The Impact of Impatience on Customer Loyalty and Satisfaction

Rannveig Guðmundsdóttir

Thesis of 30 ECTS credits
Master of Science in Engineering Management

June 2015

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Abstract

The Impact of Impatience on Customer Loyalty and Satisfaction

In managing business the relationship with customers is of the utmost importance. One of the biggest goals for those who offer products or services is to be the customer's first choice. To be someone's first choice depends on many different variables. Some variables are known to influence the lifetime value of the customer, such as price, but what about non-financial variables that can be just as important?

This study will see if and how impatience can influence loyalty or satisfaction. Another question answered will be if it is possible to evaluate in cost how much loss follows an unhappy customer. This was evaluated from literature and studies available and from an extensive survey conducted in two call centres from two companies in Iceland, one bank and one power company. Almost one thousand people participated and gave their answers that either indicated that they were patient or impatient.

The customer were categorised based on their patience level and whether they received service or abandoned the queue. Then each category was arranged by their loyalty and satisfaction levels. The next step was to compare each category to each other for each question to see whether the categories could be differentiated from each other. This was done with a two sample t-test that returned the test decision for the null hypothesis that the data in the two compared samples came from independent random samples, i.e. could be distinguished from each other. The results showed how impatience influences loyalty and satisfaction for both companies. For loyalty there is a clear impact from impatience for three categories while one is not so clear cut. The results for satisfaction do not show as much of a correlation between satisfaction and the impatience categorisation. Thus impatience has real impact on loyalty and satisfaction. Impatience has also an incremental effect on customer loyalty but this cannot be established for satisfaction.

This thesis puts forth ideas of methods for cost evaluations that take into account the impatience of customers. For these ideas different kinds of metrics were used such as customer lifetime value, expected spending and queuing method combined with the Taguchi loss function. A specific equation was not constructed, only suggestions of approaches possible to use as methods this cost evaluation of impatience. Finding and constructing that specific equation would be considered the first step in future work from this thesis.

Keyword: Non-financial parameters, Impatience, Loyalty, Satisfaction, Significance tests, Cost evaluation on impatience.

Úrdráttur

Áhrif óþolinmæði á tryggð og ánægju viðskiptavina

Sambandið við viðskiptavininn skiptir gríðarlega miklu máli fyrir rekstur fyrirtækja. Fyrir þann sem býður vörur og þjónustu til kaups skiptir miklu máli að vera fyrsta val viðskiptavinarins. Hvort það tekst getur verið háð mörgum og mismunandi breytum. Þó þekkt sé að sumar fjárhagslegar breytur eins og t.d. verð, geti haft áhrif á lífstíðar virði viðskiptavinarins kunna ýmsar ófjárhagslegar breytur að vera mjög mikilvægar.

Þessi rannsókn mun leitast við að meta hvort og hvernig óþolinmæði hefur áhrif á tryggð og ánægju viðskiptavina. Önnur spurning sem fjallað verður um er hvort það sé mögulegt að kostnaðarmeta hversu mikið tap fylgir ósáttum viðskiptavini. Framangreint er metið út frá fyrirliggjandi fræðilegum skrifum og rannsóknum og yfirgripsmikillar könnunar sem gerð var í símaverum tveggja íslenskra fyrirtækja, einum banka og einu orku fyrirtæki. Tæplega þúsund manns tóku þátt í þessari könnun. Svörin hjálpuðu til við að ákvarða hvaða viskiptvinir voru þolinmóðir og hverjir óþolinmóðir.

Viðskiptavinirnir voru síðan flokkaðir út frá þolinmæði og hvort þeir fengu þjónustu eða yfirgáfu röðina. Hverjum flokki var svo stillt upp út frá tryggð eða ánægju. Næsta skref var svo að bera saman flokka til þess að geta séð hvort hægt væri að greina á milli þeirra. Þetta var gert með t-prófi tveggja úrtaka sem skilaði niðurstöðu fyrir núlltilgátu um hvort að gögnin í þessum tveimur úrtökum koma frá ólíkum þýðum eða ekki, þ.e. ekki sé hægt að aðgreina þýðin hvort frá öðru. Niðurstöðurnar sýndu hvernig óþolinmæði hafði áhrif á tryggð og ánægju viðskiptavina beggja fyrirtækjanna. Óþolinmæðin hafði augljós áhrif á tryggðina í þremur flokkum en í þeim fjórða var það ekki jafn skýrt. Niðurstöðurnar fyrir ánægju sýndu ekki jafn mikla samsvörun milli ánægju og óþolinmæði. Þess vegna er hægt að segja að óþolinmæði hafi raunveruleg áhrif á tryggð og ánægju viðskiptavina. Óþolinmæði hefur einnig stigvaxandi áhrif á tryggð viðstkipavina en það sama er hinsvegar ekki hægt að segja um ánægju.

Þessi rannsókn setur fram hugmyndir að aðferðum við kostnarðarmat sem taka tillit til óþolinmæði viðskiptavina. Mismunandi mælikvarðar voru notaðir fyrir þessar hugmyndir eins og virði viðskipavina, áætluð eyðsla og aðferðafræði raða blandað saman við Taguchi tapfall. Engin eiginleg jafna var búin til heldur lagðar fram tillögur að aðferðum sem mögulega væri hægt að nota til að kostnaðarmeta óþolinmæði. Í áframhaldandi rannsókn um þetta efni yrði fyrsta skrefið að útbúa þessa jöfnu.

Lykilorð: Ófjárhagslegar breytur, óþolinmæði, tryggð, ánægja, tölfræðileg marktektarpróf, kostnaðarmat á óþolinmæði.

Acknowledgements

I wish to express my sincerest thanks to Ágúst Þ. Þorbjörnsson, my supervisor. I am extremely thankful to him for sharing his expertise, and sincere and valuable guidance and encouragement extended to me. Furthermore, I would also like to thank Páll Jensson, professor at Reykjavík University, for his advice and guidance.

I also wish to thank my family for their continuous encouragement and endless support throughout the creation of this thesis.

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1 INTRODUCTION

In this chapter, the introduction for the research is set. The subject of the thesis is introduced as well as the background of the research. The aim and objectives are defined and limitations of the thesis described. Finally the thesis outline is formulated.

1.1 THE STUDY

In managing business the relationship with customers is of the utmost importance. One of the biggest goals for those who offer products or services is to be the customer's first choice. To be someone's first choice depends on many different variables that can be difficult to have an impact on. Products and services vary in price based on detailed calculations. These financial variables are quite important. However many non-financial variables can even be just as important [1]. Companies strive to keep their customers happy, simply because one can assume that a satisfied customer is worth more than a dissatisfied one. And in return, a dissatisfied customer will cost more in lost revenue for the company. This means that many non-financial variables, such as customer loyalty, satisfaction and waiting time, could have a real impact on the revenue of a company.

Most managers do realise the importance of tracking the information about non-financial variables for their business. They understand that these parameters can be vital information to understand and monitor their business. However, many managers only put some value on these variables without any preparation or reasoning, for example to meet customer demand managers just put a certain amount of staff on each shift simply because it has worked so far, not based on any calculations to back up their decisions. Managers are quite often so focused on numbers of profit that they don't see the real potential of non-financial variables [2]. So how is it possible to incorporate these important non-financial parameters into cost evaluations to insure that executives and corporations take these parameters into account?

This study will try to incorporate non-financial variables into cost evaluations. The non-financial variables used will be loyalty, satisfaction and impatience or waiting time. In other words, this study will try to answer the question of if it is possible to evaluate in cost how much loss follows an unhappy customer. This will be evaluated from literature and studies available and from an extensive survey conducted in five different companies in Iceland.

1.2 BACKGROUND

This theses is a part of a PhD project by Ágúst Þorbjörnsson, the title of which is "Workforce Management Optimization with Simulation for the Retail and Service Industry – Assumptions for the input parameters"

The main aim of the PhD research is to develop a model to optimize manpower needed in the retail and service sector and to investigate the underlying assumptions. One of the key assumptions in the optimization model is customer impatience which is crucial for developing valid service level measures.

A big survey was conducted in the PhD study in five different companies in Iceland. These companies were two grocery stores, one high end and one low end, one electric appliance store and two call centres, one at a local bank and the other at a power company. A total of 4186 customers were offered to participate and 2491 agreed to participate, that would give the response rate of 59.5%. Excluded from the study were those who did not speak Icelandic, those individuals that were calling on behalf of other companies and those who used the option of a call-back. The call-back option was possible at the bank were the customer could leave a message about receiving a call-back at a later time.

This research will focus on the two call centre, i.e. the call centre of a bank and a power company. The customers that called the call centre on a particular day were called back the same day and asked if they could participate in the study. There were 1485 customers that were offered to participate and 914 of those individuals completed the survey. More of the methods of the survey are described in chapter 3.1 as well as the results that can be seen in more detail in chapter 4.1.

Data from the survey mentioned above will be used to categorise customers into four different categories, α, β, γ or δ. This division is based on whether the customer received service or not and if he became impatient or not. As shown in Figure 1, α and β categories stand for the customer that did receive service and γ and δ for those who abandoned the queue. The customer in category α did not lose any patient and neither did customers in category δ. However, in category β and δ are the customers that got impatient.

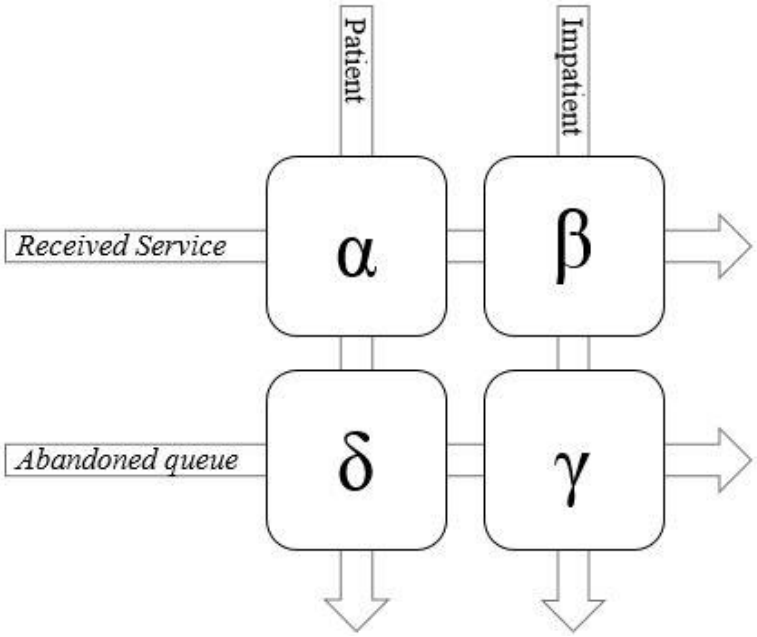

Figure 1: Four different customer categories

1.3 AIM AND OBJECTIVES OF THE STUDY

If a person needs service from a call centre he calls in and most likely arrives in a queue. At the beginning of the queue waiting time the customer is calm and patient. If the customer does not get service there is a point in time where he reaches his maximum patience threshold and begins to lose patience. This point in the waiting time curve should be the service level that the company should strive for. Because at this point the customer gradually gets more irritated until he either receives service or reaches his maximum impatience threshold and simply abandons the queue. This scenario is shown metaphorically in Figure 2.

