There will also be a small number of customers who increase their individual spend for the added benefits; nonetheless, the average spend per user in the elite customer base is not expected to increase drastically.

The first observation to be made from the comparison of the forward and backward value creation process analyses is that the initial marketing objectives for the unlimited price plan product are not a true reflection of its capabilities. The product customer value proposition elements were developed in reaction to competitor price plan products, in order to retain the organisation's existing elite customers, knowing that some of the elite customers' spend will decrease, and to acquire new elite customers from competitors by introducing a product with appealing customer value propositions. So it can be concluded that the forward analysis is a better representation of the marketing strategy objectives of the product. The marketing strategy objectives are 42 per cent acquisition-driven because of the great number of appealing customer value propositions; 18 per cent customer growth-driven due to the possibility of acquiring new elite customers; and 40 per cent customer retention-driven because the product ensures that the organisation remains competitive in the post-paid market.

Refined Kano's quality attributes:

Although the first observation about the marketing objective comparison confirms that the customer value propositions are thoroughly planned and understood from the perspective of the customers, it is still necessary to reflect on the differences between the predicted composition of the Refined Kano's quality attributes and their actual composition.

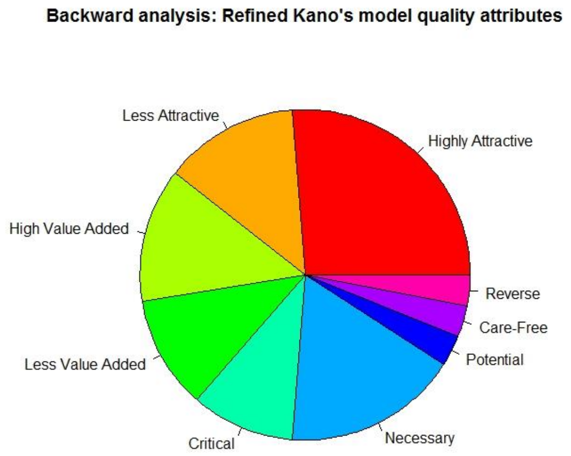


Figure 62: Case study, Backward analysis Refined Kano's model quality attributes pie chart

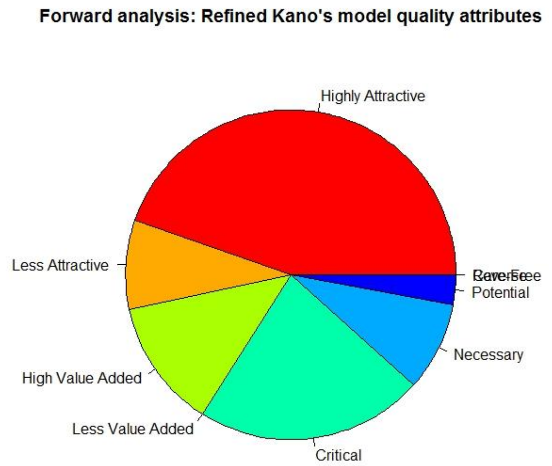


Figure 63: Case study, Forward analysis Refined Kano's model quality attributes pie chart

Figures 62 and 63 illustrate the differences between the Refine Kano’s attribute composition of the backward and forward analysis. The major difference between the two models is that within the actual design of the customer value proposition, represented in the forward analysis, no reverse or care-free quality attributes are designed into the product to begin with. This results in a different composition and importance rating of the Refined Kano’s model attributes, which reflect back on the total forward analysis of the process.

After the new alignment of the marketing objectives had been accepted, two changes were made in the customer value proposition elements. The price plan product was initially planned to include a 2GB data bundle; however, to ensure that the product would attain a 42 per cent acquisition-driven marketing objective, the customer value proposition of a 2GB inclusive data bundle was elevated, and the final product value proposition offered an inclusive ‘unlimited’ data bundle. Also to drive the acquisition marketing objective, the unlimited product was coupled with a significant prize that a customer could win if the customer adopted the product.

The forward and backward analysis of the value creation process can be repeated as many times as necessary in order to find equilibrium between the marketing objectives and the customer value propositions. The value creation process is a very effective tool for the integrated value proposition design framework implementation team to develop a set of value propositions that is in alignment with the organisational objectives.

7.2.4 Function 7: Customer experience

The customer value proposition of the unlimited price plan product is embedded in the customer journey and the customer touch points, which makes up the customer experience. To ensure that the set of customer value proposition elements is designed with a holistic understanding, the set of customer value proposition elements is compared against the customer experience designs.

7.2.4.1 Customer journey map

The aim of comparing the customer value propositions against the customer journey map is to ensure that the desired customer experience will be met along the customer journey with the defined set of customer value proposition elements. Figure 64 is a modified customer journey template for the desired customer journey experience with the unlimited price plan product.

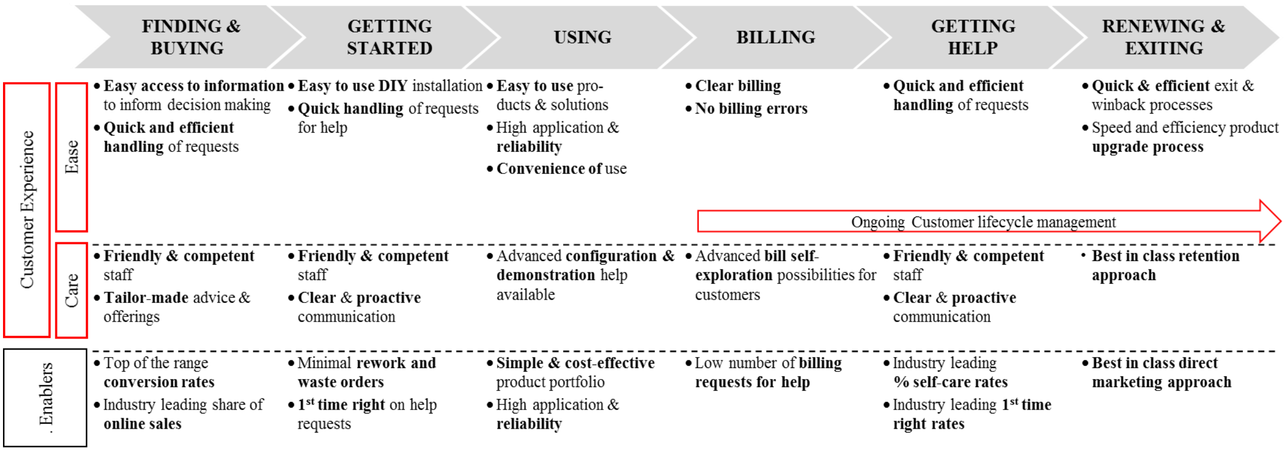


Figure 64: Case study, Customer journey CVP template

	Customer value propositions	Importance Rating	Customer Journey					
			Finding and Buying	Getting Started	Using	Billing	Getting Help	Renewing and Exiting
Product	Unlimited Voice	5			9			
	Unlimited SMSes	5			9			
	2 GB inclusive data	5			9			
	Unambiguous product	5	3	5	3			
VAS	Airport lounge access	4	5	5	3		7	
	Superb smart phone handset	5	9	5	7		7	5
	LTE/4G internet coverage	5	5	5	7			
	Priority calling – call centre	5	3	3			9	3
	The organisation's app inclusive	5	1	3	9		3	
	Dual SIM depletion	3	3	5	7			
Pricing	Monthly subscription: R1 999 p/m	5	3		3	9	3	
	Transparent and simple	4				9		
Place	Branded stores	2						
	Online & Telesales	5						
	Digital channels	5						
Position	Communications strategy	5	3	3	3	3	5	3
	Radio, Print, TV	5	3	3	3		3	3
	Digital channels & website	5	7	3	5		5	3
	Newsletter emails	4	5	3	3		3	3
People	Efficient training	5	3	5	3		5	3
	Information package	4	5	5	5		3	
	Effective call centre	5						
Process	Effective network processes	1						
	Raw score		269	242	415	96	252	112
	Relative %		19%	17%	30%	7%	18%	8%
	Importance Rank		3	3	5	1	3	1

Figure 65: Case study, Customer journey QFD

Figure 65 is a rating of the customer value proposition elements' ability to fulfil the requirements of the customer journey template in Figure 64. The QFD prioritises the customer journey phases, and this in turn provides an integrated focus on the importance of each phase in the customer journey. The product's main focus is on enhancing the customer's experience of the product by providing the customer with unlimited talking minutes, unlimited SMSes, and unlimited data usage, coupled with a top-of-the-range handset. Thereafter the customer's experience while finding and buying the product is enhanced because, if a customer adopts the unlimited product, he or she stands a chance to win a significant prize that complements the airport lounge value proposition. Lastly, the third most prominent encounter on the customer journey is that unlimited product customers have their own priority call centre, which optimises the customer's experience when asking for help.

7.2.4.2 Customer touch points

The touch points are the connection points where the customer adopting the unlimited product will interact with the organisation. Figure 66 is a template of the desired customer experience at these touch points.

		Online Telesales	Branded	ICSP	Call Centre	Web	Application / Device	Media	Airport Lounge
Customer Experience	Ease	• Hassle-free order processing & reporting • Stock availability	• Low waiting times • Intuitive self-exploration	• Low waiting times • First time right	• Low waiting times • First time right	• User-friendly website • No downtimes	• Instant access • First time right	• Easy to read. • Target customer can relate to the language use.	• Spacious and comfortable. • Always accessible.
	Serve	• Best-in-class dealer support & retention programs • Delivery at customers door step	• Friendly & competent staff • Advanced con-figuration & demo help available • Tailor-made advice	• Friendly & competent staff	• Friendly & competent staff • Tailor-made advice	• Tailored web portal to customer needs • Comprehensive self-care possibilities	• User-friendly applications • Tailor made customer interface	• Friendly • Tailor-made media campaigns.	• Fast and effective service. • Friendly and competent staff.
Enablers		• Share of wallet • Handling cost/ transaction	• Advanced self-service tools • Top of the range conversion rates	• 1st time right • Average Handling Time	• % IVR • Bad volumes • 1st time right	• Industry leading self-care rates • Industry leading online sales rates	• Industry leading % usage • Low # of requests for help	• New and innovative. • Industry leading media campaigns.	• Top of the range airport lounge. • Modern and sophisticated.

Figure 66: Case study, Customer touch points CVP template

Figure 67 is a rating of the customer value proposition elements' ability to fulfil the requirements of the customer touch point template in Figure 66. According to Figure 67, the digital channels, such as the organisation's social media touch points, are priority touch points, together with the on-line telesales, call centre, website, airport lounge, and branded stores. The unlimited product logo and advertising campaigns at every customer touch point are noticeable and visually appealing. The touch point engagements are optimised to promote a luxury product and to associate the organisation with industry leading products.

			Customer touch points								
	Customer value propositions	**Importance Rating**	Online Telesales	Branded	ICSP	Call Centre	Web	Device	Digital	Media	Airport Lounge
Product	Unlimited Voice	5									
	Unlimited SMSes	5									
	2 GB inclusive data	5									
	Unambiguous product	5	5		3	3					
VAS	Airport lounge access	4									9
	Superb smart phone handset	5	3					9			
	LTE/4G internet coverage	5	3	3		3	3				
	Priority calling – call centre	5				9					
	The organisation's app inclusive	5					7	3	9		
	Dual SIM depletion	3	3	3		3	3				
Pricing	Monthly subscription: R1999 p/m	5									
	Transparent and simple	4									
Place	Branded stores	2		9							
	Online & Telesales	5	9								
	Digital channels	5							9		
Position	Communications strategy	5	3	7	3	5	5	3			9
	Radio, Print, TV	5								9	3
	Digital channels & website	5					9		9		
	Newsletter emails	4									
People	Efficient training	5	5	7	5	7			9		5
	Information package	4									
	Effective call centre	5									
Process	Effective network processes	1									
	Raw score		149	112	55	144	129	75	180	45	121
	Relative %		**15%**	**11%**	**5%**	**14%**	**13%**	**7%**	**18%**	**4%**	**12%**
			4	3	1	4	3	2	5	1	3

Figure 67: Case study, Customer touch points QFD

The implementation team for the integrated value proposition design framework can add additional customer value proposition elements if they find that there are not enough such elements to enhance the customer experience with the organisation and with the product. However, the framework implementation team can not alter the existing set of value proposition elements, nor can they remove the existing value proposition elements before the new set of customer value proposition elements is tested in the value creation process to ensure that the organisation's marketing objectives and customer value propositions are still in line.

The functional tasks within the integrated value proposition design framework enable the implementation team to develop a set of marketing objectives and customer value propositions that are aligned throughout the value creation process. The QFD functions not only as a planning methodology for the organisation, but also as a communication tool among the stakeholders to think through and validate decisions.

7.3 THE ECONOMICS OF THE CASE STUDY

The economics of the integrated value proposition design framework are aimed at supporting the functional tasks within the framework, and to create a holistic customer-centric focus by analysing the prime components that guarantee the success of a customer-centric organisation. At the end of the stochastic modelling and forecasting exercise for the unlimited price plan product in the elite customer segment, the findings are coupled back towards the functional tasks in the framework by delivering a detailed summary of the customer segment parameters and the impact that the customers have on organisational performance. The code used to model each figure in Chapter 7, Section 7.3, is presented in Appendix B.

7.3.1 Segmentation model

As described in Chapter 4, Section 4.2, the method used for customer segmentation is value band customer segmentation. Customers are clustered according to their average spend per user within the post-paid price plan customer base. The clustering exercise was conducted in R; the code for the segmentation model can be found in Chapter 5, Section 5.5. Figure 68 illustrates the value bands derived from the segmentation model.

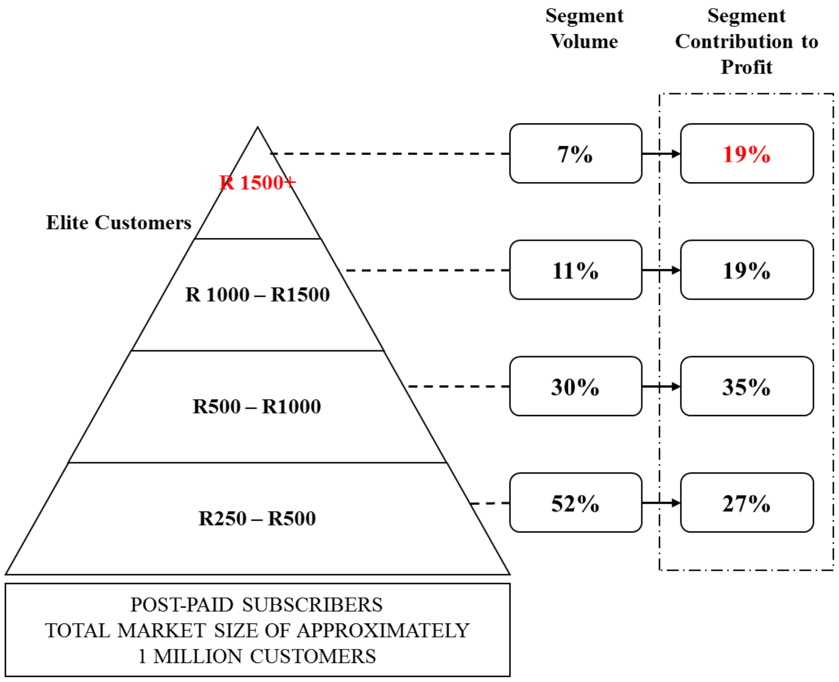


Figure 68: Case study, Customer value band

Figure 68 represents the value bands within the organisation’s post-paid subscription customer base. The elite customer segment that is targeted with the unlimited price plan product is the customers who spend on average more than R1,500 per month on their post-paid subscription. The assumption is that customers who spend more than R 1,999 per month will certainly migrate to the unlimited price plan product because they will see the product as financially more viable. However, there is a chance that customers who spend between R 1,500 and R 1,999 might also migrate to the product due to the product's appealing customer value propositions.

The right-hand side of Figure 68 shows the percentages of the organisation's customer value bands in terms of the volume of the total post-paid subscription customer base, and the amount of revenue that the customer value band generates for the organisation in terms of the organisation's post-paid subscription customer base. As noted, the elite customer value band is the smallest of the four post-paid customer value bands in terms of the number of customers – yet this band contributes 19 per cent of the total profits earned from the post-paid subscription fees.

