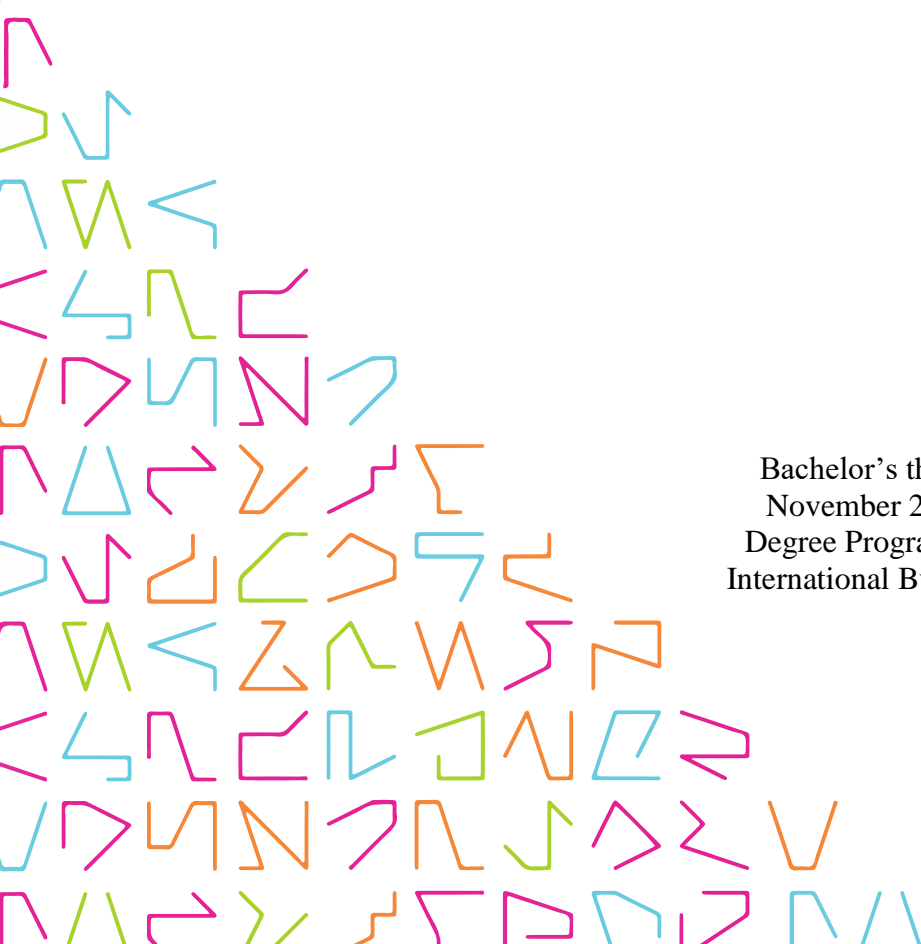


IMPLEMENTING QUALITY MANAGEMENT TOOLS IN MEDIUM SIZED ENTERPRISES

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ABSTRACT

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This bachelor's thesis has the finality of finding the most efficient and less impactful ways of implementing Quality Management tools and principles for processes in medium to large sized organizations. The understanding of the corporate environment and its challenges was elucidated by a SWOT and PESTLE analysis on different case studies within the company, and the elaboration of a Process Mapping plan. Interviews with the company's employees were also conducted. The choice of these methods was to identify the problems related to the enterprise and gain knowledge of the company. The result of this study conducted was the identification of the main points for improvement and elaboration of an ideal approach to the specific study case. The solutions proposed were made using established theoretical background on Quality Management Principles, Six-Sigma Design, Tools, and principles for Innovation in the corporation environment. Those mentioned, proved to be essential part on the development of efficient mechanisms for implementing principles of Quality Management with the aim of increasing productivity and efficiency in the company's overall processes.

The recommendations given were the implementation of processes measurements and data analysis software for more efficient data gathering, strategic management charts for processes, GUT matrices for hierarchization, and Balanced Scorecard (BSC) principles and tools. One of the expected outputs of this research is the explanation of patterns and on companies facing challenges related to the implementation of quality management tools, how their response to this process was, and what can be done to avoid unnecessary efforts and possible mistakes.

Key words: quality management, innovation, quality tools, six-sigma, processes

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ABBREVIATIONS AND TERMS

DPMO	Defects Per Million Opportunities
QC	Quality Control
NC	Non-Conformity
HR	Human Resources
PDCA	Plan, Do, Check, Act
DMAIC	Define, Measure, Analyze, Improve Control
AI	Artificial Intelligence
TQM	Total Quality Management
SWOT	Strengths, Weaknesses, Opportunities, Threats
IBGE	Brazilian Institute of Geography and Statistics
ABRASEL	Brazilian Association of Bars and Restaurants
BNDES	Brazilian National Bank of Development
IoT	Internet of Things
NC	Non Conformity
B2B	Business-To-Business
B2C	Business-To-Customer

1 INTRODUCTION

With several variables posing influence, such as globalization and the strong development of social media, competition tends to increase throughout the years. New factors are constantly taking place and competitive advantage becomes a more complex concept. World markets face the appearance of several new companies in a great number of different sectors that were created in the past ten years and many other ones to come in sectors that are nonexistent today. Competition became a highly unpredictable variable on which businesses are constantly struggling to deal with.

The fast pacing technology development is becoming as well, more difficult to predict. Technological changes are very rapid and shifts in the market are constant. The succession of different economic crisis has lead the investors to doubt more and instability increases. Products or services that are currently dominating a market can lose their market space within weeks and be replaced by new and furthermore more innovative solutions. With so many options available, companies are having difficulties to find the best solutions for their challenges.

In this context of extreme volatility, principles of Quality Management are important assets for managers and administrators as leverage from its competitors. Successful companies are the ones focusing on improvement to satisfy their customers (Summers, D. 2009) The implementation of quality management tools, is a real way of increasing the quality of production and consequently generate higher consumer satisfaction. The greatest challenge imposed to organizations who are not strongly adopting those principles is the difficulty in shifting their actual processes and go through the change of implementing these new tools.

It is common that companies have pre-established protocols for the execution of their internal processes. But in many cases, those protocols, and patters of behave are not following stablished quality standards or are not the most efficient methods that could be in use. In this case, a great effort is required for the company to abandon those methods and adequate itself into solving these non-conformities. Many managers are projecting and implementing processes through the company, and not directing efforts into planning alongside with quality management. The benefits of the creation of process with quality management tools are very evident, such as time saving, efficiency increasing, sustainability, etc.

The importance of business intelligence systems is tremendous and so is the struggle of enterprises to adapt to those technologies even though they are an asset. Re-shaping an organization towards technological development is a change that requires efforts from all possible ways, some skilled workers will not be a fit for the new demands. Even though change in organizations is a well-developed theme, change within corporative space is an always open subject of research, considering the constant change on the so-

ciety. New companies are built and prepared from their beginning to embrace changes in their environments. The challenge exists in more traditional business and the industry, on which the operational aspect does not necessarily faces constant changes, and processes remain unaltered for many years. In those cases, change in the managerial environment can be strongly perceived and face different difficulties.

Change in the managerial environment can take place in different aspects, from management strategy to philosophy, from the company's mission to its market place. The core subject of this study is to investigate the specific aspects and challenges of *change* alongside with *innovation* in the context of the implementation of Quality management tools.

2 BACKGROUND OF THE STUDY PROBLEM

2.1 Background of Brazilian Medium and Large Sized Enterprises

Considering Brazil during the years of 2017 and 2018 as reference, the problem presented is enhanced, due to the strong effects of an economic and political recession the country is going through. The Federative Republic of Brazil is the largest country in both South America and Latin America. As the world's fifth-largest country by both area and population, it is the largest country to have Portuguese as an official language and the only one in the Americas. Bounded by the Atlantic Ocean on the east, Brazil has a coastline of 7,491 kilometers, a population of 207.750.187 inhabitants in 2017 a GDP of 1.789 Trillion in 2016 and \$8,727 per capita.

The Brazilian economy in a historical perspective, is famous for its constant difficulties and great shifts. Political instability has always been a strong factor for contributing into those difficulties, together with the fact that the currency in the country has changed several times throughout the years and its value constantly flows with the high levels of volatility in the inflation.

In a more recent perspective, during 2008 and the American mortgage crisis which generated the world economic recession, Brazilian economy remained minimally affected and had one of its strongest moments in 2011, still not perceiving any clear sign of recession. Back then, the government was constantly implementing series of diverse measurements for the country's economy and international trade to keep having their original rhythm and even grow. As an alternative to the great fluctuations of the American market, international investors saw the growing Brazilian economy as a solid and secure investment in a moment of world crisis. Sectors such as retail, agriculture and Civil construction are the strongest sectors to perceive the overall economic situation of the country and in 2011 they had their best year in many decades.

Since the beginning of 2014, the country goes through an extreme moment in its political sphere. The political crisis was triggered by a combination of different factors, but all intrinsically connected to the economic situation the country was going through. The president by then Dilma Rouseff, representing the Workers Party won the presidential election of 2014 with a tight and minimal advantage from the second candidate. It was

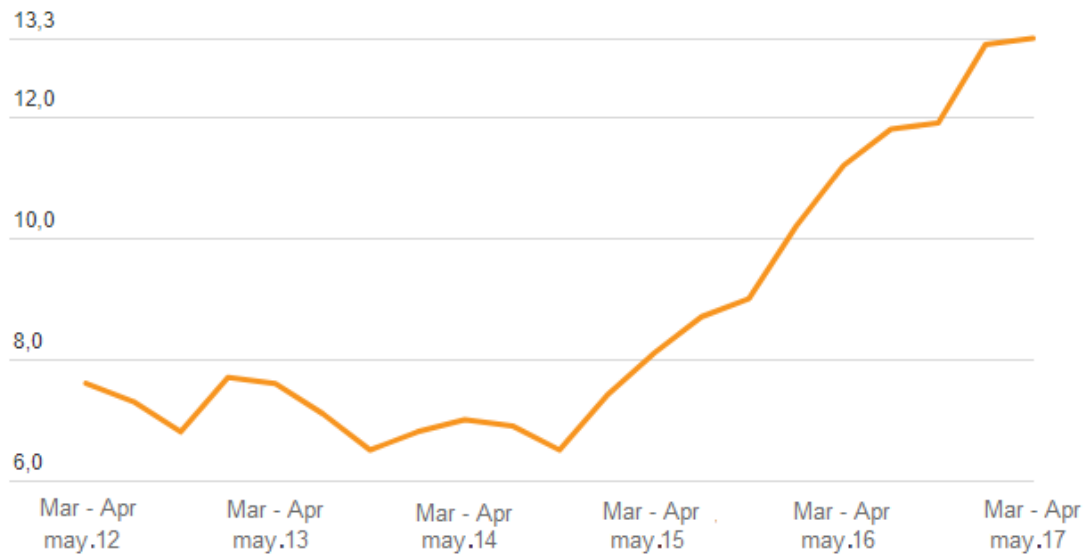
considered the tightest presidential victory in Brazil's history. That aspect by its own was responsible for a strong political and ideological separation in the country. Alongside with the Division, Dilma's presidential campaign was marked by manifestations, controversies, and the rising of a series of political scandals involving several allies of the president and the entire political class, that would be revealed in the following years.

During 2015, several protests against the government took place on Brazilian streets. Simultaneously, manifestations in defense of the president-elected took place. The initial result was a gigantic drop on the market, with the share prices and the price of the national currency dropping highly, but soon returned to a relatively controlled stability with the entering of the new president, Dilma's chosen Vice president, Michel Temer. Soon after starting his presidency, Temer was involved in several scandals by the choosing of his ministers. Many of them were being investigated by the public ministry in partnership with the Brazilian federal police for participation in corruption schemes. Furthermore, the investigations showed testimonials that Temer himself was involved in active corruption.

With a combination of all those factors, Brazilian Currency and stocks went down in proportions never seen before, and it strongly fueled the crisis throughout the country. This succession of different factors acted negatively strong in all the spheres of the economy. The signs of the world economic recession showed simultaneously, and this combination of aspects lead the country into economic recession.

