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Laundry's Process Optimization: A Case Study in a Five Star Hotel

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Master Thesis

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To my loving family

Abstract

The constant evolution of market is leading companies to develop best strategies day after day. Hospitality industry is not different and faces the challenges of increasing offer and most demanding customers. The main objective of this project was to enhance the competitiveness and sustainability of a hotel by improving processes related to Laundry, an impactful department for the business. The principal methodology used for this was Case Study. The processes in matter were mapped using flow chart, swim lane and value stream mapping and the improvements proposed focused on the 8 wastes of lean production. A future value stream mapping were also proposed, as well as the performance indicator to be addresses. Due to Covid-19 pandemic not all objectives could be fully achieved for this project, specially the ones regarding the implementation of actions and performance measures. Still, this project was able to meet the principal goal, improving processes by using Lean Thinking, and presented positive outcomes. The relevance of this thesis is the usage of a methodology created for a manufacturing environment and adapt it for a service-based context.

Keywords: Process improvement, lean thinking, hospitality industry, laundry.

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Table of Contents

1	Introduction.....	9
1.1	Motivation.....	9
1.2	Research Objectives	10
1.3	Report outline.....	10
2	Literature Review	12
2.1	Process Improvement	12
2.2	Lean Thinking.....	16
2.3	Business Process Management (BPM).....	17
2.3.1	Business Process Modeling.....	18
2.3.2	Business Process Mapping.....	18
2.4	Value Stream Mapping.....	19
3	Problem Characterization.....	20
3.1	Company Description	20
3.2	Sustainability.....	21
3.3	Process to be addressed.....	21
3.4	The Laundry Operations.....	23
4	Methodology.....	24
4.1	Philosophical Worldviews.....	24
4.2	Research Designs	25
4.3	Research Methods	27
4.4	Research Design Adopted	27
5	Results	29
5.1	Project Implementation Planning.....	29
5.2	Specify Value	29
5.3	Process Mapping	29
5.4	Process Description	30
5.5	Identify the Value Stream.....	31
5.6	Flow Improvement.....	34
5.7	Improvement Implementation.....	36
5.8	Perfection.....	38
6	Conclusion and Future Research.....	40
	References	42
	APPENDIX A: Total Quality Management Gurus.....	45
	APPENDIX B: Laundry Processes Flow Chart.....	46
	APPENDIX C: Laundry Processes Swim Lane	47
	APPENDIX D: Current Value Stream Mapping	48
	APPENDIX E: Proposed Value Stream Mapping	49

List of Tables

Table 1 Lean production eight types of waste (Source: adapted from Duffy & Wong (2016))	15
Table 2 Value adding attributes (Source: adapted from Dubé & Renaghan (2000))	22
Table 3 Type of linen per department (Source: author)	23
Table 4 Performance indicators to be deployed (Source: author)	38
Table 5 Total Quality Management Gurus (Source: adapted from Kiran (2016))	45

List of Figures

Figure 1 Chronological evolution of manufacturing methodologies (Source: Stamm, Neitzert & Singh (2009)).....	12
Figure 2 Lean - a framework (Source: Hines, Holweg & Rich (2004))	16
Figure 3 Swim Lane Model (Source: Damelio (2011))	18
Figure 4 Value stream mapping method (Source: Sunk, Kuhlang, Edtmayr & Sihn, 2017) ..	19
Figure 5 The Fladgate Partnership Structure (Source: author)	20
Figure 6 Estimative of possible cost saving (Source: adapted from Styles, Schoenberger & Galvez-Martos (2015))	22
Figure 7 Research design framework (Source: W Creswell (2009))	24

List of abbreviations

BPM: Business Process Management

DMAIC: Define, Measure, Analyse, Improve, Control

HVAC: Heating, Ventilating and Air Conditioning

ISO: International Organization for Standardization

JIT: Just-in-time

PDCA: Plan, Do, check, Act

TOC: Theory of Constrains

TPM: Total Productive Maintenance

TQM: Total Quality Management

1 Introduction

The project for this thesis was conducted at a five star hotel based in Vila Nova de Gaia with the purpose of implementing lean thinking principles to its processes. Due to the complexity of the operation and the lack of lean experience, it was defined to focus on a specific department, in order to validate the actual application of the tools and techniques related to this subject. The department in matter is the Laundry and it was chosen for several reasons, among them we can highlight the spectrum of connection with other departments, once the Laundry serves the hotel as a whole, and the value that Laundry aggregates from a final customer perspective.

1.1 Motivation

Market

In 2016, the tourism in Portugal represented the major export activity in the country. From 2005 to 2015, the revenue from tourism increased by an annual average rate of 6,3% which, in comparison to the competitors, was the second highest rate, after only Malta Island. In the same period, the larger airports in the country registered an increment of international passengers flow from 8,5 to 16,1 million, increasing almost 90%. It is important to highlight that the performance of the sector led Portugal to occupy the top 15 most competitive destinations around the world, according to the Travel & Tourism Competitiveness Index. With a brilliant past and even more promising future, the strategic plan established for tourism sector aims to reach the mark of 80 million room nights and € 26.000.000.000 of revenue up to 2030, an evidence of the importance of this sector for the Portuguese economy over the next decade. (Estratégia turismo 2027, 2017)

In parallel with the growth of the tourism, the offer of accommodation followed the trend and the competition became more vigorous. Also, data collected in the past years showed that the number of room nights does not follow the increase of tourists that visit the country. In 2018, the collective accommodation sector registered a variation of 4,3% on offered capacity, 5,1% in guest number and 3,1% in room nights (against 10,7% in 2017), evidencing an important slowdown. Still, the demand was concentrated in Algarve, Metropolitan Region of Lisbon, North Region and Autonomous Region of Madeira. (Instituto Nacional de Estatística, 2019)

For these reasons, hotels had to invest more and more to captivate clients and maintain the sustainability of the business. With that in mind, several studies were deployed in order to define the attributes that create value from a customer perspective. Kashyap and Bojanic (2000) found on their research that the value perception is an instrument for customers' decisions making, enhancing the need for companies to deploy strategies for value creation. They also defined two ways of adding value: improving perceived quality by providing desired amenities and lowering perceived price, through the reduction of monetary and nonmonetary costs. Another important finding of the study was the difference of value perception among business and leisure travelers, forcing companies to adjust price and improve quality according each group. Oh (1999) study shows that perceived value has a strong connection with customer satisfaction and repurchase intention, affecting also word-of-mouth. Another interesting finding is that besides the price and service quality, performance perception also affect perceived value. Petrick (2002) in turn proposes measuring value

perception through five interrelated dimensions: quality, emotional response, monetary price, behavioral price and reputation.

As we can see, there are some similarities on studies above mentioned findings regarding value perception, namely price, quality and overall performance. The scope of this project is to address how to increase processes performance and quality and enable cost reduction (and consequently price) through the implementation of process improvement methodologies. Further in this dissertation, different approaches will be mentioned, but the focus and matter of analysis will be Lean Thinking.

Sustainable Tourism

Another considerable trend in Hospitality Industry is sustainable tourism. The crescent demand for sustainable products and services lay on the increasing sensibility of customers over environmental issues, suggesting a great potential for organizations. Even though many companies believe that sustainability represents a necessary and admirable global goal but in practice is an expensive concept to apply, in practice, many economic benefits are related to the adoption of sustainable practices. We can cite regional economic development, customer comfort and convenience with optimized resources, better work environment and enhanced productivity, build up competitive advantage, enhanced profits by diminishing costs and increased overall company value. (Bohdanowicz, Churie-Kallhauge, Martinac & Rezachek, 2001)

1.2 Research Objectives

This project aims to cover three main objectives:

Objective 1: Verify the applicability of Lean Thinking in hotel operations context;

Objective 2: Map and analyse the current processes in Laundry;

Objective 3: Propose an improved flow for the Laundry.

As the name suggests, Lean Manufacturing and its derived Lean Thinking, are concepts developed for the manufacturing industry, but in the past years have been largely used in different contexts with many positive outcomes. This dissertation aims to cover if the same applicability is true for the hospitality industry and to provide an actual improved model by using the methodology.

1.3 Dissertation outline

This dissertation is divided in 6 main sections as it follows:

- Introduction: provides an overall picture of the study, contextualizing the motivation and objectives of the paper;
- Literature review: this section comprises detailed review of the literature regarding process improvement, business process management and business process mapping. It presents a timeline of philosophies and methodologies in order to understand the evolution of concept over time and current trends;
- Problem characterization: describes the company where this project took place and the issues addressed during research.

- Methodology: this item has two major sections. The first part provides a summary of distinctive research approaches found in literature. After that, the research agenda defined for the project is detailed, including the chosen technical methodology and tools.
- Results: this section is dedicated to present the process mapping before improvement, process analysis according to company's necessity, recommended improvements and suggested performance indicators to be employed in the sector;
- Conclusion and future research: finally, this section aims to analyse if the research objectives were accomplished, the difficulties found during the journey and gives suggestions for futures research agenda.

2 Literature Review

2.1 Process Improvement

The concept of process improvement is relatively dated and its evolution confusing, due to the number of different approaches suggested over the past decades. In order to better comprehend the evolution of methodologies as well as their drivers and needs, Stamm, Neitzert, & Singh (2009) propose a framework that condense manufacturing methodologies chronologically as presented in Figure 1.

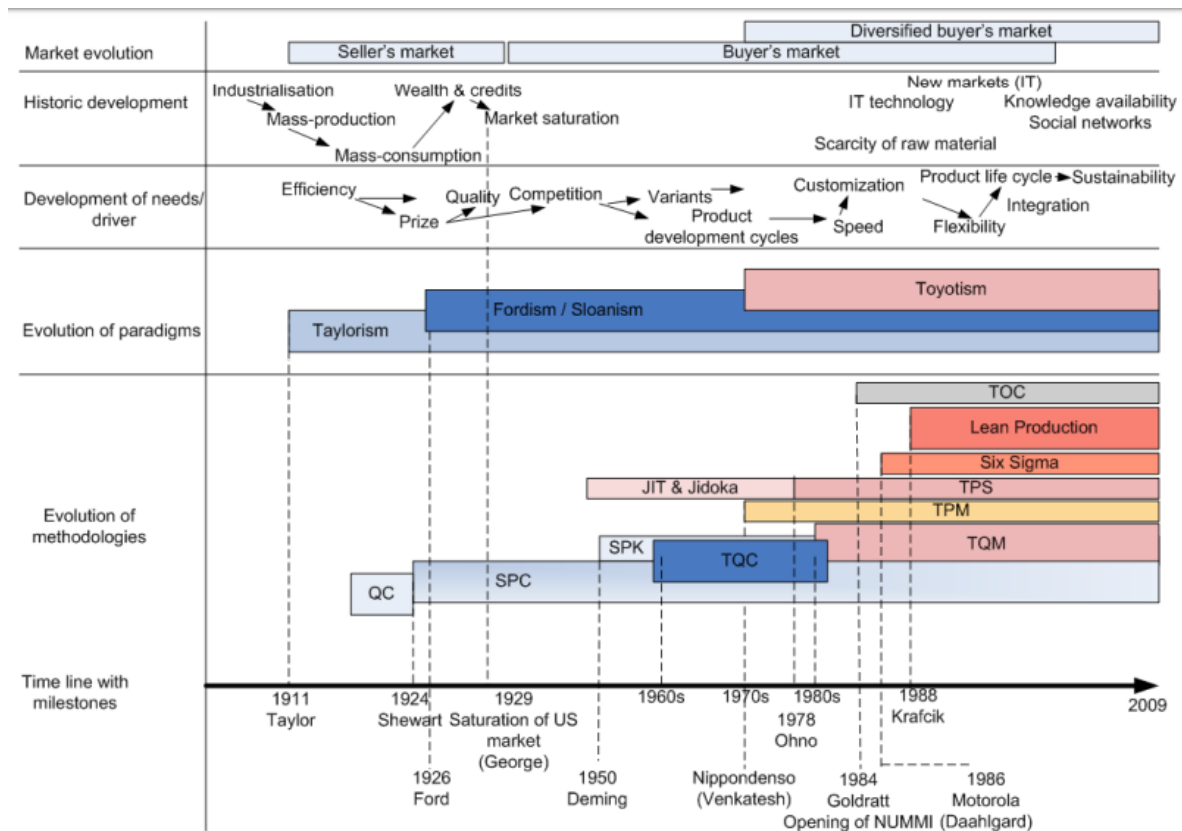


Figure 1 Chronological evolution of manufacturing methodologies (Source: Stamm, Neitzert & Singh (2009))

As we can see, the first studies around this agenda can be traced to the beginning of 20th century, however it became more vigorous from 1950 on. The more relevant methodologies will be explained next.