The organisation's competitors introduced similar products to the elite customer market; so the main reason that the organisation feels the need to develop a product that will satisfy the needs of the elite customer segment is to retain their elite customers – those who contribute 19 per cent of the profits from post-paid subscriptions.

7.3.2 Customer segment, product and organisation parameters

The product lifetime uptake model, the customer lifetime value model, and the goodwill firm value model are driven by parameters that are unique to each customer segment, to each product, and to each organisation. The parameters for the unlimited product and elite customer segment were obtained as described in Chapter 5; where data was unavailable, the parameters were empirically determined from managerial input.

Customer segment parameters		
Market size	m	16147
Innovator rate of diffusion	p	0.0121103
Imitator rate of diffusion	q	0.120744
Price elasticity	Α	-0.55
Advertising elasticity	β	0.39
Churn rate per month	c	0.2%
Subscription time period	t	24 months
Acquisition cost per customer	ac	R 800.00
Subscription fee	S	R 1999.00
Product parameters		
Product cost	C	+/- R 1 399.00*
Forecast product price over the product lifecycle	P	R 1 999.00
Forecast advertising spend over the product lifecycle	A	R 120 000.00
Fixed expenses per time period	E	R 750 000.00*
Product acquisition cost	AC	R 1 702 362.00

Once-off product overhead costs	OC	R 15 000 000.00*
Organisation parameter		
The organisation's discounted rate per year	d	12%

Table 9: Case study, Customer segmentation parameters

* Does not represent actual amounts due to sensitivity of information

7.3.3 Product lifetime uptake model

The product lifetime uptake model is configured in three steps. First, the product's natural diffusion in the market is obtained by making use of a normal Bass model; then the marketing mix of the organisation is taken into consideration; and last, inevitable risks are accounted for with a Monte Carlo simulation. The code for the product lifetime uptake model can be reviewed in Chapter 5, Section 5.5, and the code used to model each figure is provided in Appendix B.

7.3.3.1 Normal Bass model

The unlimited product's natural diffusion in a market is illustrated in Figures 69 and 70.

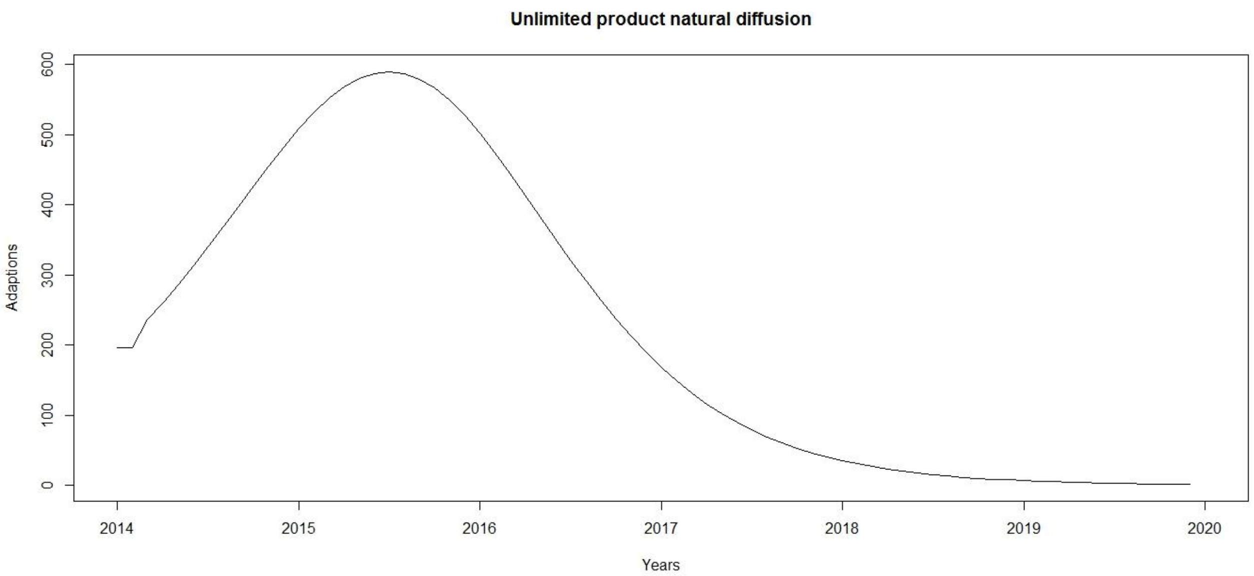


Figure 69: Case study, Unlimited price plan product's natural diffusion in the market

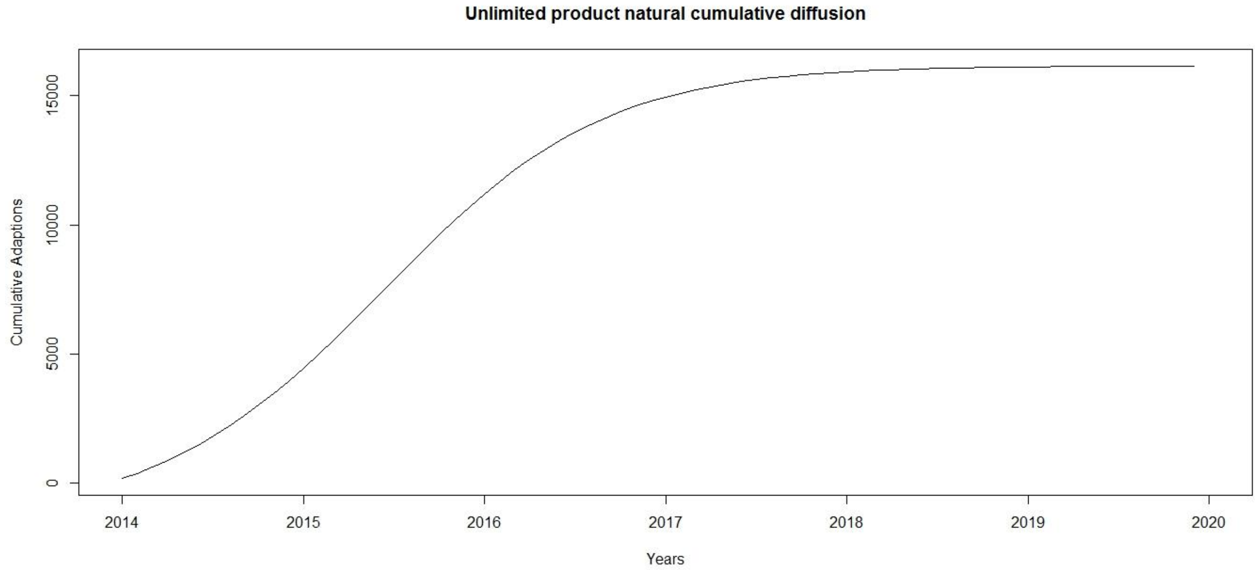


Figure 70: Case study, Unlimited price plan product's natural cumulative diffusion in the market

Four distinct observations can be drawn from the unlimited product's natural diffusion in the market. The first is the product lifecycle length; the second is when the unlimited product will reach its maximum adoptions per month; the third is the high rate at which the product is initially adopted in the market; and the last observation is the rate of the diffusion curve.

The number of customers adopting the product over a 72-month period is presented Table 10.

	2014	2015	2016	2017	2018	2019
January	196	509	502	168	35	6
February	196	532	475	149	30	6
March	237	552	445	132	27	5
April	261	568	414	116	23	4
May	286	580	383	102	20	4
June	313	588	352	90	17	3
July	341	**590**	321	79	15	3
August	369	587	292	69	13	2
September	398	579	263	60	11	2
October	427	566	237	53	10	2
November	456	549	212	46	9	2
December	483	527	189	40	7	1

Table 10: Case study, The number of customers adopting the product via a natural diffusion in the market

Figure 69 graphically demonstrates – and Table 10 empirically confirms – that after the 48th month of the product lifecycle, the product uptake will not exceed more than 40 products per month. However, after the 48th month, the product could still potentially be adopted by 259 additional customers. The CLV and NPV calculations of the product will indicate when the product will no longer generate profit. However, due to the competitiveness of the telecommunications industry and ever-changing technology, it is assumed that a post-paid price plan product will be replaced within 48 months.

According to the normal diffusion of the product in the market, the unlimited product will reach its top adoptions per month in the 19th month of the product lifecycle. After the 19th month, the product uptake will most likely decline because competitors have matched the product value propositions or have introduced a product to the market that exceeds the unlimited product's offerings.

The third observation is the high initial adoption rates of the product. Mobile cellular products are not an innovative concept in the market; so high initial adoption rates can be expected.

The fourth and last observation is the curve of the diffusion speed through the market. The unlimited price plan is a subscription type of product, and it is expected that post-paid contract customers will adopt the product. The diffusion curve does represent a decent bell-shaped curve for the initial adoptions per month. However, the cumulative adoptions per month do not produce a perfect S-shaped curve. Although customers are aware of the product from the product launch date onwards, the expected customer base will have to wait for their previous product contracts to lapse before the customers can adopt the new product. So the cumulative adoptions are less of an S-shape during the initial months of the product lifecycle.

7.3.3.2 The generalised Bass model

Now that the framework implementation team knows the product's natural diffusion in the market, the team can forecast the product price and advertising spend if they want to speed up the diffusion process of the product through the market due to price and advertising elasticity.

The framework implementation team decided to keep the product price at R 1,999 per month for the first 18 months; thereafter the product price declined by R 100 every six months. The advertising spend per month consisted of 16 per cent of the fixed expenses per month (R 120,000 advertising spend per month). The advertising spend was increased after the 15th month for the next six months to between R 20,000 and R 50,000 per month in an attempt to stretch the peak adoption time period and to make the market aware of the upcoming price promotion. The generalised Bass model yielded the result shown in Figure 71. The input product price and advertising spend data used to model the generalised Bass model is shown in Appendix A.

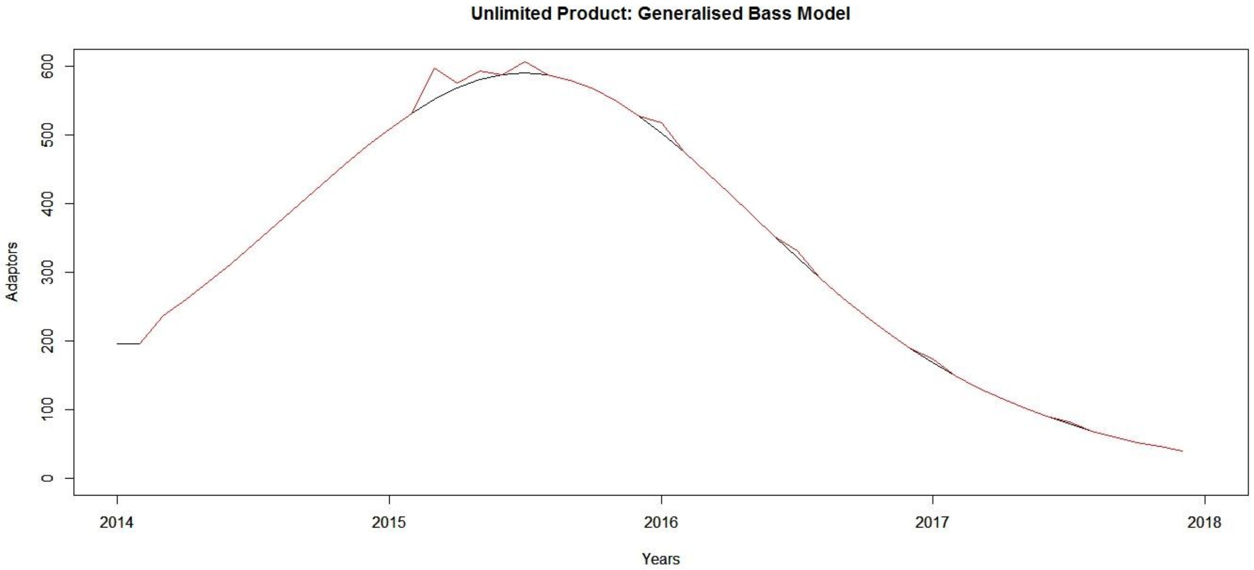


Figure 71: Case study, Generalised Bass model product uptake

Due to the increase in advertising spend and the decrease in product price, most of the activity occurred between month 16 and month 22. Table 11 presents the results of the generalised Bass model uptake assumptions.

	2014	2015	2016	2017
January		509	518	175
February	196	532	475	150
March	237	597	446	132
April	261	576	415	117
May	287	593	384	103
June	313	588	352	90
July	341	**608**	332	82
August	370	588	292	70
September	399	580	264	61
October	428	567	237	53
November	456	549	213	47
December	483	528	190	41

Table 11: The number of customers adopting the product according to the generalised Bass model

The diffusion speed of the product in the market increases, with the product reaching its maximum monthly adoptions in the 19th month, but already showing a remarkable increase in sales in the 15th month. Every time there was a decrease in the product price or an increase in advertising spend, a slight increase in the diffusion speed was noted. The generalised Bass model only incorporates the change in diffusion speed on the basis of the influence of marketing mix parameters, and assumes that the market size will remain unchanged. If the difference between product price and advertising spend between two time periods is constant, the product will retain its natural diffusion in the market.

7.3.3.3 Monte Carlo simulation

In order to account for a variable market size and any inherent uncertainty in the Bass model parameters, a Monte Carlo simulation was run. The input parameters are replaced with probability distribution functions. The probability distribution functions of the innovator rate of diffusion, the imitator rate of diffusion, and the market size parameters were obtained by sketching different scenarios for the uptake of the product. The Bass model parameters for every scenario were calculated, and the mean and standard deviations of these parameters were taken as input for the Monte Carlo simulation. (Please refer to Appendix A to view the different scenarios sketched.)

The average Bass model parameters yielded the results in Table 12:

Parameter	Mean	Standard deviation
m	16146.97	204.0942 + 500
p	0.0121103	0.0002780613
q	0.120744	0.002023575

Table 12: The Monte Carlo simulation parameters

To account for a variable marketing mix factor, the standard deviation of the marketing mix parameter was enlarged by 500 adoptions, according to managerial participation.

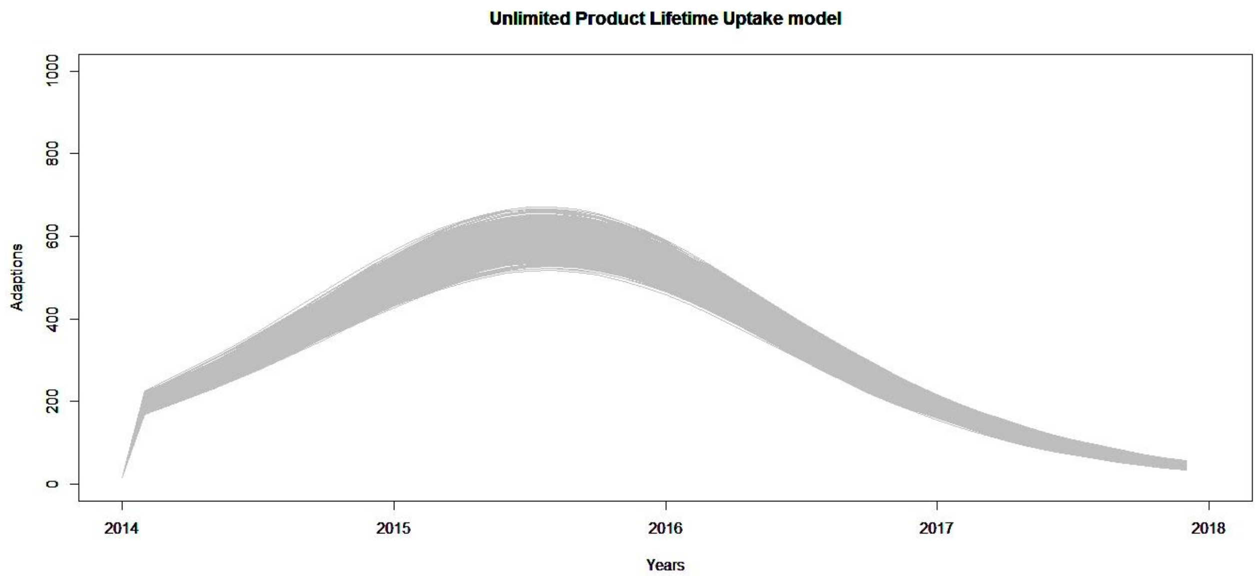


Figure 72: Case study, Product lifetime uptake model

The product lifetime uptake model for the unlimited price plan product produced the diffusion simulation curve presented in Figure 72. The summary of the product lifetime uptake is presented in Table 13.