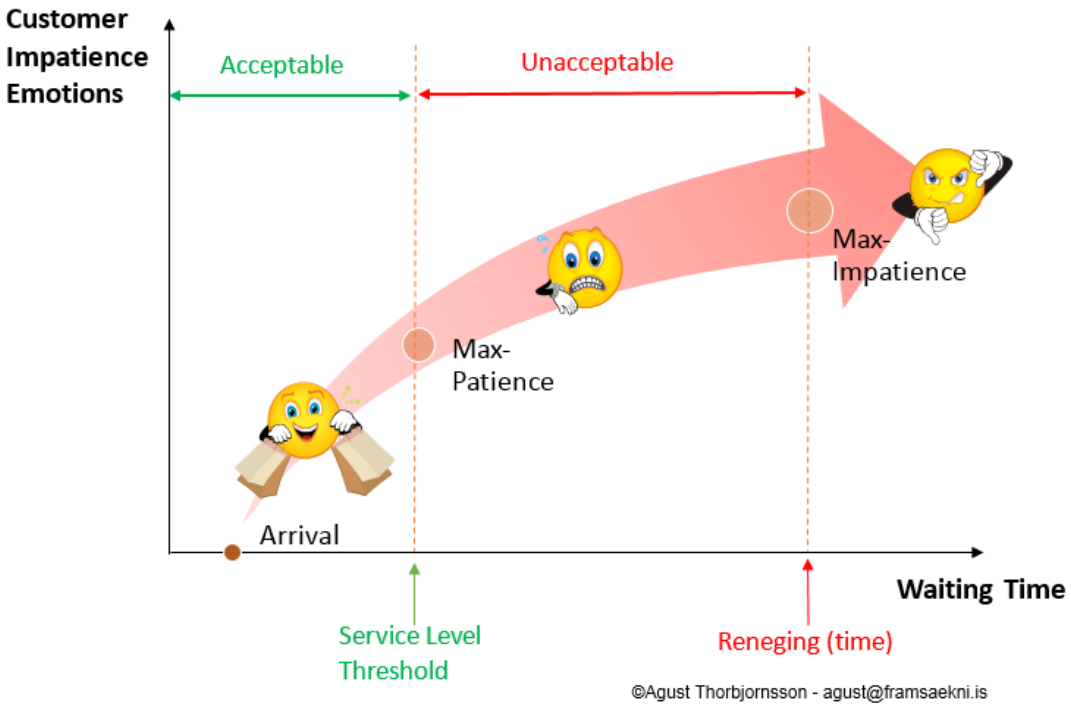

Figure 2: Customer Impatience Emotions vs Time

This scenario is the main focus of this study and will be examined with two research questions in mind:

1. **Question:** If a customer loses patience, does it have real impact on customer loyalty or customer satisfaction?

2. **Question:** If it has real impact, is it then possible to cost evaluate a penalty for this loss in patience?

1.4 LIMITATIONS

Limitations for research question one

When the survey was conducted at the grocery stores and the electric appliance store, all customers that got into a queue finished the wait for service. This means that there were no customers who abandoned the queue and thus there were no customers categorised as either γ or δ. The call centre for the bank and the power company were the only companies that had all information regarding all four categories. For the grocery stores and the electric appliance store there were no information about reneging simply because there were no customers that abandoned the queue. This is why the call centres are the two companies used in this research.

For the call centres there is some time that passed between the customers calling the centre until the survey was carried out. This might alter the outcome simply because the customer might have been really irritated and then calmed down or been quite calm and gotten frustrated as the time went on. This can affect the self-reported waiting time and that can influence whether or not a customer is put into α, β, γ or δ category.

Limitations for research question two

This thesis will not strive to make a proper equation for the cost penalty for impatient customers. There will however be speculations and approximations on potential cost functions. This means that the method for cost estimations will not be a specific penalty cost function but simply examples of potential usage of methods.

1.5 THESIS OUTLINE

This thesis will be divided into six chapters; Introduction, theoretical framework, methods and results followed by discussion and conclusion.

Theoretical framework will contain the theoretical material that the research is based on. First in chapter 2.1 there will be a discussion about those non-financial parameters that are used in this research, which are loyalty and satisfaction. It is showed how impatience can have influence on loyalty and satisfaction. Following in chapter 2.2 will be a theoretical discussion about cost estimations. Chapter 2.3 sums up how impatience, loyalty, or satisfaction can influence cost estimations.

The third chapter is about methods and contains the procedure and the research methodology. This includes the processing of data, information analysis including methods to analyse categories for customers with different patience levels, how the process for this analysis was conducted and finally how cost estimations will be examined.

The fourth chapter, Results, shows the results of the research methodology. This includes numerical information about the outcome of the questionnaire, how impatience has an impact on loyalty and finally results for the cost evaluation.

The thesis then ends on a discussion and a conclusion chapter followed by references used for the research as well as additional material in the appendices.

2 THEORETICAL FRAMEWORK

In this chapter, the theoretical framework for the research is set. This chapter covers in details topics as Loyalty, Satisfaction and impatience as well as Customer Relationship Management, Customer Lifetime Value and Expected Dollar Spending. Finally cost for penalty functions is discussed.

The objective of the theoretical framework chapter is to identify the background of the study. This includes literature of relevant subjects to the research aims and objectives that establishes a foundation for the thesis.

2.1 LOYALTY, SATISFACTION AND IMPATIENCE

2.1.1 CUSTOMER LOYALTY

Customer loyalty has become a big concern of managers around the world mostly due to increased competition and the focus on the relationship between customers and organisations [3][4]. Loyalty is when the customer makes a commitment to repurchase a preferred product or service from a specific brand or company every time in the future when they need or want that type of product or service [5]. The term brand loyalty is most often used about loyalty to a specific product. However, in terms of service or intangible goods the term service loyalty is the proper term [4].

Service loyalty is most often divided into three dimensions; behavioural loyalty, attitudinal loyalty and cognitive loyalty. The most common ways to measure customer loyalty are behavioural measures and to examine repurchase behaviour [6][7]. Simply see if the customer comes back for the specific product or service in the future and see if the brand or organization is their first and only choice. The act of comparing competing brands and evaluating what is the customer's most fitting choice is called attitudinal loyalty [4]. What companies strive to is that in the end they are the customers first and only choice and that they don't even consider other brands for the specific service or product needed.

How and what to measure when it comes to loyalty varies between different sources and scholars. Commonly used is net promoter score that measures to what degree the customer would recommend the product or service to others. This can be a good indicator as to the loyalty the customers shows to the company [8] and if the customer is willing to encourage friends and family to do business with the company [4].

Other measures are to see if the customers word of mouth is positive, if the customer considers the company as their first choice or if he is wanting to do business with the company in the future [4]. A common question asked in questionnaires that indicates whether or not the customer is loyal is: "How likely are you to recommend the product/service/company on a scale from 0-10 [9]?"

The customers that rate the company as nine or ten are called promoters and are the loyal ones that are far more likely to remain customers over time [10]. They are also responsible for about 80-90% of all positive word-of-mouth about the company [11]. The customers that rate the company between seven and eight are called the passives and the group is satisfied for now. This group has 50% lower recommendation and repurchase rate than the promoters group. Finally the group that gives a score between zero and six are the detractors. This group is almost solely responsible for negative word-of-mouth about the company, they have high rates of defection and are in general the unhappy customers [10].

However, from an accounting standpoint, a customer in the detractors group might appear to be quite profitable. But when taken into account their bad attitude that can have a negative impact on the company's reputation, on business with new customers and even on the employees motivation, the profitability might be questioned [10]. Detractors can also have a high serving cost that is significantly more than with promoters. For example for a bank; detractors put more demand on call centres, they are more likely to raise an issue that needs to be solved and less likely to use self-service tools (e.g. online banking) [12].

2.1.2 CUSTOMER SATISFACTION

Studies show that customer loyalty and customer satisfaction are quite connected and satisfaction can have bad and good impact on a customer's loyalty [13]. Satisfaction is when a customer compares his experience with a certain product or service to his expectations. If the experience exceeds his expectations then the customer is highly satisfied, if it matches the customers' expectations then he is satisfied and if the experience falls short of his expectations the customer is dissatisfied [5].

Many companies measure customer satisfaction regularly simply to see to that the expectations of the customers are met and to ensure customer retention. Some companies use surveys, others track customer loss rate and some even use mystery shoppers [5]. Surveys show the level of satisfaction amongst different customers where satisfaction is rated on a scale. At a very low level of satisfaction the customer is more likely to forsake and even badmouth the

company. While at a high level the customer is more likely to repurchase the product or service and talk about the company in a positive way [5]. An example of a survey question about satisfaction is simply: “Overall, how satisfied or dissatisfied are you with the product/service/company?”

The satisfaction response of the customer can be more lenient depending on the relationship between the customer and the company. If the customer has a strong loyalty relationship with the company then the perception of the experience can be more favourable [5][14]. Also, a highly satisfied customer is more likely to stay loyal longer and consequently buy more goods and services in the future [5]. So there is a clear connection between loyalty and satisfaction and vice versa. This connection has been wildly researched and according to Bodet [3] this relationship is assorted into three groups in these studies. The relationship on an aggregated, company-wide level, on an individual level with repurchase intentions in mind and finally the focus is on the individual level with real purchasing data.

2.1.3 WAITING TIME AND IMPATIENCE

A basic queueing process can be as follows:

> Customers requiring service are generated over time by an input source. These customers enter the queueing system and join a queue. At certain times, a member of the queue is selected for service by some rule known as the queue discipline. The required service is then performed for the customer by the service mechanism, after which the customer leaves the queueing system. [15]

Waiting time is a term in this queueing process and is the time between when the customer enters the queue until being served. Waiting time can be divided into four categories: objective, subjective, cognitive and affective [16]. Objective is the actual waiting time the customer has to wait before being served. Subjective is the customers estimation of the time waited and is called perceived waiting time. Cognitive is where the customer decides if the waiting time is reasonable for the service provided. Affective is the customers emotional response to the elapsed waiting time such as irritation, frustration, happiness, etc. [16].

The affective aspect of waiting time affects different customers in various ways. This is where the patience of individual customers comes in. Some customers might find the waiting time acceptable and wait patiently for their turn, while others might find the exact same waiting time too long and become impatient and irritated. After a customer becomes a part of a queue customer reaches his or hers maximum patience threshold, which is the first point in time

were the customer starts to lose patience until the maximum impatience threshold is reached and they will abandon the queue. That means that the company loses the exchange with that particular customer because of impatience [17][18].

2.1.4 HOW IMPATIENCE CAN AFFECT SATISFACTION AND LOYALTY

Waiting time in a queue is a balance between the company and the customer and most customers do consider this waiting time as a necessary sacrifice for receiving the service. However, the length of the waiting time is a big concern for the service companies and the reason is that if the waiting time is too long it can have negative impact on customer service perception [16][19]. Research has shown that satisfaction decreases if waiting time increases and that perceived waiting time has a great impact on customer satisfaction [20]. This waiting time is therefore fairly determinative of the customer satisfaction and loyalty [21]. According to Smidts and Pruyn [21] the perceived waiting environment, the perceived waiting time, the acceptable waiting time and the appraisal of the wait are more important than the actual objective waiting time in terms of affecting satisfaction. This waiting time can have a strong impact on overall satisfaction with the service and customer loyalty [21].

For this thesis, the relationship between waiting time and loyalty, and impatience and loyalty was researched. However, very few studies were found that went into detail about how this relationship behaves and what influences it. And even some use queueing models that quite simply have no abandonments from the queue and consequently no customers become impatient, which is very far from actual reality.

This potential relationship between the waiting time, customer impatience, customer loyalty and customer satisfaction is therefore one of the main focus of this research.

Figure 3: Potential relationship between waiting time, loyalty/satisfaction and impatience

2.2 CUSTOMER RELATIONSHIP MANAGEMENT

An increasingly popular approach in revenue and cost management for firms is evaluating the customer instead of the product or service. Customer Relationship management takes into account all processes that are connected to customer acquisition purchases, customer cultivation, and customer retention [22].

Many methods exist to measure the customer performance/value; for example [23][24]:

- "The Share of Wallet (SOW)" that measures how much money the customer spends for the product or service at the company compared to the total spending of the customer in similar products and services
- "Historical profit" takes the approach that the buying patterns of a customer in the past will be similar to the future.
- "Reach, Frequency and Monetary Value (RFM) metric" takes into account how long it has been since the customers' last transaction, the customers' frequency of orders in the past, and the average spent on a transaction.

However, these methods do not include customer future behaviour. That means whether the customer will ever come back or how much he will spend if he comes back [23]. In other words, these methods do not take into account whether a customer will be active in the future or not.