UNEMPLOYMENT RATE IN BRAZIL

By trimester, in %

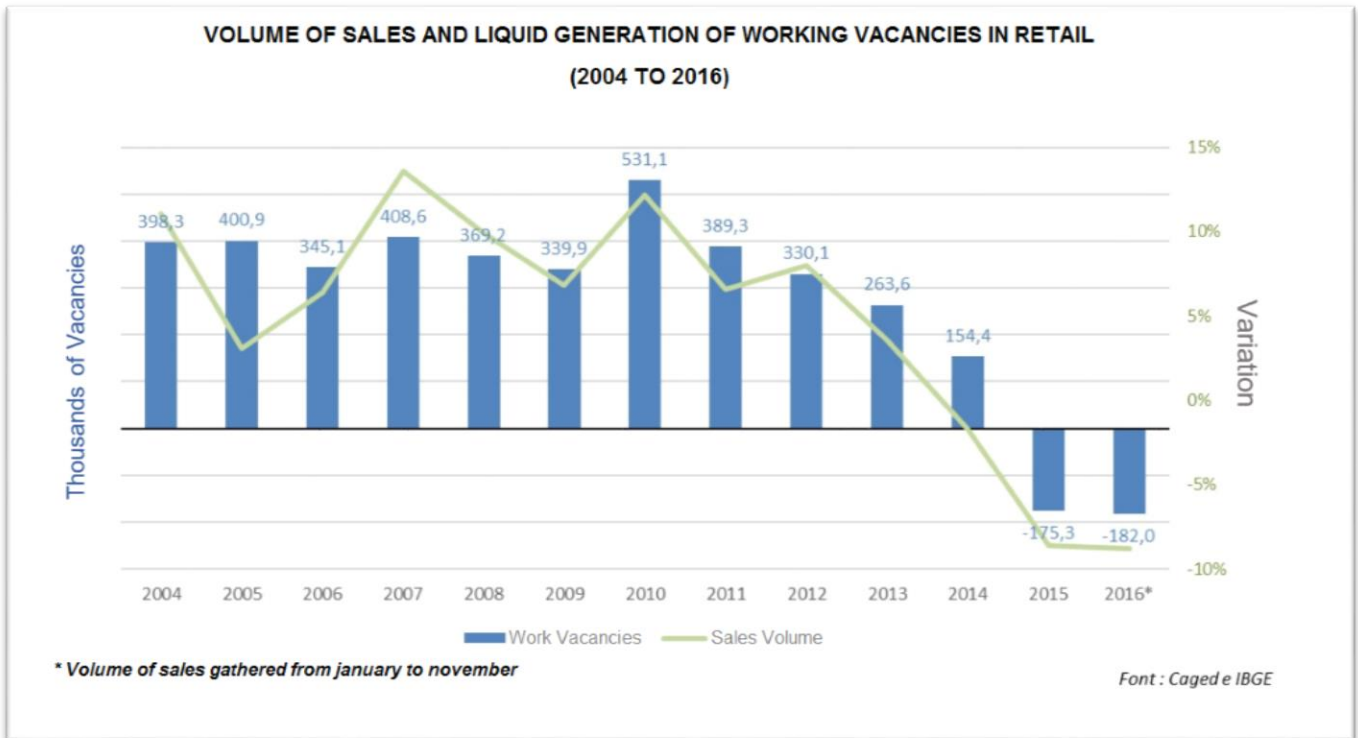


Font: PNAD Continua, IBGE

FIGURE 1. Unemployment Rate in Brazil, by trimester and by percentage (PNAD, IBGE 2017)

The sudden increase in Unemployment brought with it the expected surrounding problems, 2016 was the worst year ever recorded in history for Retail, having the lowest sales and greatest amount of companies shutting their doors. In many cases, companies who did their best years were the ones who only fired 35% of their employees (IBGE). Higher criminality rates were also perceived with the country having 60.000 assassinations during 2017 (Brazilian Government. 2017). Foreign investment in the country was severely reduced. Therefore, the banks made it more difficult for citizens to have access to financing as a response due to the non-fulfillment of loans and contracts that skyrocketed. Some banks as well were close to bankruptcy both for the non-loyalty of the contracts and for their involvement with different corruption scandals.

The unique decision of the banks to tighten their repayment policies was enough for several businesses to terminate their operations (BNDES, 2017). The strongest loss was felt by the construction sector which counted completely on the payment conditions offered by the banks, to finance their products to their clients and finance their constructions, so their debt with the banks increased while the sales declined.



FIGURE

2.

Volume of sales and liquid generation of working vacancies in retail (Caged, IBGE
2004 to 2016)

Even with the wave of pessimism that reached the country, the actual government managed to implement different legal measures to contain the crisis. Some business such as exporting services from Brazil are managing to profit on the high price of the dollar. The competition against other international products was advantageous since the Brazilian currency price was lower than the other competitors with relatively high product quality. For international investors, the lowering on the prices might be an advantage.

Some of the traditional advantages of investing in the Brazilian Market remained still. The country still counts with a relatively cheap labor cost, having the base salary in 2018 as 954 R\$ which corresponds to 217€ on 02/08/2018. During 2011, the government has also provided legal capacity for several private universities to have different engineering courses, what on the past was exclusivity of public universities. This legalization provided to the market a substantial increase on high skilled labor and ended almost completely the problem faced in 2011 when the economy was at its highest and not enough qualified workers were available.

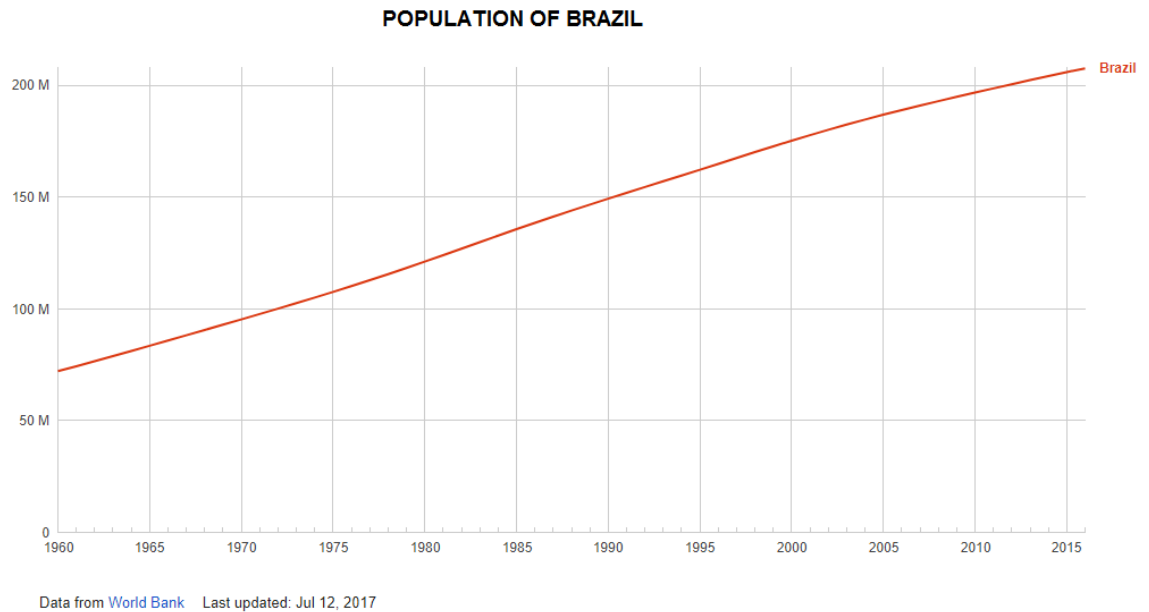


FIGURE 3. Population of Brazil in millions (World Bank, 2017)

Another apparent and constant advantage in comparison with European countries is the still growing population of 213.793.633 inhabitants (IBGE, 2018). With all the difficulties that the economy imposes.

As a solution to the crisis, the companies had to redraw their business models and start acting in different marketplaces and using different strategies. The reality of the society presented to be highly volatile and so should be the businesses. The main challenge faced is how to keep the quality standards within a constantly changing environment. Entrepreneurial practices (Drucker, 1985) were a necessity for business continuation.

Some companies found different solutions for those problems presented. Construction companies shifted their priorities for the very rich that remained relatively unchanged with the crisis, professional services, and the low-income class. The government has habitational projects on which they provide the population with residences in order to eliminate city-slums, as well as projects of financing those residences at an extremely low cost. The companies which managed to shift for those solutions were the ones able to keep operating in the crisis.

The procedures taken and on-going by several companies and business throughout Brazil are a good example that in many times, it is common to happen that external factors from the business start posing stronger influence than internal management itself. The

assurance of an efficient management of internal processes, procedures, and operational aspects in situations of economic crisis is not enough to assure business survival. The economic situation of the place in question has an important impact on the decision-making process for managers. It shapes the company primarily for survival up to profitability both on managerial and technical level (Gygi C. DeCarlo N. Williams B. 2005.) The importance of the implementation of quality management tools and principles in organizations should always be taken with the consideration of external factors.

2.2 The environment of PLANC Ltd.

Planc Ltd. Engineering and Incorporations Ltd. Is a civil construction company, from the northeast state of Paraíba, Brazil. The company has from 500 to 1500 workers, 30 years of existence and successfully concluded 80 buildings for civil retail. Planc Ltd. Is the leading company on the private sector of Civil Construction in the mentioned state, they also act in surrounding states. Planc Ltd. since its beginning has been focused in luxury apartments with some projects directed to the Brazilian medium class. Brazilian states are very large in population and dimensions so their understanding can be complex, the state of Paraíba on which Planc Ltd. is strongly dominant, counts with a population of 4.025.348 inhabitants (2017, IBGE) and a stronger growing rate than the national.

Their main business strategy is to have a high level of flexibility with their clients in all the aspects. From rebuilding their apartments and changing initial projects in the way the clients prefer without additional costs, to facilitating payment methods according to each client needs. Being those aspects their greatest difference from competitors that are highly inflexible about those features. Alongside with this, they have managed to create a good relationship with clients that are constantly investing on their projects.

Civil construction is the sector of Brazilian economy that most strongly felt the effects of the economic and political recession. The two majority reasons for the immense decrease in this sector are the lack of interest from the consumer and the banks that are not willing to concede loans and financing plans for costumers as previously mentioned.

The Brazilian consumer had increasingly lost their interest in purchasing an apartment mostly because of the extreme fluctuation rates on the inflation and the uncertainty of

the economic prospects of the country. The impact previously mentioned was presented in a macro perspective, on which the economy is constantly showing signs of failure, but in a personal level, several individuals are worried about losing their jobs and are not willing to commit to long-term loans even if they had the possibility of doing so. This shift in the populational behavior has helped increase the perception of the crisis for the market.

Even with the presented difficulties, Planc Ltd. Managed to remain a leader in the sector, with the implementation of new projects during the crisis. Their main strategy to overcome the recession was to remain with their operations growing instead of lowering. To focus on the private business sector stronger than before. Their constructions were more directed to Office buildings designated to Lawyers, Doctors and other independent professionals that remained relatively less impacted by the recession. At the end of 2018 they will be delivering their last achievement which is considered the most advanced office building in the state, thirty-four floors and highest standards of engineering techniques and architectural solutions.

Considering this scenario, Planc Ltd. Invests great effort on their quality control to remain the effective tracking of quality in their other sectors. The company has several different sectors with many employees, so the control of the quality is an endless and constant effort with space for improvements. Exists on the company a constant Quality Function Deployment (Summers, D. 2009) with efforts in having the customer heard on the development process of their products. The economic crisis has changed many sectors of the company, the marketing, sales, and administrative sectors had to be differentiated since the company took a stronger approach in B2B sales instead of B2C that was their main approach in general private civil construction.