Minimum	Mean	Maximum
30.78555	331.1871	671.4362

Table 13: Product lifetime uptake model results summary

The average period of time before a post-paid price plan product is replaced or re-engineered is assumed to be 48 months for the Monte Carlo simulation. The summary statistics of the unlimited product's diffusion in the market indicated that the maximum possible adoptions per month for the unlimited product will not exceed 672; the minimum adoptions per month will not go below 30, and the average number of adoptions per month over 48 months is 332.

The product lifetime uptake model can be used as a forecast simulation foundation to conduct scenario analysis. Figure 73 represents a model from which 27 scenarios were simulated. What-if scenarios are compared according to what the uptake would look like if the innovator rate of diffusion were slow, medium, or fast; if the imitator rate of diffusion were slow, medium, or fast; and if the market size were high, medium, or low. Depending on the rate of diffusion and the market size, the peak rate of product adoptions and the maximum number of total adopters varied. In Appendix A there is a graphical representation of the formulation of the different scenarios as well as the peak time periods and maximum number of adoptions.

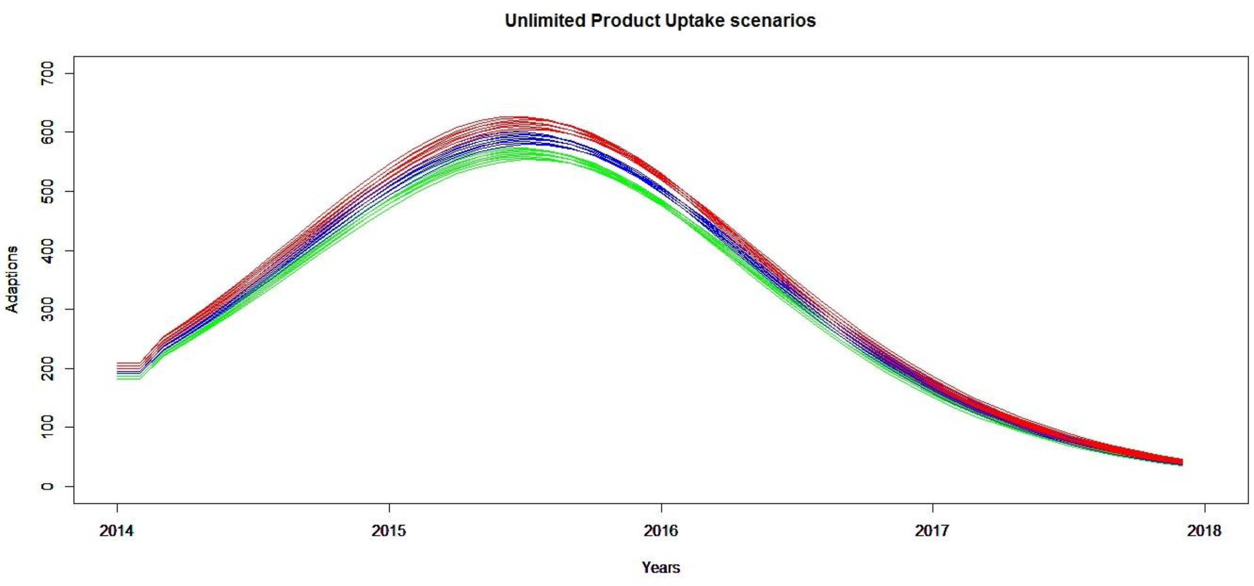


Figure 73: Case study, Unlimited product uptake scenarios

According to the scenario analysis, the organisation can prepare for different combinations of innovator rate of diffusion, imitator rate of diffusion, and market size in the elite customer segment market. If the innovator rate has a high diffusion speed, the innovator rate of diffusion is high, and the market size is at its uppermost, the unlimited price plan product will reach its maximum number of adopters at month 19.

7.3.4 Customer lifetime value model

The customer lifetime value for a customer adopting the unlimited price plan product is the net present worth of the customer over the subscription period of the unlimited product. CLV is calculated on the various product prices as forecast in the generalised Bass model by the framework implementation team. The input parameters for the CLV model calculation are as follows:

Product price:	
Month 0 – 18	R 1 999.00
Month 19 – 24	R 1 899.00
Month 25 – 30	R 1 799.00
Month 31 – 36	R 1 699.00
Month 37 – 42	R 1 599.00
Month 42 – 48	R 1 499.00
Product cost	R 1 399.00
Churn per month	0.2%
Discounted rate	12%
AC	R 200.00
Contract time period	24

Table 14: Case study, Customer lifetime value modelling parameters

It is important to note that the product price represents the subscription fee for 24 months, depending on when the customer adopted the product. The CLV for the unlimited price plan product is calculated as follows:

$$CLV_{\mathrm{i}} = \sum_{t=1}^{t=24} \frac{(p_t - c_t)r_t}{(1+i)^t} - AC$$

The CLV for customers adopting in the various time periods yielded the results presented in Table 15:

Time period	Product price per time period	CLV
Month 0 – 18	R 1 999.00	**R 11 669.01**
Month 19 – 24	R 1 899.00	R 9 590.84
Month 25 – 30	R 1 799.00	R 7 512.67
Month 31 – 36	R 1 699.00	R 5 434.51
Month 37 – 42	R 1 599.00	R 3 356.34
Month 42 – 48	R 1 499.00	R 1 278.17

Table 15: Case study, CLV results

7.3.5 Goodwill firm value model

To forecast the amount of profit the unlimited price plan product will generate for the organisation, the product lifetime uptake model is used in conjunction with the CLV modelling calculations. The input parameters for product NPV calculations are as follows:

Fixed expenses per month	FE_t	R 750 000.00
Product acquisition cost	PAC	R 1 702 362.00
Once-off product overhead costs	OC	R 15 000 000.00

Table 16: Case study, Product NPV input parameters

7.3.5.1 Product NPV scenario 1

The first NPV scenario is conducted on the assumption that the product price will stay constant over the product lifecycle, and that the organisation's marketing spend will also stay constant over time. The input parameters for the first calculation are used as presented in Table 16, while the CLV for the unlimited product customers with a constant price is R 11,669.01, as shown in Table 15. The number of adopters is calculated in the normal Bass model over a 48-month period, as presented in Table 10.

The net present value of the product is then calculated as follows:

$$NPV(Unlimited) = \sum_{t=1}^{48} \frac{(n_t \times CLV) - FE_t}{(1+i)^t} - (PAC + OC)$$

Findings:

The total NPV for the unlimited product in scenario one yielded **R 107,216,885.00**

Figure 74 is a column chart of the predicted net present monthly worth of the unlimited product. The initial product acquisition costs and initial overhead cost were deducted on a monthly basis. Figure 75 is a column chart of the monthly cumulative net present worth of the unlimited product, where the initial product acquisition cost and initial overhead costs were deducted at time period 1.

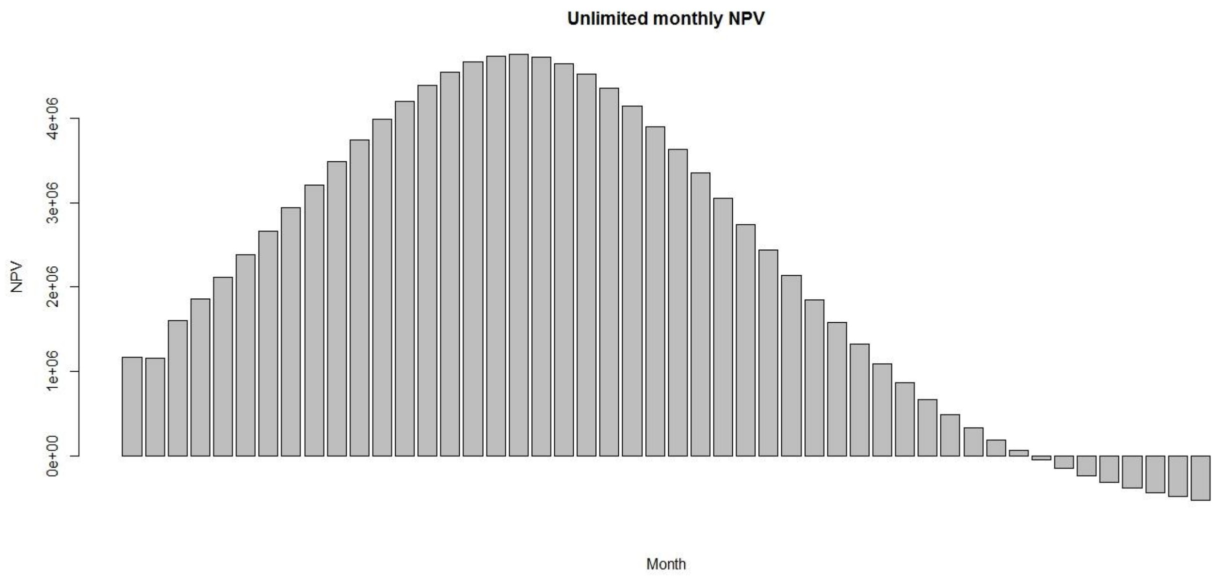


Figure 74: Case study, Unlimited monthly NVP, natural product diffusion, and constant price CLV

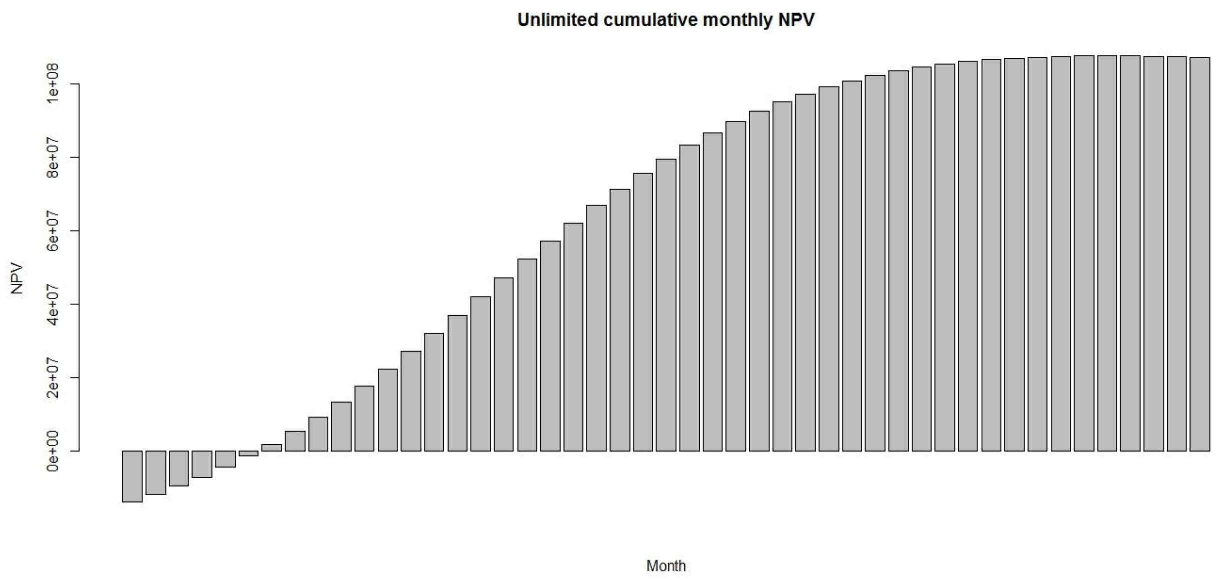


Figure 75: Case study, Cumulative unlimited monthly NVP, natural product diffusion, and constant price CLV

7.3.5.2 Product NPV scenario 2

The second NPV scenario is to analyse the influence of the marketing mix factors as determined in the generalised Bass model (Table 11) by taking the various CLV possibilities into consideration (Table 15). The NPV for the second scenario is then calculated as follows:

$$NPV(Unlimited) = \left(\sum_{t=1}^{18} \frac{(n_t \times CLV_1) - FE_t}{(1+i)^t} + \sum_{19}^{24} \frac{(n_t \times CLV_2) - FE_t}{(1+i)^t} + \sum_{25}^{30} \frac{(n_t \times CLV_3) - FE_t}{(1+i)^t} + \sum_{31}^{36} \frac{(n_t \times CLV_4) - FE_t}{(1+i)^t} + \sum_{37}^{42} \frac{(n_t \times CLV_5) - FE_t}{(1+i)^t} + \sum_{43}^{48} \frac{(n_t \times CLV_6) - FE_t}{(1+i)^t}\right) - (PAC + OC)$$

The second NPV scenario is conducted on the assumption that the product price and the advertising spend will vary over the product lifecycle. Therefore the generalised Bass model is used within the NPV calculation. The advertising spend of the generalised Bass model is included within the fixed monthly expenses. However, where the advertising expense exceeds the R 120,000.00 monthly spend, as explained in Section 7.3.3.2, the additional monthly expense is also subtracted.

Findings:

The total NVP for the unlimited product in scenario two yields **R 97,359,723.00**

Both Figure 76 and Figure 77 are NPV diagrams of the unlimited product according to the CLV calculations and the product uptake of the generalised Bass model. Figure 76 is a column chart of the predicted net present monthly worth; the initial product acquisition cost and overhead costs were deducted per month. Figure 77 is a column chart of the monthly cumulative net present worth; the initial product acquisition cost and overhead costs were deducted at time period 1.