Total Quality Management (TQM)

According Kiran (2016) this methodology first arose during the 1920s, when statistical theory began to be applied to product quality control and evolved during the years until the current concept of Total Quality Management. The author claims that the evolution of TQM had 5 phases, suggested by Feigenbaum: operative quality control, foreman quality control, inspection quality control, statistical quality control and total quality control.

Many gurus took part in this evolution. APPENDIX A presents the most relevant ones and their contributions (Kiran, 2016). The number of people involved shows the relevance and complexity of this methodology.

Diamandescu (2016) provide in his paper an analysis about the principles of TQM. To do that, he consulted specialists and the SR EN ISO 9000:2006 – Chapter 2 and established eight principles for quality management. This study brings a more updated vision on this subject as considers impact of ISO standards and Kaizen System on different enterprises. The principles suggested by the author are:

- a) Customer Advocacy: regards attending customer needs by understanding their expectations, establish corporate objectives according to that information, promote customer loyalty, manage customer satisfaction and plan actions on results and promote a relationship with the client;
- b) Ensuring leadership / Management involvement: aims to guarantee the commitment of leaders in different levels of the organisation during the implementation of TQM, which, in turn, will involve employees;
- c) Involvement of staff in decision making: means to develop individuals to have the necessary skills to solve problems, make decisions and engage in quality improvement. To implement this principle is vital to implement a culture of quality inside the organisation.
- d) Process approach to management: in this case, a process is understood as “*set of activities that relate and interact to transform inputs into outputs*” and this principle aims to identify processes needed for quality management system and their interaction inside the company, enabling continuous improvement;
- e) System approach to management: regards the need of full involvement of all company for quality management as the neglect of one department may waste the effort of others. This principle also treats quality management as one part of a bigger structure that a company comprises and goes along with human resources, health and safety and other vital processes. In other words, it is a systematic approach to quality management;
- f) Continuous improvement in performance: regards involving people from different levels inside the organisation in projects to improve internal capabilities. In this principle, the author mentions two main approaches: PDCA Cycle and Kaizen;
- g) Management by facts: in simple terms, means that every decision must be supported by facts, reducing decisions made by “personal opinion”;
- h) Mutually advantageous relations with suppliers: in common terms, it means to have a “win-win” kind of relationship with suppliers. While suppliers must fill quality requirements, the manufacturer takes in consideration their interests, promoting a beneficial relation for both.

Jaeger & Adair (2016) provide a summary of a literature review around the major benefits, practices and obstacles during the implementation of TQM from different author's perspectives. According to the study, positive impact on employees, productivity, quality, customers, cost and competitiveness are commonly presented as great benefits of adopting this methodology.

Total Productive Maintenance (TPM)

The conception of Total Productive Maintenance was originated in 1951 in Japan with the advent of preventive maintenance, a North American concept. In 1960, Nippondenso was the first company to implement wide preventive maintenance to its plant. Also, due to an increase in process automation and the need to reinforce maintenance team, the company established autonomous maintenance, a feature of TPM. The concept of TPM originates from the merge of preventive maintenance, maintenance prevention and maintainability improvement. (Venkatesh, 2007)

Sharma & Shudhanshu (2012) provide on their study a comparison between different authors who suggest the pillars of TPM. According to the authors, the most accepted approach is the eight pillars of Nakajima Model: focused improvement, autonomous maintenance, preventive maintenance, education and training, maintenance prevention, quality maintenance, office TPM and safety, health and environment.

As the implementation of TPM improve process productivity by enhancing reliability and reducing waste, this methodology plays an important role to support TQM. (Kiran, 2016)

The main advantages of implementing this methodology are increase productivity, resolve customer complains, reduce manufacturing costs, enhance customer satisfaction, decrease accidents and pollution control. Other indirect benefits regard the improvements on work place and positive change on team's behavior. (Venkatesh, 2007)

Just in Time (JIT)

Gunasekaran & Lyu (1997) defines JIT as *"a system that produces the required item at the time and in the quantities needed"*. Still according to the authors, this approach combines contradictory objectives: low cost, high quality, manufacturing, flexibility and delivery dependability.

The basis of JIT is 5S: *seiri*, *secton*, *seize*, *seiketsu* and *shitsuke*, that in English correspond to sort (classify materials according to usability), set in order (organize materials on place), shine (remove unnecessary materials), standardize (maintain the good shape of shop floor), and sustain (to promote teams good habits and establish rules). (Gunasekaran & Lyu, 1997)

Looking to the origins of JIT, Kiichiro Toyoda would be the "father" and Henry Ford the "grandfather" of what has been already referenced as a method, a concept, a goal, a belief, a philosophy, a system, an approach, a process, a strategy, a program and a state of mind. Parallel to JIT evolution in Japan, in the United States companies started to pursue continuous incremental improvements through *Kaizens*. (Vokurka & Davis, 1996)

In practice, firms that adopt JIT and properly involve employees and suppliers enjoy the reduction of goods rejection, of inventories, lead time, set up time and labor turnover. Still, the major part of companies believe that JIT may be beneficial for relationship with suppliers, customer service, products quality and monetarily. (Wafa & Yasin, 1998)

Toyota Production System (TPS) & Lean Production

With successful background producing textile machinery, after the World War II Toyota decided to invest in producing cars and trucks, skills developed during the war due to the necessity of produce trucks for military. However Japan had a small and diversified market, which demanded several types of car in small quantities, and labor regulations were implemented by American occupation, leading workers to require more favorable conditions. Nevertheless, domestic economy was devastated and competition worldwide was fierce. With

all of that, it became clear that the Western manufacturing approach had no place in Japan, which, in the hands of Eiji Toyoda and Taiichi Ohno, gave birth to The Toyota Production System, later baptized Lean Production. (Womack, Jones & Ross, 2007)

Spear & Bowen (1999) propose four rules that form the essence of The Toyota Production System. They are:

- a) How people work: relates with the way individuals perform their activities .It means deliver a specified content, in the right sequence, programed timing and proper outcome;
- b) How people connect: relates with the way people interact to each other. It is a supplier-customer relationship that specifically defines standards, direction, people involvement, volume to be delivered, form of request and time expected to be attended, eliminating grey zones between processes.
- c) How the production line is constructed: relates to have a simple and specified flow to be followed by the product or service, without forks or loops.
- d) How to improve: determines that improvements must be made by the lower organizational level possible, following a scientific method and under the supervision of a professor.

Duffy & Wong (2016) state that the major focus of this methodology is reducing waste and optimizing processes from customer's perspective. The eight category of waste are presented in Table 1.

Table 1 Lean production eight types of waste (Source: adapted from Duffy & Wong (2016))

#	Type of waste	Description
1	Overproduction	Product being produced in excess quantity and being made before the customer needs them.
2	Waiting	Periods of inactivity in a downstream process that occurs because an upstream activity does not produce or deliver on time.
3	Transportation handling	Unnecessary movement of materials or double handling.
4	Over processing	Spending more time than necessary to produce the product or service.
5	Unnecessary inventory	Any excess inventory that is not directly required for the current customer's order.
6	Unnecessary motion	Extra steps taken by employees and equipment to accommodate inefficient process layouts.
7	Defects	Errors produced during a service transaction or while developing a product.
8	Intellect	Inefficient use of resources based on job level, skill, knowledge, and experience.

Theory of Constraints (TOC)

Goldratt (1990) defines system constrain as “*anything that limits a system from achieving higher performance versus its goal*”. The author defines the following steps to apply this methodology:

- a) Identify system's constraints;
- b) Decide how to exploit system's constraints;

- c) Subordinate everything else to the above decision;
- d) Elevate the system's constraints;
- e) If in the previous steps a constraint has been broken, go back to step a).

Six Sigma

The concept of Six Sigma was created by Motorola engineers in 1981, who were inspired by the gurus of TQM and TPS, and aims to improve process quality by reducing identifying and eliminating the causes of defects. In other words, this methodology permits to reduce the variation of the process. When a company achieves six sigma level, it means that per a million of opportunities, only 3,4 have defects. For this methodology, the improvement cycle used is DMAIC (do, measure, analyse, improve and control). (Kiran, 2016)

2.2 Lean Thinking

A more recent approach to these methodologies is proposed by Womack & Jones (2003) and focus on value. The authors suggest five steps to implement lean thinking in organizational context, they are:

- a) Specify value: value is created by producer, but can only be defined by the customer. As the author claims *"providing the wrong good or service in the right way is muda"*;
- b) Identify the value stream: the analysis of value stream will lead to three different types of activities. The ones that actually aggregate value, the ones that don't aggregate value but are necessary and the ones that don't aggregate value and are unnecessary.
- c) Flow: after eliminating waste, the next step is rearrange value creation processes in a logical flow;
- d) Pull: this step is also customer-centric and proposes that companies produce according to customer needs instead of produce and push products to the customer;
- e) Perfection: as the four previous steps are interrelated, the process improves constantly and continuously, in a way that perfection is no longer an unattainable concept.

Hines, Holweg & Rich (2004) propose a framework that comprises the methodologies mentioned above in a way to support the implementation of Lean Thinking, according to Figure 2 **Lean - a framework** (Source: Hines, Holweg & Rich (2004)).

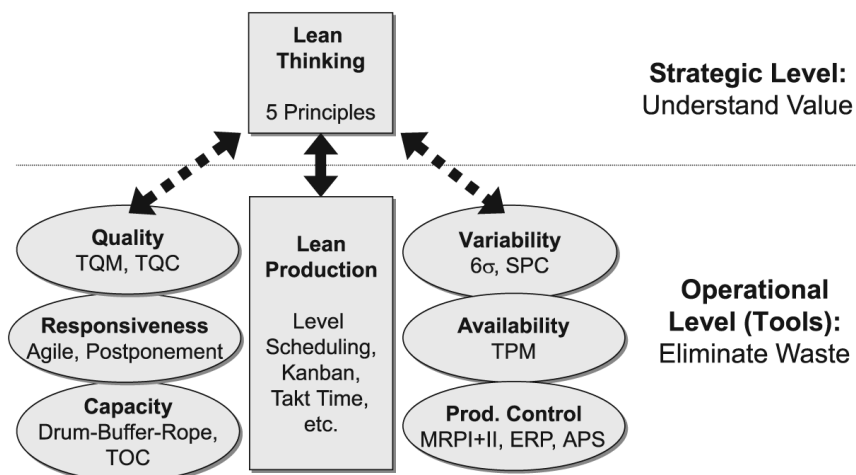


Figure 2 Lean - a framework (Source: Hines, Holweg & Rich (2004))

2.3 Business Process Management (BPM)

Another concept derived from quality movement is Business Process Management. Hitpass (2014) defines business process as “*a set of activities that, driven by events and carried out in a certain sequence create value for a customer (internal or external)*”. The author suggests three characteristics that define a business process: it should be triggered by the customer, from beginning to end and must be valuable from customer's perspective. Hitpass (2014) also highlights that not necessarily a macro process will be a business process, for instance procurement is a complex and big process, however is not triggered or valuable for customer and for that reason, cannot be considered a business process.