This shift has affected the company's quality sector strongly and has imposed new challenges. Many workers had to be relocated to different functions than their original and the creation of new processes and protocols is needed to keep the quality standards. Today, the company is accredited with the ISO 9001 certification for Quality Management and several other national qualifications for quality assurance. The greatest internal challenges faced by the company today are to keep their accreditations and insure the quality control changes imposed by the economic crisis while dealing with the external

problems. In this aspect, the implementation of quality management tools is a necessary part of for improvement in the working effectiveness.

2.2.1 Questions and Objectives

As presented previously, the implementation of quality management techniques and tools is a necessary part for the survival of an enterprise being affected by all those factors. The practical purpose of this research is to offer applicable advice and guidance on how to implement those in medium sized and already established enterprises causing the minimal impact on its operational aspects, and serving as a guide to small sized companies or start-up's. The aim of the research is to answer the given questions:

1. What are the relevant Quality tools for management in medium to large sized companies?
2. How to implement these relevant tools on the smoother way for the company's general operational aspects?

Due to the high level of operational similarities in processes of large corporations which are credited with the ISO9001 certification, the response for those questions can be used as guidelines for enterprises from wishing to adequate their operations for receiving this qualification, to companies of any size which are looking to implement quality management tools for increasing their effectiveness in any way. Those practices can be more efficiently applied on a company which has the practice of Entrepreneurship (Drucker, 1985) as it's values.

The steps to be followed to answer those questions will be (1) the Identification of the main problems related to quality issues in general cases and in the case study presented to Planc Ltd, (2) The identification of the best quality tools suited to answer the company's needs (3) Identify indicators for the elaboration of quality control measurements (4) Explain the best ways to implement those measurements causing the least impact possibly on the company's operational aspects.

One of the main general expected outputs of this research is the explanation of patterns and repeated behaviors on company's facing the challenges related to the implementation

of quality management tools, how was their response to this process and what can be done to avoid unnecessary efforts and possible mistakes.

2.2.2 Methodology

The research presented in this study was developed using qualitative research methodologies but still strongly considering elements of quantitative research. Among the reasons for choosing this method, were timely issues, and the nature of the study which required an exploratory approach.

During the different studies conducted in this thesis, different research methodologies were used accordingly to the necessity. Combining different intersections of ideas (Johansson F. 2004) and frameworks during the process mapping on the company's departments, interviews were made with employees who described their functions, this allowed the Quality Management department to create mechanisms for the elaboration of data collection tools for future gathering of statistics. For the elaboration of the SWOT analysis the gathering of available data (previously collected) was made and interviews were also conducted with key employees. Studies of competitor's aspects were made using available data on consumers reports and published data.

The exploratory nature of this work could not give the possibility of conducting a detailed quantitative study on data, since many of the data collecting mechanisms are still being implemented and this study has its function of understanding the process of implementing them, making it impossible the understanding and analysis of their data.

The study conducted, and principles applied are made using theoretical background on Quality management, six-sigma and lean six sigma principles, Quality control principles, strategic management, and other management principles.

3 THEORETICAL BACKGROUND

3.1 Quality Management

Quality management has strong theoretical background in several different approaches developed throughout the years. Initially quality was thought as a way of controlling and standardizing production, and what existed was quality control which furthermore developed to quality assurance and finally reached Quality management.

The understanding previously given to quality management was limited by numerous aspects. The intention of managers was to generate the notion of quality by the standardization of the products and diminishing the amount of errors and failures in production. The most important and missing aspect of this overall operation is the customer satisfaction, even though that would be the planned result of the standardization of products, managers did not have this specific goal to be led by. Today Total Quality Management (TQM) has been an important development of the entire concept.



Figure 5: PDCA cycle, Plan Do Check Act.

The PDCA cycle also called PDSA (Summers, D. 2009) on where the S stands for Study. is an important tool for quality control and quality management. It helps procedures and processes to follow simple standardization methods and makes possible continuous improvement. PDCA was born from the adaptation of the scientific method created as "hypothesis"–"experiment"–"evaluation" by the renaissance philosopher Francis Bacon. In the case study mentioned the implementation of PDCA in the company's processes was successfully made and adapted to include the DMAIC methodology. This

hybridization went far beyond both the PDCA and DMAIC since it's result was a customized solution for PLANC Ltd, on which the needs of the company were better responded.

Quality control and quality assurance are mainly focused in dealing with failure, be it on the production, standardization or even execution of processes. Quality management aims to implement the culture of quality allied with management planning and execution, with the overall goal of implementing systems that are built with those principles within. The idea behind this concept is the substantial reduction of failures in the company's general operational. So while quality control is dealing purely with the failure aspects presented in the production or processes, quality management deals with finding the best way to implement measures and resources to stop those failures from happening.

The way to implement an efficient Quality management in an enterprise is by using tools and proven techniques (Pyzdek, T. Keller, P. 2014) , those tools can strongly vary according to company's size, culture, needs, sectors and several other aspects. In many cases, companies need to create their own tools for the implementation of quality control and the term "Quality Management Culture" can be applied to this, on which company's make use of quality management principles to create their own methods.

In this context, another important concept is the term "indicator". An indicator is a variable source on which the quality management tool is built upon. It is the source of information for data analysis for example. To understand and build efficient quality management mechanisms, the administrator must have good control and understanding over the company's indicators. Data collection and analysis is considered by many as the most important part of quality management.

3.1.1 Data Driven Management

Life in society nowadays, is a constant gathering of data. It is advantageous for the industry that all the possible devices can gather information somehow. Self-driven cars are a near reality and automakers are struggling with the complexity of data gathering to enable this independence, since the urban scenario is going through constant change, the solution was to develop a system on which all the owners of these vehicles would work

as components of a bigger chain. All their devices would be constantly sending data to an artificial intelligence data centre which would be constantly updating itself.

Data analytics also acts in this way. Consumer behaviour studies have turned to algorithms and data predictions to build their understanding of customers. Habits and behave patterns are understood and studied by the selection of websites that individuals see, pages liked and seconds taken staring to some specific thing the screen shows. All this information is instantly understood and the system responds by offering the best buyable solution to whatever needs were identified.

As life in society, management has taken the data driven approach. As far as ten years ago, business intelligence was a bureaucratic operation even though possible. In case a manager would have to deal with gathering data about some specific matter, the process would start with contacting the Information Technology (IT) department which would provide a report with the information required. Today's reality is far from this. Business managers are counting with fully customizable tools to provide them instantaneously updated data on every imaginable matter. Internet of Things (IoT) has also an incredible participation in improving business intelligence. IoT devices are data gathering gadgets responsible for providing the data to be analysed.

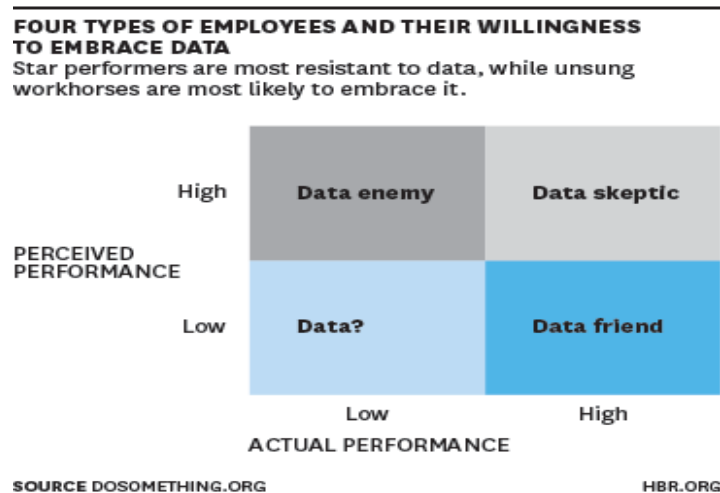


FIGURE 6. Four types of employees and their willingness to embrace data. Source dosomething.org and hbr.org

Alongside with the operational aspect, implementing data can be a problem for certain individuals in a corporation environment. As presented on FIGURE 6. Employees with a high perceived performance and a high actual performance could be considered ideal

employees for any kind of corporation, but still, they tend to be data sceptic, while workers with a low perceived performance but high actual performance are data friendly, which means that they rely on data and valuable customer input (Pyzdek, T. Keller, P. 2014) for decision making but also turn data information into usable change for the corporation's improvement.

This scenario brings up one of the trends that fits along with quality management. Data-Informed culture in corporations. In this case, data collecting tools are already part of the company, but the data informed culture does not stop there. The most important part of this approach is the deep understanding of the data provided and the actual execution of the possible actions shown by the data analysis. The data informed culture is not limited to read the information, but to understand it and turn it into actions. This is the greatest challenge about creating a culture of using data in the proper way.

In a synthesis, it is not only necessary that employees are qualified to perform their functions but are also willing to rely on data provided and be able to act from it, in this context the hardest part for an administrator willing to implement quality tools in a company is to properly lead the firm's human resources.

Artificial intelligence (AI) is the next big innovation towards data driven management. Every day, the algorithms are getting more sophisticated and it is just a matter of time until business operations and even decision-making processes to be controlled by AI software. This is already a reality in the stocks market. Investments company's software automatically chooses, buys, and sells the better stocks, based on several different variables such as likelihood of rise or decrease in prices, possible faults, etc.

AI is a strong ally for quality management to create action in all organizational aspects (Summers, D. 2009) The high-speed technology develops itself makes possible the lowering of prices and consequently allows businesses access to it. Today, AI is not a standard reality for most businesses, even though its applications for it are limitless. Companies which recognize the importance of quality management and understand that the topic requires the implementation of data gathering mechanisms, will benefit from the near-to-happen popularization of AI technologies.

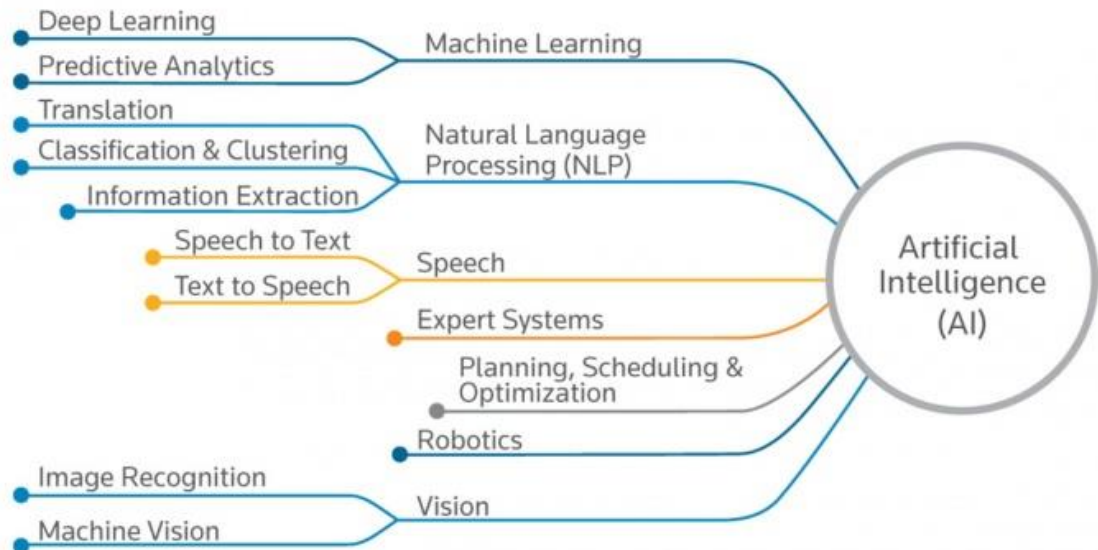


FIGURE 7. The components of Artificial Intelligence. Font: Neota Logic

The application of data driven management concepts in the Brazilian corporate environment is a very innovative concept to the relatively traditional businesses. Unfortunately, most enterprises tend to see innovation with precaution, because in their view, to innovate means *change* which to the them, comes with high investments, high allocation of costs together with times of costs contention. This traditionalism present in Brazilian enterprises helps to enhance the image that innovation can only be achieved throughout high financial investments, while on the reality, innovation lives more in a cultural or even philosophical and scientific approach (Pyzdek, T. Keller, P. 2014) that any company can have.

