Maria Henriqueta Colaço Tavares de Almeida Oliveira e Sousa
Mestre em Gestão de Sistemas de Informação

Towards Lean Service sustainability: an action research approach

Dissertação para obtenção do Grau de Doutor em Engenharia Industrial

Orientador: António Carlos Bárbara Grilo, Professor Doutor, Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa

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FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA

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Faculdade de Ciências e Tecnologia and Universidade Nova de Lisboa

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Dedicatory

To my mother Maria Henriqueta and father Mário Delfim

To Marcos, Tiago and Maria Inês

To the memory of Eduardo Colaço

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List of Abbreviations and Symbols

AHP	Analytical Hierarchy Process
AR	Action Research
CAR	Canonical Action Research method
CI	Consistency Index / Conformity Index
CPM	Cyclical Process Model
CSF	Critical Success Factors
DEMATE	Decision-Making Trail and Evaluation Laboratory
EU	European Union
ERP	Enterprise Resource Planning
FS	Financial Services
GDPR	General Data Protection Regulation
INE	Instituto Nacional de Estatística (National Statistics Institute)
IS	Information Systems
IT	Information Technology
IEOM	International Engineering and Operations Management
ITC	Infrastructure Technologies and Communications
ITIL	Information Technology Infrastructure Library
JIT	Just-in-Time
KPI	Key Performance Indicators
Lean FS	Lean implementation in Financial Service provider
Lean IT	Lean implementation in Information Technology
LS	Lean Service
LSSA	Lean Service System Approach
LT	Lean team
LTM	Lean Transformation Model
OC	Organisational Culture
OECD	Organisation for Economic Co-operation and Development
PDCA	Plan, Do, Check and Act or Adjust
PDSA	Plan, Do, Study and Act

POI	Protection of Investment
QM	Quality Management
RI	Average of Consistencies
RCA	Researcher-Customer Agreement
RQ	Research Question
SCI	Sustaining Continuous Improvement
SE	Software Engineering
SIPOC	Suppliers, Inputs, Process, Outputs and Customers
SW	Software
TBL	Triple Bottom Line
TOPSIS	Technique for Order of Preference by Similarity to Ideal Solution
TPS	Toyota Production System / Thinking People System
UNIDEMI	Research and Development Unit for Mechanical and Industrial Engineering
UK	United Kingdom
US	United States of America
VOC	Voice of the Customer
VOE	Voice of the employee
VSM	Value stream map / mapping
WIP	Work in Progress
5S	Sort, Set in Order, Shine, Standardise, and Sustain

Abstract

This thesis argues that the sustainability of Lean philosophy adoption depends on following a systemic and holistic thinking, combining Lean technical and social dimensions. Based on the constructivism research paradigm, the study was supported on the Action Research methodology (AR), particularly the Canonical Action Research method (CAR). Acknowledging on lessons learned from two research cycles, the evolving approach to applying and sustaining Lean in a financial services provider was performed. The result was positive and the innovative approach followed was coined as Lean Service System Approach (LSSA). It combines the standard roadmap in *Lean Leap* model with *Lean Service Critical Success Factors*, covering the four perspectives of organisation, people, process and customer, within continuous improvement cycles. This approach was able to anchor Lean in the organisation over time and answered the research question of how to sustain Lean thinking in service organisations. Future research perspectives were also identified to foster further contributions to the Lean community, practitioners and academia.

Keywords: Lean Service, Lean sustainability, Social and technical dimensions, Action research.

Resumo

Esta tese argumenta que a sustentabilidade da filosofia Lean nas organizações depende da adoção de um pensamento sistémico e holístico e da combinação das suas dimensões: técnica e social. A investigação foi baseada no paradigma científico do construtivismo, suportada na metodologia de Action Research (AR), particularmente no método de Canonical Action Research (CAR). Após os dois primeiros ciclos de CAR, com a incorporação das lições aprendidas e com o propósito de manter o Lean na organização, foi efetuada uma abordagem evolutiva aplicada na implementação do Lean em um fornecedor de serviços financeiros. O resultado foi positivo, tendo sido criada uma abordagem inovadora nomeada de Lean Service System Approach (LSSA). Esta combina o modelo Lean leap com os fatores críticos de sucesso do Lean Service abarcando quatro perspetivas: organização, pessoas, processos e clientes, em ciclos de melhoria contínua. Esta abordagem foi capaz de ancorar o Lean na organização e respondeu à questão de investigação de como manter o pensamento Lean em organizações de serviços. Foram igualmente identificadas perspetivas futuras de investigação para fomentar novas contribuições para a comunidade Lean, para a indústria e para a academia.