ABPMP (2013) proposes a BPM lifecycle, composed by the interactive phases of process planning and strategy, analysis of business processes, design and modelling of business processes, process implementation, process monitoring and controlling and process refinement. The frontiers to these phases can be a constraint or an enabler and can be summarized as values, beliefs, culture and leadership. The author also highlights the critical success factors of BPM: alignment of strategy, value chain and business process, goals alignment, executive sponsorship or governance, process ownership, metrics, measures and monitoring and institution practices.

Roseman & vom Brocke (2015) propose six core elements of Business Process Management. The factors and capability areas connected proposed by the authors are presented below:

- a) Strategic Alignment: BPM must always be aligned with the organisation strategy, in a way that organisational priorities and enterprise processes are linked and enable continuous improvement of business performance. Capability areas are: process improvement planning, strategy and process capability linkage, enterprise process architecture, process measures and process customers and stakeholders;
- b) Governance: establishes accountability for roles and responsibilities and also support decision making and reward process. Capability areas are process management decision making, process roles and responsibilities, process metrics and performance linkage, process related standards and process management compliance;
- c) Methods: tools and techniques that support activities. Capability areas are process design and modeling, process implementation an execution, process monitoring and control, process improvement and innovation and process program and project management;
- d) Information Technology: enhance the understanding of software around the processes to be executed. Capability areas are process design and modeling, process implementation and execution, process monitoring and control, process improvement and innovation, process program and project management;
- e) People: individuals or groups who use their skills and knowledge to improve business performance. Capability areas are process skills and expertise, process management knowledge, process education, process collaboration, process management leaders; and
- f) Culture: regards creating a beneficial environment to complement BPM initiatives. Capability areas are responsiveness to process change, process values and beliefs, process attitudes and behaviors, leadership attention to process and process management social networks.

2.3.1 Business Process Modeling

The Business Process Modelling connects processes and skills in order to promote a deeper understanding of business processes, enabling their analysis, design and performance assessment. A process model is never a complete representation of it, once it aims to provide attributes and information from one or more perspectives. The main advantages of adopting Business Process Modelling are: models are convenient (fast, easy and cheap), they are also easier to understand when compared to other types of documents, provide a baseline for measurement, simplify process simulation and impact assessment and models leverage standards and techniques. (ABPMP, 2013)

Lin, Yang & Pai (2002) propose on their study a generic structure for business process modeling. It contains 6 perspectives (functional, behavioral, informational, organizational, verification/validation and modeling procedure) in which Business Process Modeling can be viewed and the ten components covered by them (activity, resource, behavior, event, information, relation, agent, entity, verification/validation/simulation and modeling procedure).

2.3.2 Business Process Mapping

Process mapping is a technique used to detail the important elements that influence the behaviour of a process. Process mapping is often performed following three steps: first is identify the beginning and the end of the process, as well as products and services related to it; then gather data and prepare; and finally transform data in visual representation. (Soliman, 1998)

There are several techniques for process mapping according to the objective. Some of the most used for process improvement will be presented below.

Flow Chart

Widely used, counts on a simple set of representations for tasks, decisions and processes. Many authors credit the creation of Flowchart technique to the Total Quality Management movement, already mentioned in this paper. Other notation have been used over the years to represent machinery, materials, roles and others, however the typical symbols are lozenges, ovals or rounded rectangles to represent process start and end, arrows to indicate direction, rectangles for processes, parallelogram for inputs and outputs and diamond for decision making. The representation of process must follow the directions up down and from left to right. (ABPMP, 2013)

Swim Lanes

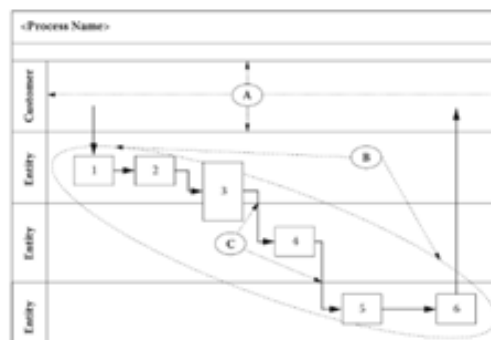


Figure 3 Swim Lane Model (Source: Damelio (2011))

Evolution of flow chart, this technique also provides information on how the process flows across organisation by using boxes and rows (ABPMP, 2013). Figure 3 brings a model for swim lane.

2.4 Value Stream Mapping

Originated in Toyota, this technique represents the flow of material in a manufacturer (ABPMP, 2013). Sunk, Kuhlang, Edtmayr & Sihn (2017) propose a four-step method for deploying a value stream mapping (see Figure 4) that comprises the actions of choose a product family to map, draw a map of the current condition, develop a target condition, establish an action plan and implement the target condition.

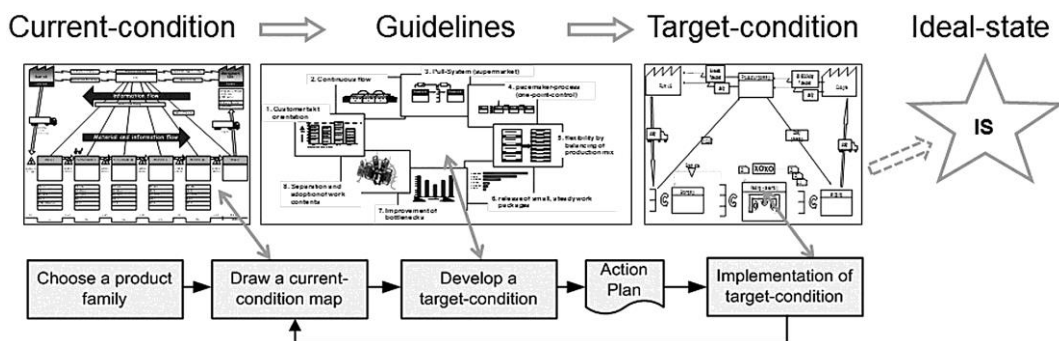


Figure 4 Value stream mapping method (Source: Sunk, Kuhlang, Edtmayr & Sihn, 2017)

Besides that, Hines & Rich (1997) propose on the study seven value stream mapping tools: process activity mapping, supply chain response matrix, production variety funnel, quality filter mapping, demand amplification mapping, decision point analysis and physical structure mapping. The authors also cross those tools with the seven traditional wastes of lean in order to classify the types of waste that each tool better approach.

Haefner, Kraemer, Stauss & Lanza (2014) by turn, propose the Method of Quality Value Stream Mapping (QVSM) in order to integrate inspection processes, quality control loops and quality related costs. This method complements traditional Value Stream Mapping and comprises 4 phases: preparation, quality value stream analysis (QVSA), quality value stream design (QVSD) and implementation. According to the authors, this method promotes a systematic visualization, analysis and optimization of multistage manufacturing processes from a quality assurance perspective.

3 Problem Characterization

3.1 Company Description

Very traditional in Portugal, the holding owner of the hotel is The Fladgate Partnership. Founded in 1692 with Taylor's, nowadays the corporation aggregates businesses in different segments, as presented in Figure 5.

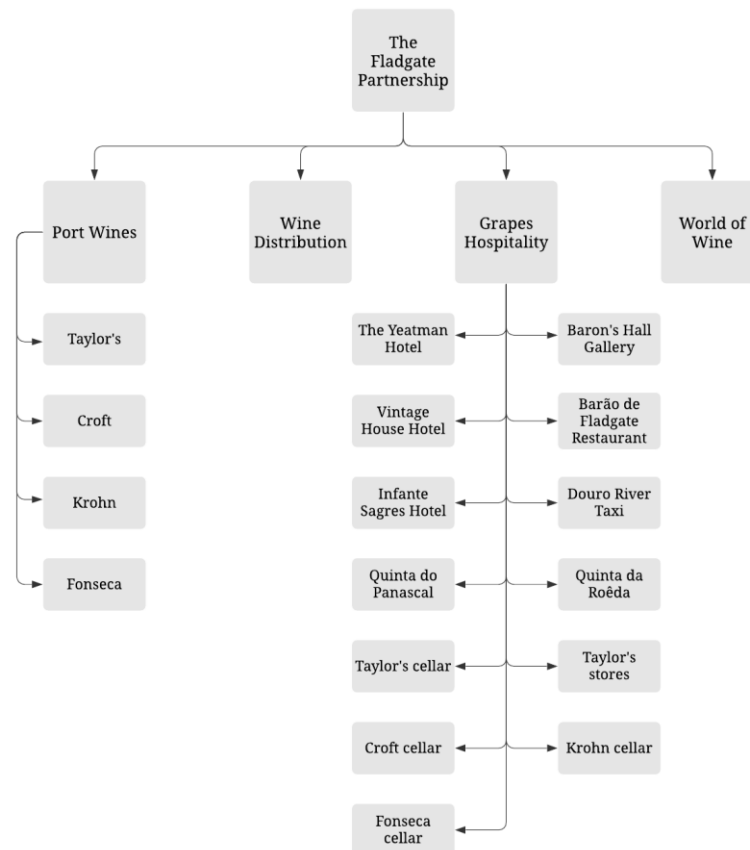


Figure 5 The Fladgate Partnership Structure (Source: author)

Port wines segment represents, as the name suggests, the production of port wine. Taylor's was the first brand, however the company acquired later Croft, another very traditional brand. Nowadays Krohn and Fonseca complete the group. Besides the production, the company has a strong operation on distributing wine of several partners, which relates to the second segment presented in Figure 5.

Most recent and significant investment, World of Wine will be launched in 2020 is a great bet of the group. With a substantial structure, this enterprise is located in Vila Nova de Gaia, right beside of the Yeatman Hotel, and will offer a vast number of experiences such as cooking classes, wine museum, stores and many others. Due to the complexity of operations, it was decided to separate this project from tourism segment.

Finally, tourism segment is managed inside Grapes Hospitality and aggregates restaurants, luxury hotels, cellars, stores (In Porto and Lisbon) and river passenger transport. The management is centralized in The Yeatman Hotel, including the general manager.

The hotel where this project took place is The Yeatman Hotel. Launched in 2010 and located in Vila Nova de Gaia, the hotel offers, besides accommodation, well-being services on a Caudalie Spa, it has two restaurants (one of those holds two Michelin stars), offers a large space for events as well as promotes public events over the year. It also counts on a store that offers a variety of products. Besides those services, the hotel differentiates from others by its unique view of Douro River and historic centre of Porto. Due to the complexity of operations, The Yeatman Hotel is the benchmark for the other hotels of the group.