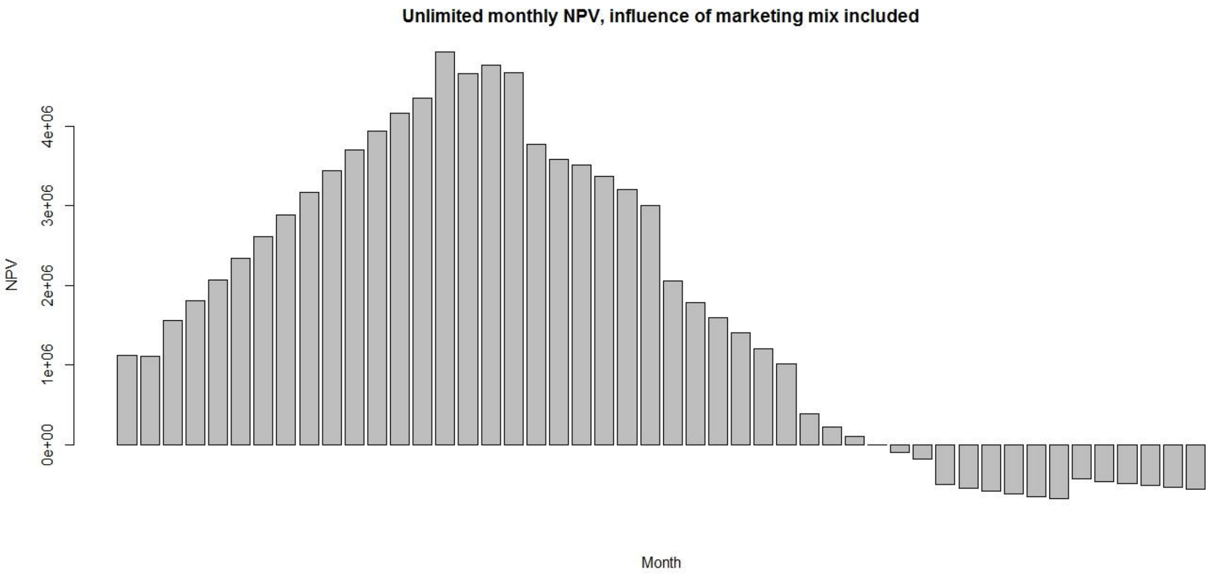


Figure 76: Case study, Unlimited monthly NPV, generalised Bass model diffusion with varying price CLV

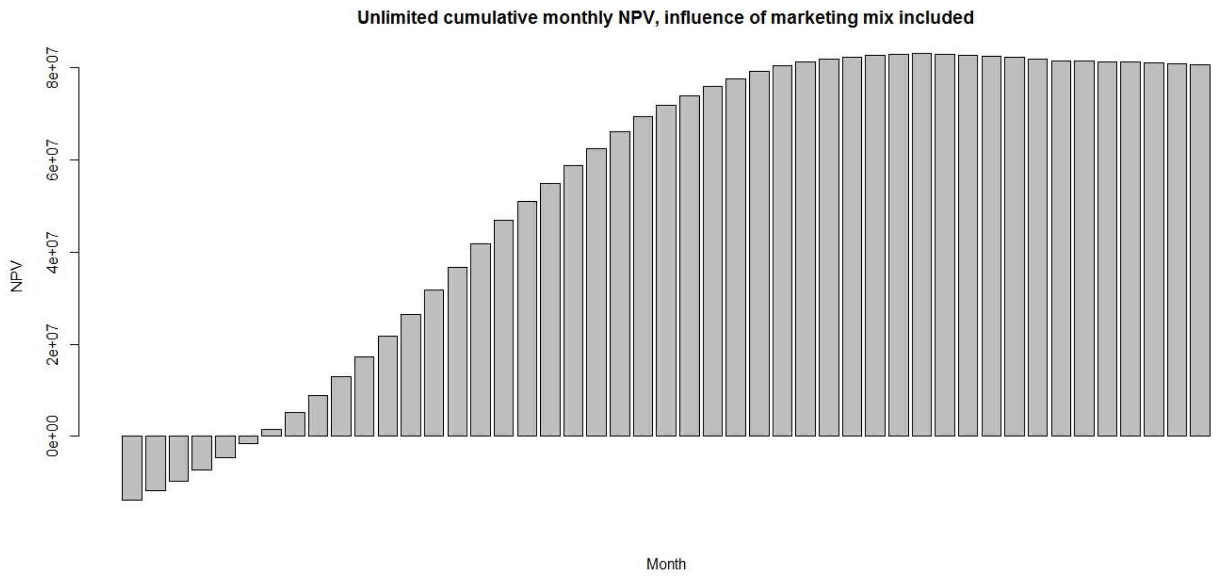


Figure 77: Case study, Unlimited cumulative monthly NVP, generalised Bass model diffusion with varying price CLV

At this point in the implementation of the stochastic simulation and forecasting model, the product manager, in consultation with the framework implementation team, has to model various price estimates, using the generalised Bass model, the CLV model, and the product NPV model to predict the best product price and advertising spend strategy. For the purpose of this case study, the product price and advertising spend were held constant over the lifecycle of the product, as presented in Scenario 1, Section 7.3.5.1.

The unlimited product is a subscription product, and any decrease in price should be carefully considered because any decrease is not once-off, but applies to the entire subscription length of the product. If the decrease in price cannot be validated by an increase in customer acquisitions, the loss in profits is too big.

Figure 74 shows that the product should be replaced after 40 months. If the initial product acquisition costs and overhead spend are spread over the 48 month time period, the product will not generate any profits after 40 months. When referring to the cumulative NPV per month, as presented in Figure 75, the organisation can safely assume that the initial product acquisition cost and various initial overhead costs will be recovered within the first six months after the product launch.

The basic premise of the stochastic modelling and forecasting exercise within the integrated value proposition design framework is that the implementation team can get an estimate of the product worth at that point. In other words, the team can state that the unlimited price plan product's goodwill firm value is presently R 107,216,885. At this point in the PLM process and the integrated value proposition design framework, this estimate can contribute immensely to the strategic decision-making process in the organisation. Ultimately the NPV of the entire organisation's product portfolio will be calculated; this in turn will forecast the organisation's goodwill firm value. Due to the limitation and sensitivity of data, the company's goodwill firm value could not be presented in this case study.

7.4 CUSTOMER SEGMENT RATE CARD

At the end of the implementation of the integrated value proposition design framework, the implementation team has to create a customer segment rate card.

Figure 78 is an illustration of the customer rate card for the elite customer segment.

ELITE CUSTOMER

"Time, passion, persistence, and discipline are my drivers. Excellence is a habit."

Innovator rate of diffusion	**0.0121103**
Imitator rate of diffusion	**0.120744**
Churn per month	**0.2%**
Price elasticity on demand	**-0.55**
Advertising elasticity on demand	**0.39**
Subscription period	**24 months**
Customer Lifetime Value	**R 11 669.01**
Market size	**16 147**

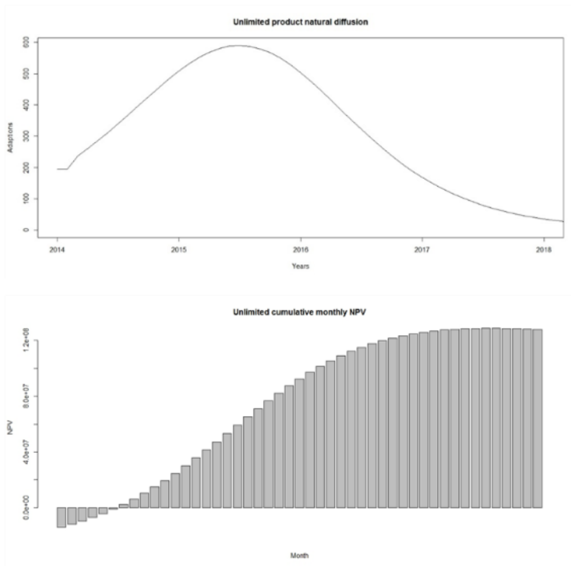


Figure 78: Case study, Elite customer segment profile parameters

The customer rate card of the elite customer segment adopting the unlimited price plan product indicates that the segment is relatively inelastic in price and advertising; the segment is driven rather by appealing value offerings and by word-of-mouth appraisal. The customer segment has a low churn rate, indicating that they are loyal. Their subscription period is 24 months, as the contract indicates. The crucial customer segment parameter is the CLV parameter for the customer's engagement with the organisation in adopting the unlimited price plan product, which yields R 11,669.01. The total potential market size of the elite customer segment is 16,147 customers. On the right-hand side of the rate card, the product lifetime uptake model and the goodwill firm value model are recalled for convenience.

7.5 INTEGRATED VALUE PROPOSITION DESIGN FRAMEWORK: ONE-PAGER

One of the objectives of the integrated value proposition design framework is to present the findings in a one-page design to enhance the communication between the framework implementation team members. Figure 79 presents the integrated value proposition design framework one-pager for the unlimited price plan product. Three documents promote the integrated value proposition design framework's information feedback capability within PLM: the customer segment profile document, the customer segment rate card, and the product one-pager. These three documents form an information archive that in turn supports new product development and product portfolio management endeavours.

Unlimited price plan product one-pager

Customer Lifetime Value						
R 1,999.00	R 1,899.00	R 1,799.00	R 1,699.00	R 1,599.00	R 1,499.00	**Monthly ARPU**
24	24	24	24	24	24	**Tenure**
R 11,669.01	R 9,590.84	R 7,512.67	R 5,434.51	R 3,356.34	R 1,278.17	**CLV**

Segment	
Elite	**Segments**
LSM 9 - LSM 10	**LSM Levels**
100.00%	**Customer Composition**

Marketing Objectives		
Customer Acquisition	Customer Growth	Customer Retention
42%	18%	40%

Value Creation Categories			
Functional Value	Economic Value	Psychological Value	Creative Value
27%	11%	31%	31%

Value Proposition: MTN CREDIT COVER		Blue Ocean Strategy against Competitors: Create	Raise	Reduce	Eliminate	Maintain	Improve
Product	Unlimited Voice talking minutes.		X				
	Unlimited SMS's					X	
	Unlimited data					X	
	Simple and unambiguous price plan.	X					
VAS	Airport lounge access	X					
	Top of the range smart phone handset		X				
	LTE/4G internet coverage		X				
	Priority calling – call centre service		X				
	The organisation's app inclusive		X				
	Dual SIM depletion					X	
Pricing	Monthly subscription fee of R1999 p/m.					X	
	Transparent and simple	X					
Place	Physical channels: Branded stores.						X
	Online & Telesales.		X				
	Digital channels.		X				
Position	Integrated communications strategy		X				
	Advertising campaigns: Radio, Print, TV.		X				
	Digital channels and website.		X				
	Prestige customer's newsletter emails.	X					
People	Efficient training		X				
	Information package.		X				
	Effective call centre services.		X				
Systems	Effective network processes						X
RELATIVE %		22.00%	42.00%	7.00%	9.00%	17.00%	4.00%

Value Proposition: MTN CREDIT COVER		Customer Journey: Finding & Buying	Getting started	Using	Billing	Getting help	Renewing and Exiting
Product	Unlimited Voice talking minutes.			X			
	Unlimited SMS's			X			
	Unlimited data			X			
	Simple and unambiguous price plan.	X	X	X			
VAS	Airport lounge access	X	X	X		X	
	Top of the range smart phone handset	X	X	X		X	X
	LTE/4G internet coverage	X	X	X			
	Priority calling – call centre service	X	X			X	X
	The organisation's app inclusive	X	X	X		X	
	Dual SIM depletion	X	X	X			
Pricing	Monthly subscription fee of R1999 p/m.	X		X	X	X	
	Transparent and simple				X		
Place	Physical channels: Branded stores.						
	Online & Telesales.						
	Digital channels.						
Position	Integrated communications strategy	X	X	X	X	X	X
	Advertising campaigns: Radio, Print, TV.	X	X	X		X	X
	Digital channels and website.	X	X	X		X	X
	Prestige customer's newsletter emails.	X	X	X		X	X
People	Efficient training	X	X	X		X	X
	Information package.	X	X	X		X	X
	Effective call centre services.						
Systems	Effective network processes						
RELATIVE %		19.00%	17.00%	30.00%	7.00%	18.00%	8.00%

Value Proposition: MTN CREDIT COVER		Customer Touch Points: Online Sales	Branded	ICSP	Call Centre	Web	Device	Digital	Media	Airport Lounge
Product	Unlimited Voice talking minutes.									
	Unlimited SMS's									
	Unlimited data									
	Simple and unambiguous price plan.	X		X	X					
VAS	Airport lounge access									X
	Top of the range smart phone handset	X					X			
	LTE/4G internet coverage	X	X		X	X				
	Priority calling – call centre service				X					
	The organisation's app inclusive					X	X	X		
	Dual SIM depletion	X	X		X	X				
Pricing	Monthly subscription fee of R1999 p/m.									
	Transparent and simple									
Place	Physical channels: Branded stores.		X							
	Online & Telesales.	X								
	Digital channels.							X		
Position	Integrated communications strategy	X	X	X	X	X	X			X
	Advertising campaigns: Radio, Print, TV.								X	X
	Digital channels and website.					X		X		
	Prestige customer's newsletter emails.									
People	Efficient training	X	X	X	X			X		X
	Information package.									
	Effective call centre services.									
Systems	Effective network processes									
RELATIVE %		15.00%	11.00%	5.00%	14.00%	13.00%	7.00%	18.00%	4.00%	12.00%

Figure 79: Case study, Integrated value proposition design framework one-pager

7.6 CASE STUDY – CONCLUSION

The integrated value proposition design framework was developed over the seven months from March 2013 to November 2013 at a leading telecommunications company in South Africa. The integrated value proposition design framework is a combination of the techniques that were recognised as beneficial to the value proposition design process, along with various additional methods, tools, and processes that delivered an integrated approach to customer value proposition design. Within the case study period of observation and contribution at the telecommunications company, the unlimited post-paid price plan product was developed from concept development to concept design. Given that the organisation already had the necessary infrastructure in place to support the development of the product, the concept development and design were the major phases within PLM that would guarantee the success of the product.

The implementation of the integrated value proposition design framework on the unlimited price plan product delivered a top-down approach to design and validate the product’s customer value proposition elements. Early on in the concept development effort within PLM, the implementation of the functional tasks within the framework provided a very clear focus on which product value propositions had to be included to realise the marketing objective, and contrariwise.

The product development team misunderstood how the product would realise the marketing objectives. One of their most important marketing objectives was to grow the average spend per user; but, given that the price plan would most likely be adopted by customers who spend more than the monthly subscription fee, this marketing objective was highly unlikely. At the beginning of the product development effort, the development team’s lowest objective was for the product to drive customer acquisition. The product was coupled with very appealing customer value proposition elements that would most probably result in customer acquisition, which was validated with the framework. Once the product development team had recognised its potential to acquire customers, the customer value propositions that resulted in customer acquisitions were expanded even more. For example, the initial data bundle – which was the largest data bundle on offer in the market at that time – was replaced by an unlimited data bundle that exceeded the industry offerings by far. The airport lounge access was coupled with a competition offering the customer who adopted the product within a certain period a major prize that was in line with the airport lounge value proposition.

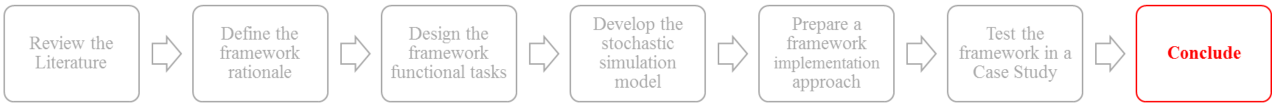
The stochastic simulation and forecasting model that supports the functional tasks within the framework delivers a way strategically to validate the development of the unlimited price plan product customer value propositions. The product lifetime uptake model is a foundation on which the framework implementation team can build what-if scenarios. An example of a typical scenario analysis exercise was provided, and in that way the organisation could anticipate what the product uptake would look like in different market scenarios.

The CLV calculations, in combination with the product lifetime uptake model, deliver an estimation of the goodwill firm value of the unlimited price plan product. The NPV of the unlimited product is an indication of what the product is worth at this moment, yielding R 107,216,885. The NPV worth of the product validates the implementation of the customer value proposition elements.

The integrated value proposition design framework is concluded by delivering a customer segment rate card that summarises the customer segment in terms of its key parameters, along with a one-page summary of the unlimited price plan product – all of which makes information feed-back possible in the implementation of PLM.

The unlimited product case study is a clear demonstration that the implementation of the integrated value proposition design framework can be successfully executed in a new product development effort, and that the framework can optimise the PLM by shifting the organisational focus towards customer-centricity.

8 CHAPTER EIGHT: CONCLUSION



The research assignment set out to shift an organisation's PLM focus from being predominantly product-centric to being customer-centric. The research assignment was conducted on the premise that the customer-centric shift within PLM can be achieved by formal practices in the design of customer value propositions.

The five main causes of problems found in the literature (Chapter 1, Section 1.1) were converted into a research problem statement. These five causes of problems within PLM pointed to two main problems of PLM implementation that the study attempted to address. The research problem stated that the main problems associated with the current methodologies of PLM implementation are that PLM has a strong product-centric focus, and that there is a lack of integration between resources, stakeholders, data, and business processes.

The first four causes of problems within PLM were management's misperception about PLM, universal product lifecycle management issues, integration and communication issues within the PLM, and PLM complexity. These pointed to a universal problem: a lack of integration and communication within PLM. This problem is addressed in the study by making use of a framework that promotes multifunctional team integration and business process parallelisation.

The fifth cause of problems within PLM – a product-centric versus customer-centric focus – pointed to a universal problem: that PLM has a strong product-centric focus. This study addressed the problem by introducing best practice customer-centric processes and methodologies into PLM by means of the framework.

An engineering approach was employed to deliver the integrated value proposition design framework. The framework took customer value propositions – which are usually defined subjectively, with few concrete methodologies to measure their actual business impact – and transformed the design of the customer value propositions into a meticulously chosen and robust process. The value proposition design process holds the organisation accountable for the customer value propositions, because they are in line with the greater organisational objectives.

This chapter presents the conclusions of the research assignment. First, the empirical findings are listed. Then the procedural and theoretical implications of the research assignment are stated, the limitations of the research assignment are discussed, recommendations are made for future research opportunities, and a concluding statement is offered.