2.2.1 CUSTOMER LIFETIME VALUE (CLV)

Another method is customer lifetime value, which is the profit or the net present value of expected future purchases from the customer. Kumar [25] describes Customer lifetime value as: "CLV is defined as the sum of cumulated cash flows – discounted using the Weighted Average Cost of Capital (WACC) – of a customer over his or hers entire lifetime with the company." CLV is also described as the present value of future cash flow associated to the customer relationship [26]. When compared to the methods mentioned above, CLV overcomes their shortcomings by considering probability of customers transactions in the future and the cost of retaining that customer [23].

Many methods are used to calculate CLV [5]. Here, two methods will be illustrated on calculation for the lifetime value of a customer. The first method calculates the average of CLV by applying an aggregate approach. The second method is where the individual level CLV is calculated by using an individual approach [25].

2.2.1.1 AGGREGATE APPROACH

An aggregate approach is where customer equity (CE), which is the sum of individual lifetime values, is divided by the number of customers [25]. This approach is recommended to estimate the CLV for a not-yet-acquired customers [5].

The equation for the CLV with the aggregate approach is [25][24][5]:

$$CLV = \sum_{t=0}^{T} \left[\frac{(GC - M)}{(1+d)^t} * r^t \right] - A$$

Equation 1: CLV - aggregate approach

where

r	is the rate of retention
d	is the discount rate or the cost of capital for the firm
t	is the time period
T	is the number of time periods considered for estimation CE
GC	is the average gross contribution
M	is the marketing cost per customer
A	is the average acquisition cost per customer

However this method does not take into account that retention varies between customers and should be considered in the calculation for CE.

2.2.1.2 INDIVIDUAL-LEVEL APPROACH

With an individual-level approach the CLV is found as the sum of cumulated cash flow of a customer over the lifetime of the firm or company [25].

The general form of the equation for CLV with the individual-level approach is [25]:

$$CLV_i = \sum_{t=1}^{T} \frac{(Future\ contribution\ margin_{it} - Future\ cost_{it})}{(1+d)^t}$$

Equation 2: CLV – individual-level approach

where,

i	is the customer index
t	is the time index
T	is the number of time periods considered for estimating CLV
d	is the discount rate.

The individual-level approach includes calculating the future contribution margin which should include the probability of the customer being active at the future time period, P(active), and the average gross contribution margin (AMGC), which is the average revenue from the customer deducted by the average cost of goods sold to that customer[27]. The Future cost is the marketing cost, M_{it}. Therefore the CLV of an acquired customer would be[27]:

$$CLV\ of\ customer\ i = \sum_{t=1}^{T} P(active)_{it} * \frac{(AMGC_{it}) - M_{it}}{(1+d)^t}$$

Equation 3: CLV of customer i

2.2.2 EXPECTED SPENDING AND CUSTOMER SATISFACTION

Ho, Park and Zhou [28] did a study with the main goal to develop a model to show the relationship between revenue and customer satisfaction. They established theories and equations where the arrival rate of the customer was dependent on the satisfaction of that particular customer. This arrival rate depends on the customers most recent purchase experience where he either was satisfied or dissatisfied and the arrival rate reflects that experience. Ho et al. based their model on a model from Schmittlein et al. [29] and extend the model to incorporate arrival rate that is dependent on satisfaction. This means that for customer i, i ∈ {1,…,N}, his next purchase has arrival rate λ_{iD}, if the customer is dissatisfied, and λ_{iS} if he is satisfied where either arrival rate depends only on the most recent purchase encounter[28]. Customers can be affected by satisfaction to the point of defect however for simplification it is assumed that the defection rate or death rate, μ_i, is independent of satisfaction.

It is assumed that customers purchasing behaviour is influenced by satisfaction to the point that a satisfied customer purchases more frequently than a dissatisfied customer. Thus a proposition was put forward by Ho, Park and Zhou [28] that predicts R, the expected spending from the customer base during (0,T], and takes into account satisfaction of the customer. The equation is:

$$R = \bar{Q} \sum_{i=1}^{N} \left[\frac{\lambda_{iD}\lambda_{iS}}{\gamma_i \mu_i} (1 - e^{-\mu_i T}) + \frac{p(1-p)(\lambda_{iS} - \lambda_{iD})^2}{\gamma_i(\gamma_i + \mu_i)} * (1 - e^{-(\gamma_i + \mu_i)T} \right]$$

Equation 4: Total expected spending during (0,T] from the customer base

where,

$\bar{Q}$ is the spending. Follows a general random distribution with expectation $\bar{Q}$ and is independent of satisfaction
N is the total number of customers
i is the customer i, $i \in \{1, \dots, N\}$
λ_{iD} is the arrival rate for next purchase if customer i is dissatisfied
λ_{iS} is the arrival rate for next purchase if customer i is satisfied
μ_i is the defection or death rate for customer i
p is the probability of customer being satisfied

$$\gamma_i = p\lambda_{iD} + (1-p)\lambda_{iS}$$

Equation 4 shows the possibility to predict lifetime value based on customer satisfaction[28]. The premises of the equation is that the defection rate (death rate) is independent of satisfaction [28]. This means that the customer would not defect because he or she were not satisfied but because of other reasons. This is a simplification and does not apply in real life situations. The spending is also independent of satisfaction. This might apply to certain situations but not all and therefore is a simplification of the real life situation.

However, in the same paper Ho, Park and Zhou propose more complicated methods that improve applicability and overcome the simplification of Equation 4. These new methods differ from the previous method in three ways. Firstly, satisfaction can have an effect on expenditure. Secondly, customers' departure process is contingent on if customers are satisfied. Thirdly, a customer's satisfaction in the past can have an influence on current satisfaction. All of these improvements in accuracy conduct three new equations. These equations are shown in Appendix A.

2.3 PENALTY COST FOR IMPATIANCE

Penalty functions are in itself a fairly simple concept. There have been some methods used in calculating service levels where penalty functions are used when the service level has not been reached [30]. Then some fixed penalty cost is assigned to the task, for example where a specific task is scheduled to be finished by a specific time and if it exceeds the time limit some fixed cost is used as a penalty. A service level penalty cost function can come in different shapes such as linear function, piecewise linear function, a stepwise function, or any other general curve[30].

One method is simply calculating what the customer is prepared to pay at a certain time point. If he has to wait for a long period the customer might not be prepared to pay as much until eventually he will decide to walk away from the purchase and can even go as far as never

using the service again or at least not for a long time. The penalty for the company is then the cost difference for the initial purchase the customer was prepared to pay and the endpoint of the customer [13].

Hallowell [13] showed that customer satisfaction is related to customer loyalty and customer loyalty is related to profitability. However during the research there was no method or equation found that could simply calculate the cost of changes in customer loyalty. As mentioned in chapter 2.2.2 there are some existing methods that take into account customer satisfaction while calculating customer profitability and expected spending. It might be possible to use similar methods for cost estimations for loyalty or impatience.

General queuing theories do not have a cost function for waiting time so Fink and Gillett [31] propose a technique by combining a M/M/1 queuing model with the Taguchi loss function. The M/M/1 queue has one server with the arrival rate as Poisson distributed, an exponentially distributed service rate and infinite waiting area [32]. The Taguchi loss function is most commonly used for quality engineering and indicates that any deviation from a target value results in a loss instead of the loss or cost starting at a specific tolerance level [31][33]. By combining the Taguchi loss function to the queuing method the calculations gives equations that determines cost of dissatisfaction associated with waiting time.

The expected cost per customer for time in line, C_q, would therefore be [31]:

$$C_q = \int_0^\infty \lambda(1-\rho)e^{-\mu(1-\rho)t} K t^2 \, dt = \frac{2K\rho}{[\lambda-\mu]^2}$$

Equation 5: Expected cost per customer for waiting time

where,

- λ is the arrival rate
- $1-\rho$ is the probability of no waiting time
- ρ is the utilization where $\rho=\lambda/\mu$
- μ is the service rate
- K is the average loss coefficient and is determined from the cost of rejecting the item at the specification limit and the distance from the target value to the specification limit
- t is the time in line

A separate equation calculates the K coefficient [31]:

$$K = \frac{R}{(USL - T)^2}$$

Equation 6: The average loss coefficient

where,

R is the loss or cost of rejecting the item

USL is the upper specification limit

T is the target value

An example of calculations for this method can be seen in Appendix B.

One possibility for incorporating impatience or loyalty into cost estimations would be to use a penalty function with customer lifetime value calculations and one possibility would be to use the cost function above as that penalty. An individual enters a queuing system as a patient customer and if he crosses a certain patience threshold he starts to get impatient. Since customers' patience is expected to be exponentially distributed [18] this scenario described might end in a cost function that looks like the function in Figure 4**Error! Reference source not ound.**.

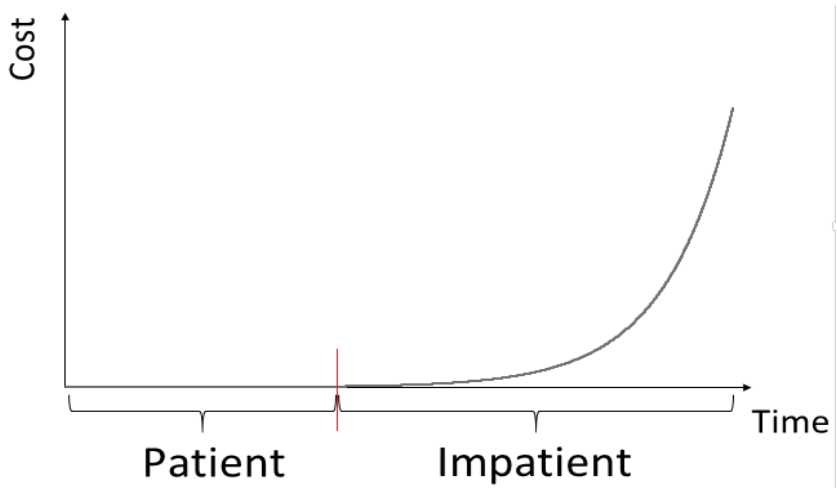

Figure 4: An estimation of the cost function for the company of a customer becoming impatient

For this thesis this cost function will be described as the impatience cost function and is shown in Figure 5. Where a customer reaches a maximum patience threshold where his impatience increases exponentially until a maximum impatience threshold is reached. There the

customer abandons the queue. The cost function then reaches a maximum penalty cost for the customer which is the highest cost the company can lose for that particular customer. This is based on methods from the PhD study.

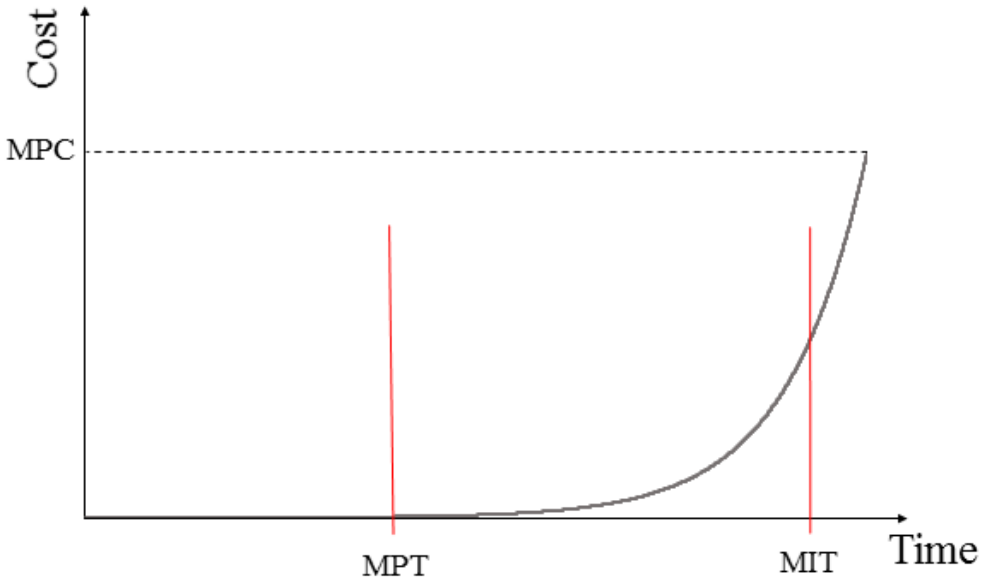

Figure 5: An estimation of the impatience cost function

3 METHODS

In this chapter, the methods of the research are described. An introduction is followed by methods regarding impatience and the impact on loyalty and satisfaction. Finally methods for cost evaluations are described.