3.2 Sustainability

In the past years, the The Fladgate Partnership have been investing heavily to promote sustainable initiatives across all segments and beyond company's boards, stimulating a strong benchmark with different organizations worldwide, enhancing social awareness under this topic. To endorse this affirmation, is important to highlight that the Company is the principal sponsor of Climate Change Leadership Porto, an important event that discusses the impacts of global climate change. Two of the most memorable speaker invited in the paste years are Al Gore and Barack Obama.

Climate Change Leadership also gave origin to another important initiative, The Porto Protocol, a non-profit corporation that aims to permit knowledge exchange and inspire the adoption of green practices by intercompany cooperation. Founded by Taylor's, many of The Fladgate Partnership enterprises are signatory of The Porto Protocol, including The Yeatman Hotel.

3.3 Process to be addressed

The aspects that motivated this project are mainly an external demand: enhance competitiveness by decreasing costs and grasp the opportunity of attend a crescent market, oriented to sustainability. However, this subject gains strength due to the internal pressure to enhance the sustainability of business.

With that in mind, the challenge proposed by hotel manager was to analyse internal processes and propose improvements that would decrease costs and the consumption of energy and water.

Considering the limited time available to deliver this project, implement corporate sustainable practices inside a company as The Yeatman Hotel is unfeasible, for that reason it was decided to choose one process or department to analyse, which should attend the expectations of the manager, enhance value from final customer perspective, promote relevant gains and would also be deliverable in available time framing.

Kandampully, Zhang & Jaakkola (2018) conclude on their study that the management of customer experience should be holistic and, for hospitality industry, must consider strategy, human resources, marketing, social media, technology, design and operations. Nevertheless, the alignment of functional factors is vital for managing customer experience.

Dubé & Renaghan (2000) by turn, provide on their study relevant insights on the attributes that create value during guests staying. Table 2 show results from most voted on, focusing in top 10. This paper provides more detailed information in order to understand how to add value on hotel operations from customer's perspective.

Table 2 Value adding attributes (Source: adapted from Dubé & Renaghan (2000))

#	Value-driver category	Hotel attributes
1	Guest-room design	Room overall, size, cleanliness, comfort, kitchenette, aesthetics, work equipment, entertainment and HVAC.
2	Physical property	Property overall, cleanliness, aesthetics, size, architecture, public space and location landscaping.
3	Interpersonal service	Service friendliness, attentiveness, professionalism, customization and personal recognition.
4	Functional service	Service overall, speed, efficiency, check-in and check-out efficiency.
5	F&B related services	F&B overall, quality, atmosphere, room service, variety, low or good prices.
6	Quality standards	Health club, security, variety of services, housekeeping, indoor pool, executive floor and business center.
7	Location	Convenient location
8	Value for money	Low or good prices and value for money.
9	Bathroom furnishings	Bathroom overall, amenities, size, furniture and cleanliness.
10	Brand name and reputation	Brand familiarity, image and recommendation.

By this time, one attribute that comes to eye concerns cleaning, one it is present in most of the value-driven categories. Once it was defined what value is from customers perspective, the next step was crossing that information with data of internal processes and departments water and energy consumption. However, as this data was no available internally (the system to measure consumption was still being installed), it was needed to appeal to literature.

Styles, Schoenberger & Galvez-Martos (2015) provide on their study an analysis of the key processes and evaluate the potential of cost saving considering both water and energy consumption for a 100 room hotel. The results are presented in Figure 6.

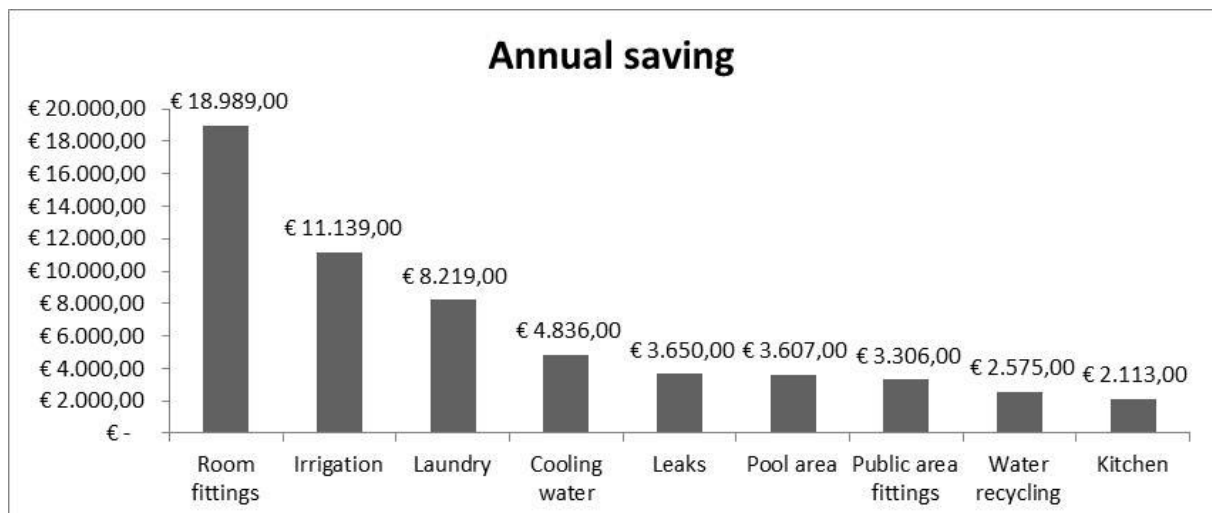


Figure 6 Estimative of possible cost saving (Source: adapted from Styles, Schoenberger & Galvez-Martos (2015))

As room fitting comprehend showers usage, room toilets usage, room taps (retro-fitted) and room cleaning, to optimize this process would be necessary both maintenance involvement, investments and also customer involvement, for that reason it was dropped. Optimize irrigation,

by turn, does not aggregate value from customers perspective and does not also implicate is cost saving, once the hotels uses groundwater. Even though enhance sustainability, this process was also discharged.

Laundry, by turn, attended all the requirements. Agregate value from customer perspective, once it is intimately related to cleanliness, can promote relevant gains by reducing costs in operations, water and energy consumption, could be delivered in time framing and it was promptly accepted by the manager. For that reason this was the department chosen to deploy this project.

3.4 The Laundry Operations

The Laundry operates from 6 a.m. to 11 p.m. on normal circumstances, however overtime may occur if needed. Also, the normal operation count on 4 employees during the whole day, split in several different shifts according to the activities. For instance, only one employee arrives at 6 a.m. who is responsible for unload the machines left operating in the previous day and start the operation for the day. In addition, the process is managed following a functional structure that counts on a director, supervisor and a leader and also stratifies operational employees according to their experience, in a way to balance shift and guarantee the best result. It is important to highlight how this department assist several sectors inside the hotel. Table 3 shows the most common linen treated according to the sector.

Table 3 Type of linen per department (Source: author)

Department	Linen
Housekeeping	Uniforms; Bed linen: sheets, pillowcase, quilt cover (all for single and double room) Bath linen: face towel, hand towel, bath towel, bathroom mats; Robes; Slippers; Curtains; Guest garments; Cleaning cloths.
Spa	Uniforms; Pool linen; Bath linen: includes all linen used for procedures, with different sizes and shapes; Cleaning cloths.
Restaurant	Uniforms; Table cloths: different sizes and colours; Tissue napkins; Cleaning cloths.
Kitchen	Uniforms; Cleaning cloths.
Others	Uniforms in general

4 Methodology

McCusker & Gunaydin (2015) define research as “the systematic and rigorous process of enquiry which aims to describe phenomena and to develop and test explanatory concepts and theories”. In order to do that, a proper plan must be set to achieve the goals and objectives presented.

W Creswell (2009) proposes a framework for research design connecting worldviews, strategies of inquiry and research methods, as we can see in Figure 7, which offers a more comprehensive understanding of the differences between the three traditional research designs: Qualitative, Quantitative and Mixed methods. This approach will be used as the basis for the construction of this dissertation' Methodology.

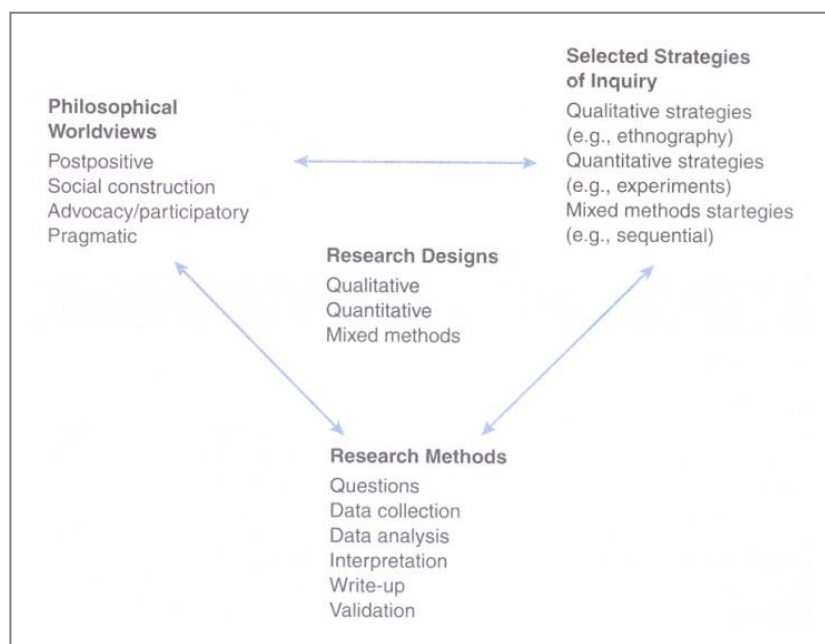


Figure 7 Research design framework (Source: W Creswell (2009))

4.1 Philosophical Worldviews

Wolters (1989) suggests that the modern humanistic views of history, science, and religion define the notions about worldview. Babbage and Ronan (2000) on their turn, found on their study a link between philosophical worldview, scientific predilections and personality, finding also a different view according gender. While women see themselves as organismic, males tend to rate themselves as more mechanistic. Both studies support W Creswell (2009) concepts, which clarify that philosophical overviews are the philosophical ideas that influence researches and their studies, even though they try to suppress it and, for that reason, should be identified. Also, the author suggests four main categories of Philosophical Worldviews.

Postpositive

Also known as scientific method, science research, positivist/postpositivist research, empirical science and postpositivism, this worldview regards the need to identify how causes affect outcomes by reducing the ideas to a small set to test, namely the variables covered by hypothesis and research questions. Often used for quantitative research, its main elements are

determination, reductionism, empirical observations and measurement and theory verification (W Creswell, 2009). Another understanding proposed by Ryan (2006) claims that “*Positivist researchers believe that they can reach a full understanding based on experiment and observation*”.

Social construction

Often used for qualitative research, in social construction worldview researchers design subjective meanings for their experiences on objects and things, in a way to expand the view instead of narrowing. The main elements in this case are understanding, multiple participant meanings, social and historical construction and theory generation (W Creswell, 2009). Kim (2001) establishes that social construction relies on specific assumption about reality (nothing more than a social invention), knowledge (meaning is created by the interaction between human and environment) and learning (which occurs through social activities engagement).