8.1 EMPIRICAL FINDINGS

The empirical findings of the research assignment are considered in the light of the objectives of the integrated value proposition design framework (Chapter 3, Section 3.3). The successful realisation of the objectives is measured in terms of the framework implementation within the case study (Chapter 7).

The first objective was to make use of *best practices to increase the effectiveness and efficiency of PLM*. In order to establish a comprehensive customer-centric approach within the framework to extend PLM, the framework aligned methodically chosen best practices. The case study presents an explanatory analysis of the amalgamation of these best practice tools, methods, and processes. The best practices proved to enhance the effectiveness of PLM by providing a way to capture the right information about the product customers; and they enhanced the efficiency of PLM by aligning the information with enhanced customer satisfaction. The best practices also delivered a way to implement the framework correctly, as discussed in Chapter 6.

The second objective was to *create a deeper understanding of customer requirements, problems, and market opportunities while tracking the creation of customer value*. The second objective was met with the framework's ability to capture an organisation's marketing objectives and translate them into product quality attributes, as perceived by the customer, and then validating the customer value propositions to ensure that the marketing objectives would be realised. The value creation process are documented, and can be outlined graphically.

The third objective was to *integrate large multifunctional team members across various departments into the value proposition design process*. The first way in which multifunctional teams are integrated into the value proposition design process is to set multiple decision-making requirements. At every stage in the process of implementing the framework, it requires integrated input from a number of multifunctional teams. The second way in which the multifunctional teams are integrated into the framework is with an implementation approach that delivers a comprehensive tactic to integrate the multifunctional teams in the implementation of the framework. The implementation approach was defined by improving the observed style of the actual implementation of the initial PLM phases through the case study.

The fourth objective was to *simplify all value proposition design elements into a one-page design for communication purposes*. Although the implementation of the framework initially appears intricate, the framework is straightforward to implement once the implementation team is familiar with its theoretical definitions and concepts. Figure 79 represents a one-page summary of the integrated value proposition design framework, and functions as a simplified communication tool that demonstrates the product's value creation process. The one-page value creation blue-print, together with the customer segment profile and the customer segment rate card, generates an information feed-back loop, and in turn sustains product portfolio management and enhances new product development efforts.

The fifth objective was to *support trade-off analysis and decision-making efforts in the design process by means of a quantitative measurement tool*. The House of Quality in QFD is known for its ability to facilitate trade-off analysis and decision-making efforts. QFD is used to implement the integrated value proposition design framework process. It provides a way to trace, measure, and prioritise the value creation between the organisation and its customers.

The last objective was to *validate the value proposition designs alongside a stochastic simulation and forecasting model*. This model confirms the predicted performance of a product in the market and its value impact on an organisation, and functions as a strategic measurement of the organisation's future position in the market. It amounts to the total economics of a customer-centric organisation at a high level.

8.2 IMPLICATION FOR PROCEDURE

The research assignment suggests a new implementation procedure within PLM. Where traditional PLM methodologies considered the design of customer value propositions as a once-off procedure, the integrated value proposition design framework views it as an on-going process of design, measurement, and validation.

The integrated value proposition design framework should constantly be redefined and measured as the product progresses through its lifecycle. The on-going estimation of the product's performance in the market applies to the implementation of the value creation process and to the stochastic simulation and forecasting model.

The value creation process within the implementation of the framework functional tasks is a way to define customer-perceived value propositions, and to measure the channels through which the organisational objectives are met. As the product matures in the market, the customers' perceptions of the customer value positions fluctuate with it. Therefore the value creation process should constantly be adjusted as the product matures in the product lifecycle, to ensure that the customer value propositions and the organisational objectives are constantly aligned.

The estimates produced by the stochastic simulation and forecasting model input parameters are subject to change. The more that actual product uptake data becomes available, the more accurately the product lifetime uptake model predicts the product lifecycle. Likewise with the CLV model: as the amount of real-life data increases, the accuracy of the input parameters increases, and the more precise the prediction of the goodwill firm value. Therefore the stochastic simulation and forecasting model should constantly be redefined as the product matures in the market, to improve the accuracy of the predictions.

8.3 THEORETICAL IMPLICATIONS

The research assignment has two distinct theoretical inferences. The first is the shift in PLM towards customer-centricity; the second is using the product lifetime uptake model and the CLV model to determine the organisation's goodwill firm value.

Traditionally PLM is considered to be a business strategy that creates a product-centric organisational focus. The research assignment suggests that the success of a product in a market is measured in terms of the product-customer's reaction to the customer value propositions embedded within the product. The research assignment delivers a framework that extends PLM to incorporate best practice customer-centric methods and processes. The framework defines a product in terms of its customer value propositions, and measures the net value impact that the product has on the organisation. The framework extends the customer-centric focus within PLM – which typically applies only to the initial design phases – to range over the entire product lifecycle.

The second theoretical implication is that an organisation's goodwill firm value is calculated by combining a product's lifetime uptake prediction and the CLV of the product-customers. Goodwill firm value is an intangible asset of an organisation, and is mainly seen as the value of an organisation's customer base and of good customer relations. The framework provides a practical method to forecast an organisation's goodwill firm value as a result of the product's forecast uptake in a market and the product-customer's CLV.

8.4 LIMITATION OF THE STUDY

The research assignment has four known limitations. The first two limitations are relevant to the case study, and the last two limitations are relevant to the product lifetime uptake model. These limitations in turn creates research opportunities, as mentioned in the next section of this chapter.

The first limitation of the research assignment is that the practical application of the framework was not tested on a wide range of products, the integrated value proposition design framework was formulated and implemented in one case study. The second limitation of the research assignment is that empirical improvements could not be delivered with regard to reducing time-to-market or increasing product quality.

The integrated value proposition design framework makes use of the generalised Bass model to forecast the long-term product uptake in a market, combined with a Monte Carlo simulation. The third limitation of the research assignment is that the Bass model does not incorporate the probability of return customers; and this could influence the product's net value impact on the organisation. The fourth limitation of the research assignment is that the generalised Bass model does not incorporate a variable market size parameter. The product lifetime uptake model does account for a variable market size parameter within the Monte Carlo simulation, which provides a platform for conducting what-if scenario analysis. Nonetheless, the product lifetime uptake model does not explicitly account for a variable market size parameter due to internal and external effects.

8.5 RECOMMENDATIONS FOR FUTURE RESEARCH

The research assignment has the potential to be extended in three distinct ways. The first recommendation for future research is to conduct an *empirical study of the implementation of the integrated value proposition design framework.* This research would test whether the integrated value proposition design framework can be applied to a wide range of different types of products and organisations. The objective of the research would be to define empirically the time-to-market and product-quality improvements, and to obtain an average product improvement likelihood summary, depending on the size of the product's customer value propositions.

The second recommendation for future research is to *refine the shift towards customer-centricity within PLM*. The integrated value proposition design framework is one of the first concrete extensions of PLM that facilitates a shift towards customer-centricity. But the framework can be extended and refined to include more customer-centric tools, methods, and processes. The objectives of this research would be to improve the framework's ability to identify customer requirements in the market, to refine the design process of customer value propositions, to enhance the validation methodology of customer value propositions within a value creation process, and to intensify the customer-centric focus within PLM.

The third recommendation for future research is to *make the economics of the integrated value proposition design framework more sophisticated*. The stochastic simulation and forecasting model used in the integrated value proposition design framework is designed on a high level, and supports the functional tasks of the framework. The stochastic simulation and forecasting model has the potential to be developed to a high degree of complexity. This research would primarily focus on the economics of a customer-centric organisation. The objective of this research assignment would be to extend the high-level stochastic simulation and forecasting model of the integrated value proposition design framework into an intricate model that overcomes the limitations of the product lifetime uptake model, and extends the model into a SMART business model. The aim of this research would be to deliver a sophisticated model that quantifies the total economic effects of a customer-centric organisation in a market.

8.6 CONCLUSION

This research assignment delivers an integrated value proposition design framework that is a top-to-bottom methodology for creating a customer-centric organisational focus within PLM. The framework is an amalgamation of various customer-centric tools, methods, and processes gathered primarily from the disciplines of Systems Engineering, Marketing, Project Management, and Financial Management. The framework functions as a planning and communication tool, and has the ability to integrate large multifunctional teams into the customer value proposition design process of products. It is strengthened by a stochastic simulation and forecasting model that delivers an objective forecast of the product's performance in the market, and a presumption of the crucial customer segment parameters. The framework was validated in a case study of a telecommunications post-paid price plan product that proved its ability to extend and improve the PLM. The framework aligns design specifications with the voice of the customer. The research assignment provides a carefully-chosen methodology that has the ability to reduce process schedules within PLM, to reduce the time-to-market of new products, and to increase the overall quality of product portfolio management.

9 REFERENCES

Ameri F & Dutta D. 2005. Product Lifecycle Management: Closing the Knowledge Loops. *Computer-Aided Design & Applications*. Vol. 2, No. 5, pp 577-590

Anderson J, Narus J, & van Rossum W. 2006. Customer Value Propositions in Business Markets. *Harvard Business Review*. Vol. March 2006, pp. 1-10

Ang L & Buttle F. 2006. Customer retention management processes: A quantitative study. *European Journal of Marketing*. Vol. 40, No. 1/2, pp.83 - 99

Ang L & Buttle F. 2006. Managing For Successful Customer Acquisition: An Exploration. *Journal of Marketing Management.* Vol.22, pp.295-317

Barns C, Blake H, & Pinder D. 2009. *Creating and delivering your value proposition: Managing customer experience for profit*. USA: Kogan Page Limited

Bass F, Jain D, & Krishnan T. 2004. *Modelling the Marketing-Mix influence in new product diffusion*, in Mahajan V, Muller E, & Wind Y. New Product Diffusion Models. United States: Springer Science & Business Media, pp. 99-120

Bass F, Krishnan T, & Jain D. 1994. Why the Bass Model fits without decision variables. *Marketing Science*. Vol. 13, No.3, pp. 203-222

Bass F. 1969. A New Product Growth Model for Consumer Durables. *Management Science*. Vol. 15, No. 5, Theory Series (Jan 1969), pp. 215-227

Boehner R & Gold S. 2012. Modelling the impact of marketing mix on the diffusion of innovation in the Generalized Bass model of firm demand. *Developments in Business Simulation and Experiential Learning*. Vol. 39, pp. 75-91

Bolton R, Gustafsson A, McColl-Kennedy J, Sirianni N, & Tse D. 2014. Small details that make big differences: a radical approach to consumption experience as a firm's differentiating strategy. *Journal of Service Management*. Vol. 25, No.2, pp. 253-274

Bustamante A, Sawhney R. 2011. *Agile XXL: Scaling Agile for Project Teams*. Seapine Software, Inc.

Cadle J, Paul D, & Turner P. 2010. *Business Analysis Techniques: 72 Essential Tools for Success*. The Chartered Institute for IT: United Kingdom.

Chai C & Chan H. 2008. Intelligent value-based customer segmentation method for campaign management: A Case Study of automobile retailer. *Expert Systems with Applications*. Vol. 34, pp. 2754-2762

Clatworthy S. 2011. Service Innovation Through Touch-points: Development of an Innovation Toolkit for the First Stages of New Service Development. *International Journal of Design.*Vol.5, No.2, pp. 15-28

Dean J. 1976. Pricing Policies for New Products. *Harvard Business Review*. Vol. Nov-Dec, pp.1-12

Epetimehin, FM. 2011. Market Segmentation: A Tool for Improving Customer Satisfaction and Retention in Insurance Service Delivery. *Journal of Emerging Trends in Economics and Management Sciences*. Vol. 2, No.1, pp. 62-67

Gardener D. 1986. *The Product Lifecycle: It's Role in Marketing Strategy/Some Evolving Observations about the Life Cycle*. USA: University of Illinois Library at Urbana-Campaign Bookstacks.

Gecevska V, Chiabert P, Anisic Z, Lombardi F, Cus F. 2010. Product lifecycle management through innovative and competitive business environment. *Journal of Industrial Engineering and Management*. Vol. 3, No.2, pp. 323-336

Gupta S & Lehmann D. 2005. *Managing Customers as Investments: The Strategic Value of Customers in the Long Run*. United States: Wharton School Publishing

Gupta S, Hanssens D, Hardie B, Kahn W, Kumar V, Lin N, Ravishanker N, & Sriram S. 2006. Modelling Customer Lifetime Value. *Journal of Service Research*. Vol. 9, No. 2, pp. 139-155

Hassan A. 2012. The Value Proposition Concept in Marketing: How Customers Perceive the Value Delivered by Firms – A Study of Customer Perspectives on Supermarkets in Southampton in the United Kingdom. *International Journal of Marketing Studies*. Vol. 4, No. 3, pp. 68-87

Hauser J & Clausing D. 1988. The House of Quality. *Harvard Business Review*. May-June 1988, pp. 1-13

Jeong, J. 2010. *Stages of the Product Life Cycle*. Wiley International Encyclopedia of Marketing. 1.

Johansson A, Kazemahvazi S, Henriksson B, & Johnsson M. 2013. Why product lifecycle management should be on every executive's agenda: Turning PLM into a business success. *PRism*. Vol.1, pp. 56-69

Johnson J & Tearney M. 1993. Goodwill - an Eternal Controversy. *The CPA Journal*. Vol. 63, No. 4, pp. 1-10

Johnston R & Kong X. 2011. The customer experience: a road-map for improvement. *Managing Service Quality*. Vol. 21, No.1, pp. 5-24

Kessler E, Bierly P & Gopalakrishnan S. 2001. Vasa syndrome: Insights from a 17th-century new-product disaster. *Academy of Management Executive*. Vol. 15, No. 3, pp. 80-91

Kim C, Mauborgne R. 2004. Blue Ocean Strategy. *Harvard Business Review*. October 2004, p.1-10.

Kim C, Mauborgne R. 2005. *Blue Ocean Strategy*. United States: Harvard Business School Press

Kumar V & Rajan B. 2009. Profitable Customer Management: Measuring and Maximizing Customer Lifetime Value. *Management Accounting*. Vol. 10, No. 3, pp. 1-18

Lalsing V, Kishnah S, & Pudaruth S. 2012. People Factors in Agile Software Development and Project Management. *International Journal of Software Engineering & Applications*. Vol.3, No.1, pp. 117-37

Lam S, Shankar V, Erramilli M & Murthy B. 2004. Customer Value, Satisfaction, Loyalty, and Switching Costs: An Illustration from a Business-to-Business Service Context. *Journal of the Academy of Marketing Science*. Vol.32, pp.293-311

Laurence K & Lawton W. 1981. *Applications of Diffusion Models: Some Empirical Results*. *New Product Forecasting*. United States: Lexington Books.