Just as quality, strategic, and data management, Innovation management has the same idea behind its concept, that its application should be implemented as a constant effort to develop those “qualities” into a functional part of a corporation. Quality management should not only be an emergent feature to provide aid in case something or some process went out of standardization. While strategy should not be only associated with projects or products, but something that embraces the entire philosophy behind an enterprise. Innovation should be the same. While to some enterprises specially on the Nordic scene, is seen it as natural, others are facing the difficulties of its implementation.

Many companies are struggling to make data analysis and artificial intelligence easier tools to be used by anyone, and that is their challenge to solve. On the vanguard of many, google has its Google analytics as shown on Appendix 3.

3.2 Quality Management Tools and Applications

Being on the form of IoT devices, software or even control sheet, quality management strongly relies on the implementation of tools. Very frequently those tools are related to the collection of data, which enhances once again the importance of having information to work on. For managers to predict or even plan possible actions within the corporative environment, they need to understand and rely in data of some form, if not, the decisions have a high change to be equivocated and possibly generate negative consequences for the company. “If you know the enemy and know yourself, you need not fear the result of a hundred battles. If you know yourself but not the enemy, for every victory gained you will also suffer a defeat. If you know neither the enemy nor yourself, you will succumb in every battle.” (Sun Tzu, the art of war). The implementation of quality concepts in an organization requires strong efforts from the managerial team and going through changes does not necessarily occurs smoothly.

Management tools are important keys for different aspects of management. Decision making processes are made incredibly easier when the manager can rely in trustable data, such as the increase in the effectiveness of operations by the automatic identification of errors, are essential tools for corporations.

In many managerial environments, the implementation of quality management tools is an innovative move for the company which involves all employees (Summers, D. 2009). Large sized organizations tend are on the leading vanguard of creating and implementing quality management principles, but medium to small sized organizations tend to have difficulty in following these tendencies. Understanding the processes of implementing them is an essential part of reducing the possible negative impacts that change and innovation could bring to the corporation.

Previously, the use of quality management tools was very limited since it required a lot of computational knowledge and each operational system had its several variables to be learn and mastered. Today, with the high advance of technology, managers are dealing with extremely friendly environment for its tools, highly customizable and efficient. This facilitation has helped to deeply improve the data gathering and analysis environment and so on, be an important asset for managers.

In the case study which involves Planc Ltd., the process was initiated by an understanding and mapping of the processes within the sectors of the organization. The mapping of

processes made possible a greater understanding of the company's procedures and how they are executed. Room for improvement was identified and an initial action plan elaborated. As seen in the Appendix 1. Mapping processes is an important tool to help visualizing the operational aspects of processes. Six Sigma principles such as DMAIC were an important asset to create a personalized framework for the report and solving of failure in internal processes. DMAIC was also used for the treating of non-conformities on the ISO9001 quality certification. Along with Six Sigma Principles, a SWOT analysis was essential to generate a diagnosis on the company's current situation. The SWOT tool gave the possibility to build a picture on which the main aspects surrounding the company were inserted such as its four elements, Strengths, Weaknesses, Opportunities and Threats, and those made possible to set priority on the urgent needs, enhance the strengths and opportunities and set priority and possibly eliminate the threats. To treat the possible failures encountered during the SWOT analysis, the priorities for the problems were settled using GUT matrixes, this application made possible for emergencies efforts to be applied for the necessary needs and the creation of time-line based action plans.

Quality management is a broad concept that relies mainly on the culture of implementing quality, which comes along with data-driven approach and innovation culture. The tools used in this procedure are many, and its applications are several. For relevant reasons, this study was limited to the quality tools used on its study case, and necessary for the company in question.

3.2.1 Six Sigma

Six Sigma in a general definition, is a set of tools and techniques to improve the quality of processes and reduce mistakes. "The essence of six sigma is to solve problems" (Gygi, C. DeCarlo, N. Williams, B. 2005) the need is initially created when there is a will to improve the quality for generating higher consumer satisfaction. Six sigma tools act upon the collection of data and its analysis for process understanding and improvement, optimization methods, analysis of variance, mistake-proofing, waste reduction, failure reduction and aims to generally increase the quality of the product and maximize the productivity.

The term Six-Sigma was generally introduced by Motorola (Pyzdek, T. Keller, P. 2014) when looking for a way to improve quality in processes and reduce the number of defects in production, possibly reaching an error-free production (Pyzdek, T. Keller, P. 2014). The sigma rate exemplifies the percentage of products that are made without defects. In large corporations, the implementation of six sigma is normally initiated by projects, those require mostly the commitment of the top managerial sectors, the project has a defined timeline for its implementation, execution, and end. In small or even medium sized corporations, the full implementation of a six-sigma project is in many ways inviable, the implementation costs can be high and great commitment is required.

For small companies to have access to the solutions created by six-sigma methods, the best solution is the application of six sigma concepts and tools as an asset for its business strategy. *Lean* six-sigma is the business strategy that aims to improve the bottom line to improve consumer satisfaction and is a popular application of six-sigma.

Six Sigma as philosophy is a great combination of existing methods for increasing the quality in the overall process. With that defined, any company can make use of this principles for increasing their productivity, provide better consumer satisfaction and consequently create better profitability.

Examples of Six Sigma Tools and Analytical Concepts	
Basic	Intermediate
<ul style="list-style-type: none"> • DMAIC • SIPOC • DPMO • Computer Skills • Scales of Measurement • Pareto analysis • Process Mapping, Flowcharts • Check Sheets • Cause-and-Effect Diagrams • Scatter Plots • Run charts • Histograms • Ogives • Descriptive Statistics (e.g., mean, standard, deviation, skewness) • Enumerative vs. analytic Statistics • Stem-and-leaf, boxplots • Basic probability concepts • Discrete probability distributions (binominal, Poisson, hypergeometric) • Continuous probability distributions (Normal, exponential, etc.) • 7M tools • FMEA • Sampling • CTx Identification 	<ul style="list-style-type: none"> • Control charts for measurements • Control charts for attributes • Process capability • Yield analysis (e.g., first pass yield, rolled throughput yield) • Measurement error analysis (gage R&R) • Correlation analysis • Simple linear regression • Chi-square • Type I and Type II Errors • Confidence interval interpretations • Hypothesis Tests • Normality assessments and transformations • Z-transformations • Process sigma calculations

FIGURE 8. Example of six sigma tools and analytical concepts, Thomas Pyzdek, Paul Keller the Six Sigma handbook.

In the case-study presented on this thesis, special attention was given to the process of implementing the DMAIC tool. The reason for this, is the concept behind this application. The DMAIC methodology can surely serve as the basis of the six-sigma methodology and its uses and applications are beyond to the organization of processes into product development (Creveling, C. Slutsky, J. Antis, D. 2003). In the case study one of the main benefits of the application of DMAIC, was the implementation of the six-sigma culture in the enterprise. In this case the DMAIC served as well as a guide for decision making, problem solving and project development.

As mentioned, the DMAIC methodology, is one of the most important tools of management within the six-sigma method. DMAIC on its original meaning, is an action

plan, to directly act on the implementation of six sigma principles on the organization's processes.

DMAIC is an abbreviation for the process, which stands for: Define, Measure, Analyze, Improve, Control. (Pyzdek, T. Keller, P. 2014).

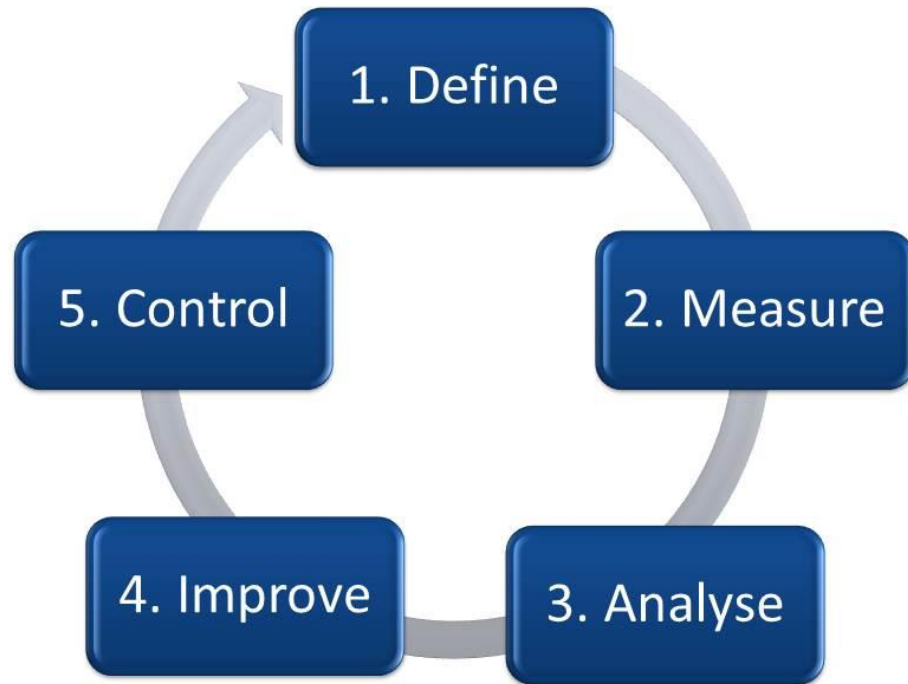


FIGURE 9. DMAIC cycle.

- Define: In the initial moment, the process should be clearly articulated and understood to implement the step. The problem should be defined and its resolution goal. The critical factors affecting on the quality should also be elucidated and classified by priority. The scope of the project as well as the timelines should also be defined during this period. The team responsible for this implementation should as well be selected.
- Measure: The process of measuring, is a step of data and information collection. It is a function of the previously selected team to stablish what data is relevant for the specific case. One of the objectives of this step is to stablish performance base for the projects, to be used in the future as a comparison aspect. The data collected initially will be compared to the results at the end of the implementation project. In this step, it is interesting that the team can understand what were the factors that made processes to increase their productivity or decrease and how it happened. Another function of the team is to stablish mechanisms to analyze relevant data, in case those do not exist. A well succeed DMAIC implementation, counts completely on the data collection, the analysis of data is the key point for precise prediction of indicators and a precise diagnosis of the company.

- Analyze: The purpose of the analytical step is to identify, validate, and select relevant aspects on the chosen indicators. There are different approaches to the analytical step. In case the data has shown non-conformities with expectations previously established, different approaches can be taken. The Ishikawa Diagram (Yang, K. El-Haik, B. 2009) is a very popular method for the understanding and mapping of possible errors. In case the problem was successfully mapped, the team should set the priority on the causes and roots that should be firstly treated. Even though the Ishikawa Diagram is the most popular method for problem identification and priority setting, other methodologies are applicable such as Pareto analysis, Histograms, Sheets, and Statistical tests.