Advocacy/participatory

This worldview arose to address marginalized individuals and justice issues that are not covered by postpositivism and constructivism by establishing politics and political agenda. It also considers important social issues as empowerment, inequality, oppression and others. To avoid marginalize participants in results, researchers assume that participants will be collaborative and may also help designing questions, data collection and information analysis. Even though this kind of worldview is more often used for qualitative research, it may also be foundation for quantitative research (W Creswell, 2009).

Pragmatic

The last worldview discussed by W Creswell (2009) is pragmatism. According to the author, in this one the main elements are consequence of actions, problem-centered, pluralistic and real-world practice oriented. Unlike postpositivism the focus is on the consequences instead of the causes.

4.2 Research Designs

Strategies of inquiry are defined by W Creswell (2009) as the “... *types of qualitative, quantitative, and mixed methods designs or models that provide specific direction for procedures in a research design*”. They are also called approaches to inquiry and research methodologies. Each type will be presented below.

Quantitative strategy

Quantitative methodology or strategy aims to quantify social phenomena, collect and analyze numerical data by linking a small number of attributes among many cases (Tuli, 2010). Lately, this type of strategy is used for complex experiments evolving many variables and treatments (W Creswell, 2009).

According to Choy (2014) the main strengths of quantitative strategy are the reliability by critical analyzed, short time frame for administered survey and facilitated numerical data for groups and extends of agree or disagree from respondents. Meanwhile, the weaknesses are the lack of human perceptions, beliefs and resources for large scale research and the shallow description of the experience.

Queirós, Faria & Almeida (2017) provide a set of methodologies and their uses as it follows:

- Correlational study: exploratory technique that aims to define the relationship between variables, their strength and direction. They are quantified through the establishment of a correlation coefficient. This technique does not identify causation, only correlation.
- Multivariate analysis: set of methods used for multiple measurements made for individual, object of one or more samples that allows the researcher to identify the relationship between variables. It can be used for market research, process optimization, quality control and others. It is often complex and requires the use of specialized software, enhancing the associated costs.
- Field experiments: occur in real life situation by isolating and manipulating different variables, in order to test the effects of each. Commonly used in sociology and applied sciences, enables the researcher to observe a large group of people in a more natural scenario. The main issue is to replicate the conditions once it is difficult to control the environment.
- Simulation: consists in applying mathematical models in computer to imitate real operations and processes. It is used to describe the behavior of a system, construct theories and hypothesis, to predict the behavior by using the model, to analyze complex and large practical model and to compress a time frame, in order to speed up the investigation of change effects in real life. The main issues are the need of deep knowledge, time consuming and high costs.
- Surveys: set of organized questions that allows the collection of data from a person involved in the research. Besides the high representativeness of population included in this technique, one of the main advantages is the low cost of application. The main issue is the need of good survey structure and response accuracy to enhance reliability.

Qualitative strategy

Qualitative methodology in turn, aims to understand the meaning of social phenomena, focusing on linking many attributes across a few set of cases. (Tuli, 2010)

The main strengths of this approach are the view of homogeneous exploration, the raise of more issues through broad and open-ended inquiry and the understanding of values, beliefs and assumptions. The main weaknesses are the lack of objectively verifiable results, skilful requirements for interviewers and time consuming during interviewing and intensive category processes. (Choy, 2014)

Once more, Queirós, Faria & Almeida (2017) provide the following methodologies:

- Focus groups: differently from interviews, the focus group involves a higher number of people, who are interviewed collaboratively. It is used to investigate complex behavior and provide broader information. The main issues are the difficulty to manage it and also to encourage people to participate.
- Case studies: largely used in the field of applied sciences, offer a good opportunity to investigate complex situations with multiple variables, enabling the advance of the knowledge base. Even though it can be a good combination with focus group, it may be difficult to establish a cause-effect connection for the conclusions and to generalize the results.
- Structured interviews: well-designed assessment model that enable comparison between responses from different interviews. Usually have high response rate and the

interviewed is present to explain the answer and avoid misinterpretations. The major issues are time consuming and inflexibility of answers, hindering the possibility to explore interesting lines of research, even though they come up during the process.

- In-depth interviews: unstructured, direct and personal interviews that usually start with a generic question where the respondent can speak freely about the subject. A variant of this methodology is the semi-structured interview, which has a set of pre-defined questions but is possible to explore one of those in more detail. In-depth interviews are often used to provide very rich information, to ask follow-up questions, probe additional information, justify previous answers and connect several topics. The main issues are the lack of generalization and time-intensive.
- Observation: process of observe a phenomenon on the natural environment and to collect information and data. Subtle and flexible, it is indicated to study an unexplored topic in order to understand it on normal conditions. In some cases, as behavior of people and animals, is the only way to obtain reliable data. The major issues are the time consuming and dependency on researcher analysis.
- Ethnography: combination of participants' interviews and observation, in order to interpret a situation from their perspective, enabling the researcher to acquire in-depth knowledge about the situation in analysis. The main disadvantages are time consuming and the difficulties to extract clear conclusions due to the diversity of results.
- Field research: the process of data collection on the field, allowing the researcher to have depth understanding of peoples' behavior and experiences and processes. The main issues are the difficulties to generalize the results and to document the observations.

Mixed methods strategy

Less well-known, this strategy arose in 1959 with Campbell and Fisk during the study to validate psychological traits. During the 1990s, the concept evolved in order to integrate or connect quantitative and qualitative data. Three main strategies derived from mixed methods: sequential, concurrent and transformative. (W Creswell, 2009)

4.3 Research Methods

Last framework element, research methods are the actual forms of data collection, analysis and interpretation used by the researches to conduct the studies. (W Creswell, 2009)

4.4 Research Design Adopted

As the aim of this study is to explore the application of Lean Thinking in a hotel operations context and propose an improvement process, the research design chosen for this purpose is the Qualitative.

To allow a profound investigation, a case study will be deployed. In order to elaborate process mappings and raise the opportunities of improvement, two main techniques will be used: observation and in depth-interviews. The first one regards the need to understand the real process and behaviour of people involved, without interferences. In depth interviews, in turn, will be used to provide a wide range of variables that affect the performance of the sector, from operational and managerial points of view.

It is important to highlight that the data gathering will happen firstly through observation. Once we have a clear notion of the department dynamics, we will deploy the interviews to complete the scenario. Validations through the process will follow the same techniques.

As already cited in Literature Review, there is a wide range of methodologies that can be used for process improvement. As Lean Thinking provides a more systematic approach, this was the chosen methodology. For process mapping both flow chart and value stream mapping were used.

5 Results

5.1 Project Implementation Planning

The deployment of this project was divided in 6 main phases:

- a) Specify value: to define with management the issues to be addressed during the project and the expectations;
- b) Process mapping: to map the current process as well as value added according to previous item;
- c) Propose improvements: to evaluate the process and, according to value defined by management, propose actions to improve overall performance;
- d) Propose improved process: to set a new mapping with improvements proposed;
- e) Improvement implementation: after propose the actions, this step aims to validate them with managers, analyse feasibility and implement actions;
- f) Measure gains: finally, the final step is to evaluate the gains obtained by implementing improvement actions.

These steps are divided in many items, which will be addressed below.

5.2 Specify Value

As specified in Problem Characterization, the main objective of this process improvement is to decrease cost and enhance sustainability. With that in mind, the process will be analysed focusing on reduce the eight wastes of Lean Production and with special attention to water and energy consumption.

5.3 Process Mapping

The first step of this project was to map the processes and activities related to Laundry, as well as the resources used to deploy them. It started with a meeting involving the sector manager, where the objectives and expectations were aligned by both sides. This meeting occurred as a non-structured interview and the outcomes are those already described in Problem Characterization.

Next, the project was introduced to the team by the manager. From this moment on, two main methodologies were used: observation and non-structured interviews. The strategy adopted was to observe the environment and behaviour of both internal clients and Laundry operators in order to understand interactions and possible gaps. This particular phase took a couple of weeks until interviews started to be deployed and had the objective of collect the largest possible number of attributes, in order to permit focusing interviews and direct the project.

With that information, general questions were made to the operators to uncover employee's perceptions around processes, management and overall insights concerning Laundry operations. Non-structured interview was the adopted methodology due to the necessity of obtain wide and unbiased outcomes.

After this, observation and interviews were alternated until the process was fully mapped and opportunities of improvement identified. Nevertheless, informal meetings were deployed with the manager to align and validate the project evolution.

The major issue found during this step was the lack of formal standardization. With that, significant variance was detected during observation and interviews and the actual process had to be defined according to the statements of more experienced employees, even though it was not executed by the team as a whole.

APPENDIX B presents a broad view of processes, splitting them by manual and mechanical. Of 25 mapped processes, 17 are manual or use a machine but need manual handling during operation. That means that almost 70% of Laundry's processes are dependent of labour force to operate. Nevertheless, even though materials follow a well-defined sequence, the operations actually are parallel and the inputs occur during almost all shift.

5.4 Process Description

To better understand the complexity involving Laundry's processes, we will start with a briefing of the processes as a whole. APPENDIX C presents the swim lane of Laundry's processes, which will be now described.

To start the process, there are two main ways to linen get into Laundry: to collect and to receive. The first one regards the activities associated to Housekeeping, once both departments are part of the same sector: Accommodation. Two principal types of linen are included here, those related to room cleaning as bath towels, bed linen, robes, slippers and others and also guests garments, a service provided directly to final customer. Even though Housekeeping and Laundry count on different teams, is common to see mutual collaboration between them according to priorities established by the management. Reception, on its turn, regards all linen brought to Laundry by the sector responsible or owner. The most common items are restaurant and spa linen and uniforms.

After that, the linen is identified with the name of the employee, in case of uniforms, or the name and room number, in case of guests garments. Also, the amount and type of linen dropped are also registered in order to control the material entered, except for linen collected during Housekeeping as bed and bath linen, which goes directly to separation.

Split process aims to separate linen by type: sheet, pillowcase, bath towel, bathroom maths, robes, cleaning cloths, tablecloth, tissue napkins, trousers, shirts and others. Once the linen is separated, it is directed to washing process. In general terms, almost all linen derived from internal clients can be processed by Laundry, however if a different processes is needed, the department subcontract an external supplier.

Washing process is mostly mechanical, once the only activities that demand manual effort are loading and unloading the machines. There are several recipes according with the type of linen, in a way that the time of process lays on the material washed during the day. As a high level of sanitization is mandatory, a set of harsh chemicals are used, as well as high temperatures (up to 70°C), provided by the general hot water system of the building (water heated by gas). It is important to highlight that most of the times it is still necessary to heat water inside the machine, which is done with electricity, enhancing time needed to complete wash.

From this point on, the process splits in three principal paths. The first one, used mainly for bath towel, spa towel (all kinds), bathroom mats, robes, cleaning cloths, slippers, pillows and uniforms as a whole, consists on drying the linen in rotating dryers. As well as washing machines, this process is mainly mechanical in a way to have manual operation only for loading and unloading. It also has different recipes of drying according to the type of linen and its necessities. After that, in case of clothes, as uniforms for instance, the next step is ironing, which is manual with support of iron and manikins. By this point, all linen is reviewed in order to guarantee the attendance to quality, which may lead to four different situations: rework in case of stains or dirty, sew in case of rips, waste when there is no other way to recover or reuse the fabric and, when no issue is detected, fold the item when needed (not used for pillows or slippers, for instance). Finally, the last step of this process is to deliver the item. This delivery may be done directly to the responsible, in case of uniforms; can go to storage to be delivered when asked, in case of restaurant linen for instance; or it can wait in the Laundry waiting to be picked up. In this last case, as the time of waiting is smaller it is not necessary to keep on separated storage.