3.1 INTRODUCTION – PROCESS OF THE QUESTIONNAIRE

The questionnaire, used in the research, was designed to evaluate different measures for service quality, customer preferences, customer satisfaction and perceived waiting time. Additional information was gathered from the call centres where the actual waiting time of each customer was obtained. This additional information was however only gathered if permission from the customer was granted. All regulations and laws regarding personal information were followed as set by The Data Protection Authority [34].

The study was implemented from January to April in 2014 between 16:00 and 21:00 in two different companies, one was a bank the other a power company. The questioners, which were employees at the call centres, received interviewing training from an impartial individual. That training contained among other things that the questioners would have to read the questions exactly as they were written and emphasized the importance of receiving high response rates.

Customers called the call centre at the bank or the power company and either received service or not. The companies then made a randomly generated list of the phone numbers of the customers that called that day. Then the questioners called the customers and asked if they would be willing to participate in the study. They were informed that by participating in the study they might receive a prize. For the power company the prize was a gift certificate at a local restaurant and for the bank it was theatre tickets. Those who agreed to participate were informed that they were by no means obligated to answer any question and that all information from the survey would not be traceable back to them. The customers were then asked the survey questions that contained 20 to 25 questions which varied between the two groups, those who received service and those who abandoned the queue. Everyone were asked the same questions, however a few questions had small differences between the two groups. An example of the difference is shown in Table 1 for the first question about patience where the question for those who received service and those who abandoned are slightly different.

For this research only a few questions from the survey will be examined. These questions are the ones listed below in Table 1. The first question is about satisfaction and the second about loyalty. These questions were chosen because of the clear relationship between satisfaction and loyalty and then loyalty and repurchase behaviour, as discussed in chapter 2.1.2. The next four questions that will be examined are the once that measure patience and impatience. This study will examine whether impatience does have an effect on the satisfaction/loyalty relationship and consequently that impatience can have an impact on customers purchasing behaviour in the future.

All of these relevant questions, both for those who received service and those who abandoned the queue, with all possible answers are listed in Table 1.

	Received Service	**Abandoned queue**	**Possible Answers**
Satisfaction	Overall, How satisfied or unsatisfied are you with the call centre?	*Same question as for those who received service.*	1. Very Satisfied 2. Quite satisfied 3. Neither satisfied nor dissatisfied 4. Quite dissatisfied 5. Very dissatisfied 6. Don't know 7. Do not want to answer
Loyalty	How likely or unlikely is it that you will recommend the call centre on the scale of 0 to 10, where zero is equal to very unlikely and ten is very likely?	*Same question as for those who received service.*	1. 0 7. 6 2. 1 8. 7 3. 2 9. 8 4. 3 10. 9 5. 4 11. 10 12. Don't know / Do not want to answer

Patience: Q1	How short or long did you have to wait to reach the customer service?	How short or long did you have to wait before you hung up?	1. Very short 2. Quite short 3. Neither long nor short 4. Quite long 5. Very long 6. Don't know 7. Do not want to answer 8. Didn't wait. Hung up right away
Patience: Q2	a) What would you estimate in seconds or minutes the time you had to wait before getting intouch with the customer service? *Compared with:* b) What do you consider an acceptable waiting time, in minutes, for service when you call the call centre, that is for how long do you remain calm while waiting?	a) What would you estimate in seconds or minutes the time you had to wait before you hung up? *Compared with:* b) *Same question as for those who received service.*	1a. Don't know 2a. Do not want to answer 3a. Seconds or minutes 1b. Don't know 2b. Do not want to answer 3b. Seconds or minutes
Patience: Q3	How much or little did the waiting test your patience?	*Same question as for those who received service.*	1. Very much 2. Quite much 3. Neither much nor little 4. Quite little 5. Very little 6. Don't know 7. Do not want to answer

Table 1: Relevant questions and their answers for this study

Each question has its own measurement scale where the answer is rated. Each question has also the option “I don’t know” or “Do not want to answer”. The first question in Table 1 measures the satisfaction the customer has for the call centre, on a scale that ranged from “very satisfied” to “very dissatisfied”. The second question, measuring loyalty, is on a scale from zero to ten. This is a common method as was discussed in chapter 2.1.1. The last four questions in Table 1 are questions measuring patience and determine if the customer is either patient or impatient. The first patience question measures the customer thoughts on his waiting time in a cognitive sense, that is how short or long the customer thought the waiting time was. The next two patience questions ask about perceived waiting time and acceptable waiting time. By comparing these two questions it is possible to see if the customer went over his patience threshold or not, e.g. if his estimated waiting time was longer than he considered acceptable he became impatient. Finally, the last question measures how much influence the waiting has on the customers’ emotions, which is the affective waiting time.

The patience questions are the ones that determine which category the customer is a part of. These categories, as described and shown metaphorically in chapter 1.2, are the α, β, γ, and δ categories. As described in chapter 1.2, categories α and β are the ones that received service while γ and δ are the ones that abandoned the queue. The individuals in category α or δ are the patient customers and the ones in β or γ are the impatient customers.

If any answer from the three patience questions indicates impatience the customer is categorised as either β or γ, If all the answers point to patience the customer is either α or δ. For example, if a customer answers the question “How much or little did the waiting time test your patience?” as “very little” or “quite little”, he is still classified as patient. If the answer to the other two questions are also positive, which means that the first question is answered as “very short” or “quite short” and the second question indicates that the customer waited within his definition of acceptable waiting time, the customer will be categorised as α, if he received service, or δ, if he abandoned the queue. If the customer would have answered any of the three questions regarding patience negatively he would have been categorised as impatience and would become a part of category β, if he received service, or γ, if he abandoned the queue.

All the questions along with their answers were gathered into a database. The information was received in Microsoft Excel®. Then the data was moved into MATLAB®[35] were the information about each customer was carefully analysed. Firstly the information wanted, that is the

relevant questions and their answers, was indicated. E.g. if the information wanted was loyalty, then the information in the α, β, γ, and δ categories will be the result of the customers answers to the loyalty question.

In the database all information about each customer was carefully reviewed to ensure that all information necessary was obtainable. If the customer did not answer all necessary questions, to be able to conclude whether the customer was patient or impatient, or if he simply did not participate in the survey the individual was excluded from the data. However, if all information was available, the customers' information was used to figure out what category he belonged to and then all the information was put into the corresponding category matrix. This process was implemented for all companies and all categories, first for all the customers that abandoned the queue and then the once that received service. The whole process is shown in Figure 6.

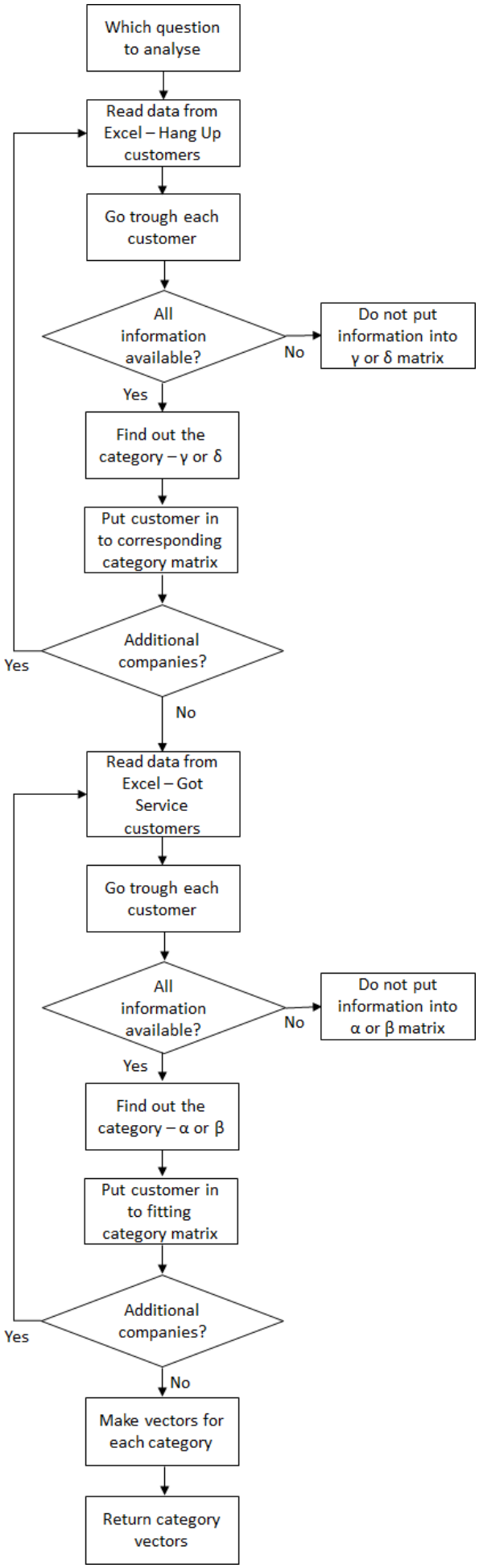

Figure 6: Flowchart of Matlab code for categorising customers

3.2 IMPATIENCE AND THE IMPACT ON LOYALTY AND SATISFACTION

Following the methods described in chapter 3.1 was the analysis of each category. Firstly, the information needed form the customer database is obtained. Then the customers are divided into their category using the process shown in Figure 6. Then the average for each category is calculated and the result put into a vector.

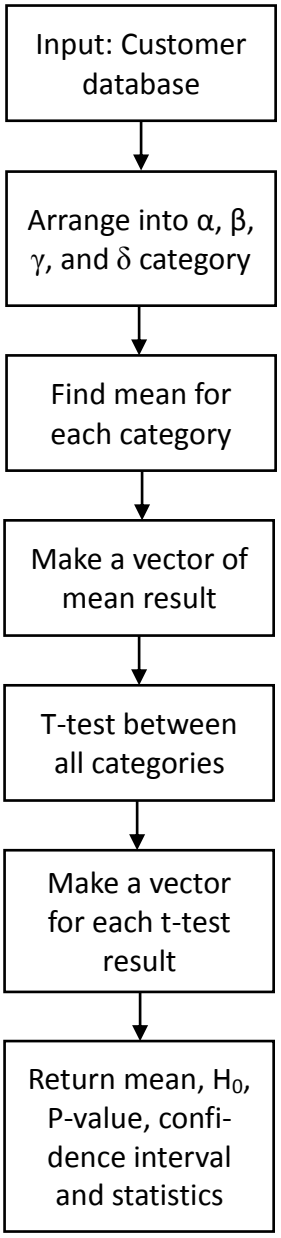

Figure 7: Flowchart of Matlab code for t-test for each category

The next step is to compare each category to each other for each question to see whether the categories can be differentiated from each other. This is done with a two sample t-test that returns the test decision for the null hypothesis that the data in the two compared vectors come from independent random samples with equal means and equal but unknown variances[36]. To determine this the t-test returns the null hypothesis (H_0), P-value, confidence interval and statistics. The H_0 examines if the compared categories come from independent samples. The P-value estimates the probability of rejecting the null hypothesis with a specific significant level (5%) and the confidence interval is the lower and upper boundaries of the 95% confidence interval.

Finally the t-test returns statistics including the tstat that shows value of the test statistics, the degree of freedom and the standard deviation. When the t-test has been conducted the next time in the process is to make vectors with the results. The code then returns the vectors for the mean, the H_0, the P-value, the confidence interval and statistics. The whole process can be seen metaphorically in Figure 7.