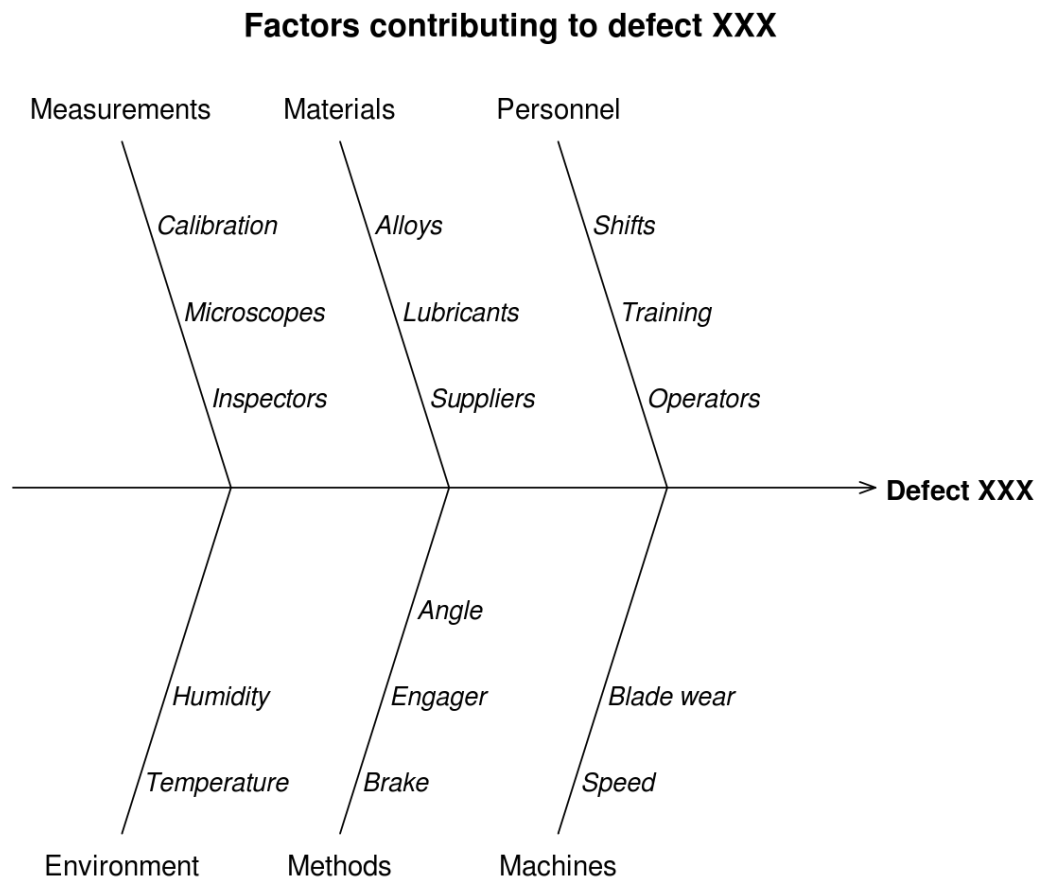


FIGURE 10. Ishikawa Diagram Example. Source: Wikipedia

- Improve: The objective of improving is to identify, test and implement a solution for the object of the question, be it a problem, failure or error, process etc. The solution or project presented, by its scope can be partial or total. In this context, it is necessary the creation of an “actions plan” with detailed attention to the procedures and steps to be taken for reaching the goal. The solutions presented should be as simple as possible to cut expenses and save time. In this step of creation, it is extremely important to test the applicability solutions found, to anticipate possible risks associated with it

- Control: The objective of this step is to keep the gains obtained. Monitoring the results and outputs of the previous steps is a way to keep a sustainable success and constantly improve. The creation of a control plan is an important part of keeping the control over the change or implementation made. Control graphs and software for the related issue are commonly used for this type of tracking.

3.2.2 SWOT analysis and GUT

SWOT analysis is deep within understanding the company's micro and macro environment. Is a part of a diagnosis to understand where the company is place itself and its main characteristics (Yang, K. El-Haik B. 2009). SWOT is an acronym for Strengths, Weaknesses, Opportunities and Threats. The SWOT analysis is a first step on identifying possible goals for project planning implementation. It serves as guide to understand the company and plan possible actions on it. Converting SWOT analysis data and general material into actions, is an important part of implementing the data-driven culture in organizations and consequently reaching the quality management level. Organizations keep constantly updating their SWOT analysis since the necessities and other variables of the company keep changing constantly. In large sized organizations, the sectors of the company tend to have high level of independency, which generates extremely different needs. In this case, the SWOT analysis is more efficiently conducted sector by sectors, which means that each independent sector will have its own SWOT analysis, and that contributes for the creation of a general SWOT of the entire company.

It is important for managers to identify possible patterns in mistakes reported by the employees of individual sectors. It will mean that the problem is relevant enough to happen throughout the company, causing a big impact on its operational aspect. Together with this, the manager should understand that the employee in each sector should be the responsible person for understanding his function the best. In many cases, SWOT's are conducted

SWOT ANALYSIS



FIGURE 11: SWOT analysis. Font: Professional Academy

SWOT's can also be used to have an understanding in projects, in this case, the SWOT analysis is conducted on the project team and its components, having them as an independent cell. In some project cases, SWOT could be used to for charting market possibilities for the implementation of a project. On that case, the characteristics and factors within the research will be used for understanding the outputs in case the project would be implemented and visualize the expected challenges and opportunities for its implementation. In this case, the SWOT analysis would be used as a planning asset, to assure the quality of the project.

The elements of a SWOT analysis are very synthetic, but are enough to have a greater understanding of the company's main aspects, both negative and positive.

- Strengths: The factors giving the company, sector or project that are advantageous. The importance of discovering the company's strengths is to understand the aspects that made that operation turn into a strength. This understanding will help improve other processes which are not elevating the company, and turn them into strengths.
- Weaknesses: The factors contributing for the company, sector or project to be disadvantageous. Together with the strengths, the weaknesses are micro values for the company. Aspects inherent to the micro-environment of the company and

its operations. The understanding of weaknesses is to better predict moves and not getting surprised with possible errors.

- Opportunities: Are possibilities on the business environment that the corporation, project or sector could use for its advantage. Opportunities are measurements in case taken, will elevate the business capability and increase its potential.
- Threats: Are elements on the business that could cause problem to the business, project or sector. Threats should be well understood and possibly classified on their priority order. The higher threats are the ones which are posing a direct threat on the business survival, those are ones which should be solved the fastest. To the least likely threats. Threats and Opportunities are two factors of the SWOT analysis which are more likely related to the company's macro-environment.

In the case study of this thesis, Planc Ltd was primarily using the SWOT analysis in a more general approach. Their first attempts to create a picture using SWOT were using the corporation as whole reference to elaborate it. The result was a vague picture of the company, and that could not be a faithful basis for decision-making process nor the implementation of action plans. Furthermore, as a part of this study, the elaboration of a Sector divided SWOT analysis was made, on which every sector of the company would have its own. The result of this solution was ideal and the picture formed was extremely more precise and the high management had the opportunity to deeply understand each sector. At the end, a general SWOT was elaborated for the entire corporation.

The method chosen was the conduction of interviews with all the workers from every sector and their key leaders. The employees had to answer a standardized questionnaire form, as seen in Appendix 4, with the following questions:

- 1) What are the strength points of your sector and which aspects work very well?
- 2) What are the necessary conditions to keep those strength aspects?
- 3) What are the weakest points of your sector and which aspects do not work very well?
- 4) What are the factors that keep these weak points happening?

- 5) What measurements should be taken to help your sector?
- 6) How could those measurements be implemented?
- 7) What factors could interrupt immediately your sector or pose a high threat?
- 8) What should be done to stop those risk factors?

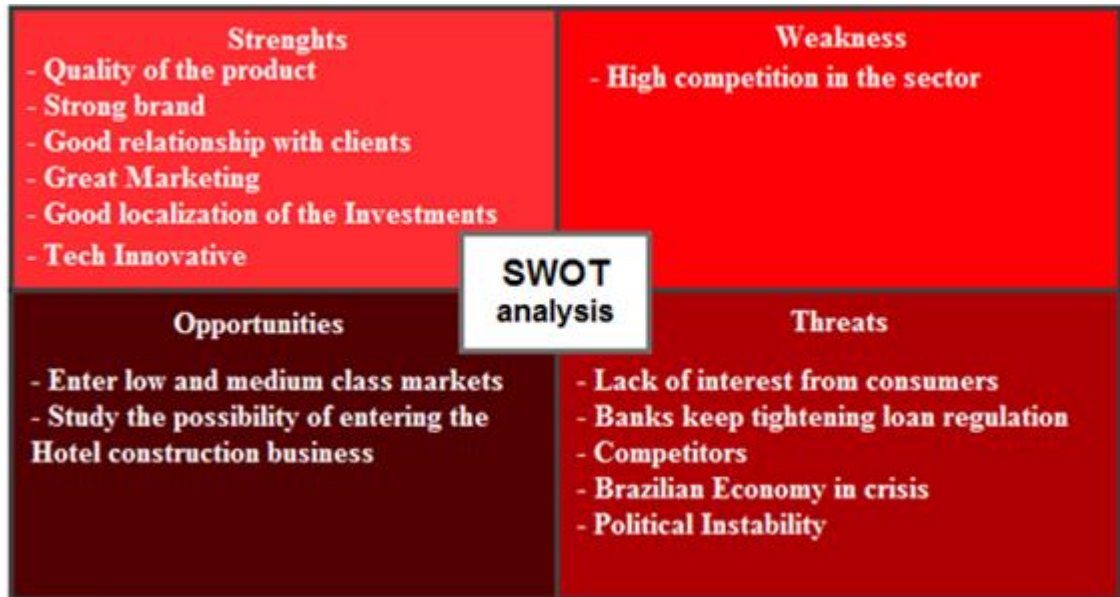


FIGURE 12. A current SWOT analysis of PLANC Ltd. (2017)

A solution was found for a more efficient elaboration of a SWOT analysis, which is the integration of the analysis with a questionnaire. The general approach to this questionnaire is to include all the SWOT elements in it. As well as the understanding that the worker has the better knowledge of its own sector's needs. The first two questions presented are related to the strengths of the company, the third and fourth are related to weaknesses, the fifth and sixth questions are related to the possible opportunities while the last two questions are related to the threats. From the questionnaire, the sectors could identify and quantify the needs and solutions from each sector. This could also be interpreted as a tool of Critical Parameter (Creveling, C. Slutsky, J. Antis, D. 2003).

With the results obtained from each sector, the threats and weaknesses were classified using a GUT matrix (Tregoe B., Kepner C. 1981) for setting priorities on which questions needed the highest priority. This process was important for the elimination of unnecessary efforts in questions that were apparently urgent but happened not to be. The classification was implemented on the following model:

- **Gravity:** How strong will the impact of the issue be, in case it is not solved.
 - 1- Very Low
 - 2- Low
 - 3- Medium
 - 4- High
 - 5- Very High

- **Urgency:** How fast does this problem need to be solved. How can it wait to be solved or does it need to be done immediately?
 - 1- It can wait
 - 2- Not so urgent
 - 3- Urgent
 - 4- Very Urgent
 - 5- Immediate Action

- **Tendency:** It is designated to define if the situation is going to change, stay, or get worse very fast.
 - 1- Does not change
 - 2- Worsens Slowly
 - 3- Worsens at a Medium pace
 - 4- Worsens Fast
 - 5- Worsens Very Fast

After framing the issues in this classification, they should be ranked and action plans should be created for each of the problems found. The creation of actions plans was immensely simplified with the classification of the issues. Some issues with the highest volatility were treated with emergency and solved using DMAIC methods while less important reasons showed to be resolved by itself as the classification considers. The increase in the effectiveness is perceived in the corporation and this single tool has many different and important applications. A possible and desired result is the creation of a Lean system, on which wasteful actions are eliminated (Yang, K. El-Haik, B. 2009).

4 SUMMARY

4.1 Conclusions and Recommendations

The conclusions found in this study were based on the results of the implementation of quality management tools and principles in the company Planc Ltd. which is the study case in question. Some of the recommendations presented here have the possibility of being applied in other situations on the corporations, in case the needs and problems have a similar scope. The case study company Planc Ltd is considered a medium to large sized enterprise, and the main conclusions of its aspects could be related to other medium sized enterprises in the Brazilian or in worldwide context.

Recommendations for start-ups are given related to the aspect of implementing quality tools. The aim of those recommendations is to demonstrate to start-up companies the importance of quality management tools and how overall efficiency can increase with them (Pande, P. Neuman, R. Cavanagh, R. 2002). As well as the importance of implementing quality culture in start-ups since its beginning. Quality tools pose important relevance specially when start-ups or small companies are transitioning themselves into more professional services. The implementation of quality tools by start-ups can be a strong asset on their organizational background.

As a general conclusion, even though quality management tools are more related to functional aspects such as software, measuring tools, techniques and planning tools, for the managers and the corporation. the greatest challenge on implementing them is related to Human Resources (HR) and the acceptance of the culture. Managers and employees have difficulty in adapting to new ways of organization processes, especially when they are used with different operational ways or come from a culture on which quality does not pose an important influence in the corporation environment.