Palavras-chave: Lean aplicado aos serviços, Sustentabilidade do Lean, Dimensões Social e Técnica, Action Research.

Chapter 1 Introduction

The purpose of this chapter is to provide an overview of the thesis, starting by identifying the research aim, then explaining the rational of the research, presenting the context in which theoretical and empirical research literature was found lacking, and ultimately justifying the research theme. Based on these, objectives and researcher's motivations are highlighted, and the research question is formulated answering a call for research from the theory background. It is explained how the investigation was conducted in four phases translating theory into practice and how research ethics addressed the challenges of the selected research methodology. The chapter finishes with the thesis structure and a summary.

1.1 Aim

This thesis aims to contribute to the scientific body of knowledge in Engineering and Operations Management fields, regarding the sustainable adoption of systems of work and value delivery based on the Lean philosophy, the western declination of Toyota Production System. A novel approach is presented as a product of the underlying research in the Services sector, dubbed Lean Service System Approach (LSSA). This approach not only reinforces the applicability of Lean to the immaterial nature of the tertiary sector, as it emphasizes and addresses a common shortcoming in many unsuccessful implementations of this philosophy in western organisations: not considering the human factor as a fundamental pillar in such transformations, in stark contradiction with the Japanese original.

1.2 Rationale for this research

In 1988, John Krafcik coined the term *Lean* to define the organisation and the production system of Toyota, the Japanese automobile corporation (Krafcik 1988). However, the term gained a wider expression in 1990 with Womack et al. (1990) book. In this work, the authors described the transition from a non-industrialised production to Henry Ford-based mass production, and then from Ford to Toyota's Lean production (Poppendieck 2002). The mass production in Ford's factories was mainly characterised by specialised machinery fabricating standard components and high usage of unskilled shop-floor workers. Due to this lack of skills, the manufacturing work had to be complemented by qualified workers in several other departments, such as quality control, production control and production planning (Womack et al. 1990). Ford was thus able to produce cheap automobiles through mass production, taking advantage from economies of scale. Yet, due to the repetitive and intellectually uninspiring work, this model created unmotivated shop-floor workers and implied high-qualified indirect labour costs, which were not adding value to the final customer (Womack et al. 1990).

On the other hand, in Toyota's context, Japan was facing the consequences of Second World War, namely lack of raw materials, financial and human resources. This situation decreased investment options in labour and machinery, so Toyota managers realised they had to do differently, meaning *doing more with less* (Womack et al. 1990). Therefore, they created what was lately termed *Toyota Production System* (TPS). Context constraints forced Taiichi Ohno (who is considered the 'father' of TPS) to take several strategic decisions. Inspired by the American supermarkets supply shelves model, with low inventories in the production line, he created the concept of *just-in-time*, with the purpose of providing customers with *the right product, with the right quantity and at the right time* (Womack and Jones 2003). A notion

extending to the production line itself – providing every workstation with the right materials with the right quantity at the right time. Additionally, he employed fewer workers in the shop-floor, and through an intense training program empowered them with competencies and skills. The purpose was to provide the appropriate knowledge that enabled workers to perform different tasks concurrently and to encourage workers to take decisions and be responsible for those (any shop-floor worker was allowed to stop a production line if an issue was detected). This strategy decreased the need for quality inspection and production control and consequently, decreased manufacturing costs with indirect labour costs and production waste. In the same way, leadership roles were also empowered, encouraging managers to work closer to their team-workers. Joining training with job experience, Toyota's leaders were able to (1) identify waste, (2) know and understand the real problems of daily work better and (3) solve problems directly with workers. This approach resulted in a deeper perception of the issues, identifying and addressing problem root causes systematically, and increasing the communication flows throughout all levels of the organisation. To sustain TPS, Ohno created a simple and visual set of tools to induce behaviours and attitudes, creating a culture of continuous improvement (Womack et al. 1990).