The second path after wash is used mainly for bed and restaurant linen, which must be properly straight. To speed the process and enhance the quality, it is used an industrial calender which dries and irons the linen. Even though is machine based, this process only is possible with, at least, two people to load and unload. After that, all linen is reviewed and may be send to rework, in case of dirt, or sew in case of rips. Unlike the previous description, in this case there's no waste, once even the worst item can be transformed and reused. A good example is transform bed linen in cleaning cloths. If linen is in accordance to quality standards, then the linen is manually folded and delivered. The delivery, in this case, usually means to be put in wait until the sector picks up on the next day.

Finally, the third path is not so common and regards specially curtains. In this case, after washing, they are held in racks for natural dry. Then they are reviewed, which may lead to rework or sewing as previously mentioned, and delivered to Housekeeping to be hung again. This last path usually occurs when the occupancy rate is lower and, as a consequence, the total amount of linen is lower.

Besides all of those, there are also other services provided by Laundry, however they will not be approached on this project once they are not aligned with the research objectives.

5.5 Identify the Value Stream

As the income materials change every day according to a set of factors as the occurrence of events, number of clients in restaurant, occupancy rate as well as seasonality, we decided to specify and study the most frequent flows. The value stream mapping of current process is shown in APPENDIX D.

Reception

Since we are considering only the main processes, the first one presented on the value stream mapping is the reception of materials. Linen from housekeeping operations are separated in specific bins according to the type, e.g. sheets and pillowcases have one bin, while towels have another one. This separation is made already by the room maid that drops the linen in Laundry.

In the other hand, the rest of linen received must be registered, forcing a Laundry operator to pause his or her activities to attend hotel employees, the internal client.

Identify/Register

This step regards specially the activity of register linen entrance from sector and individuals. Specifically, all uniform received is registered in order to control the items handed by employees. Also, linen from spa, for instance, is also counted to avoid stock breakage inside the department.

Linen from restaurant has a special flow due to the end of the shift. As the Laundry closes at 11 p.m. and restaurants around 1 a.m., the linen from dinner lays outside of the Laundry and, by the morning, is counted and registered by a Laundry operator. It also happens for some kitchen uniforms, but this case is truly an exception.

Separate

Separation concerns split linen by type, according to washing recipes. This step does not take into consideration the presence of stains, the level of dirt or other quality issues, only intrinsic characteristics such as department origin, fabric, colour, size, texture and so on.

By the end of this step, there's an inventory, once the linen comes to Laundry in big batches and the internal processes have smaller ones or continuous processes.

Wash

This can be considered the core process of Laundry, after all, is the one that most aggregate value. If this process doesn't go right and issues are not detected, dissatisfaction is imminent. Mostly mechanical, the possible steps are: humectation, prewash, wash, bleaching, softening and rinsing. The steps, chemicals, time and temperature used are according to the type of linen and dirt level, e.g. bed linen has a regular recipe and also very dirty linen one.

The chemicals dosage is automatic and uses a set of metering pumps and dispensers. It also counts on a software that provides information about the total amount of chemicals, water and electricity used and also the amount of linen washed per recipe. Another interesting information provided is the status of washing machines, in a way that the manager can control if they are operating or not.

It is important to highlight that the amount of linen to be washed is defined "by eye". In other words, the operator fills the machine until the point it looks properly completed, neither full nor empty.

Prioritization is defined by Laundry management, according to the need manifested by internal customers.

By the end of this step, there is another inventory and linen can follow two main paths.

Path #1

Dry

Mainly mechanical, consists of two rotating dryers that operate with different recipes. The only variables, in this case, are time and temperature. Even though it has humidity sensor, in practice, by the end of a cycle (and sometimes during) a Laundry operator has to open and "feel" the level of drying. It happens especially for thicker items as

slippers and pillows, for instance. Also, the time that linen waits to be dried and environmental conditions impact the dry process.

As in washing process, prioritization is defined by Laundry management.

After properly dried, linen holds on trolleys waiting for the next process.

Iron

This step is exclusively used for uniforms. It is a manual process that counts on tools to enhance speed, those are industrial iron and steam manikins. There is only one operator per shift who deploys this activity. It is the same person that usually attends whoever comes to Laundry.

Review

By now, all linen is checked to guarantee attendance to standards. If stains are detected, a located chemical treatment is deployed to check the possibility of recovery, if the stain is removed then is checked the need to wash the item again, otherwise the item goes to sew to be transformed and used as, for instance, cleaning cloths. If rips are identified it also goes to sewing to fix.

Also, the level of cleanliness is verified. If doesn't attend the required quality, it goes back to wash. In that case, the recipe used is more rigorous.

The amount of rejected items is registered for internal control

Fold

In general terms, is the process that condition linen to storage.

Deliver

As the name of the process suggests, it is basically the return of linen to the responsible. In case of items used in other processes, as spa or accommodation linen, it is usually delivered in higher amounts according to the department necessity. In that sense, the Laundry has a supermarket stock to speed up operations. This is also truth for uniforms, which lays hang on a rack available to be picked up. As already mentioned, for this process a Laundry operator must be present, in a way to delay other activities.

Path #2

Calender

The calender is basically a heated cylinder used to "iron" linen. It is used for bed and table linen and work with an operator feeding the machine in one side and another operator removing ironed linen on the other side. When possible, it also runs with four people, speeding up the process.

As the linen composition is 100% cotton, it operates at 170-180 °C and uses only electricity.

Calender operators are also responsible for washing machines, for logistic reasons, and, at times, may help attending Laundry customers (hotel employees).

Once more, the manager is responsible for defining prioritization.

Review

In the same way of path #1, at this point all linen is checked to guarantee attendance to standards. In case of stains, these are locally treated. In case of rips or necessity to recycle linen, the items are sent to sewing and, if the linen is grimy, goes back to washing process, being submitted to a more aggressive recipe. Again, the amount of rejected items is registered for internal control.

Fold

Once more, is the process that condition linen to storage.

Deliver

Also counts on supermarket stock. For restaurant linen, distribution occurs similar to other processes, such as spa, and is manually registered. In case of bed linen, Housekeeping trolleys are prepared according to daily need, in a way that maids only ask for more materials in case of some change in schedule. Otherwise, this department doesn't require further attendance.

5.6 Flow Improvement

To improve flow, we are now provide an analysis of each process described in current value stream mapping and propose improvement actions according to 8 wastes of lean production.

Reception

The two major categories of waste to be mitigated are motion, once the operators have to stop their activities and attend internal clients; and non-utilized talent, since employees specialized in Laundry operations run less complex activities. These issues were already identify by Laundry Management previously to this study and have a possible solution under analysis, physically changing the place of attendance in order to facilitate the movement of operator to front desk. This change will also allow a better organization and movement inside the sector.

Even though the proposed change may be beneficial to the overall operation, it still doesn't solve the described issues. Therefore, two associated changes are now suggested: the first regard establishing service timetables, in a way that the laundry can actually schedule activities and attendance, reducing movement and total time needed for material reception. The second one is complete the team with an employee dedicated to administrative operations. To avoid increase cost, this person could be, for instance, an intern that would also help with other activities that will further described, namely the development of performance indicators.

Identify/Register

As registered information about received items is used as a control only and does not assist decision making, we have considered this process as overproduction. Despite the usual approach of reduce waste, the suggestion is to increase the aggregated value of this process. The information collected can be very useful from performance management perspective, once it allows the department to have a clear understanding of the overall performance of the sector. The proposed indicators will be further addressed.

Moreover, this process is deployed manually, enhancing time needed to complete attendance and to process information. For that reason, is proposed to automate this process.

Separate

This process is probably one of the most important if the objective is decrease waste. As the quality of linen is checked only by the end of value chain, items with defects can be only detected after fully processed, enhancing cost associated to achieve quality. For that reason, this step should not only consider type of item, but also the conditions, such as presence of rips, stains and level of dirt, in a way to avoid reprocess, enhance quality during wash, once it allows to choose the most adequate recipe, and also checking the source of defects (internal or external).

Wash

The first waste in washing relates to the amount washed by cycle. As loading is empirical, the operator could miss for more or less cargo. In the first case, the linen can be poorly washed, increasing defects by the end of the chain; in second case, there is a clear waste of supplies, such as chemicals, water and energy, once the recipe is designed for the full machine. Once more, this problem was already under study by Laundry management before the beginning of this project. To solve this, an industrial scale is being quoted and should be installed shortly.

Despite that, another important waste was detected during the cycle itself, especially for recipes which demand higher temperatures. As the hot water added into washing machine is originated from building hot water pipe and temperature vary according to a set of circumstances, total time of washing process fluctuate significantly among batches (an increase of a 100% was observed). To solve this issue, a small project was proposed: the installation of a hot water tank dedicated to washing.

Path #1

Dry

A great waste detected during the analysis is extra-processing. In order to avoid intermediate inventory is common to see dryer machines operating almost empty, which increases highly energy consumption and decreases the equipment total life time. In this case, it was suggested to train the team and standardize the process to avoid reoccurrence. This is the type of waste that we commonly detect among different processes in different companies, the one in which the employee believes to be acting in the best way and have great intentions, but the lack of overall vision leads to unwanted behaviour.

Iron

Basically, the waste in this case relates to attending people, which was already addressed on reception process.

Review

Once more, extra-processing was detected on this process. The standards used to fail items are highly strict and, with reprocessing, raise the cost of operation. For instance,

if a small stain is detected in a sheet, even though it wouldn't be visible for being under the mattress, the item is reprocessed. Also, as this is an empirical process, it changes according to the employee. For those reasons, is suggested to revisit level of demand and properly standardize the process and train the team.

Fold

No waste was detected.

Deliver

The opportunities of this process are the same as the reception process.

Path #2

Calender

As the calender requires time to heat, it stays on during the time slot defined for this process. This slot is flexible and can change according to team size, seasonality and others. For that reason, the main waste occurs when the team assigned for calender have to stop the activity to deploy other ones, as during attendance or to load/unload washing machines. In the first case, the improvements proposed for reception would mitigate the problem. The second case represents a minor issue and, by this moment, seems to be balanced from a systemic perspective.

Review

Same as previously mentioned.

Fold

Same as previously mentioned.

Deliver

Same as previously mentioned.

Cross-sectional opportunities

Another suggestion to increase performance and reduce costs in most of processes is bolder and requires a deep analysis. Except for uniforms, all linen used in hotel operation is composed by 100% cotton, which need high temperatures to dry and also retains dirt more easily than some synthetic fabrics.

Finally, the last suggestion regards traceability of linen. This idea arose due to a problem detected during the project, which increased significantly waste of spa linen. As the items doesn't have identification of batch, we couldn't verify if the issues detected were restricted to old pieces or comprehended new pieces as well, enhancing difficulty to detect root cause. Also, by the time was not possible to check linen lifetime.

5.7 Improvement Implementation

After mapping improvement opportunities, the next step was to evaluate each of them considering difficulties to implement, costs and possible gains and actually deploy them. However, by this time the project confronted a great challenge. In face of Covid-19 pandemic,

in the middle of March the hotel had to make important decisions and the operations were suspended. The staff was sent in lay-off and the hotel activities kept paralysed until the beginning of June. With that, it was not possible to conclude the implementation of actions and evaluate gains, even though management demonstrated strong interest on them. Next, an overview of implemented actions and a plan for implementing the others will be provided.