The implementation of quality management tools in corporations require great effort from the high management team, but in medium sized corporations this importance is reduced and the HR sector receives mostly of this responsibility. So as an synthetic conclusion, differently from the initial theoretical thought of the direct implementation of quality management tools, the practical application has shown that the efforts of this

implementation in enterprises, should start by the process of raising awareness of the employees towards the importance of quality management as a culture in the enterprise, to strategic planning and finally implementation of the innovations.

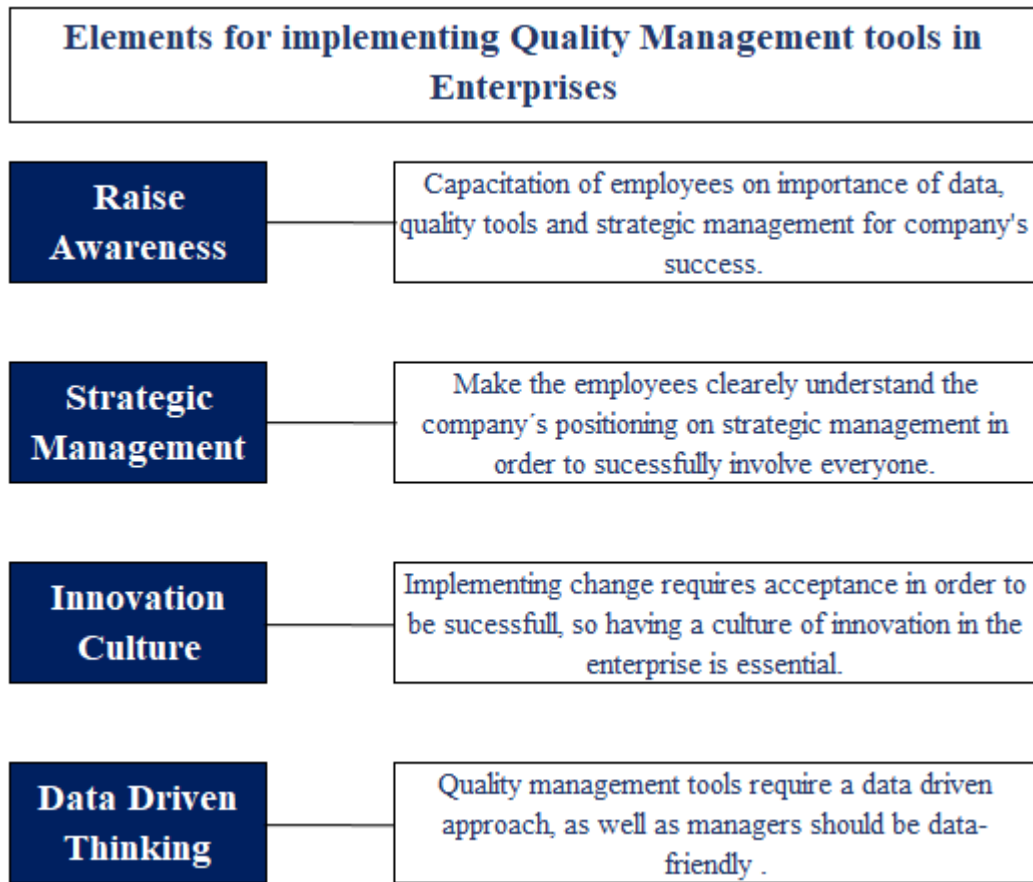


Figure 13. Elements for Implementing Quality Management tools in Enterprises.

Different important aspects should be taken into consideration, but even so, the implementation of quality management tools has been a success on the case study. The application of quality tools has shown to be extremely valuable and its applications are not limited to its original functions. The customization of its use was made naturally, since employees found to be useful for their designated functions, different management tools.

4.1.1 Conclusion of the Study Case

As a conclusion, the process of implementing quality management tools for Planc Ltd, even though not concluded, is being smoothly conducted causing minimum negative impact on the corporation.

When process mapping is made as a first step on the implementation process, the managers can deeply understand the company's dynamicity and better predict the consequences of changes in those processes. Process mapping is useful as well to improve the business as whole. As a recommendation made by this study to Planc Ltd. The process mapping started by sectors and is still an ongoing research during 2017. In 2017 the company had 18 main sectors with respective sub-sectors, so this procedure is an exhaustive research with several processes and variables taking place.

Mapping processes is also an important part of understanding the needs of each sector, to identify the correspondent indicators and implement the respective management and quality tools, and shift from strategy to tactical applications (Creveling, C. Slutsky, J. Antis, D. 2003). The bigger amount of processes mapped, generates bigger opportunities for improvement. Quality certifications and accreditations are also important aspects to be considered. As part of the demands of ISO 9001, process mapping poses an important place. To receive the certification ISO9001 – 2015 companies need to provide mapped processes and those processes need to be respected and followed as described.

Furthermore, Planc Ltd. is implementing the DMAIC methodology for the control of processes, repair of failures and non-conformities, registering of new processes and other different applications (Creveling, C. Slutsky, J. Antis, D. 2003) The implementation of DMAIC was extremely successful since the method had several other applications. Again, the use of DMAIC was a useful tool for adapting and follow the recommendations and demands from the ISO9001-2015 where they ask the companies to create measures using the same principle. The gain for the enterprise was immense, since they were organizing their processes in an efficient way and getting one more element for the accreditation of ISO9001 as well.

Since Planc Ltd. had a specific sector for quality management and implementation, this sector had the duty of providing the orientation for workers to deal with new aspects to

be implemented. This solution caused a great reduction on overworking both the management and the Human Resources sectors.

In engineering, technological and industries, having a sector for in-field quality control is a necessary and standard part of the enterprise's operation. This sector ensures quality for on-site constructions, job safety and has as part of its functions to search its processes and develop solutions to increase quality control and reduce hazards anyhow. Planc Ltd. had as a complementary sector, for quality implementation in processes and administration. This sector made possible an ongoing and never-ending job for implementing quality tools, since they are constantly changing and updating itself, new software is always arriving on the market and tracking for processes follows them. This was an important step for Quality planning and quality management, because from this on, the company had the possibility to plan the implementation of quality instead of implementing quality control issues that were most probably originated from problems. The work of the sector is made in a preventive way instead of remediating past failures.

The implementation of the quality tools chosen by Planc Ltd. was made by sectors, since the company had many and those had very specific needs and operational differences. In other large sized corporations, quality standards are emitted as general recommendation for all the employees. The advantage of this is the saving in working time, since the recommendations need to be followed independently of sector. But, this results in possible misinterpretations by managers and the possibility of not adaptation for the specific needs of a determined sector. Customization in any service requires more time, more effort, and consequently more money invested, but for companies willing to reach highest level of quality, customizing the implementation of quality principles is the key for implementing it smoothly and causing minimum negative impact.

At Planc Ltd, the implementation of the SWOT questionnaire designed by this study was also an important step into the understanding of each sector dynamics. Medium and Large sized corporations could use those guidelines for implementing quality management tools, since there is a high level of similarity with the specifications of Planc Ltd. The main points on this process are:

- 1) The understanding that quality management is an on-going process and a part of the company's strategical approach. The reason for its continuity is that the needs and values of the society are constantly changing and so do quality stand-

ards, new measurements and new procedures are taking place constantly. Ensuring quality in processes and to the enterprise has vital importance. It is function of the management team or designated quality team to keep a constant search for new tools (software, charts, control plans, action plans, etc) for the corporation to benefit from them.

- 2) All the processes in the corporation should be mapped and standardized.
- 3) Change for quality should be embraced by the firm and so by the employees
- 4) The process of implementing quality management tools is better applied when customized for each sector for the several previously presented reasons.
- 5) Tailored solutions are necessary to fit each company's needs. It is a function of the management team or quality team, to create mechanisms and tailored solutions for each corporation. Those solutions should be based on pre-existing models of quality control in order to apply them correctly and not to happen the occasion on which the solution creates a non-conformity with pre-established quality rules and standards
- 6) The creation of quality control sector for management and process controlling is a very important aspect on saving time and efforts. In this way, other sectors would not need to be overloaded, specially the human resources sector which would be responsible for providing capacitation for the workers to follow the new standards and rules.
- 7) Quality tools can have different applications throughout the company's operations and sectors. The intelligent use of those tools is a necessary part of implementing quality.

4.1.2 Recommendations for Start-up's

In case of start-up's, a different approach should be taken. Most start-ups are not large enough for their sectors to have a rigid separation. In many cases, employees from start-ups are performing different functions from different sectors throughout their career or even work day, causing their functions to blend. Initially, the operations of a start-up are not necessarily ruled, since time and several other limitations are a reality, but with development and when company's reach a higher level of maturity, the lack of organization is not seen as an asset and should be considered a problem. In this case, implementing quality management tools and principles is a clear asset for differentiation.



Figure 14. Relevant Factors for Start-up's to apply principles of quality management.

Within those characteristics and limitations, applications of this study can be used by start-ups. Initially the multiple application of quality tools is a decisive aspect of implementing quality principles in start-ups. The main benefit from using those tools, is to organize and set priorities for different tasks within the company's environment. Customized implementation for start-ups means that start-ups can set the use of quality tools and change them according to their needs, instead of following procedures and needing to take in consideration quality certifications and audits, start-ups can use those tools uniquely for their benefit. In the beginning, processes in start-ups are unorganized and not controlled, but with the development of the company, many managers tend to maintain the informality that surrounds the start-up culture. The creation, understanding and mapping of processes can be an ally to standardize the company's procedures and so on, increase the overall efficiency and performance standards (Pande, P. Neuman, R. Cavanagh, R. 2002).

The development of a start-up towards an established company is a subject of deep studies and analysis in nowadays researches, but once again, the question presented is related to the difficulty on managing human resources, since the members of start-up's are dealing with a question of transitioning from relative "informality" to a higher level of "formality" if organization and standardization could be understood as so. Even though more data-friendly, start-ups still face this conflict. In case start-ups are built within a framework, the main advice is to include the implementation of quality tools as part of the company's development plan. In case implemented too early, it could cause the problem of limiting the freedom of the start-up to operate, and in case implemented too late, it could increase the difficulty of the members to adapt to the new policy. So being part of the development plan, could be an asset towards a smoother acceptance of those tools and a better identification of them.