Moreover, it is also important to mention Toyota's context in the Japanese culture when TPS was created. The company had specific characteristics as explained by Sugimori et al. (1977). Toyota workers had (1) group consciousness, (2) sense of equality, with little discrimination between blue-collar and white-collar staff and (3) higher education and desire to improve, as promotions to managerial positions were available for workers. Consequently, a feeling of unity among the workforce was encouraged by Toyota, creating a respect for people system: workers could actively participate in running and improving their work (any worker could suggest improvements) and were able to demonstrate their full capabilities. Toyota developed a flexible workforce, where the number of labour hours was adjusted to demand changes and a creative thinking enterprise was growing from employees' ideas and suggestions (Monden 1983). Therefore, for Ohno (1988) TPS was a production system, a management system and a business philosophy, featuring two major pillars: waste elimination and respect for people. When Sugimori et al. (1977) described TPS, they also highlighted the concepts of just-in-time production (JIT) and respect for people system.

Accordingly, Bicheno (2008) described Toyota as a 'systems' company, meaning Lean enforced a systems approach, featuring systemic and holistic thinking. Despite the wider adoption of Lean by western companies, where the Toyota technical dimension of JIT and waste elimination were more easily replicated, organisations faced constraints in understanding and incorporating the mindset (Hines et al. 2004). In order to explain the mindset behind the five Lean principles of *value*, *value stream*, *flow*, *pull* and *perfection* identified by Womack and Jones (1996), these authors introduced the concept of *Lean thinking*. According to the latter, when an organisation decides to start a Lean implementation, organisation members must learn and understand the principles and the thinking behind each principle from the outset. Based on this assumption, for Womack and Jones (2003), Lean could be adopted in any industry or economic sector outside Japan if the Lean principles, tools and techniques were merged with the correct thinking and put into practice. Several studies demonstrate that Lean technical dimension of waste elimination/continuous improvement was broadly implemented, but the human system pillar mentioned by Ohno (1988) was not as per Magnani et al. (2019); Ciano's et al. (2019) literature review identified that Lean studies started to focus on the relationship between Lean and human resources. According to Bowen and Youngdahl (1998), the lack of a people-oriented system becomes an obstacle in Lean implementation, as people are an important enabler in Lean adoption.

Although some studies demonstrated Lean to be an evolving concept, namely Hines et al. (2004) stating that Lean evolved from a production toolkit into a value system, the majority of Lean studies did not address Lean as a system, but rather as a compilation of practices and techniques (Gupta et al. 2016). This tendency to adopt just the technical

dimension (tools and techniques) **did not create the necessary cultural shift to sustain Lean in organisations** (Grigg et al. 2020). Therefore, companies realised that isolated application of Lean tools and techniques was not synonymous of long-lasting improvement (Liker and Morgan 2006; Amaro et al. 2020). Duarte and Cruz-Machado (2020) cited authors that argued the importance of adopting a **holistic and systemic approach**, since there is a need to integrate social and technological practices (Hadid et al. 2016; Paez et al. 2004).

Regarding **the application of Lean to services**, although the thinking or philosophy behind Lean principles remains unchanged from manufacturing to tertiary sector, adjustments must be made in *Lean Service* (LS) implementations, as services are delivered by people-to-people (Gupta et al. 2016). Indeed, services require intensive knowledge-workers (Staats et al. 2011), where a focus on the human system is required (Leite and Vieira 2015).

Furthermore, aiming to **sustain Lean Service in organisations**, theory background pointed out a list of *critical success factors* (CSF) and for Lins et al. (2019) the identified CSF covered: (1) organisational aspects, (2) people management, (3) processes, and (4) customer. Hoss and ten Caten (2013) stated that persistent practical problems should guide production and operations management research, such as the difficulties companies face with the adoption and sustainability of lean practices. Lean sustainability is pointed out by Parmer and Desai (2019) in their literature review as a future research direction, as studies recognised the role of Lean practices to upholding organisation development and competitiveness (Ciano et al. 2019). As organisations sustainability can be measured by Elkington' (1998) *triple bottom line* (TBL) of economic, environmental and social dimensions, for Kamble et al. (2020) Lean practices are relevant in achieving sustainable operation performance; Martensson et al. (2019) also demonstrated the positive influence of Lean towards performance sustainability. Thus, as stated by Pinto et al. (2018a) a positive correlation between Lean implementations and business performance has been highlighted in numerous researches.