Concerning reception, it was not possible to implement the proposed actions and for that reason two associated changes are now suggested: the first regard establishing service timetables, in a way that the laundry can actually schedule activities and attendance, reducing movement and total time needed for material reception. The second one is complete the team with an employee dedicated to administrative operations. To avoid increase cost, this person could be, for instance, an intern that would also help with other activities that will further described, namely the development of performance indicators. These suggestions could be completely or partially adopted and still improve performance by reducing the mentioned wastes. For instance, this other employee could attend during hours with higher flow of people and Laundry operators attend during the rest of the shift. Once more, if adopted, these solutions should be flexible, not strict. From those suggestions, the major problem would be the timetabled service, once the hotel has countless shifts according to department and even seasonality. However, this could be minimized by having flexible and adaptable slots.

Regarding identification and register process, the automation in matter doesn't require sophistication, the suggestion here is to provide a computer with basic softwares that support activities handled in this process, in a way to speed up the process itself and enable to use that information to measure performance.

The separation process may be improved not only by enhancing the attributes evaluated, but also by managing the moment to do that. The recommendation proposed is to aggregate those attributes not only in Laundry but also for Housekeeping. Once the housekeepers already check the linen of the rooms while they are extended, it would be easier to identify the condition of these materials. With that, the bigger adaption would have to be on their trolleys, enabling to have more than one option to split dirty linen.

Regarding the hot water tank, the implementation would have some investment and structural change. It should have heat exchange pipes in order to take advantage of dismissed hot water from washing machines, in a way to reduce energy used. With that, total cycle time would be reduced, increasing laundry capacity, reducing intermediate stocks and permitting better manage the department. Once this is complete, recipes can be evaluated and optimized. It is important to highlight that the recipes themselves are already complex and require deep technical knowledge on textile environment. Even though, the main most relevant ones were analysed and improved, however the gains couldn't be measured.

On drying process, by the time it was identified the issues regarding behaviour, the manager already convoked a meeting with the team and highlighted the importance of operate the machines correctly. An informal standardization was also deployed. In this specific case, the observation showed a great increase in performance, once this issue did not reoccur.

Nevertheless, formally standardize processes is a great opportunity for the sector, as it will avoid discrepancies and variation and also enhance overall productivity.

In the matter of changing fabrics used in hotel operations, during the project only one sample could be evaluated, a mix of 50% cotton and 50% polyester, however it didn't achieve expected results for bed linen. The tests for table linen and other mixes for bed linen couldn't

be deployed due to the issue of Covid-19. Still, it is important to highlight that even though cotton is traditionally used in hospitality industry and has great quality in terms of touch, modern synthetic fabrics can also deliver softness and comfort and are more affordable in price and less consuming to handle. Therefore, there is a clear opportunity on substitute part of linen for more efficient fabric with the purpose of enhance overall efficiency and decrease operational costs. Once more, this action requires breaking old patterns and be opened to innovative solutions.

Last, the traceability of linen is already implemented. As the hotel counts on a major supplier for linen, this need was presented and he promptly agreed on provide the number of batches for the next orders. Once more, it was not possible to measure results.

During the analysis it became clear that even though the processes are pushed, their origin is pulled. In other words, the responsible for setting priorities is always internal client, in a way we can consider that this department works with a pulled system on its essence. Furthermore, we also understood that establishing pulled system in the middle of processes (by Kanban or any other tools) is not applicable due to the nature of the processes. In general terms, the linen received is processed in same day, with a few exceptions. With all of that in mind, it is clear that the prioritization always satisfy the internal client needs.

5.8 Perfection

In order to achieve perfection, it is mandatory to measure process performance. Table 4 provides the suggested performance indicators to be deployed, according to the definition of value cited previously. With that, the manager will be able to make decisions based on reliable data, in a way to improve the overall operation and promote continuous improvement, until perfection can be achieved. APPENDIX E presents the proposed value stream mapping with the performance indicators information flow added.

Table 4 Performance indicators to be deployed (Source: author)

Process	Performance Indicators	Justification
Identify	Volume received/day	The aim of these indicators is to assess the real capacity of this process and evaluate the variation, in order to be able to properly size and manage team.
Wash	Total volume washed/day	Aims to track Laundry's performance, trace inefficiencies and assess the impact of seasonality on Laundry.
	Volume washed/recipe/day	Aims to assess how the different recipes impact the overall performance of the sector and justify the previous indicators.
	Cost/day	Crossing this information with recipes, it is possible to understand the impact of that in company's results and manage budget properly.
	Downtime/day	As all linen pass through this process, downtime can delay the rest of the processes and become a bottleneck.
Dry	Total volume dried/day	Aims to track Laundry's performance, trace inefficiencies and assess the impact of seasonality on Laundry.
	Volume dried/recipe/day	Aims to assess how the different recipes impact the overall performance of the sector and justify the previous indicators

Table 4 Conclusion

Calender	Total volume/day	These indicators aim to assess the capacity of this process and, most important, to equalize the time the equipment stays on and the actual time of usage.
	Volume/type/day	
Review	Total volume rejected/day	These indicators aim to bring to the surface issues that may be occurring during processes, in a way to enable continuous improvement.
	Volume rejected/type of linen/day	
	Volume reject/type of defect/day	
Deliver	Volume delivered/day	Aims to assess the real capacity of this process and evaluate the variation, in order to be able to properly size and manage team.
	Volume delivered/sector/day	Aims to assess the impact of other sectors on Laundry's operation.

As already exposed, due to the issues with Covid-19 these performance indicators couldn't be deployed. These are the suggested indicators that should be measured after concluding the implementation of improvements.

6 Conclusion and Future Research

As already mentioned in the beginning of Chapter 5, this project was divided in 6 main phases. The first 4 (specify value, process mapping, propose improvements and propose improved process) were successfully achieved and met the expectations. However, the last 2 (improvement implementation and measure gains) were highly compromised with the necessity of paralyse the hotel activities. In order to remedy this situation, a roadmap for implementing pendent actions and the performance indicators to measure future gains were suggested and can be revisited as soon as the situation achieves its normality again.

The aim of this project was to verify if traditional process improvement methodologies designed for manufacturing industry would apply for a service based context. Even though it is not properly a recent agenda, very few studies have being deployed to understand the actual application of methodologies and techniques.

Around the first object of this research, verify the applicability of Lean Thinking in hotel operations, the results show that this methodology is not only applicable but also brings satisfactory outcomes. In Laundry context, there is a clear material flow and unit operations, providing an environment that is similar to manufacturing perspective. The major difference in this case, is the proximity with final customer, enhancing value perception of the team involved.

For the second research objective, map and analyse the current process in Laundry, the bigger issue relates to the considerable fluctuation of process among time. Priorities and material received change drastically from one day to the next, hindering to assess actual performance. It is important to highlight that those issues are inherent to this department, once the demand for its services change according to customers' needs and probably repeat in this industry. Still, the processes are well defined and follow a specific flow, enabling their mapping and analysis.

The final objective of this research, propose an improved flow for the Laundry, was partially achieve. Even though many improvement actions were proposed, many of those couldn't be applied due to the restrictions associated to Covid-19.

On the barriers to this implementation, as Lacksonen, Rathinam, Pakdil & Gülel (2010) conclude on their paper, lean initiative has its roots in Japanese culture and their application in other countries require an extreme organizational culture change. Moreover, the hotel industry is antique and has highly embedded practices, enhancing the challenge of mind shift. Still, the objectives of this project were mainly achieved and results positive.

The suggested agenda for future research follows:

- a) Apply Lean Thinking for other processes in hotel context: as Laundry has several similarities with manufacturing industry, the application of lean principles were intuitive and didn't require many interpretations or changes on the application format;
- b) Verify scalability: such as in this study, many companies worldwide count on more than one establishment, with different characteristics and needs. For that reason, study the scalability of results in different contexts would enhance reliability and offer important insights on variables that impact outcomes;

- c) Assess level of gain: finally, an important research to be deployed is to measure the actual gains of lean implementation in hospitality industry and verify if the results obtained in manufacturing industry can be replied in this context.

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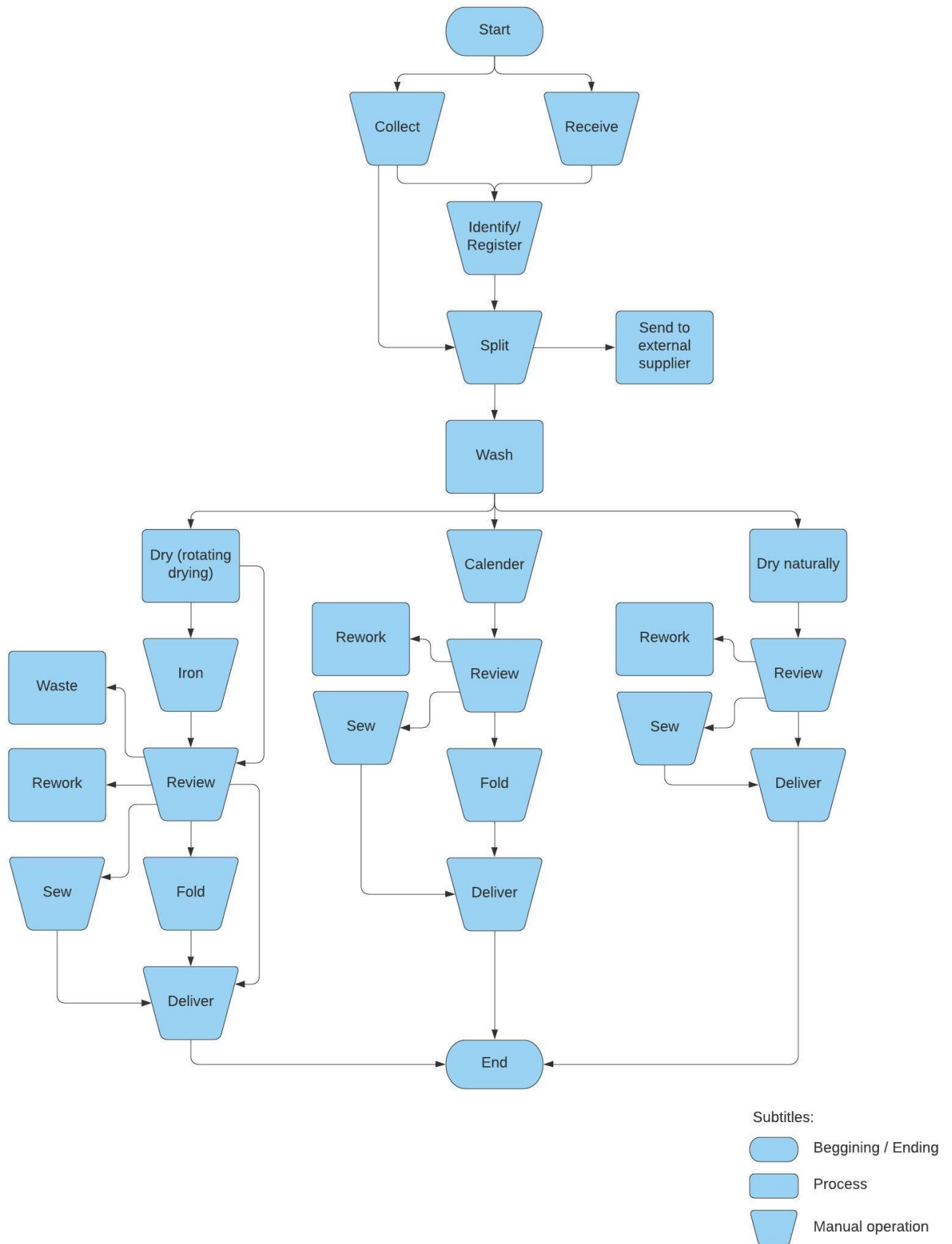
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APPENDIX A: Total Quality Management Gurus