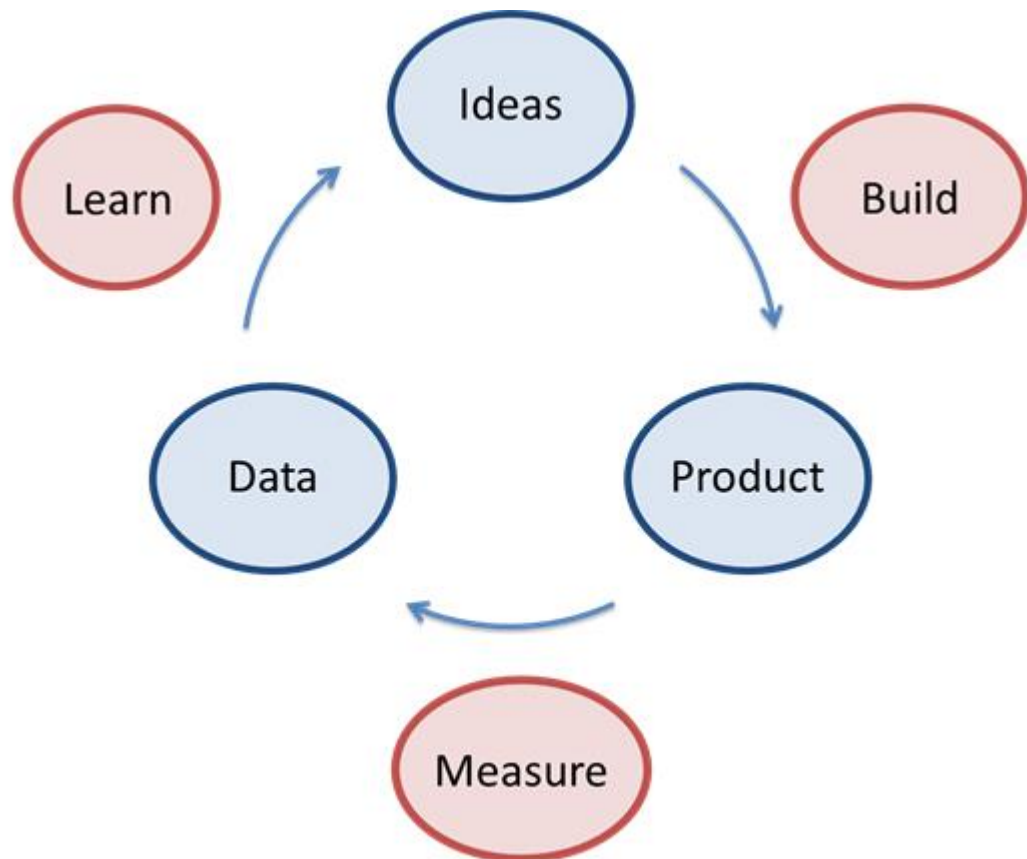


FIGURE 15. The Lean Start-up Cycle. Font: Agile Academy

Considering the development of a startup in phases, those stages are built with the idea of understanding the product output throughout data analysis. Principles of quality can be a strong asset into developing more efficient ways of measuring this data. It is important for startups to understand their outputs but also create mechanisms on collecting

relevant data. This shows that to generate a great learning output, the quality of the analysis depends on the quality of the indicators. And, always having their consumers as the most critical element in product development (Summers, D. 2009)

Startup's environment counts with high level of flexibility in basically all aspects, as well as innovation are part of its culture. The culture of innovation is a great advantage for implementing quality tools, many startups are built on change, due to their experimental nature, some of them don't even have a defined space on the market and their disruptive nature embraces innovation as natural. The acceptance for change poses the most important aspect for successfully implementing quality since it mainly counts with the embracing from employees into turning data in practical actions.

4.2 Case Study Practical Implementation Example

Regarding the case study of this thesis, recommendations established by this study were applied in different situations on the company's operational. As previously mentioned the most effective tool to be applied was the use of DMAIC for different applications, with real focus on the customer (Pande, P. Neuman, R. Cavanagh, R. 2002). The most important application for DMAIC was treating non-conformities related to the certification ISO-9001. It is the function of the management team to find and implement the most intelligent usage existing tools, and possibly even creating new ways of implementing the quality management culture. In the case study, a slight adaptation on the original usage was made, and its application, as a recommendation from this study.

With the presented market situation in Brazil, the economy is going through serious shifts and the companies should find ways to deal with change. That change can be perceived in different aspects throughout the company, from its micro environment on the change of internal processes to its macro environment where new regulations are constantly being imposed and the action of competitors tends to tighten even more the possibilities of operations. Within this scope, managers should find viable solutions for differentiating from competitors, and among them, investing in credibility is a great option. Since several companies had to terminate their operations and declare bankruptcy, surviving through the crisis, and still strongly operating is a marketing plus. Companies found in this situation, are having their time to build credibility, and the best way to do this is by having quality standards certification. The benefits can be observed in two

ways. Primarily the company having such certification is perceived by the customer as having higher quality than its competitors, while secondly the company will be implementing high level of quality standards that will help ensure a more effective and sustainable environment.

“The ISO 9000 family of quality management systems standards is designed to help organizations ensure that they meet the needs of customers and other stakeholders while meeting statutory and regulatory requirements related to a product or program”.(Poksinska B. Dahlgaard J. Marc A. 2002). Alongside with ensuring the overall quality in a company, receiving the ISO-9001 qualification is a plus, on generating trust with the customer and enhance credibility. In the case study company, Planc Ltd. The maintenance of this certification is an essential differential factor for its operations. In the Brazilian North-East market, the certification is seen as a highly appreciated accreditation and it truly provides the customer a sense of seriousness and professionalism, since many companies don't possess it yet.

To receive or maintain the certification ISO-9001, companies should be audited by a certified auditor, for the inspection and analysis if the company is truly following the pre-requisites established by the certification provider. This inspection happens at an annual basis. In case some operational aspect is found to be happening and not following the established pre-requisites, this can be a *non-conformity*, in this case, the non-conformity (NC) can be either a major or minor one. A major NC can be a reason enough to stop the operations of the company, while a minor, can be a reason for a notification. The NC's can be caused by different means:

- A normative requisite not achieved or not fully achieved.
- An intern procedure not achieved
- An indicator that did not fulfill its established goal
- A complaint made by a client
- Legislation not followed

In this case, several reasons can pose influence in the appearance of NC's. Managers should have great understanding about the operational aspects of their enterprises. In case internal processes are created, the manager needs to be confident enough for them to be followed, in case not, the company can be committing a NC. It is important to create constancy of purpose (Yang, K. El-Haik, B. 2009) and as a gen-

eral recommendation, if the company is not able to fulfill the specifications of a process in any sector, this process should be extinguished and not be included in the company's operational plan.

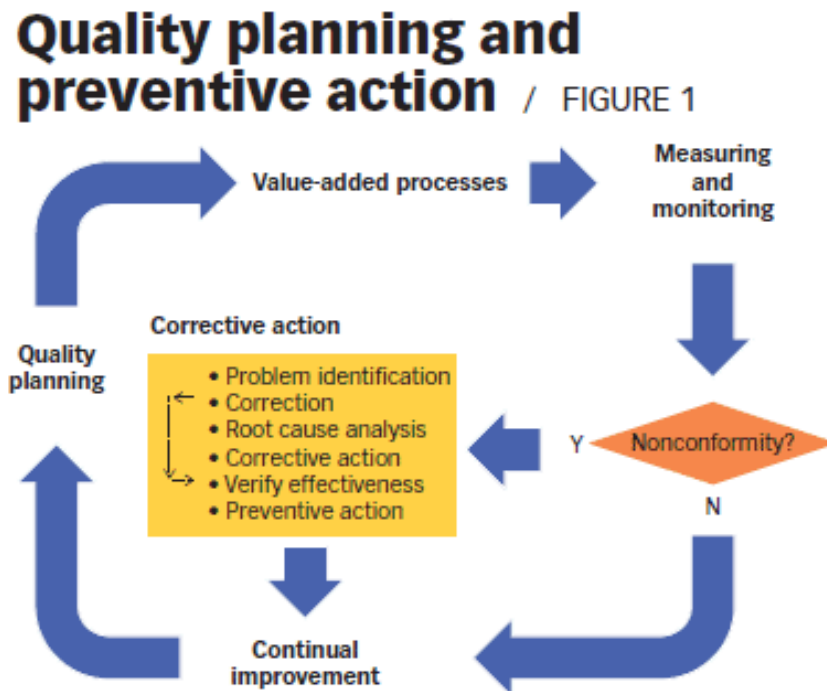


FIGURE 16. Quality planning and preventive action. Font: Quality Progress

With the non-conformity found and understood by the auditing company, it is function of the manager to implement the respective solutions. As part of those functions, the managers should not only implement solutions for solving the specific problem found, but instead, implement ways for those problems not happen again, definitive solutions. As a recommendation, the process of treating non-conformities should follow the order:

- Definition of Contention Action: The “contention action” should be an emergency solution for solving uniquely the problem presented. It does not necessarily need to be a solution for the problem not to happen again.
- Scope Evaluation: Aims to identify and determine the scope of the presented non-conformity and stablish how strong is the impact of the problem on the company. The importance of the Scope Evaluation is to understand the data provided.
- Correction Action: Aims to implement mechanisms for the non-conformities not to happen again. This action, differently from the contention action, aims to investigate the root of the problem and treat it for the possible extinction

of it. It relates other possible problems that are happening within the same scope of the presented non-conformity.

- Cause Evaluation: Aims to search for the specific reason which caused the non-conformity. The understanding of the foundation of the problem might be a long process and for its fulfilment, the case evaluation is important. Different methodologies can be applied for this study, such as the 5 why's, Brainstorming, and the previously mentioned Ishikawa Diagram (FIGURE 10.) or a customized way that better suits the need of the specific company.
- Elaboration of an Action Plan: With the non-conformities found, its roots established and the problem fully understood, the manager should create an action plan to implement the measures for solving the problem. Those measures can differ according to the case, some require the elaboration of a completely new process or simply the modification of some aspects that generated this non-conformity. The elaboration of the action plan can be made upon different approaches, among the most commons it the 5 what's and 2 why's which stands for (1) Who? (2) What? (3) When? (4) Where? (5) Why? (1) How Much? (2) How?
- Checking the implementation: In this step, a verification of the implemented measurements will be done. The reason for this is to check if the process is running according to the predicted plan, and the indicators are matching the possible expectations. A comparison between the initial predicted values and the final outputs will be made to understand what went differently in the process in case some data doesn't match. In this step, it is important that the company has effective ways of collecting data. With best and most relevant indicators, the management team will be better prepared to control the output of the resolution of the problem.

In the case study example, Planc Ltd. Made usage of elements of DMAIC for the creation and elaboration of an actions-plan. Planc Ltd, has established the use of DMAIC in case some non-conformity might appear. The appliance for the resolution was an adaptation of its original usage and this has increased the range of usages of the same methodology by intersecting ideas (Johansson F. 2006). The usage was made and minimally modified on the following order: (1) Define the problem and understand and identify its scope, (2) Measure the problem and see how far it went by using different mechanisms. In this step, it is important that the data provided is compatible with the reality, in this case, good indicators will provide this data. (3) Analyze: Identify, validate, and select possible root causes for the non-conformities by using the Ishikawa Diagram or other possible methodologies. This step has the finality to implement a final solution instead of an emergency meas-

urement. (4) Improve: Identify, test, and implement the possible solution for the problem, if possible the solution should be previously tested to avoid unnecessary expenses. (5) Control: Maintain the gains conquered and monitor the improvements to guarantee a sustainable success. This final step aims to create a control plan for constantly updating the information on the company.

Even though minimally altered, this adaptation on the usage of DMAIC, was a solution found to simultaneously guarantee a good quality standard on the resolution of the problem by understanding and solving its root cause, and simultaneously providing a safe solution for solving a non-conformity, within the legal requirements of the quality certification providers.

The overall goal of the implementation of DMAIC together with other management tools, is to effectively create the culture of quality management on the corporation and increase customer satisfaction (Yang, K. El-Haik, B. 2009). To ensure the highest levels of quality management, and possibly a state of total quality management. The process of planning operations in the company should include quality management tools. Managers should implement those tools aiming to reduce to possibly zero, the appearance of errors and failures through all the possible processes on the company, again, using principles of six-sigma. The existence of many failures is caused by the lack of thought given to quality management while planning those processes. Even though this process might be initially time consuming, the consequences generated by it are immensely rewarding, since the reduction in correction actions is substantial. The overall operations of the company should be preventive instead of remediated.

The main consequence in implementing these tools is the increase on quality and decrease on failure throughout the processes of the company. Even though this is the expected and most likely result, the overall result goes beyond the internal aspect of the company and it is perceived by the higher satisfaction of the customer. The overall aim of this entire implementation is to provide a higher level of satisfaction for the customer and this understanding is something that should always be considered while planning the processes at any corporation.