Therefore, the following interrelated research gaps were identified in literature:

1. The lack of the human system pillar in Lean implementations and the inherent constraints in Lean adoption, particularly in services;
2. The majority of Lean studies focusing only on the technical dimension (in a set of techniques and procedures) rather than on Lean as a socio-technical system featuring systemic and holistic thinking that combines Lean social and technical dimensions;
3. The sustainability of Lean adoption in organisations.

Lastly, the call for research concerning the need for further research on how to sustain Lean in organisations (Parmar and Desai 2019).

1.3 Theme justification

The theme of this thesis is justified with the aim of filling the research gaps at the end of the previous section (and further detailed in chapter 2) and embracing the call for future research on how Lean can be sustained in (all) organisations.

As mentioned, studies pointed out several critical success factors to sustain Lean, thus, it is relevant to analyse the list of CSF and to foresee which are the most applicable in each organisation context. When starting a Lean journey, it is important to take into consideration the unique organisation context, particularly its culture and people, and to understand the CSF to take into account.

Furthermore, based on previous case studies (Ferreira et al 2018; Ingelsson and Martensson, 2014; Longoni et al. 2013; Turfa 2003), this research argues that Lean is sustainable in organisations once it becomes part of the organisational culture (OC), and this permanence must be confirmed after the implementation project has finished. The organisational culture background is explained in Amaro's et. al (2020) literature review, who cited several authors to present the roots of OC and its linkage with Lean. This thesis follows organisational culture definition from Schein (1983) cited by Amaro et. al (2020):

"Is the pattern of basic assumptions that a given group has invested, discovered, or developed in learning to cope with its problems of external adaptation and internal integration. A pattern of assumptions that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think and fell in relation to those problems."

The research aimed at confirming the research assumption that an effective way to merge Lean in the organisational culture is by (1) following a systemic and holistic approach, (2) through Lean principles, plus (3) addressing Lean social and technical dimensions and involving all organisation levels. This is materialised through the theoretical work, corroborated by two Action Research cycles, implementing Lean Service at a Portuguese organisation (anonymised in this thesis). Following the research methodology, and based on the results obtained, was demonstrated that the approach suggested, Lean Service System Approach (LSSA) is an enabler to anchor Lean in the organisational culture.

1.4 Research Question

As studies demonstrated that Lean has a positive effect on operational performance (Kamble et al. 2020; Martensson et al. 2019), this thesis aims to address a call for research regarding Lean sustainability, as mentioned in of theme justification. The research question (RQ) formulated was thus:

RQ: ***How to sustain Lean Service within organisations?***

The intention is to offer an answer by following a deductive and prescriptive approach, following the constructivism research paradigm and the Action Research methodology, with a mixed methods investigation using qualitative and quantitative approaches. Thus, this research question, proposition and hypotheses are detailed in chapter 3 (section 3.3).

Thereupon, the purpose of the investigation by answering this RQ is to present an innovative approach intended to be useful for the Lean community, practitioners and academia. Indeed, in order to conduct a Lean Service Action Research thesis, I argued that it is important to connect three knots: practitioners, community and academia, and during these years of investigation, I pursued the materialisation of this idea. As an Lean Service (LS) practitioner (knot 1) my practice experience was consolidated with the knowledge obtained from other Lean journeys through *gemba* walks in different organisations, plus the study of two Lean Portuguese case studies (Ferreira et al. 2018). Moreover, this practitioner experience was combined by interacting with the Lean community (knot 2), by networking with experts from all over the world, actively participating in the Lean Academy (www.lean.org.pt) forums, in conferences and in Lean Summit. Finally, my urge to gather a deeper understanding of the Lean body of knowledge from academia (knot 3). Learning from the literature review authors and from other Lean university initiatives such as the JELA Lean company from the University of Aveiro (Fernandes et al. 2020), as well as the Lean foundation program in Technical Superior Institute. Learning also from Nova School of Science and Technology professors, other students, UNIDEMI (Research and Development Unit for Mechanical and Industrial Engineering) researchers, and the Lean training program

of the Portuguese Engineers Union ('Sindicato dos Engenheiros'). Additionally, the relevance of connecting the academia with the practitioners knot, following the example of the Gento's et al. (2021) study regarding the industry-university collaboration between Renault company and the University of Valladolid for the development of a learning factory devoted to the learning and practicing of Lean. This learning factory concept is being put into practice by universities and companies to equip students and employees with the demanded needs (Gento et al. 2021). Hence, the relevance of connecting these knots of industry practitioners, community and academia.