This method is used to answer the first research question; if a customer loses patience, does it have real impact on loyalty or satisfaction. To be able to answer this the customers are arranged into categories (as mentioned above) by their patience and then the loyalty or the satisfaction of each category is compared to each other. Then the influence of impatience on the

loyalty or satisfaction can be seen quite clearly. This research question has therefore the hypothesis:

Null Hypothesis (H_0)	Impatience has no impact on Loyalty.
	Impatience has no impact on Satisfaction.
Alternative Hypothesis (H_A):	Impatience has impact on Loyalty.
	Impatience has impact on Satisfaction.

Table 2: Null and Alternative Hypothesis

If the null hypothesis is rejected, the alternative hypothesis is accepted. However, if the null hypothesis is not rejected it is not possible to accept the alternative one. If the comparison between e.g. the loyalties of two categories reveals that H_0 shows the rejection of the null hypothesis, at the 5% significance level, and indicates that impatience has a impact on loyalty. Otherwise, it indicates a failure to reject the null hypothesis and proposes that it's not possible to state that impatience has impact on loyalty. The same results are obtained by using the P-value, that is if the P-value is lower than the significant level it's an indication of the null hypothesis being rejected and if it is higher it points to the failure to reject. This information reveals the answer to the first research question.

3.3 COST EVALUATION AND PENALTY FUNCTIONS

If the first research question shows that impatience has real impact on loyalty or satisfaction then the second research question can be analysed. The second question of the research is if it is possible to cost evaluate a penalty for the impatience of the customer.

The methods for the calculations of cost evaluations are the once discussed in chapter 2.2 and chapter 2.3. The customer lifetime value (CLV) and other cost and revenue calculations will however have to be based on estimations. No real data is available from the two companies to ensure that these methods can be conducted correctly. Another reason for the estimations is that while researching for this thesis no specific method was found that suited the research.

As mentioned in 2.3 one possibility for incorporating impatience or loyalty into cost estimations would be to use a penalty function combined with customer lifetime value approach.

Another method would be to estimate the penalty function as the Taguchi loss function, described in chapter 2.3. The loss function is a combination of an M/M/1 queuing model and the Taguchi loss function and calculates the cost of customer dissatisfaction solely based on waiting time for service.

Finally the method for expected spending, described in chapter 2.2.2, will be used. These methods assume that certain parameters are known beforehand. For this research these parameters are not attainable so this chapter and the corresponding result chapter (4.3) will show some examples of different customers with different parameter values and how our estimation for these methods could be. The process of these calculations and methods are described here bellow.

3.3.1 CLV AND PENALTY APPROACH

The first approach would be the CLV calculations for the customer. The aggregated approach, described in chapter 2.2.1.1, is suited for not-yet-acquired customers and for the two call centres that this thesis is researching there are only current customers being analysed. Therefore the individual-level approach, described in chapter 2.2.1.2, was chosen as a CLV approach. For simplification the equation 2 was used and for that CLV approach the parameters needed are future contribution margin, the future cost, the length of the time period used and finally the discount rate. The CLV is then calculated for an example of a customer with given values for all parameters.

These calculations do not take into account loyalty, satisfaction or impatience. However, the customer might at one point end up in a queue and would have to wait for service. Then it comes into question how much the customer's impatience and waiting time might impact the CLV for that particular customer. One approach might be a possibility of using a certain percentage of the CLV as a penalty cost for the company to measure their customer impatience. One possibility is to use the percentage difference in loyalty between category α and category γ as a maximum penalty cost. The reasoning for this would be that loyalty is a very good indicator of repurchasing behaviour in the future for the customer as discussed in chapter 2.1.1. Then the percentage would be the average loyalty for category γ divided by the average loyalty for category α. The CLV is then multiplied by the percentage to find the maximum penalty cost.

3.3.2 TAGUCHI LOSS FUNCTION

Another approach would be to use the Taguchi loss function method. The method was used to calculate the penalty cost for waiting time as the expected cost per customer. Here the information needed would be the arrival rate, the probability of having to wait, the service rate, the cost of rejection, the upper specification limit, the target value and the time length. An example of these calculations is conducted in [31] where examples of parameters are used to show the process in a transparent and clear manner. This example can be seen in Appendix B. The same method as shown in that example is used to calculate the expected cost. This cost is then used as a penalty cost.

There is a certain limitation for this method because it only includes an M/M/1 queue and can therefore only be used for a queue with only one server and therefore not for a queue with multiple servers.

3.3.3 EXPECTED SPENDING

A third potential way to evaluate the cost would be to use the method for the expected spending mentioned in chapter 2.2.2 where satisfaction is incorporated into the calculations. Other more complex but more realistic equations were described in Appendix A, however those methods have more unknown parameters and might have been used in this thesis if some of the parameters would have been known for the two companies. This resulted in Equation 4 being used for the calculation of the expected spending. To keep the method in context with the other two cost evaluation methods the number of customers in the customer base was used as one, N=1. Other parameters needed for the calculations was the expected spending, the arrival rate for dissatisfied customer as well as for satisfied customers, the death rate, the probability of being satisfied and the time period for the calculations. An example was conducted for a customer with different valued parameters.

4 RESULTS

In this chapter, the results of the research methods are described.

4.1 INTRODUCTION

In both call centres there was a total of 1485 customers who were offered to take part in the study and 914 of those individuals participated, which gives a response rate of 71.1%. The participants consisted of 473 men, aged 18-89 with the average age of 49.7 years (standard deviation=17.4), and 441 women, with the age range of 18-90 and the average age of 51.5 years (standard deviation=17.4). The number of customer varied between the two companies. The customers at the bank were 498, thereof 281 that received service and 217 that abandoned the queue. The number of customer at the power company were 416 and thereof 247 that received service and 169 that abandoned the queue.

This study's main focus is not on the whole questionnaire but on the six relevant questions along with all possible answers are listed in chapter 3.1, one for loyalty, one for satisfaction and four for patience. The customers' answers for both loyalty and satisfaction can be seen in Figure 8 and Figure 9 as a percentage of the total number of customer for each company. As can be seen in Figure 8, most of the banks customers rate their satisfaction level as 1, "very satisfied", and at the power company the most common answer was 2, "quite satisfied". The answers 6 and 7 stand for "don't know" and "do not want to answer".

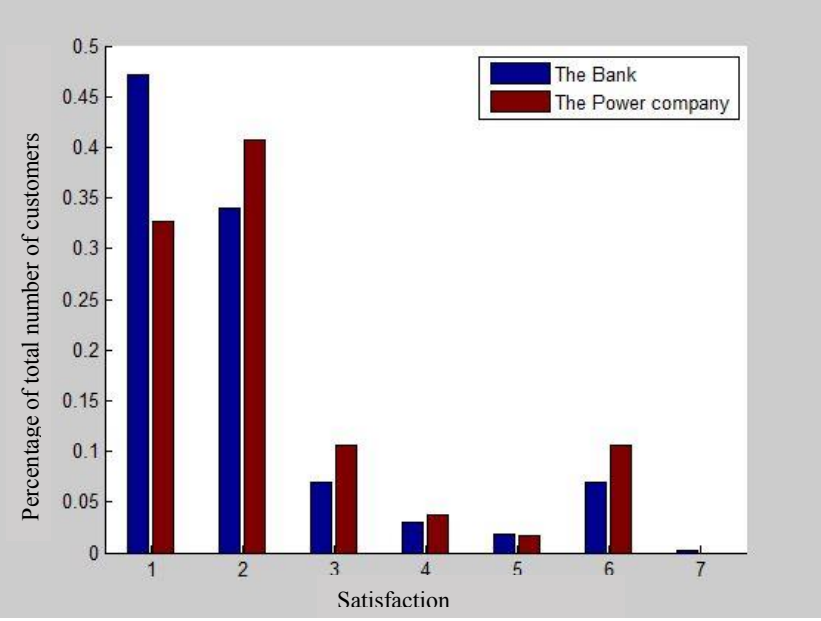

Figure 8: Number of customers for each satisfaction answer

The answers for loyalty, see Figure 9, the most common answer was 8 and 10 for the bank and 8 for the power company. The customer that answered "don't know" or "do not want to answer" are the ones with the value 11.

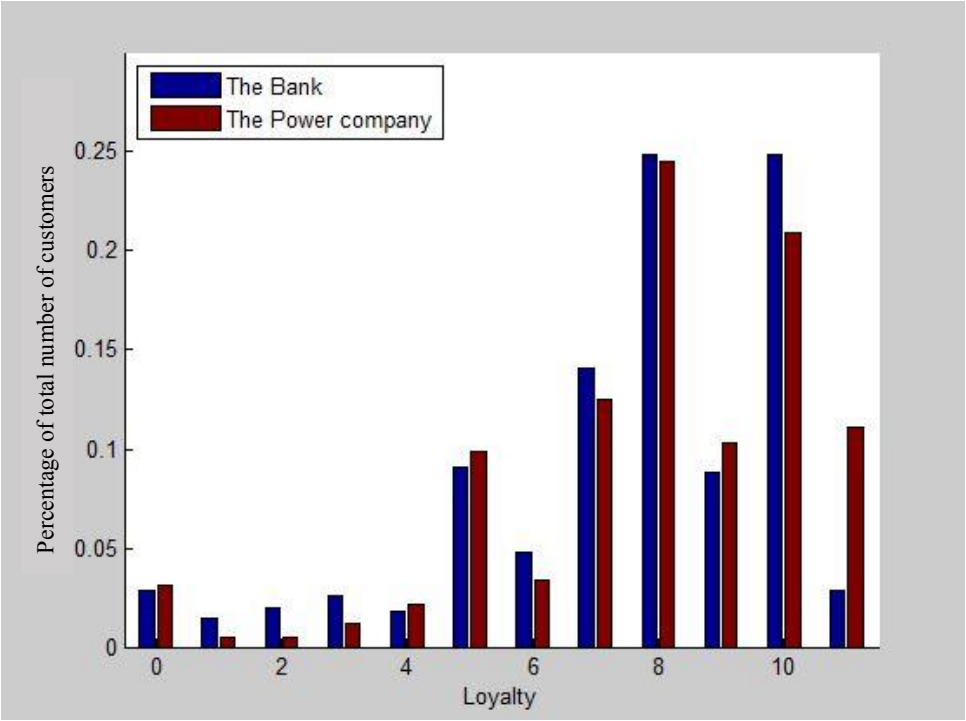

Figure 9: Number of customers for each loyalty answer

Each of the customers answered the six questions relevant to this study as listed in Table 1 in chapter 3.1. Summation of the average answer for each question can be seen in Table 3.

	Bank		**Power Company**	
Questions	*Received service*	*Abandoned queue*	*Received service*	*Abandoned queue*
Satisfaction	1.6071	1.8018	1.7438	2.1389
Loyalty	7.7345	6.9952	7.9776	6.8299
Patience - Q1	2.6085	3.4793	2.0607	3.3432
Patience - Q2.a)	3.8973	3.4924	2.7855	4.3189
Patience - Q2.b)	3.4967	3.3018	3.4395	3.0661
*Difference**	-0.4007	-0.1906	+0.6540	-1.2528
Patience - Q3	3.8541	3.6774	4.4615	3.3846

*Table 3: Average answer for each question for the customers that received service and abandoned the queue at each company. * Q2.b) - Q2.a)*

As shown in this table every average rating for both loyalty and satisfaction questions, for both companies, were always better for those who received service compared with those who abandoned the queue. As a reminder satisfaction is rated from 1-5 were 1 is “very satisfied” and loyalty is rated on a scale from 0-10 were 0 is the lowest score and 10 the highest.

For patience question 1 and 3 are the ones that received service and were in general happier with the waiting time than the ones that abandoned. As for patience question 2.a) the results between the companies vary. The bank shows that their customers that received service estimated their time waiting as a little less than half a minute longer than the once that abandoned the queue. At the power company the result for question 2.a) is the exact opposite, the customer that abandoned the queue were the ones that estimated their waiting time as 1 and a half minute longer than the ones that received service.

The results for both companies showed that on average the customer who abandoned the queue thought the acceptable waiting time should be shorter compared to those who received service. This tells us that for the bank the average person has become impatient, because of the difference in patience question 2, and at the power company the average person would still be patient.