Levitt T. 1965. Exploit the product lifecycle. *Harvard Business Review*. Vol. Nov-Dec, pp.81-94

Lien C, Ramirez A, & Haines G. 2006. Capturing and Evaluating Segments: Using Self-Organizing Maps and K-Means in Market Segmentation. *Asian Journal of Management and Humanity Sciences*. Vol. 1, No. 1, pp. 1-15

Lilien G, Rangaswamya A, van Bruggen G, & Wierenga B. 2002. Bridging the marketing theory--practice gap with marketing engineering. *Journal of Business Research*. Vol.55, pp.111 – 121

Liu W, Zeng Y, Maletz M & Brisson D. 2009. *Product Lifecycle Management: A Review*. Proceedings of the ASME 2009 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference. San Diego, USA. August 30-September 2. USA: ASME

Lynn P. 2014. *Self-Organising Maps for Customer Segmentation using R*. [Online]. Available: http://shanelynn.ie/index.php/self-organising-maps-for-customer-segmentation-using-r/ [18 September 2014]

Majahan V, Muller E, Bass F. 1995. Diffusion of new products: Empirical generalizations and managerial uses. *Marketing Science*. Vol 14, No 3(2). 1995, pp. 80-88

Matzler K & Hinterhuber H. 1998. How to make product development projects more successful by integrating Kano's model of customer satisfaction into quality function deployment. Technovation. Vol. 18, no.1, pp. 25–38

McClure B. *DCF Analysis: Calculating the Discount Rate*. [Online]. Available: http://www.investopedia.com/university/dcf/dcf3.asp [8 September 2014]

Metropolis N & Ulam S. 1949. The Monte Carlo Method. *Journal of the American Statistical Association*. Vol. 44, No. 247, p. 335-341

Meyer C & Schwager A. 2007. Understanding Customer Experience. *Harvard Business Review*. Vol. 2, pp. 1-11

Osterwalder A. 2012. Achieve product market fit with our brand new value proposition designer canvas. *Business Model Alchemists*. [Online]. Available: http://businessmodelalchemist.com/blog/2012/08/achieve-product-market-fit-with-our-brand-new-value-proposition-designer.html [10 July 2014]

Payne A & Frow P. 2005. A Strategic Framework for Customer Relationship Management. *Journal of Marketing*. Vol. 69, pp. 167–176

Payne A. *The Value Creation Process in Customer Relationship Management (White Paper)*. Cranfield, UK: Cranfield School of Management

Product lifecycle management problems costing operators dear, survey finds. 2013. *European Communications*. [Online]. Available: http://www.eurocomms.com/industry-news/49-online-press/9286-product-lifecycle-management-problems-costing-operators-dear-survey-finds [23 June 2014]

Rashid M. 2010. A review of state-of-art on Kano model for research direction. *International Journal of Engineering Science and Technology*. Vol. 2(12), pp. 7481-7490, 2010

Rogers E. 1962. *Diffusion of Innovations 1st edition*. New York: The Free Press

Rogers E. 1983. *Diffusion of Innovations 3rd edition*. New York: The Free Press

Rudeck E. 2014. A Brief History of Product Lifecycle Management. *Concurrent Engineering Blog*. [Online]. Available: http://www.concurrent-engineering.co.uk/Blog/bid/100180/A-Brief-History-of-Product-Lifecycle-Management [24 July 2014]

Satoh D. 2001. A discrete Bass model and its parameter estimation. *Journal of the Operations Research*. Vol. 44, No. 1, pp. 1-18

Sembhi R. 2010. *Capabilities Enabling Product Orientation and Service Orientation: A Study of Canadian Software Firms*. Waterloo, Ontario, Canada. University of Waterloo. (PhD – Thesis)

Shen X. 2002. *Factors Affecting Multifunctional Teams in Innovation Processes.* Hamburg, Germany. Northern Institute of Technology. (Master's Thesis)

Sheth J, Sisodia R, & Sharma A. 2000. The Antecedents and Consequences of Customer-Centric Marketing. *Journal of the Academy of Marketing Science*. Vol. 28, No. 1, pp. 55-66

Srinivasan V & Mason C. 1986. Nonlinear Least Squares Estimation of New Product Diffusion Models. *Marketing Science*. Vol. 5, no. 2, pp. 169-178

Straub R & Kirby J. 2014. Better Management Could Spur a New Era of Economic Growth. *Harvard Business Review Blog Network*. [Online]. Available: http://blogs.hbr.org/2014/05/better-management-could-spur-a-new-era-of-economic-growth/ [16 May 2014]

Sultan F, Farley J, & Lehmann D. 1990. A Meta-Analysis of Applications of Diffusion Models. *Journal of Marketing Research*. Vol. 27, No. 1, pp. 70-77

Value Chain Group. VCOR. [Online]. Available: http://www.value-chain.org/ [12 August 2014]

Van de Ven, AH. 1986. Central problems in the management of innovation. *Management Science*. Vol. 32, No. 5, pp. 590-607

Van den Buite, C., & Lilien, G. *Why Bass Model Estimates May Be Biased (and What It Means).*

Van den Bulte C & Lilien L. 1997. Bais and systematic change in Parameter Estimation of Macro-Level Diffusion Models. Marketing Science. Vol.16, No. 4, pp.338-353

Verhoef P, Lemon K, Parasuraman A, Roggeveen A, Tsiros M, & Schlesinger L. 2009. Customer Experience Creation: Determinants, Dynamics and Management Strategies. *Journal of Retailing*. Vol. 85, no. 1, pp. 31–41

Verzuh E. 2008. *The Fast Forward MBA in Project Management*. Hoboken, New Jersey: John Wiley & Sons, Inc.

Wehrens R & Buydens L. 2007. Self- and Super-organizing Maps in R: The kohonen Package. *Journal of Statistical Software*. Vol. 21, no. 5, pp. 1-19

Wright M & Charlett D. 1995. New Product Diffusion Models in Marketing: An Assessment of Two Approaches. Marketing Bulletin. Vol. 6, No.4, pp. 32-41

Yang C & Sung D. 2010. An integrated model of value creation based on the refined Kano's model and the blue ocean strategy. *Total Quality Management & Business Excellence*. Vol. 9/2011, No.22, pp. 925-940

Yang, C. 2005. The Refined Kano's Model and its Application. *Total Quality Management*. Vol. 16, No. 10, pp. 1127–1137

10 APPENDIX A

Appendix A presents the various data inputs used within the Case Study, or outputs generated within the Case Study where applicable.

Figure 71: The Generalised Bass model

The first input data presented within the appendix is the price and advertising spend used to model the Generalised Bass model within the Case Study. The framework implementation team decided to keep the product price at R1,999 per month for the first 18 months, thereafter the product price declined with R 100 every 6 months. The advertising spend per month comprised of 16% of the fixed expenses per month which were R750,000 per month. The advertising spend was increased after the 15th month for the next 6 months between R20,000 and R50,000 per month in attempt to stretch the peak adaption time period and to make the market aware of the upcoming price promotion.

Month	Price	Advert
1	1999	120000
2	1999	120000
3	1999	120000
4	1999	120000
5	1999	120000
6	1999	120000
7	1999	120000
8	1999	120000
9	1999	120000
10	1999	120000
11	1999	120000
12	1999	120000
13	1999	120000
14	1999	120000
15	1999	151656
16	1999	156622
17	1999	165421
18	1999	164968
19	1899	157865
20	1899	154378
21	1899	120000
22	1899	120000
23	1899	120000
24	1899	120000
25	1799	120000
26	1799	120000
27	1799	120000
28	1799	120000
29	1799	120000
30	1799	120000
31	1699	120000
32	1699	120000
33	1699	120000

34	1699	120000
35	1699	120000
36	1699	120000
37	1599	120000
38	1599	120000
39	1599	120000
40	1599	120000
41	1599	120000
42	1599	120000
43	1499	120000
44	1499	120000
45	1499	120000
46	1499	120000
47	1499	120000
48	1499	120000

Figure 72: Monte Carlo simulation input parameters

The second data presented in Appendix A is the various uptake scenarios used to establish the input parameter distribution functions for the Monte Carlo simulation of the product lifetime uptake model. Eight uptake scenarios were created, the Bass model input parameters were derived from a non-linear least squares estimation procedure, the code for the estimation procedure are available in Appendix B (Figure 72). The mean and standard deviation from the bass model parameters were calculated and used as input normal distribution functions for the random variables used within the Monte Carlo simulation.

Uptake 1	Uptake 2	Uptake 3	Uptake 4	Uptake 5	Uptake 6	Uptake 7	Uptake 8
178	172	175	186	173	184	176	190
198	203	209	204	178	184	179	203
205	211	188	192	202	210	186	202
214	211	193	211	207	212	210	214
216	211	225	224	195	205	229	194
219	213	193	211	227	224	193	207
482	465	519	460	492	468	505	464
502	508	457	472	484	519	485	497
547	469	525	474	553	491	500	462
522	495	535	512	471	473	508	464
482	471	493	477	473	482	469	475
543	490	485	520	526	524	485	467
698	694	693	632	635	696	681	655
630	575	620	634	575	648	668	640
610	670	627	651	575	657	617	604
712	650	634	650	713	674	662	674
627	588	683	594	625	603	618	672
676	570	634	674	576	634	576	618
517	521	527	458	457	481	453	469
520	553	515	522	516	494	471	558

456	511	529	446	448	468	443	505
518	529	542	494	464	468	470	464
504	530	530	487	515	472	524	473
470	521	509	519	514	520	485	456
338	350	363	380	381	336	382	377
406	400	368	385	402	348	385	348
336	361	328	379	380	347	360	328
336	382	357	392	376	333	351	344
345	390	386	392	348	398	387	337
326	368	376	386	345	334	376	355
236	263	256	240	246	253	236	262
244	235	260	243	257	243	248	250
243	248	208	239	213	207	216	215
248	251	217	237	220	229	216	232
256	267	256	255	241	247	231	270
248	257	227	223	231	239	221	249
184	178	172	158	173	166	157	177
178	164	164	167	160	173	173	165
196	190	191	176	175	191	185	184
166	168	174	159	161	186	168	168
173	186	165	180	174	185	187	161
186	162	162	169	178	188	169	183
43	52	47	38	51	50	38	51
37	46	39	49	39	41	46	42
38	37	51	48	35	48	51	39
42	49	53	53	39	50	48	52
54	48	41	51	52	38	43	39
40	47	34	48	49	35	41	38
Bass Model Parameters per scenario m, p, q							
16285.27	**16448.64**	**16327.19**	**16238.5**	**16008.26**	**16027.69**	**15965.75**	**15874.42**
0.01235036	**0.01180458**	**0.0117055,**	**0.01197602**	**0.01222092**	**0.01244849**	**0.01237463**	**0.01200186**
0.1225098	**0.1189959**	**0.1245009**	**0.1195433**	**0.118974**	**0.1205475**	**0.1191027**	**0.1217778**

Figure 73: What-if scenario analysis

Figure 73 is a what-if scenario analysis for the product lifetime uptake model. The diffusion parameters could take on three different states, a 'low' diffusion speed, a 'medium' diffusion speed, or a 'high' diffusion speed, and the market size could have resulted in a 'small' market size, a 'medium' market size, or a 'large' market size. This resulted in 27 different uptake scenarios. The following equation explains how the various input parameters were paired to formulate the 27 uptake scenarios.

$$m1\begin{bmatrix} p1q1 & p1q2 & p1q3 \\ p2q1 & p2q2 & p2q3 \\ p3q1 & p3q2 & p3q2 \end{bmatrix}, m2\begin{bmatrix} p1q1 & p1q2 & p1q3 \\ p2q1 & p2q2 & p2q3 \\ p3q1 & p3q2 & p3q2 \end{bmatrix}, m3\begin{bmatrix} p1q1 & p1q2 & p1q3 \\ p2q1 & p2q2 & p2q3 \\ p3q1 & p3q2 & p3q2 \end{bmatrix}$$

Where:

- *p1* = **low** innovator rate of diffusion
- *p2* = **medium** innovator rate of diffusion
- *p3* = **high** innovator rate of diffusion
- *q1* = **low** imitator rate of diffusion
- *q2* = **medium** imitator rate of diffusion
- *q3* = **high** imitator rate of diffusion
- *m1* = **small** market size
- *m2* = **medium** market size
- *m3* = **high** market size

The table below summarises the output data from the various uptake scenarios in terms of the peak time and the peak number of adaptions. The code used to model Figure 73 is shown in Appendix B.

Scenario	**Peak time (Months)**	**Peak number of adaptions**
Scenario 1	19	574
Scenario 2	19	572
Scenario 3	19	570
Scenario 4	19	567
Scenario 5	19	564
Scenario 6	19	562
Scenario 7	19	559
Scenario 8	19	557
Scenario 9	19	554
Scenario 10	19	600
Scenario 11	19	598
Scenario 12	19	596
Scenario 13	19	592
Scenario 14	19	590
Scenario 15	19	588
Scenario 16	19	584
Scenario 17	19	582
Scenario 18	19	582
Scenario 19	19	**626**
Scenario 20	19	624
Scenario 21	19	622
Scenario 22	19	618
Scenario 23	19	616
Scenario 24	19	613
Scenario 25	19	610
Scenario 26	19	607
Scenario 27	19	605

11 APPENDIX B

Appendix B provides the code used to model each figure within Chapter 5 and 7. The code is listed below according to the chapter and figure. The code was written in the language R, and was modelled in CRAN R. R is a freeware statistical software. For a detailed description of the model code, please refer to Chapter 5, Section 5.6.

CHAPTER 5

Chapter 5 is the economics of the integrated value proposition design framework. The figures model within Chapter 5 is mainly used to demonstrate the product lifetime uptake model.

Figure 25 and Figure 26

```
## Figure 25 & 26
# Parameters

p <- 0.003
q <- 0.38
m <- 160000
Period <- 100

# Bass model

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

# Convert vectors into time series

Uptakeseries <- ts(Uptake, start = c(2013, 1), frequency = 12)
CumUptakeseries <- ts(CumUptake, start = c(2013, 1), frequency = 12)

# Figure 25

plot(Uptakeseries, main="Bass Model with p = 0.003, q = 0.38, & m = 160000", xlim =
c(2013, 2021), ylim = c(0, 15000), xlab="Years", ylab="Adaptions")

# Figure 26

plot(CumUptakeseries, main="Cumulative Bass Model with p = 0.003, q = 0.38, & m =
160000", xlim = c(2013, 2021), ylim = c(0, 160000), xlab="Years", ylab="Cumulative
Adaptions")
```

Figure 27 and Figure 28

```
## Figure 27 & 28
# Parameters

p <- 0.002
q <- 0.22
m <- 160000
Period <- 100

# Bass model
```

```
Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

# Convert vectors into time series

Uptakeseries <- ts(Uptake, start = c(2013, 1), frequency = 12)
CumUptakeseries <- ts(CumUptake, start = c(2013, 1), frequency = 12)

# Figure 27

plot(Uptakeseries, main="Bass Model with p = 0.002, q = 0.22, & m = 160000", xlim =
c(2013, 2021), ylim = c(0, 9000), xlab="Years", ylab="Adaptions")

# Figure 28

plot(CumUptakeseries, main="Cumulative Bass Model with p = 0.002, q = 0.22, & m =
160000", xlim = c(2013, 2021), ylim = c(0, 160000), xlab="Years", ylab="Cumulative
Adaptions")
```

Figure 29 and Figure 30

```
## Figure 29 & 30
# Parameters

p <- 0.001
q <- 0.1
m <- 160000
Period <- 100

# Bass model

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}
# Convert vectors into time series

Uptakeseries <- ts(Uptake, start = c(2013, 1), frequency = 12)
CumUptakeseries <- ts(CumUptake, start = c(2013, 1), frequency = 12)

# Figure 29

plot(Uptakeseries, main="Bass Model with p = 0.001, q = 0.1, & m = 160000", xlim =
c(2013, 2021), ylim = c(0, 4000), xlab="Years", ylab="Adaptions")

# Figure 30
```

```
plot(CumUptakeseries, main="Cumulative Bass Model with p = 0.001, q = 0.1, & m =
160000", xlim = c(2013, 2021), ylim = c(0, 160000), xlab="Years", ylab="Cumulative
Adaptions")
```

Figure 31 and Figure 32

```
## Figure 31
# Parameters

p <- 0.001
q <- 0.1
m <- 160000
Period <- 100

# Bass model

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

# Convert vectors into time series

Uptakeseries <- ts(Uptake, start = c(2013, 1), frequency = 12)
CumUptakeseries <- ts(CumUptake, start = c(2013, 1), frequency = 12)

# Plot the product uptake and cumulative uptake

plot(Uptakeseries, main="q>p", xlim = c(2013, 2021), ylim = c(0, 4000), xlab="Years",
ylab="Adaptions")

## Figure 32
# Parameters

p <- 0.1
q <- 0.001
m <- 160000
Period <- 100

# Bass model

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

# Convert vectors into time series

Uptakeseries <- ts(Uptake, start = c(2013, 1), frequency = 12)
CumUptakeseries <- ts(CumUptake, start = c(2013, 1), frequency = 12)
```

```
# Plot the product uptake and cumulative uptake

plot(Uptakeseries, main="p>q", xlim = c(2013, 2021), ylim = c(0, 16000), xlab="Years",
ylab="Adaptions")
```