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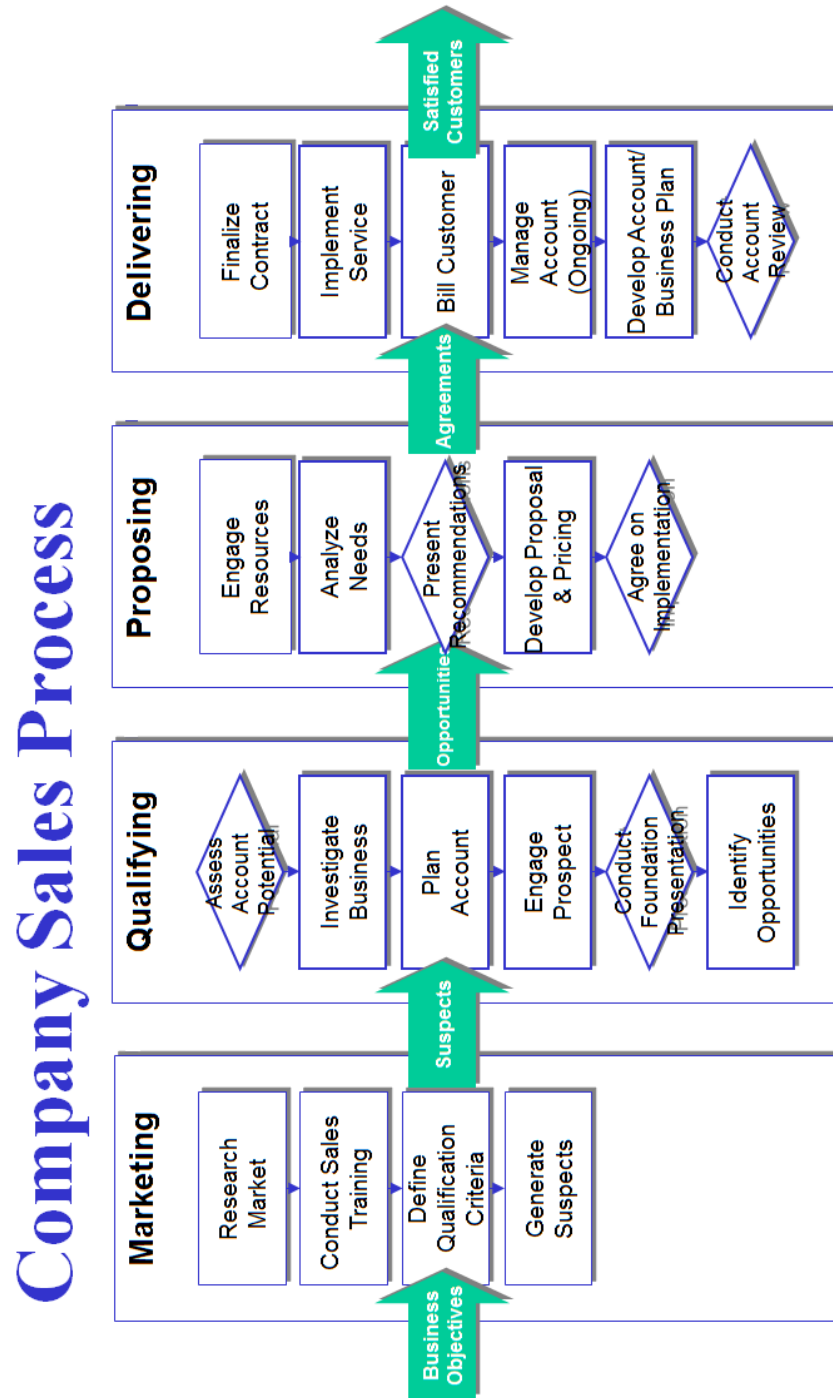
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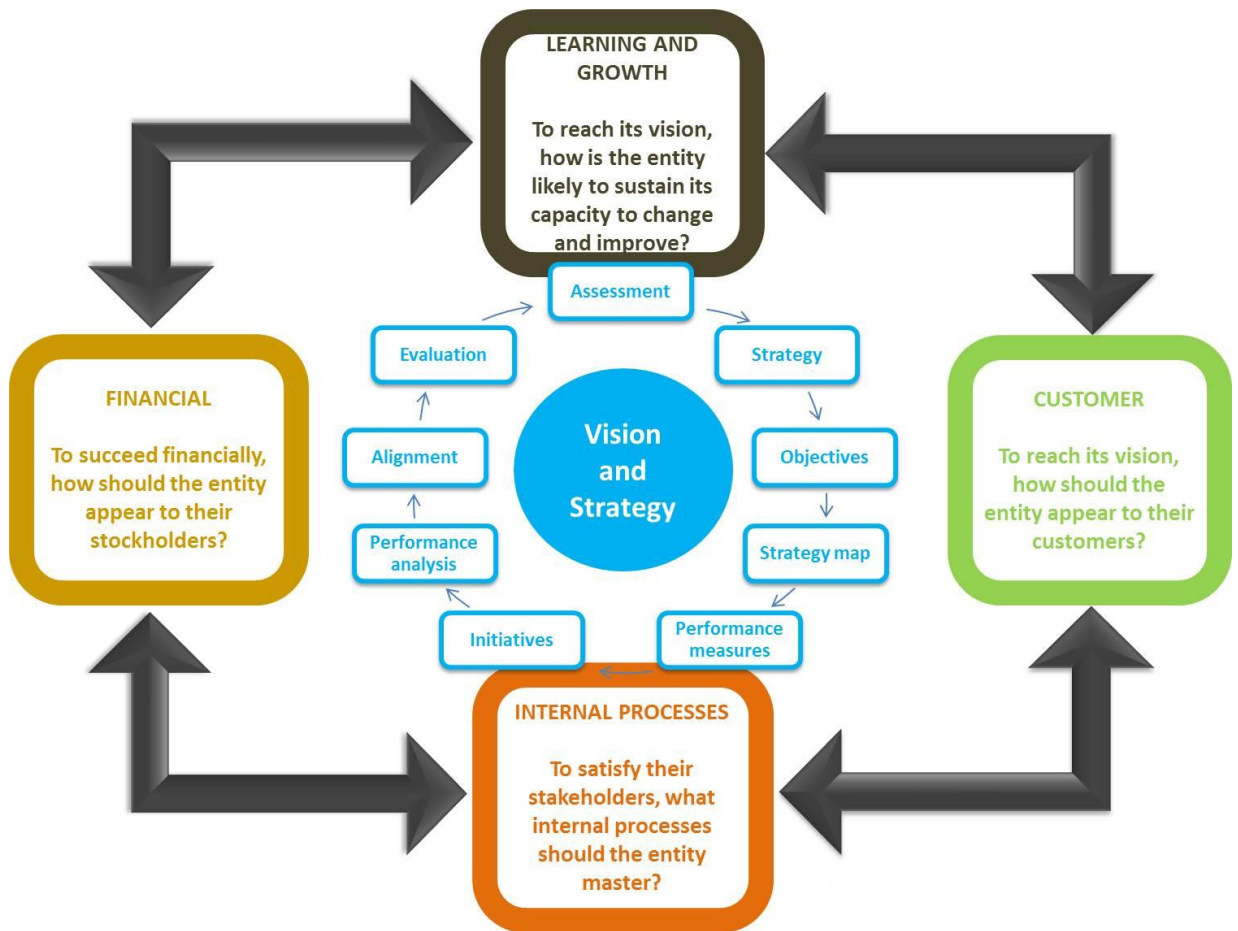
APPENDICES

Appendix 1. Company Sales Process



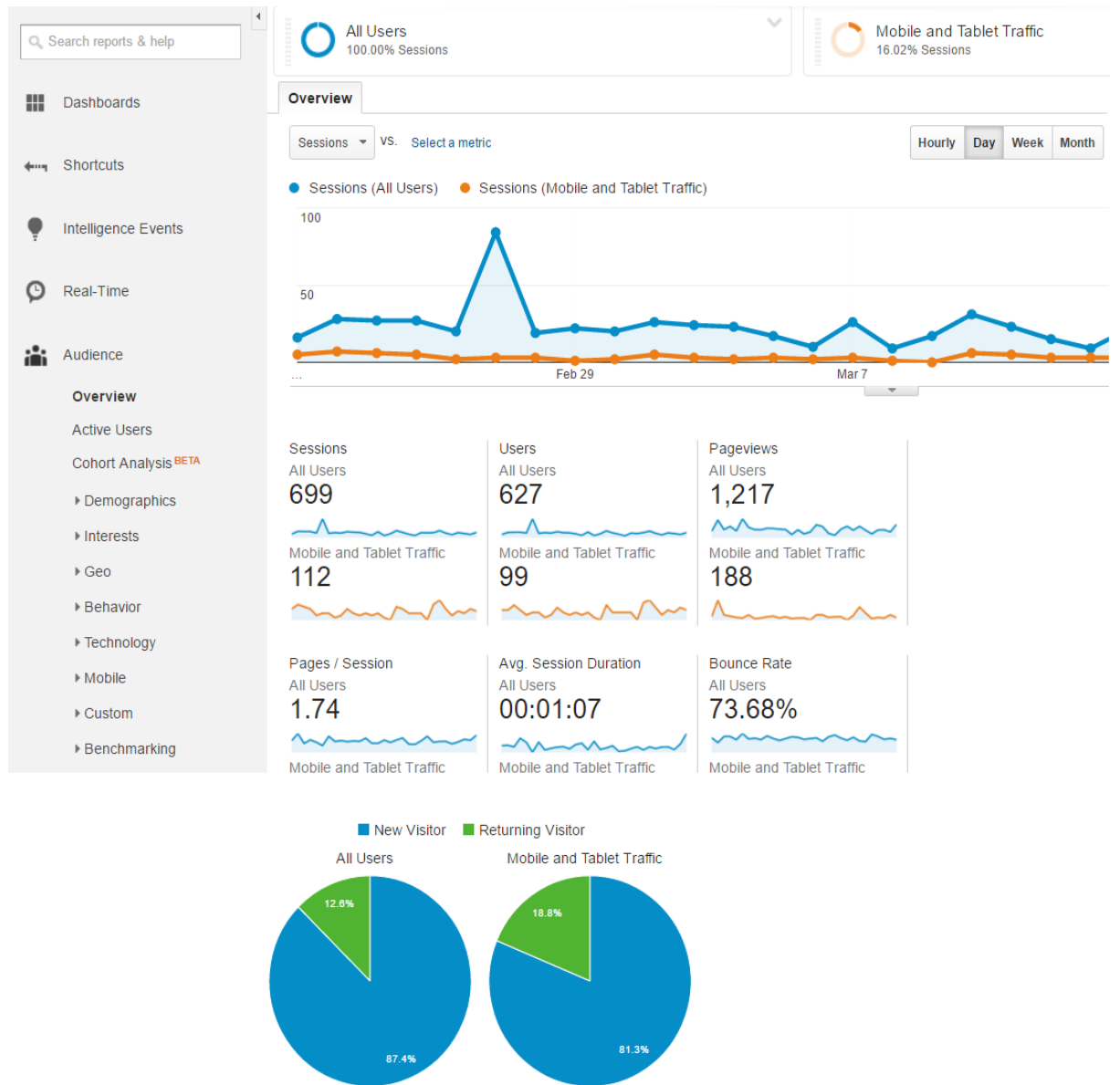
Source: I six sigma.

Appendix 2. Balanced Scorecard (BSC) Example.



Source: Lean Six Sigma Belgium

Appendix 3. Google Analytics User Interface.



Appendix 4. Questionnaire for the Elaboration of a SWOT Analysis

QUESTIONNAIRE FOR THE ELABORATION OF A SWOT ANALYSIS		
SWOT QUESTIONNAIRE FOR THE CONTROL OF QUALITY IN PROCESSES		
RESPONSIBLE:	SECTOR:	DATE:
EMPLOYEE:		
<i>This questionnaire for the elaboration of a SWOT analysis, is made for the development of a more efficient strategic plan and control of quality in sectors and processes.</i>		
S	1 - What are the strength points of your sector and which aspects work very well?	
S	2 - What are the necessary conditions to keep those strength aspects?	
W	3 - What are the weakest points of your sector and which aspects do not work very well?	
W	4 -What are the factors that keep these weak points happening?	
O	5 - What measurements should be taken to help your sector?	
O	6 -How could those measurements be implemented?	
T	7 - What factors could interrupt immediately your sector or pose a high threat?	
T	8 - What should be done to stop those risk factors?	