Both groups in each call centre were then divided into two categories, the customers that received service became part of α and β category and the customers that abandoned the queue became part of γ and δ category. The number of customers in each category for both companies can be seen in Table 4.

Company	**α**	**β**	**γ**	**δ**	**All**
The Bank	159	122	147	70	498
The Power company	190	57	120	49	416

Table 4: Number of customers in each category

4.2 IMPATIENCE AND THE IMPACT ON LOYALTY AND SATISFACTION

The four categories and their average for loyalty and satisfaction are listed in Table 5. Here it is shown that the α category has the best average for both questions and both companies, the next best results were either from β or δ category and finally the γ category with the worst results. Interesting results than can be seen in Table 5 is that the drop in loyalty between α and

γ category for the bank, 17.54%, and that drop for the power company, 18.53%, only show a difference of 1%.

	Company	α	β	γ	δ
Loyalty	*The bank*	7.98	7.42	6.58	7.84
	The power company	8.15	7.34	6.64	7.27
Satis-faction	*The bank*	1.48	1.77	1.99	1.41
	The power company	1.65	2.05	2.21	1.98

Table 5: Mean loyalty and satisfaction for each category for both companies

As described in chapter 3.2 a two sample t-test was conducted on the categories for the questions about loyalty and satisfaction. This t-test gave the results of a null hypothesis, a p-value, the confidence interval and additional statistics. If the p-value is below the 5% significance level the null hypothesis, impatience does not have impact on loyalty, is rejected. However, if the p-value is above the 5% the null hypothesis cannot be rejected.

Category	**α**	**β**	**γ**	**δ**
α	-	0.0427*	1.8127e-06*	0.6568
β	0.0427*	-	0.0114*	0.2419
γ	1.8127e-06*	0.0114*	-	0.0013*
δ	0.6568	0.2419	0.0013*	-

*Table 6: P-value for loyalty at the bank. *Null hypothesis rejected.*

The p-values for loyalty at the bank is shown in Table 6. The null hypothesis is rejected in four out of six tests, that is for the comparison between α and β, α and γ, β and γ and γ and δ. These four test therefore show that the data between each comparison, e.g. α and β or a and γ, come from different populations. For all these instances the alternative hypothesis is therefore accepted.

This indicates that when category α, patient customers, is compared to category γ, impatient customers, the result shows that impatience has significant impact on loyalty. This indicates that when category α, patient customers, is compared to category δ, patient customers, the

results shows that the null hypothesis that the impatience has no impact on loyalty cannot be rejected.

Another result that the p-value gives us is that it is possible to distinguish between the categories and that each category comes from independent samples when the null hypothesis is rejected. In other words, for the bank category α is different from category β and γ, category β is different from category γ and category γ is different from category δ. This would also indicate that it is not possible to distinguish between e.g. category α and category δ; the categories are too statistically similar and might even indicate that the two categories are one and the same.

Category	**α**	**β**	**γ**	**δ**
α	-	0.0276*	8.9806e-08*	0.0177*
β	0.0276*	-	0.0962	0.8869
γ	8.9806e-08*	0.0962	-	0.1400
δ	0.0177*	0.8869	0.1400	-

*Table 7: P-value for loyalty at the power company. * Null hypothesis rejected.*

The results of the p-values at the power company can be seen in Table 7. The results vary slightly between the bank and the power company. At the power company there are only three out of six null hypothesis rejected and those instances are for the comparison between α and β, α and γ, and α and δ. Consequently, if the null hypothesis is rejected the alternative hypothesis is accepted.

This means that for those three instances we can say that impatience has significant impact on loyalty. For the other three comparisons the null hypothesis cannot be rejected. E.g. for the power company, there is no clear difference between category β and category γ. This would indicate that a person that became impatient and received service cannot be distinguished from a customer that became impatient and abandoned the system.

While comparing the bank and the power company the t-test gives different indications of what groups can be distinguished from each other. One reason for this might be that the sample size of customers from the power company is significantly less than for the bank, or 20% less. And there the main difference in numbers are customers from category β where at the bank there are twice as many compared to the power company; At the bank they are 122 while at the power company there are only 57 customers. However, 57 customer should be a sufficient sample size since it exceeds the sample size of 40[37].

Category	α	β	γ	δ
α	-	0.0060*	2.4163e-07*	0.4689
β	0.0060*	-	0.0780	0.0112*
γ	2.4163e-07*	0.0780	-	1.4130e-05*
δ	0.4689	0.0112*	1.4130e-05*	-

*Table 8: P-value for satisfaction at the bank. * Null hypothesis rejected.*

In Table 8 the p-value for satisfaction at the bank is listed. The difference at the bank between the results for loyalty and satisfaction is that the comparison between β and γ for satisfaction does not result in rejection of the null hypothesis while the comparison between β and δ shows the rejection of the null hypothesis for satisfaction. Otherwise the result is the same for the two questions.

Category	α	β	γ	δ
α	-	0.0027*	1.0645e-07*	0.0187*
β	0.0027*	-	0.3452	0.6982
γ	1.0645e-07*	0.3452	-	0.1524
δ	0.0187*	0.6982	0.1524	-

*Table 9: P-value for satisfaction at the power company. * Null hypothesis rejected.*

In Table 9 the p-value for satisfaction at the power company is listed. The difference at the power company between the results for loyalty and satisfaction when it comes to rejecting the null hypothesis show the same result. All comparisons give the same result for both questions, i.e. loyalty and satisfaction. The p-values change slightly between the loyalty result and satisfaction result and is mainly in where the β category is compared to both γ and δ category.

These results for the tests on satisfaction shows some difference between the companies and is mainly when category δ is involved, i.e. between α and d, β and d, and γ and δ. The comparison t-test on α and δ shows that the null hypothesis for the power company is rejected while for the bank it cannot be rejected. The test on β and δ shows that for the bank the null hypothesis is rejected while it's not for the power company. Finally for γ and δ the null hypothesis is rejected for the bank but not for the power company. Additional results for both loyalty and satisfaction from the t-tests can be found in Appendix C.

Lastly the final t-tests were conducted for comparing the bank and the power company. First each category for the bank was tested against the same category for the power company. This

was done to see if the categories were statistically similar or not and if the approach to the categorisation made sense.

	α vs. α	**β vs. β**	**γ vs. γ**	**δ vs. δ**
H_0	0	0	0	0
P-value	0.4778	0.8577	0.8630	0.2049
Confidence interval	[-0.6296] [0.2955]	[-0.7617] [0.9142]	[-0.7278] [0.6104]	[-0.3179] [1.4658]

Table 10: T-test for loyalty at the same category for each company compared

The results in Table 10 show that none of the null hypothesises for loyalty are rejected. This means that every category compared to each other are not from different populations, i.e. they cannot be differentiated from each other. Another strength of this comparison is that every the p-value are high, i.e. the p-value for the δ categories is the lowest at 20% and the γ categories give p-value of 86%.

Because of this all information about all categories are pooled together and then tested as a whole. This means that there was one big α category with the loyalty information from both category α at the bank and at the power company, both companies β categories are put together, both γ categories and finally both δ categories.

Category	**α**	**β**	**γ**	**δ**
α	-	0.0017*	4.9688e-13*	0.0563
β	0.0017*	-	0.0021*	0.4569
γ	4.9688e-13*	0.0021*	-	4.8668e-04*
δ	0.0563	0.4569	4.8668e-04*	-

*Table 11: P-value for loyalty at both companies together. * Null hypothesis rejected.*

Table 11 shows that when all the loyalty information from both companies is used there are two tests where the null hypothesis cannot be rejected. These are the test between a and δ and β and d. This means that all other tests show that the categories compared come from independent random samples and the null hypothesis is rejected; thus the alternative hypothesis, impatience has impact on loyalty, is accepted.

	α vs. α	β vs. β	γ vs. γ	δ vs. δ
H_0	1	0	0	0
P-value	0.0358	0.0963	0.0702	1.6634e-04
Confidence interval	[-0.3250] [-0.0112]	[-0.6234] [0.0515]	[-0.4572] [0.0182]	[-0.8475] [-0.2763]

Table 12: T-test for satisfaction at the same category for each company compared

However, when the same tests are done for satisfaction, see Table 12, the null hypothesis for the comparison between α category at the bank and α category at the power company is rejected. Therefor for satisfaction in the categories cannot be pooled together. However, the results for loyalty illustrates that the method for the categorisations is reasonable.

The t-test for all of the categories, the two companies and for the two questions were illustrated to answer the question whether or not a customer's loss in patience had real impact on customer loyalty or satisfaction. To answer this for loyalty it is best to take a look at Table 11 where all the information about loyalty from every customer is pooled together from both companies. There is a clear impact from impatience for categories α, β and γ, while δ is not so clear cut. Category δ shows a clear impact when compared to category γ but not when compared to α or β. This might indicate that the δ category should be included somehow into categories α and β. However, there should not be a big emphasis on this because of the customers in category δ. These customers were the ones that abandoned the queue but did not become impatience. This might simply be because something came up and they could not finish the wait. There is nothing the company could have done because these individuals would have abandoned the call anyways. Therefore the emphasis should be on α vs β, a vs γ and β vs γ.

The results for satisfaction do not show as much of a correlation between satisfaction and the patience categorisation. This can clearly be seen when category α of the bank is compared to α of the power company and it shows that the two categories do come from different populations. Also the results for both companies shows that category β and γ are not distinguishable. However, the reason for this might simply be that the range of the answering scale is larger for loyalty, 0-10, than for satisfaction, 1-5, and therefore harder to distinguish between the answers for satisfaction than loyalty.

Thus, the first research question can be answered "Yes" for α and γ for all occurrences. For loyalty there is an incremental effect that impatience has on loyalty, i.e. for α vs β, a vs γ and β vs γ. However this effect cannot be established for satisfaction.

4.3 RESULTS AND IDEAS FOR COST EVALUATIONS

Chapter 4.2 illustrates that impatience has a big influence on customer loyalty. Customer loyalty is a good indicator of repurchase behaviour for a preferred product or service from a specific brand or company. High loyalty can therefore mean that in the future the customer will buy the specific product or service every time they need it from that particular company. Because of this statement, the expected spending from a specific customer for the future has to be influenced by loyalty and consequently influenced by impatience.

4.3.1 CLV AND PENALTY APPROACH

Example 1:

An example of a customer has future contribution margin 12,000 kr. pr. month and future cost 3000 kr. pr. month, discount rate at 10% and the time period of 10 years. The CLV, see Figure 10, for this time period of ten years would be 663,610 kr.

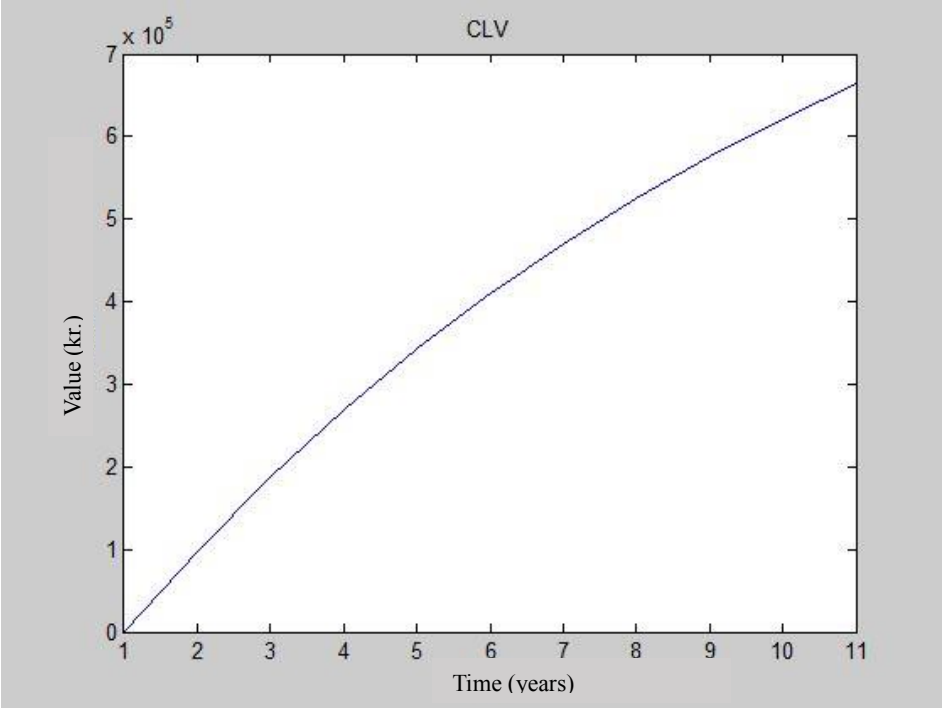

Figure 10: CLV of a customer

The result form example 1 shows that the CLV for the next 10 years would be 663,610 kr. if the customer would be loyal and satisfied for this time period. However, this customer might at one point in his history with the company end up in a queue that is shown in Figure 11. The customer comes into the queue and stays calm for about 60 seconds. At that time point the individual has crossed his maximum patience threshold (MPT) and starts to get impatient. The impatient increases exponentially until the maximum impatience threshold (MIT) is reached and the customer abandons the queue. The emotions scale could then possibly be turned into a cost scale by combining the CLV function into the impatience cost function.