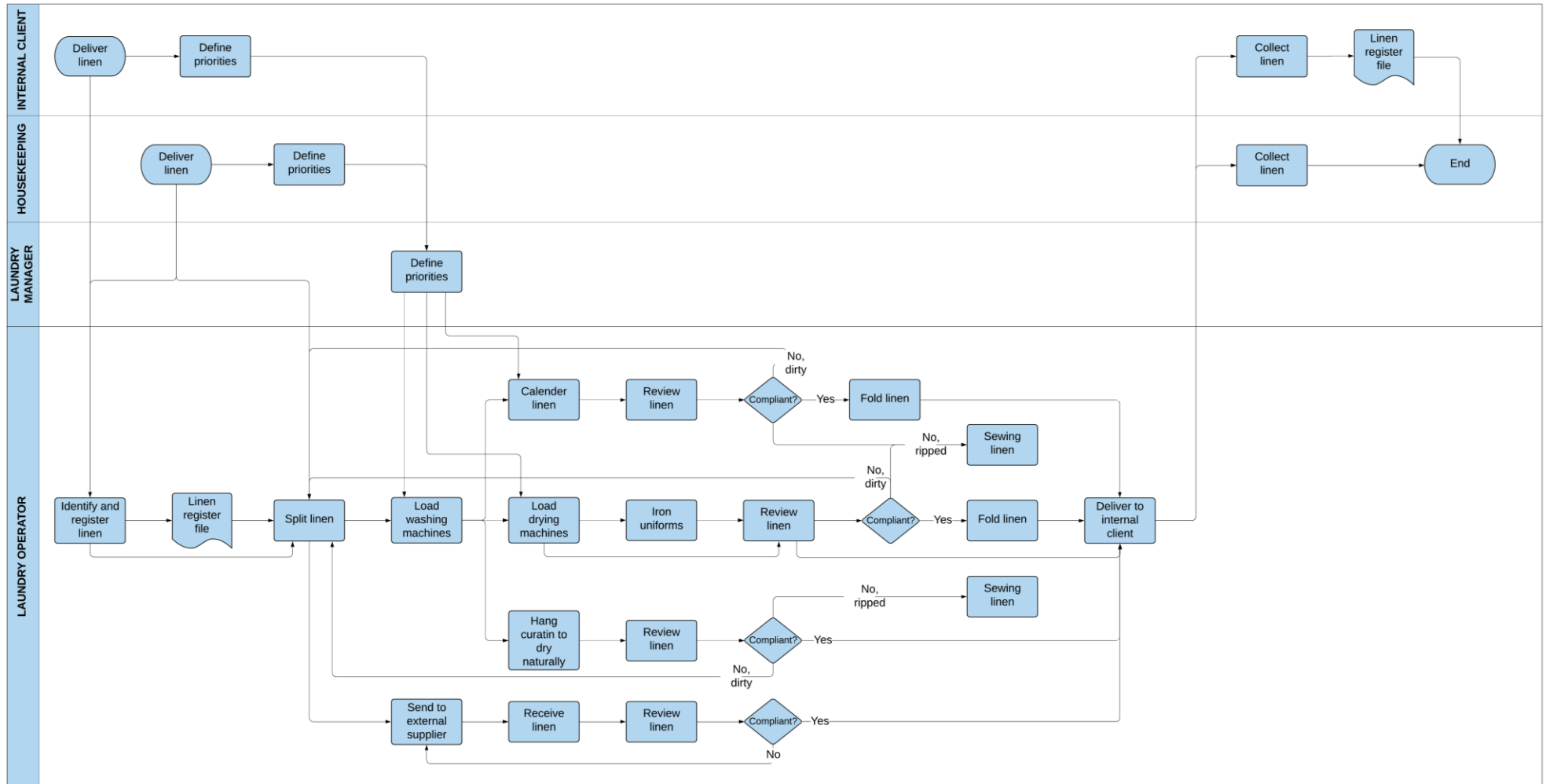
Table 5 Total Quality Management Gurus (Source: adapted from Kiran (2016))

Wilfredo Pareto	Author of Pareto Diagram, the principle behind ABC analysis.
Walter A. Shewhart	Creator of statistical process control and control chart theory, also proposed the PDSA (plan, do, study, act) cycle.
Edwards Deming	Considered “the father of Japanese quality”, his contribution is massive. After his work in Japan, proposed the Deming Philosophy.
Joseph Juran	Author of Juran Trilogy: planning, control and continuous improvement. Also proposed 10 steps for quality improvement.
Armand Feigenbaum	Creator of total quality concept, his quality philosophy lays in three steps: modern quality technology, organizational commitment and quality leadership.
Prasanta Chandra Mahalanobis	With Genichi Taguchi, developed the Mahalanobis-Taguchi Strategy.
Shigeo Shingo	Working for Toyota along with Taiichi Ohno, his success gave origin to Toyota Production system. He is also the creator of SMED (single minute exchange of dies) and Poka-yoke. Nevertheless, with Michael Hammer, he is credited to be one of the authors of Business Process Reengineering (BPR).
Taiichi Ohno	Along with Shigeo Shingo, he is the creator of Toyota Production System. He also developed the concept of 3 M's: Muda, Muri and Mura.
Kaoru Ishikawa	Creator of Ishikawa diagram, he proposed 7 statistical tools: Pareto analysis, cause and effect diagram (Ishikawa diagram), control charts, stratification, checklist, histograms and scatter diagrams.
Genichi Taguchi	Creator of Quality Loss Function Model.
Phillip B. Crosby	Known for his “do it right at the first time” concept, he participated in Martin Missile experiment, which gave birth to zero defect concept.
Yoshio Kondo	Spread the concept of Company Wide Quality Control (CWQC). Also developed a four steps approach for motivation.
Shigeru Mizuno	Along with Yoji Akao, developed the Quality Function Deployment (QFD). Also created relationship diagram, affinity diagram and systematic tree diagram.
Yoji Akao	Co-creator of QFD, was also the developer of <i>Hoshin Kanri</i> .
Noriaki Kano	Author of Customer Satisfaction Model.
Masaaki Imai	Creator of the Kaizen Institute.
Claus Möller	Set the concept of personal quality, central element of TQM, with 12 golden rules.
Blanton Godfrey	Involved in the creation of Malcom Baldrige National Quality Award (MBNQA), US delegate for ISO and participative collaborator in many publications.
Clarence Irving Lewis	Considered the father of modern modal logic, was inspiration for many quality professionals, including Deming.
David Garvin	Identified the eight dimensions of quality.
Dorian Shainin	Developed the Statistical Engineering discipline.
Edward de Bono	Creator of Six Thinking Hats (STH) and Direction Attention Thinking Tools (DATT) framework.
Eliyahu M. Goldratt	Author of the Theory of Constraints.
Eugene L. Grant	Contributed extensively for statistical quality control.
Bill Conway	Listed a set of quality improvement tools.
Yasutoshi Washio	Expert in World Class Manufacturing (WCM) through TQM.

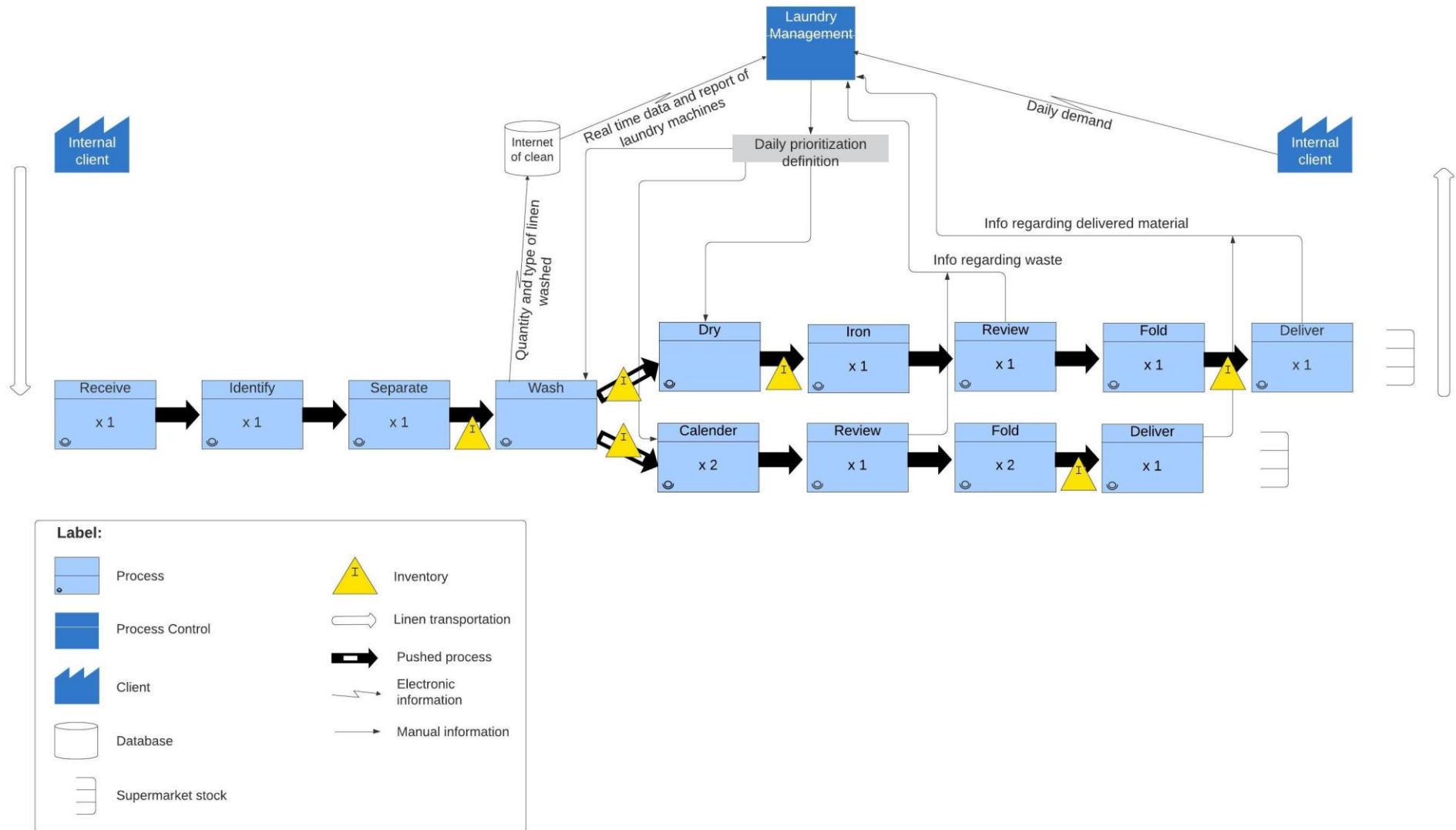
APPENDIX B: Laundry Processes Flow Chart



APPENDIX C: Laundry Processes Swim Lane



APPENDIX D: Current Value Stream Mapping



APPENDIX E: Proposed Value Stream Mapping