Figure 33

```
## Figure 33
# Parameters

p <- 0.001
q <- 0.1
m <- 160000
Period <- 100
Alpha <- -0.5
Betha <- 0.5
Price <- rnorm (Period, mean = 100, sd = 10)
Advert <- rnorm(Period, mean = 5000, sd = 200)

## NORMAL BASS MODEL

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

# Convert vectors into time series

Uptakeseries <- ts(Uptake, start = c(2013, 1), frequency = 12)
CumUptakeseries <- ts(CumUptake, start = c(2013, 1), frequency = 12)

# Plot the product uptake and cumulative uptake

plot(Uptakeseries, main="", xlim = c(2013, 2021), ylim = c(0, 5000), xlab = "Years",
ylab = "Adaptions")

# Convert Marketing Mix into time series

PriceSeries <- ts(Price, start = c(2013, 1), frequency = 12)
AdvSeries <- ts(Advert, start = c(2013, 1), frequency = 12)

# Calculate the difference in price and advertising between time periods

DeltaPrice <- diff(PriceSeries, lag=1, difference=1)
DeltaAdv <- diff(AdvSeries, lag=1, difference=1)
DeltaAdv[DeltaAdv<0] <- 0

# Calculate the Generalised Bass model factor for incorporating Marketing Mix

MarketingFactor <- 1 + Alpha*(DeltaPrice/PriceSeries) + Betha*(DeltaAdv/AdvSeries)

GeneralisedBass <- MarketingFactor*Uptakeseries

# Plot Generalised Bass model

par(new = T)
```

```
plot(GeneralisedBass, col="red", xlim=c(2013, 2021), ylim=c(0, 5000), xlab = "Years",
ylab = "Adaptions", main = "Generalised Bass Model")
```

Figure 34

```
##Figure 34
# Parameters

p <- 0.001
q <- 0.1
Period <- 100
r <- 0.5
n <- 0.5
price <- rnorm(Period, mean = 100, sd = 10)
t <- 1:Period

# Bass model with extention

m[1] <- 160
Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m[1]
CumUptake[1] <- 0

# Market size extention

m <- (m[1]*(1+r)^(t-1))-((price/price[1])^(-n))

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m[i])*(m[i] - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

# Convert vectors into time series

Uptakeseries <- ts(Uptake, start = c(2013, 1), frequency = 12)
CumUptakeseries <- ts(CumUptake, start = c(2013, 1), frequency = 12)

# Plot the product uptake and cumulative uptake

plot(Uptakeseries, main="Variable Market Size due to external influences", xlim =
c(2013, 2022), xlab="Years", ylab="Adaptions")
```

Figure 35

```
##Figure 35
# Parameters

p <- 0.001
q <- 0.1
m <- 160000
Period <- 100
P <- 100
A <- 50
e <- -1
f <- 0.5
t <- 1:Period

# Scaling factor

s <- m/((P^(-e))*(A^f))
```

```
# Bass model Extension

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p*s*(P^(-e))*(A^f)) + (1 + q - p)*CumUptake[i-1] - (q/(s*(P^(-
e))*(A^f)))*((CumUptake[i-1])^2)
CumUptake = cumsum(Uptake)
}

# Convert vectors into time series

Uptakeseries <- ts(Uptake, start = c(2013, 1), frequency = 12)
CumUptakeseries <- ts(CumUptake, start = c(2013, 1), frequency = 12)

# Plot the product uptake and cumulative uptake

plot(Uptakeseries, main="Boehner and Gold's Bass model extension example", xlim =
c(2013, 2021), xlab="Years", ylab="Adaptions")
```

Figure 36

```
## Figure 36

DensityFunc <- c()
Uptake <- c()
CumUptake <- c()
p <- 0.001
q <- 0.1
m_mean <- 160000
m_sd <- 10000

runs <- 1000
period <- 100

output <- matrix(NA, period, runs)     #Storage matrix

plot(0, col="grey", xlim=c(2013,2021), ylim=c(0, 6000), xlab = "Years", ylab =
"Uptake", main = "Product Lifetime Uptake model")

for(run in 1:runs)
{
m <- rnorm(n = 1, mean = m_mean, sd = m_sd)

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

output[, run] = Uptake
Uptakeseries <- ts(Uptake, start = c(2013, 1), frequency = 12)
par(new=T)
```

```
plot(Uptakeseries, col = "grey", xlim=c(2013,2021), ylim=c(0, 6000), xlab = "Years",
ylab = "Uptake", main = "Product Lifetime Uptake model")
}
```

Figure 37

```
# Figure 37

# Recall the Code used to model Figure 36

# Scenario 1

p <- 0.001
q <- 0.1
m <- m_mean - m_sd
Period <- 100

# Bass model

Uptake <- c()                    # Create empty entries for the for-loop
CumUptake <- c()
Uptake[1] <- p*m                 # Define the uptake at time t = 1
CumUptake[1] <- 0                # Define the cumulative uptake at time t = 1

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

# Convert vectors into time series

Uptakeseries <- ts(Uptake, start = c(2013, 1), frequency = 12)

# Plot the product uptake and cumulative uptake

par(new=T)
plot(Uptakeseries, col = "blue", xlim = c(2013, 2021), ylim = c(0, 6000), xlab="Years",
ylab="Adaptions")

# Scenario 2

p <- 0.001
q <- 0.1
m <- m_mean
Period <- 100

# Bass model

Uptake <- c()                    # Create empty entries for the for-loop
CumUptake <- c()
Uptake[1] <- p*m                 # Define the uptake at time t = 1
CumUptake[1] <- 0                # Define the cumulative uptake at time t = 1

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

# Convert vectors into time series

Uptakeseries <- ts(Uptake, start = c(2013, 1), frequency = 12)
```

```
# Plot the product uptake and cumulative uptake

par(new=T)
plot(Uptakeseries, col = "black", xlim = c(2013, 2021), ylim = c(0, 6000),
xlab="Years", ylab="Adaptions")

# Scenario 3

p <- 0.001
q <- 0.1
m <- m_mean + m_sd
Period <- 100

# Bass model

Uptake <- c()                    # Create empty entries for the for-loop
CumUptake <- c()
Uptake[1] <- p*m                 # Define the uptake at time t = 1
CumUptake[1] <- 0                # Define the cumulative uptake at time t = 1

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

# Convert vectors into time series

Uptakeseries <- ts(Uptake, start = c(2013, 1), frequency = 12)

# Plot the product uptake and cumulative uptake

par(new=T)
plot(Uptakeseries, col = "red", xlim = c(2013, 2021), ylim = c(0, 6000), xlab="Years",
ylab="Adaptions")
```

CHAPTER 7

Chapter 7 represents the case study. The code used within Chapter 7 demonstrates the product lifetime uptake model, the CLV model, and the goodwill firm value model in a real-life explanatory case study.

Figure 69 and Figure 70

```
# Figure 69 & 70

m <- 16147
p <- 0.0121103
q <- 0.120744
Period <- 100

# Bass model

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
```

```
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

# Convert vectors into time series

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)
CumUptakeseries <- ts(CumUptake, start = c(2014, 1), frequency = 12)

# Figure 69

plot(Uptakeseries, main="Unlimited product natural diffusion", xlab="Years",
ylab="Adaptions", xlim = c(2014, 2020))

# Figure 70

plot(CumUptakeseries, main="Unlimited product natural cumulative diffusion",
xlab="Years", ylab="Cumulative Adaptions", xlim = c(2014, 2020))
```

Figure 71

```
## Figure 71

# Normal Bass Model

p <- 0.0121103
q <- 0.120744
m <- 16147
Alpha <- -0.55
Betha <- 0.39
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

# Convert vectors into time series

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

plot(Uptakeseries, col="black", xlim=c(2014,2018), ylim=c(0, 600), xlab = "Years",
ylab="Adaptors")

# Incorporate Marketing Mix

# Convert Marketing Mix into time series
# Advertising and Price Elasticity

data <- read.csv(file.choose())        # Data set available in Appendix A

Price <- data$Price
Advert <- data$Advert
PriceSeries <- ts(Price, start = c(2014, 1), frequency = 12)
AdvSeries <- ts(Advert, start = c(2014, 1), frequency = 12)
```

```
DeltaPrice <- diff(PriceSeries, lag=1, difference=1)
DeltaAdv <- diff(AdvSeries, lag=1, difference=1)
DeltaAdv[DeltaAdv<0] <- 0

MarketingFactor <- 1 + Alpha*(DeltaPrice/PriceSeries) + Betha*(DeltaAdv/AdvSeries)

GeneralisedBass <- MarketingFactor*Uptakeseries

par(new = T)
plot(GeneralisedBass, col="red", xlim=c(2014,2018), ylim=c(0, 600), xlab = "Years",
ylab="Adaptors", main = "Unlimited Product: Generalised Bass Model")
```

Figure 72

```
## Monte Carlo input parameters determined for 8 uptake scenarios

# Determine Bass Model parameters

data <- read.csv(file.choose())
head(data)                                  # Data available in Appendix A

# Uptake assumption no.1

Uptake <- data$Uptake_1
Time <- 1:48
CuUptake <- cumsum(Uptake)
Bass.nls <- nls(Uptake ~ M * ( ((P+Q)^2 / P) * exp(-(P+Q) * Time) ) /(1+(Q/P)*exp(-
(P+Q)*Time))^2,
start = list(M=9310, P=0.003, Q=0.38))
summary(Bass.nls)

# get coefficient

Bcoef <- coef(Bass.nls)
m_1 <- Bcoef[1]
p_1 <- Bcoef[2]
q_1 <- Bcoef[3]

# Uptake assumption no.2

Uptake <- data$Uptake_2
Time <- 1:48
CuUptake <- cumsum(Uptake)
Bass.nls <- nls(Uptake ~ M * ( ((P+Q)^2 / P) * exp(-(P+Q) * Time) ) /(1+(Q/P)*exp(-
(P+Q)*Time))^2,
start = list(M=9310, P=0.003, Q=0.38))
summary(Bass.nls)

# get coefficient

Bcoef <- coef(Bass.nls)
m_2 <- Bcoef[1]
p_2 <- Bcoef[2]
q_2 <- Bcoef[3]

# Uptake assumption no.3

Uptake <- data$Uptake_3
Time <- 1:48
CuUptake <- cumsum(Uptake)
```

```
Bass.nls <- nls(Uptake ~ M * ( ((P+Q)^2 / P) * exp(-(P+Q) * Time) ) /(1+(Q/P)*exp(-
(P+Q)*Time))^2,
start = list(M=9310, P=0.003, Q=0.38))
summary(Bass.nls)

# get coefficient

Bcoef <- coef(Bass.nls)
m_3 <- Bcoef[1]
p_3 <- Bcoef[2]
q_3 <- Bcoef[3]

# Uptake assumption no.4

Uptake <- data$Uptake_4
Time <- 1:48
CuUptake <- cumsum(Uptake)
Bass.nls <- nls(Uptake ~ M * ( ((P+Q)^2 / P) * exp(-(P+Q) * Time) ) /(1+(Q/P)*exp(-
(P+Q)*Time))^2,
start = list(M=9310, P=0.003, Q=0.38))
summary(Bass.nls)

# get coefficient

Bcoef <- coef(Bass.nls)
m_4 <- Bcoef[1]
p_4 <- Bcoef[2]
q_4 <- Bcoef[3]

# Uptake assumption no.5

Uptake <- data$Uptake_5
Time <- 1:48
CuUptake <- cumsum(Uptake)
Bass.nls <- nls(Uptake ~ M * ( ((P+Q)^2 / P) * exp(-(P+Q) * Time) ) /(1+(Q/P)*exp(-
(P+Q)*Time))^2,
start = list(M=9310, P=0.003, Q=0.38))
summary(Bass.nls)

# get coefficient

Bcoef <- coef(Bass.nls)
m_5 <- Bcoef[1]
p_5 <- Bcoef[2]
q_5 <- Bcoef[3]

# Uptake assumption no.6

Uptake <- data$Uptake_6
Time <- 1:48
CuUptake <- cumsum(Uptake)
Bass.nls <- nls(Uptake ~ M * ( ((P+Q)^2 / P) * exp(-(P+Q) * Time) ) /(1+(Q/P)*exp(-
(P+Q)*Time))^2,
start = list(M=9310, P=0.003, Q=0.38))
summary(Bass.nls)

# get coefficient

Bcoef <- coef(Bass.nls)
m_6 <- Bcoef[1]
p_6 <- Bcoef[2]
```

```
q_6 <- Bcoef[3]

# Uptake assumption no.7

Uptake <- data$Uptake_7
Time <- 1:48
CuUptake <- cumsum(Uptake)
Bass.nls <- nls(Uptake ~ M * ( ((P+Q)^2 / P) * exp(-(P+Q) * Time) ) /(1+(Q/P)*exp(-
(P+Q)*Time))^2,
start = list(M=9310, P=0.003, Q=0.38))
summary(Bass.nls)

# get coefficient

Bcoef <- coef(Bass.nls)
m_7 <- Bcoef[1]
p_7 <- Bcoef[2]
q_7 <- Bcoef[3]

# Uptake assumption no.8

Uptake <- data$Uptake_8
Time <- 1:48
CuUptake <- cumsum(Uptake)
Bass.nls <- nls(Uptake ~ M * ( ((P+Q)^2 / P) * exp(-(P+Q) * Time) ) /(1+(Q/P)*exp(-
(P+Q)*Time))^2,
start = list(M=9310, P=0.003, Q=0.38))
summary(Bass.nls)

# get coefficient

Bcoef <- coef(Bass.nls)
m_8 <- Bcoef[1]
p_8 <- Bcoef[2]
q_8 <- Bcoef[3]

m <- c(m_1, m_2, m_3, m_4, m_5, m_6, m_7, m_8)
q <- c(q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8)
p <- c(p_1, p_2, p_3, p_4, p_5, p_6, p_7, p_8)

m_mean <- mean(m)
p_mean <- mean(p)
q_mean <- mean(q)

m_sd <- sd(m)
p_sd <- sd(p)
q_sd <- sd(q)

## Figure 72

DensityFunc <- c()
Uptake <- c()

runs <- 1000
Period <- 48

output <- matrix(NA, Period, runs)

plot(0, col="grey", xlim=c(2014,2018), ylim=c(0, 1000), xlab = "Years", ylab =
"Adaptions", main = "Unlimited Product Lifetime Uptake model")
```

```
for(run in 1:runs)
{

m <- rnorm(n = 1, mean = 16146.97 , sd = (204.0942 + 500) )
p <- rnorm(n = 1, mean = 0.0121103, sd = 0.0002780613)
q <- rnorm(n = 1, mean = 0.120744, sd = 0.002023575)

Uptake <- c()
CumUptake <- c()
Uptake[1] <- 16
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

output[, run] = Uptake
Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)
par(new=T)
plot(Uptakeseries, col="grey", xlim=c(2014,2018), ylim=c(0, 1000), xlab = "Years", ylab
= "Adaptions", main = "Unlimited Product Lifetime Uptake model")

}

#Summary Statistics
min(output)
mean(output)
max(output)
```