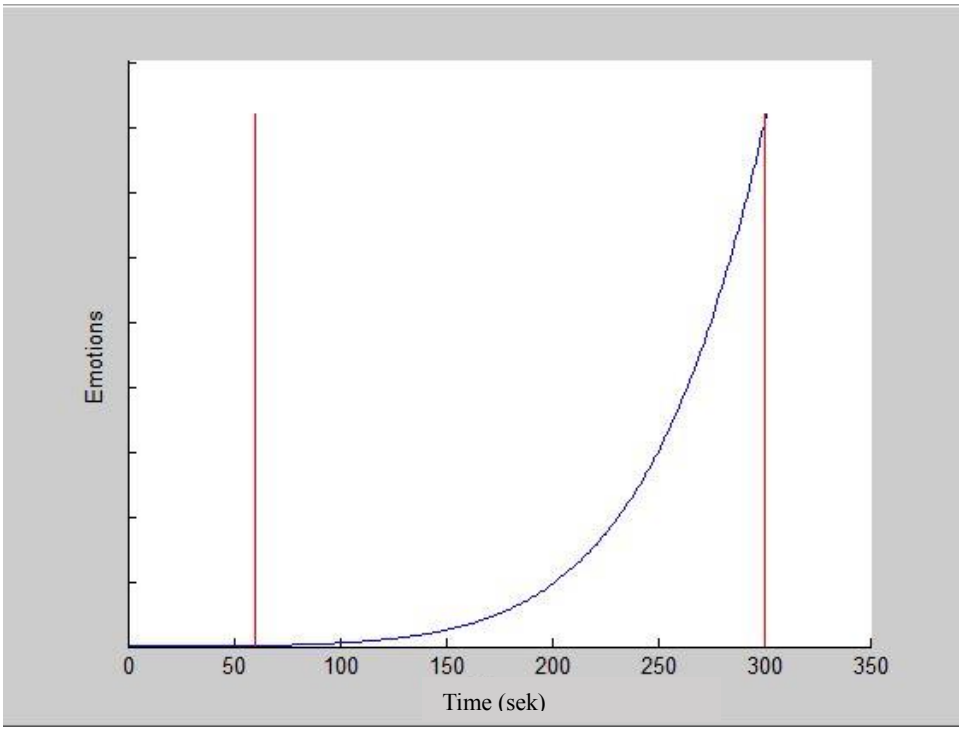

Figure 11: The impatience cost function for customer with MPT at 60 sec and MIT at 300 sec.

The highest point on the waiting time function curve could be thought of as the total CLV value for a certain time period. That would mean that if a customer waited for 200 seconds the penalty cost function would give 7,608 kr., if he waited for 250 seconds the cost penalty would be 71,055 kr. and if the customer waited for 300 seconds the cost would be the full CLV, or 663,610 kr.

This means that the assumption would be that if a customer would cross his maximum impatience threshold he would not only abandon the queue but also the company. In reality, this assumption is however very unreasonable and for most customers simply wrong. There might be some possibility that if a customer has over time reached a certain level of frustration with

the company might never come back but to assume that every customer would is not reasonable.

Therefore there might be a possibility of using a certain percentage of the CLV as a maximum penalty cost for the company to measure their customer impatience. One possibility is to use the percentage difference in loyalty between category α and category γ. The percentage then would be the average loyalty for category γ divided by the average loyalty for category α. The average loyalty for all categories is shown in Table 13.

	α	**B**	**γ**	**δ**
Mean	8.070	7.395	6.603	7.614

Table 13: Average loyalty for each category when both companies pooled together

The percentage between α and γ then would be:

$$100\% - \frac{Average\ for\ category\ \gamma}{Average\ for\ category\ \alpha} = 100 - \frac{8.070}{6.603} * 100 = \ 18.17\%$$

If the information about the customer used here above, for the calculations of the CLV, would be used for this idea of a method the penalty cost for the company would be:

$$Cost\ penalty = 663{,}610\ \ kr * 18.17\% = 120{,}580\ kr$$

The drop between α category and γ category is however the biggest drop in loyalty. This means that the 18.17% would be used as a maximum penalty percentage for this instance.

However, it is the management for every company are the once that have the final say for the extent of the percentage, i.e. the probability of losing a customer.

4.3.2 TAGUCHI LOSS FUNCTION

As mentioned before another possibility would be to calculate a penalty cost by using the Taguchi loss function and queuing method. This method uses many unknown parameters so the example here below is just a speculation about an example of a customer.

Example 2:

A customer stays in a queue for 5 minutes and then his cost of dissatisfaction with the waiting time is 5000 kr. The arrival rate for the queue is 15 customers' pr. /hour and the service rate is 20 customers' pr. /hour. The cost for the company for that particular customer would then have be: C_q = 43,200 kr.

For this example the company would have a penalty cost of 43,200 kr.

4.3.3 EXPECTED SPENDING

A third potential way to evaluate the cost of impatience would be to use the method described in 2.2.2. Equation 4 shows the expected spending out of the whole customer base. For the calculations below an example is made with one customer for the calculations to keep in context with example 1 and example 2. Also the equation does not take into account that the death rate is influenced by satisfaction.

Example 3:

The arrival rate for satisfied customers is 15 customers' pr. /hour and for dissatisfied customers is 10 customer pr. /hour. The death rate is 2% pr. year. The spending is the same monthly spending as for the customer in example 1, i.e. 12,000 kr., and the time period is also 10 years. The probability of the customer being satisfied is 80%.

$$\gamma_i = 0.8 * 10 + (1 - 0.8) * 15 = 11$$

$$R = 12{,}000 * \left[\frac{10 * 15}{11 * 0.02}(1 - e^{-0.02*10}) + \frac{0.8(1 - 0.8)(15 - 10)^2}{11(11 + 0.02)} * (1 - e^{-(11+0.02)T}\right] = 1{,}483{,}500\ kr.$$

For comparison that if the ratio percentage between category α and γ would be used as death rate here then R=754,620 kr. This shows that R is quite sensitive to changes in death rate.

However, as mentioned before, in the end it's always the managers' choice to decide what much they are willing to pay to keep their customers happy.

5 DISCUSSION

This chapter sums up the results and benefits of the research and as well as discussing future work.

This study attempts to answer the two research questions:

1. If a customer loses patience, does it have real impact on customer loyalty or customer satisfaction?
2. If it has real impact, is it then possible to cost evaluate a penalty for this loss in patience?

The customer base information was divided into four different categories based on patience and impatience, and whether the customer received service or not. The results for these categories clearly show that loyalty and satisfaction is on average lower for γ category than α category.

The t-test for loyalty showed that when each category was compared to the same category at the other company the result showed that there is no difference between the two. However, the t-test for satisfaction showed a difference in the categories between the two companies, more specifically α category for the bank could be distinguished from α category in the power company.

This meant that only the information about loyalty could be pooled together for both companies. This showed that impatience has an impact on loyalty when the customers are divided into α, β and γ categories. Impatience showed a real impact for α and γ for all occurrences at both companies and for loyalty there was an incremental effect that impatience had on loyalty, i.e. for α vs β, a vs γ and β vs γ. However this effect could not be established for satisfaction.

Whether or not a customer comes back and repurchases some product or service has an impact on how a customer is evaluated in terms of revenue and cost. This thesis puts forth ideas of methods for cost evaluations that take into account the impatience of customers. For these ideas different kinds of metrics were used such as customer lifetime value, expected spending and queuing method combined with the Taguchi loss function. A specific equation was not constructed, only suggestions of approaches possible to use as methods for this cost evaluation of impatience. Finding and constructing that specific equation would be considered the first step in future work from this thesis.

Other future work could include:

- Make the same research with more measures for both loyalty and satisfaction to see if the results can become more significant.
- Make a simulation model to predict customer behaviour with impatience.
- Estimate the probability of reaching the maximum patience threshold and the maximum impatience threshold. This could give clearer results for the whole customer base.
- Do a similar research for other types of service that is not a call centre. The questionnaire was conducted in two grocery stores and an electrical store and it might be interesting to evaluate the results by comparing them to the results for these stores. Impatience might even have more impact on customers for the stores simply because there are more competitors for the stores than the bank and the power company. It might take more effort for a customer to change banks than grocery stores. This research method might therefore be effective to use in other types of service companies.

6 CONCLUSION

This chapter sums up the results of the thesis.

This thesis was divided into four chapters; introduction, theoretical framework, methods and results. The introduction showed the problem that was set out to solve, the theoretical framework then described what has already been studied in relevant literature, the methods showed how to solve the problem and finally the results showed us if the problem was solvable.

These four chapters paved the way to a conclusion for the two research questions. These questions were; "if a customer loses patience, does it have real impact on loyalty or satisfaction?" and "if it has real impact, is it then possible to cost evaluate a penalty for this loss in patience?"

The results showed that each category was quite similar between the two companies where the difference was only 1 percent between the drop in loyalty between category α and category γ.

The results also showed that impatience has an impact on loyalty where α, β and γ category all showed that they were distinguishable from each other. It also showed that impatience had real impact on satisfaction where α and γ were clearly distinguishable however this could not be said for β and γ. Also for loyalty there was an incremental effect that impatience had on loyalty, i.e. for α vs β, a vs γ and β vs γ. However this effect could not be established for satisfaction.

The results also showed that there is premise for conducting a cost and revenue evaluations for customers based on their impatience.

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APPENDIX

APPENDIX A – EXPECTED SPENDING AND SATISFACTION

Appendix A is based on the paper by Ho, Park and Zhou [28].

The first modification on Equation *4* is that the average expenditure is influenced by satisfaction. This statements turns the equation for expected spending during (0,T] into:

$$R = [p * Q_S + (1 - p)Q_{D0}] \sum_{i=1}^{N} \left[\frac{\lambda_{iD}\lambda_{iS}}{\gamma_i \mu_i}(1 - e^{-\mu_i T}) + \frac{p(1-p)(\lambda_{iS} - \lambda_{iD})^2}{\gamma_i(\gamma_i + \mu_i)} * (1 - e^{-(\gamma_i + \mu_i)T}) \right]$$

where,

Q_s is the average random amount spent from a satisfied customer

Q_D is the average random amount spent from a dissatisfied customer

The next change to Equation 4 is to include a contingent death rate. This means that satisfaction can have an impact on the death rate. The total expected spending form the customer base during (0,T] then becomes:

$$R = \bar{Q} \sum_{i=1}^{N} \left[C_i \left(1 - e^{-\beta_{i1} T}\right) + D_i (1 - e^{-\beta_{i2} T}) \right]$$

where,

$$C_i = (p\lambda_{iS}(\beta_{i1} + \lambda_{iD} + \mu_{iD})[\beta_{i2} + \mu_{iS} + (1-p)(\lambda_{iS} - \lambda_{iD})]) * (p(1-p)\lambda_{iD}\lambda_{iS}\beta_{i1} - \beta_{i1}[\beta_{i1} + \mu_{iD} + p\lambda_{iD}] * [\beta_{i2} + \mu_{iS} + (1-p)\lambda_{iS}])^{-1}$$

$$D_i = ((1-p)\lambda_{iD}(\beta_{i2} + \lambda_{iS} + \mu_{iS})[\beta_{i1} + \mu_{iD} + p(\lambda_{iD} - \lambda_{iS})]) * (p(1-p)\lambda_{iD}\lambda_{iS}\beta_{i2} - \beta_{i2}[\beta_{i1} + \mu_{iD} + p\lambda_{iD}] * [\beta_{i2} + \mu_{iS} + (1-p)\lambda_{iS}])^{-1}$$

μ_{iD} is the reneging rate if the customer is dissatisfied

μ_{iS} is the reneging rate if the customer is satisfied

β_{i1} and β_{i2} are the two roots of the quadratic equation:

$$\beta^2 + [p\lambda_{iD} + (1-p)\lambda_{iS} + \mu_{iD} + \mu_{iS}]\beta + [\mu_{iS}\mu_{iD} + (1-p)\lambda_{iS}\mu_{iD} + p\lambda_{iD}\mu_{iS}] = 0$$

However, if $\mu_{iD} = \mu_{iS}$, the expected spending equation would be the same as for Equation *4*.

The third version of Equation *4* takes into account that customers' satisfaction in the past can have an influence on their current satisfaction. The new equation for total expected spending would then be:

$$R = (1 - p_2 + p_1)\bar{Q}\sum_{i=1}^{N}\left[\frac{\lambda_{iD}\lambda_{iS}}{\gamma_i\mu_i}(1 - e^{-\mu_i T}) + \frac{p(1-p)(\lambda_{iS} - \lambda_{iD})^2}{\gamma_i(\gamma_i + \mu_i)} * (1 - e^{-(\gamma_i + \mu_i)T})\right]$$

where,

p_1 is the probability of satisfaction if last time the customer was dissatisfied the last time

p_2 is the probability of satisfaction if last time the customer was satisfied the last time

APPENDIX B – EXAMPLE OF THE TAGUCHI LOSS FUNCTION

The parameters needed are arrival rate (λ), service rate (μ), the probability of waiting (ρ), the time index (t), the cost of rejection (R), the upper specification limit (USL) and the target value (T).

The example conducted in [31] is for a cashier at a small store. Where the assumptions are:

Parameters	
Arrival Rate (λ), (customer pr. hour)	12
Service Rate (μ), (customer pr. hour)	16
Cost of dissatisfaction (cost of rejection) ($)	40
Waiting time (min)	20
The probability of waiting (ρ), (%)	λ/μ = 0.75
The upper specification limit (USL) , (hours)	20/60 = 0.33

Then the constant K can be calculated:

$$K = \frac{R}{(USL - T)^2} = \frac{\$\ 40}{\left(\frac{20\ min}{60\ min} - 0\right)^2} = 360$$

The C_q, the cost per person, can then be calculated:

$$C_q = \frac{2K\rho}{[\lambda - \mu]^2} = \frac{2 * 360 * 0.75}{(12 - 16)^2} = \$\ 33.75$$

APPENDIX C – T-TEST – ADDITIONAL RESULTS

H_0 AND CONFIDENCE INTERVAL FOR LOYALTY

H_0 for the bank:

Category	a	b	c	d
a	-	1	1	0
b	1	-	1	0
c	1	1	-	1
d	0	0	1	-

H_0 for the power company:

Category	a	b	c	d
a	-	1	1	1
b	1	-	0	0
c	1	0	-	0
d	1	0	0	-

Confidence interval results for the bank:

Category	a	b	c	d
a	-	[0.0188] [1.1092]	[0.8357] [1.9685]	[-0.4803] [0.7604]
b	[0.0188] [1.1092]	-	[0.1904] [1.4858]	[-1.1363] [0.2885]
c	[0.8357] [1.9685]	[0.1904] [1.4858]	-	[-2.0262] [-0.4979]
d	[-0.4803] [0.7604]	[-1.1363] [0.2885]	[-2.0262] [-0.4979]	-

Confidence interval for the power company:

Category	a	b	c	d
a	-	[0.0898] [1.5248]	[0.9691] [2.0518]	[0.1544] [1.6077]
b	[0.0898] [1.5248]	-	[-0.1268] [1.5331]	[-0.9537] [1.1012]
c	[0.9691] [2.0518]	[-0.1268] [1.5331]	-	[-1.4677] [0.2088]
d	[0.1544] [1.6077]	[-0.9537] [1.1012]	[-1.4677] [0.2088]	-

H_0 AND CONFIDENCE INTERVAL FOR SATISFACTION

H_0 for the bank:

Category	a	b	c	d
a	-	1	1	0
b	1	-	0	1
c	1	0	-	1
d	0	1	1	-

H_0 for the power company:

Category	a	b	c	d
a	-	1	1	1
b	1	-	0	0
c	1	0	-	0
d	1	0	0	-

Confidence interval for the bank:

Category	a	b	c	d
a	-	[-0.4864] [-0.0823]	[-0.6891] [-0.3151]	[-0.1201] [0.2601]
b	[-0.4864] [-0.0823]	-	[-0.4602] [0.0246]	[0.0813] [0.6273]
c	[-0.6891] [-0.3151]	[-0.4602] [0.0246]	-	[0.3184] [0.8259]
d	[-0.1201] [0.2601]	[0.0813] [0.6273]	[0.3184] [0.8259]	-

Confidence interval for the power company:

Category	a	b	c	d
a	-	[-0.6633] [-0.1410]	[-0.7532] [-0.3537]	[-0.5931] [-0.0545]
b	[-0.6633] [-0.1410]	-	[-0.4671] [0.1644]	[-0.3216] [0.4783]
c	[-0.7532] [-0.3537]	[-0.4671] [0.1644]	-	[-0.0859] [0.5453]
d	[-0.5931] [-0.0545]	[-0.3216] [0.4783]	[-0.0859] [0.5453]	-

OTHER RESULTS FROM T-TESTS

TSTAT, DF AND SD FOR LOYALTY

Value of the test statistics (tstat) for the bank:

Category	a	b	c	d
a	-	2.0365	4.8719	0.4450
b	2.0365	-	2.5482	-1.1738
c	4.8719	2.5482	-	-3.2559
d	0.4450	-1.1738	-3.2559	-

Value of the test statistics (tstat) for the power company:

Category	a	b	c	d
a	-	2.2173	5.4929	2.3896
b	2.2173	-	1.6744	0.1426
c	5.4929	1.6744	-	-1.4841
d	2.3896	0.1426	-1.4841	-

Degrees of freedom (df) for the bank:

Category	a	b	c	d
a	-	273	293	222
b	273	-	258	187
c	293	258	-	207
d	222	187	207	-

Degrees of freedom (df) for the power company:

Category	a	b	c	d
a	-	221	276	219
b	221	-	147	90
c	276	147	-	145
d	219	90	145	-

Standard deviation (sd) for the bank:

Category	a	b	c	d
a	-	2.2775	2.4683	2.1750
b	2.2775	-	2.6438	2.3903
c	2.4683	2.6438	-	2.6351
d	2.1750	2.3903	2.6351	-

Standard deviation (sd) for the power company:

Category	a	b	c	d
a	-	2.2175	2.2098	2.2073
b	2.2175	-	2.3821	2.4796
c	2.2098	2.3821	-	2.3699
d	2.2073	2.4796	2.3699	-

TSTAT, DF AND SD FOR SATISFACTION

Value of the test statistics (tstat) for the bank:

Category	a	b	c	d
a	-	-2.7701	-5.2839	0.7254
b	-2.7701	-	-1.7694	2.5603
c	-5.2839	-1.7694	-	4.4441
d	0.7254	2.5603	4.4441	-

Value of the test statistics (tstat) for the power company:

Category	a	b	c	d
a	-	-3.0336	-5.4538	-2.3694
b	-3.0336	-	-0.9468	0.3890
c	-5.4538	-0.9468	-	1.4389
d	-2.3694	0.3890	1.4389	-

Degrees of freedom (df) for the bank:

Category	a	b	c	d
a	-	278	304	227
b	278	-	266	189
c	304	266	-	215
d	227	189	215	-

Degrees of freedom (df) for the power company:

Category	a	b	c	d
a	-	240	287	227
b	240	-	155	95
c	287	155	-	142
d	227	95	142	-

Standard deviation (sd) for the bank:

Category	a	b	c	d
a	-	0.8508	0.8305	0.6726
b	0.8508	-	1.0028	0.9215
c	0.8305	1.0028	-	0.8865
d	0.6726	0.9215	0.8865	-

Standard deviation (sd) for the power company:

Category	a	b	c	d
a	-	0.8642	0.8245	0.8003
b	0.8642	-	0.9555	0.9831
c	0.8245	0.9555	-	0.8707
d	0.8003	0.9831	0.8707	-

H_0 AND CONFIDENCE INTERVAL FOR LOYATY FOR BOTH COMPANIES

H_0 for both companies together:

Category	a	b	c	d
a	-	1	1	0
b	1	-	1	0
c	1	1	-	1
d	0	0	1	-

Confidence interval for both companies together:

Category	a	b	c	d
a	-	[0.2552] [1.0934]	[1.0769] [1.8554]	[-0.0124] [0.9233]
b	[0.2552] [1.0934]	-	[0.2884] [1.2954]	[-0.7970] [0.3594]
c	[1.0769] [1.8554]	[0.2884] [1.2954]	-	[-1.5753] [-0.4461]
d	[-0.0124] [0.9233]	[-0.7970] [0.3594]	[-1.5753] [-0.4461]	-

H_0 AND CONFIDENCE INTERVAL FOR SATISFACTION FOR BOTH COMPANIES

H_0 for both companies together:

Category	a	b	c	d
a	-	1	1	0
b	1	-	1	1
c	1	1	-	1
d	0	0	1	-

Confidence interval for both companies together:

Category	a	b	c	d
a	-	[-0.4395] [-0.1261]	[-0.6369] [-0.3654]	[-0.2108] [0.1111]
b	[-0.4395] [-0.1261]	-	[-0.4101] [-0.0266]	[0.0045] [0.4614]
c	[-0.6369] [-0.3654]	[-0.4101] [-0.0266]	-	[0.2510] [0.6516]
d	[-0.2108] [0.1111]	[0.0045] [0.4614]	[0.2510] [0.6516]	-

OTHER RESULTS FROM T-TESTS FOR BOTH COMPANIES TOGTHER

TSTAT, DF AND SD FOR LOYALTY

Value of the test statistics (tstat) for both companies together:

Category	a	b	c	d
a	-	3.1609	7.3979	1.9134
b	3.1609	-	3.0921	-0.7450
c	7.3979	3.0921	-	-3.5207
d	1.9134	-0.7450	-3.5207	-

Degrees of freedom (df) for both companies together:

Category	a	b	c	d
a	-	496	571	443
b	496	-	407	279
c	571	407	-	354
d	443	279	354	-

Standard deviation (sd) for both companies together:

Category	a	b	c	d
a	-	2.2475	2.3433	2.1919
b	2.2475	-	2.5458	2.4178
c	2.3433	2.5458	-	2.5272
d	2.1919	2.4178	2.5272	-

TSTAT, DF AND SD FOR SATISFACTION

Value of the test statistics (tstat) for both companies together:

Category	a	b	c	d
a	-	-3.5454	-7.2517	-0.6087
b	-3.5454	-	-2.2385	2.0071
c	-7.2517	-2.2385	-	4.4302
d	-0.6087	2.0071	4.4302	-

Degrees of freedom (df) for both companies together:

Category	a	b	c	d
a	-	520	593	456
b	520	-	423	286
c	593	423	-	359
d	456	286	359	-

Standard deviation (sd) for both companies together:

Category	a	b	c	d
a	-	0.8616	0.8316	0.7533
b	0.8616	-	0.9905	0.9602
c	0.8316	0.9905	-	0.8954
d	0.7533	0.9602	0.8954	-