Figure 73

```
## Figure 73

# M GREEN
# Scenario 1

m <- 16146.97 - (204.0942 + 500)
p <- 0.0121103 + 0.0002780613
q <- 0.120744 + 0.002023575
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

plot(Uptakeseries, main="", col = "green", xlab="Years", ylab="Adaptions", xlim =
c(2014, 2018), ylim = c(0, 700))

peak_1 <- which.max(Uptakeseries)
salespeak_1 <- max(Uptakeseries)
```

```
# Scenario 2

m <- 16146.97 - (204.0942 + 500)
p <- 0.0121103
q <- 0.120744 + 0.002023575
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "green", xlab="Years", ylab="Adaptions", xlim =
c(2014, 2018), ylim = c(0, 700))

peak_2 <- which.max(Uptakeseries)
salespeak_2 <- max(Uptakeseries)

# Scenario 3

m <- 16146.97 - (204.0942 + 500)
p <- 0.0121103 - 0.0002780613
q <- 0.120744 + 0.002023575
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0


for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "green",
  xlab="Years", ylab="Adaptions", xlim = c(2014, 2018), ylim = c(0, 700))

peak_3 <- which.max(Uptakeseries)
salespeak_3 <- max(Uptakeseries)

# Scenario 4

m <- 16146.97 - (204.0942 + 500)
p <- 0.0121103 + 0.0002780613
q <- 0.120744
Period <- 48

Uptake <- c()
```

```
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "green", xlab="Years", ylab="Adaptions", xlim =
c(2014, 2018), ylim = c(0, 700))

peak_4 <- which.max(Uptakeseries)
salespeak_4 <- max(Uptakeseries)

# Scenario 5

m <- 16146.97 - (204.0942 + 500)
p <- 0.0121103
q <- 0.120744
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "green", xlab="Years", ylab="Adaptions", xlim =
c(2014, 2018), ylim = c(0, 700))

peak_5 <- which.max(Uptakeseries)
salespeak_5 <- max(Uptakeseries)

# Scenario 6

m <- 16146.97 - (204.0942 + 500)
p <- 0.0121103 - 0.0002780613
q <- 0.120744
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}
```

```
Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "green", xlab="Years", ylab="Adaptions", xlim =
c(2014, 2018), ylim = c(0, 700))

peak_6 <- which.max(Uptakeseries)
salespeak_6 <- max(Uptakeseries)

# Scenario 7

m <- 16146.97 - (204.0942 + 500)
p <- 0.0121103 + 0.0002780613
q <- 0.120744 - 0.002023575
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "green", xlab="Years", ylab="Adaptions", xlim =
c(2014, 2018), ylim = c(0, 700))

peak_7 <- which.max(Uptakeseries)
salespeak_7 <- max(Uptakeseries)

# Scenario 8

m <- 16146.97 - (204.0942 + 500)
p <- 0.0121103
q <- 0.120744 - 0.002023575
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "green", xlab="Years", ylab="Adaptions", xlim =
c(2014, 2018), ylim = c(0, 700))

peak_8 <- which.max(Uptakeseries)
salespeak_8 <- max(Uptakeseries)
```

```
# Scenario 9

m <- 16146.97 - (204.0942 + 500)
p <- 0.0121103 - 0.0002780613
q <- 0.120744 - 0.002023575
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "green", xlab="Years", ylab="Adaptions", xlim =
c(2014, 2018), ylim = c(0, 700))

peak_9 <- which.max(Uptakeseries)
salespeak_9 <- max(Uptakeseries)

# M BLUE
# Scenario 10

m <- 16146.97
p <- 0.0121103 + 0.0002780613
q <- 0.120744 + 0.002023575
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "blue", xlab="Years", ylab="Adaptions", xlim =
c(2014, 2018), ylim = c(0, 700))

peak_10 <- which.max(Uptakeseries)
salespeak_10 <- max(Uptakeseries)

# Scenario 11

m <- 16146.97
p <- 0.0121103
q <- 0.120744 + 0.002023575
Period <- 48

Uptake <- c()
```

```
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "blue", xlab="Years", ylab="Adaptions", xlim =
c(2014, 2018), ylim = c(0, 700))


peak_11 <- which.max(Uptakeseries)
salespeak_11 <- max(Uptakeseries)

# Scenario 12

m <- 16146.97
p <- 0.0121103 - 0.0002780613
q <- 0.120744 + 0.002023575
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "blue", xlab="Years", ylab="Adaptions", xlim =
c(2014, 2018), ylim = c(0, 700))


peak_12 <- which.max(Uptakeseries)
salespeak_12 <- max(Uptakeseries)

# Scenario 13

m <- 16146.97
p <- 0.0121103 + 0.0002780613
q <- 0.120744
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
```

```
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "blue", xlab="Years", ylab="Adaptions", xlim =
c(2014, 2018), ylim = c(0, 700))

peak_13 <- which.max(Uptakeseries)
salespeak_13 <- max(Uptakeseries)

# Scenario 14

m <- 16146.97
p <- 0.0121103
q <- 0.120744
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "blue", xlab="Years", ylab="Adaptions", xlim =
c(2014, 2018), ylim = c(0, 700))

peak_14 <- which.max(Uptakeseries)
salespeak_14 <- max(Uptakeseries)

# Scenario 15

m <- 16146.97
p <- 0.0121103 - 0.0002780613
q <- 0.120744
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "blue", xlab="Years", ylab="Adaptions", xlim =
c(2014, 2018), ylim = c(0, 700))

peak_15 <- which.max(Uptakeseries)
```

```
salespeak_15 <- max(Uptakeseries)

# Scenario 16

m <- 16146.97
p <- 0.0121103 + 0.0002780613
q <- 0.120744 - 0.002023575
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "blue", xlab="Years", ylab="Adaptions", xlim =
c(2014, 2018), ylim = c(0, 700))

peak_16 <- which.max(Uptakeseries)
salespeak_16 <- max(Uptakeseries)

# Scenario 17

m <- 16146.97
p <- 0.0121103
q <- 0.120744 - 0.002023575
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "blue", xlab="Years", ylab="Adaptions", xlim =
c(2014, 2018), ylim = c(0, 700))

peak_17 <- which.max(Uptakeseries)
salespeak_17 <- max(Uptakeseries)

# Scenario 18

m <- 16146.97
p <- 0.0121103 - 0.0002780613
q <- 0.120744 - 0.002023575
Period <- 48
```

```
Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "blue", xlab="Years", ylab="Adaptions", xlim =
c(2014, 2018), ylim = c(0, 700))

peak_18 <- which.max(Uptakeseries)
salespeak_18 <- max(Uptakeseries)

# M RED
# Scenario 19

m <- 16146.97 + (204.0942 + 500)
p <- 0.0121103 + 0.0002780613
q <- 0.120744 + 0.002023575
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "red", xlab="Years", ylab="Adaptions", xlim = c(2014,
2018), ylim = c(0, 700))

peak_19 <- which.max(Uptakeseries)
salespeak_19 <- max(Uptakeseries)

# Scenario 20

m <- 16146.97 + (204.0942 + 500)
p <- 0.0121103
q <- 0.120744 + 0.002023575
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
```

```
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "red", xlab="Years", ylab="Adaptions", xlim = c(2014,
2018), ylim = c(0, 700))

peak_20 <- which.max(Uptakeseries)
salespeak_20 <- max(Uptakeseries)

# Scenario 21

m <- 16146.97 + (204.0942 + 500)
p <- 0.0121103 - 0.0002780613
q <- 0.120744 + 0.002023575
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "red", xlab="Years", ylab="Adaptions", xlim = c(2014,
2018), ylim = c(0, 700))

peak_21 <- which.max(Uptakeseries)
salespeak_21 <- max(Uptakeseries)

# Scenario 22

m <- 16146.97 + (204.0942 + 500)
p <- 0.0121103 + 0.0002780613
q <- 0.120744
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "red", xlab="Years", ylab="Adaptions", xlim = c(2014,
2018), ylim = c(0, 700))

peak_22 <- which.max(Uptakeseries)
```

```
salespeak_22 <- max(Uptakeseries)

# Scenario 23

m <- 16146.97 + (204.0942 + 500)
p <- 0.0121103
q <- 0.120744
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "red", xlab="Years", ylab="Adaptions", xlim = c(2014,
2018), ylim = c(0, 700))

peak_23 <- which.max(Uptakeseries)
salespeak_23 <- max(Uptakeseries)

# Scenario 24

m <- 16146.97 + (204.0942 + 500)
p <- 0.0121103 - 0.0002780613
q <- 0.120744
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "red", xlab="Years", ylab="Adaptions", xlim = c(2014,
2018), ylim = c(0, 700))

peak_24 <- which.max(Uptakeseries)
salespeak_24 <- max(Uptakeseries)

# Scenario 25

m <- 16146.97 + (204.0942 + 500)
p <- 0.0121103 + 0.0002780613
q <- 0.120744 - 0.002023575
Period <- 48
```

```
Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "red", xlab="Years", ylab="Adaptions", xlim = c(2014,
2018), ylim = c(0, 700))

peak_25 <- which.max(Uptakeseries)
salespeak_25 <- max(Uptakeseries)

# Scenario 26

m <- 16146.97 + (204.0942 + 500)
p <- 0.0121103
q <- 0.120744 - 0.002023575
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}

Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "red", xlab="Years", ylab="Adaptions", xlim = c(2014,
2018), ylim = c(0, 700))

peak_26 <- which.max(Uptakeseries)
salespeak_26 <- max(Uptakeseries)

# Scenario 27

m <- 16146.97 + (204.0942 + 500)
p <- 0.0121103 - 0.0002780613
q <- 0.120744 - 0.002023575
Period <- 48

Uptake <- c()
CumUptake <- c()
Uptake[1] <- p*m
CumUptake[1] <- 0

for (i in 2:Period) {
Uptake[i] = (p + (q*CumUptake[i-1])/m)*(m - CumUptake[i-1])
CumUptake = cumsum(Uptake)
}
```

```
Uptakeseries <- ts(Uptake, start = c(2014, 1), frequency = 12)

par(new = T)
plot(Uptakeseries, main="", col = "red", xlab="Years", ylab="Adaptions", xlim = c(2014,
2018), ylim = c(0, 700))

peak_27 <- which.max(Uptakeseries)
salespeak_27 <- max(Uptakeseries)

par(new=T)
plot(0, main="Unlimited Product Uptake scenarios", col = "blue",
  xlab="Years", ylab="Adaptions", xlim = c(2014, 2018), ylim = c(0, 700))

peak <- c(peak_1, peak_2, peak_3, peak_4, peak_5, peak_6, peak_7, peak_8, peak_9,
peak_10, peak_11, peak_12, peak_13, peak_14, peak_15, peak_16, peak_17, peak_18,
peak_19, peak_20, peak_21, peak_22, peak_23, peak_24, peak_25, peak_26, peak_27)

salespeak <- c(salespeak_1, salespeak_2, salespeak_3, salespeak_4, salespeak_5,
salespeak_6, salespeak_7, salespeak_8, salespeak_9, salespeak_10, salespeak_11,
salespeak_12, salespeak_13, salespeak_14, salespeak_15, salespeak_16, salespeak_17,
salespeak_17, salespeak_19, salespeak_20, salespeak_21, salespeak_22, salespeak_23,
salespeak_24, salespeak_25, salespeak_26, salespeak_27)

data <- data.frame(peak, salespeak)
write.csv(data, file.choose())
```

Section 7.3.4: CLV calculations

```
# CLV PER SUBSCRIPTION PRODUCT CUSTOMER

# Probability of a customer being active at time t

data <- read.csv(file.choose())        # CLV input data

# Input parameters

AC <- 800
d <- 0.12
c <- 0.002
t <- 1:24

r <- c()
r[1] <- 1
for (i in 2:24) {
r[i] = r[i-1]*(1-c)
}

cost <- data$Cost

# Price 1 = R 1 999.00

price <- data$Price1
Revenue <- price - cost
CLV1 <- sum((Revenue*r)/((1+(d/12))^t)) - AC
CLV1

# Price 2 = R 1 899.00

price <- data$Price2
```

```
Revenue <- price - cost
CLV2 <- sum((Revenue*r)/((1+(d/12))^t)) - AC
CLV2

# Price 3 = R 1 799.00

price <- data$Price3
Revenue <- price - cost
CLV3 <- sum((Revenue*r)/((1+(d/12))^t)) - AC
CLV3

# Price 4 = R 1 699.00

price <- data$Price4
Revenue <- price - cost
CLV4 <- sum((Revenue*r)/((1+(d/12))^t)) - AC
CLV4

# Price 5 = R 1 599.00

price <- data$Price5
Revenue <- price - cost
CLV5 <- sum((Revenue*r)/((1+(d/12))^t)) - AC
CLV5

# Price 6 = R 1 599.00

price <- data$Price6
Revenue <- price - cost
CLV6 <- sum((Revenue*r)/((1+(d/12))^t)) - AC
CLV6

CLV <- c(CLV1, CLV2, CLV3, CLV4, CLV5, CLV6)
CLV
```

Figure 74 and Figure 75

```
## Figure 74 & Figure 75

# Normal Bass model similar to figure 69, however Period = 48

m <- 16147
p <- 0.0121103
q <- 0.120744
Period <- 48

sales <- c()
cumsales <- c()
sales[1] <- p*m
cumsales[1] <- 0

for (i in 2:Period) {
sales[i] = (p + (q*cumsales[i-1])/m)*(m - cumsales[i-1])
cumsales = cumsum(sales)
}

E <- 750000
d <- (0.12)
PAC <- 1702362
OC <- 15000000
```

```
CLV <- 11669.01
t <- 1:length(sales)

Product_NPV <- (sum((sales*CLV - E)/((1+(d/12))^t))) - (PAC + OC)
Product_NPV

Monthly_NPV <- (sales*CLV - E)/((1+(d/12))^t)

NPV_Plot <- Monthly_NPV - ((PAC + OC)/48)
Cum_NPV_Plot <- (Monthly_NPV[1] - (PAC + OC)) + cumsum(Monthly_NPV[2:48])

# figure 74

barplot(NPV_Plot, main = "Unlimited monthly NPV", xlab = "Month", ylab = "NPV")

# figure 75

barplot(Cum_NPV_Plot, main = "Unlimited cumulative monthly NPV", xlab = "Month", ylab =
"NPV")
```

Figure 76 and Figure 77

```
## figure 75 & figure 76

# Generalised Bass model similar to figure 71

p <- 0.0121103
q <- 0.120744
m <- 16147
Alpha <- -0.55
Betha <- 0.39
Period <- 48

sales <- c()
cumsales <- c()
sales[1] <- p*m
cumsales[1] <- 0

for (i in 2:Period) {
sales[i] = (p + (q*cumsales[i-1])/m)*(m - cumsales[i-1])
cumsales = cumsum(sales)
}

# Incorporate Marketing Mix

#Advertising and Price Elasticity

data <- read.csv(file.choose())        # Figure 74 data

Price <- data$Price
Advert <- data$Advert

DeltaPrice <- diff(Price, lag=1, difference=1)
DeltaAdv <- diff(Advert, lag=1, difference=1)
DeltaAdv[DeltaAdv<0] <- 0

MarketingFactor <- 1 + Alpha*(DeltaPrice/Price[2:48]) + Betha*(DeltaAdv/Advert[2:48])
GeneralisedBass_Uptake <- MarketingFactor*sales[2:48]

GeneralisedBass <- c()
```

```
GeneralisedBass[1] <- GeneralisedBass_Uptake[1]
GeneralisedBass[2:48] <- GeneralisedBass_Uptake

# PRODUCT NPV

E <- 800000
d <- 0.12
PAC <- 1702362
OC <- 15000000

t1 <- 1:18
t2 <- 19:24
t3 <- 25:30
t4 <- 31:36
t5 <- 37:42
t6 <- 43:48

CLV1 <- 11669.010
CLV2 <- 9590.841
CLV3 <- 7512.673
CLV4 <- 5434.505
CLV5 <- 3356.337
CLV6 <- 1278.168

NPV1 <- (GeneralisedBass[1:18]*CLV1 -  (E + Advert[1:18] - 120000))/((1+(d/12))^t1)
NPV2 <- (GeneralisedBass[19:24]*CLV2 - (E + Advert[19:24] - 120000))/((1+(d/12))^t2)
NPV3 <- (GeneralisedBass[25:30]*CLV3 - (E + Advert[25:30] - 120000))/((1+(d/12))^t3)
NPV4 <- (GeneralisedBass[31:36]*CLV4 - (E + Advert[31:36] - 120000))/((1+(d/12))^t4)
NPV5 <- (GeneralisedBass[37:42]*CLV5 - (E + Advert[37:42] - 120000))/((1+(d/12))^t5)
NPV6 <- (GeneralisedBass[25:30]*CLV6 - (E + Advert[25:30] - 120000))/((1+(d/12))^t6)

NPV <- c(NPV1, NPV2, NPV3, NPV4, NPV5, NPV6)
NPV_Total <- sum(NPV)
NPV_Total

NPV_Plot <- NPV - ((PAC + OC)/48)
Cum_NPV_Plot <- (NPV[1] - (PAC + OC)) + cumsum(NPV[2:48])

# figure 76

barplot(NPV_Plot, main = "Unlimited monthly NPV, influence of marketing mix included",
xlab = "Month", ylab = "NPV")

# figure 77

barplot(Cum_NPV_Plot, main = "Unlimited cumulative monthly NPV, influence of marketing
mix included", xlab = "Month", ylab = "NPV")
```