1.5 Research Objectives

As the goal of this thesis is to address Lean Service sustainability by elaborating on and filling the previously identified research gaps, the research objectives can be explained through the following five academic and personal points, which can also be seen as researcher's motivations:

1. To study the Lean theory;
2. To contribute to the Lean Service body of knowledge;
3. To solve a specific problem of the target organisation and the possibility to combine Action Research methodology and Lean;
4. To participate in co-creation research projects with the target organisation focus groups and organisation customers;
5. To contribute with an innovative approach to be used in other Lean implementations.

The first point is linked to my own interest. From my standpoint, Lean is viewed as a philosophy (Bhasin and Burcher 2006), meaning continuous improvement to pursue perfection with and through people. From my working experience, I believe people are real change agents and can transform organisations, as they are the ones who can make the difference and shape companies. Thus, during the research, I meant to acquire a deeper knowledge in Lean, to complement my financial and IT management background, and that is why I decided to choose an Industrial Engineering Ph.D, where I could learn from and work with engineers.

The second objective and motivation was related to my present working context. Combining Lean principals with the service environment was a unique opportunity to contribute with my working experience to Lean Service (LS) body of knowledge. The objective was to capture new insights of Lean in tertiary sector through two Action Research cycles, in order to help find a lever to create an innovative approach to sustain Lean.

The third objective was to solve specific problems identified in the target organisation, through the Action Research methodology. The approach was implementing the Lean theory, adopting a bottom-up approach (rather than top-down), meaning: (1) working directly with the shop-floor employees, (2) making small and consistent changes, (3) focusing on the final and internal customers with the goal of (4) creating value and long-term results, and (5) learn through reflection.

The fourth objective was related with how the academic research paradigm and methodology were joined with Lean theory and implementation. As this research required an immerge implementation, where the investigator influences and interacts with the object studied, the research epistemological paradigm chosen was constructivism, with the research methodology of Action Research with mixed methods, using both qualitative and quantitative approaches. Action Research author Lewin (1946) realised the importance of how the context and the investigator's experience affect the

research, and nowadays there are several types of AR with rigour and scientific acceptance. From the AR methods list, the choice fell on the Canonical Action Research (CAR) method, which is oriented to services. Indeed, despite being the researcher I also had an active role during implementation, participating in co-creation projects with the organisation focus groups and their selected customers, which allowed me to learn deeper from the immersion experience.

Finally, and based on the knowledge acquired from (1) Lean training, (2) Lean *gemba* walks and (3) Lean Service implementation, the last objective aims at contribute with the innovative Lean Service System Approach (LSSA). The objective is to contribute with an approach, which can then be used by practitioners in other LS implementations, by the Lean community and academics as a model to sustain Lean Service within the organisations, so as to improve their performance operations over time.

1.6 Thesis methodological approach

Regarding the thesis methodological approach, the following four main phases were performed (figure 1.1):

Figure 1.1 *Thesis phases*

First phase – body of knowledge and problem identification – starting with the body of knowledge and the chosen theory definition, then, the purpose was to understand Lean state of the art, from its origin in Toyota Production System (TPS) to the identified literature gaps. The previously mentioned gaps, namely (1) the lack of human system pillar during Lean journeys, (2) the majority of Lean studies focusing only on the technical dimension (in a set of techniques and procedures) rather than on Lean as a system and (3) the sustainability of Lean in organisations, were the basis on which the research question was formulated. The objectives defined were aligned with personal and academic motivations, and due to the demand for an immerse experience, the research paradigm of constructivism and Action Research methodology were chosen.

Second phase – combining research methodology with background theory during implementation – after research paradigm and research methodology selection, the focus was the definition of the Lean theory model to implement during the journey and how to join theory and research dimensions. Therefore, several Lean models from the literature were analysed. In the thesis are described the Toyota Production System House, the Lean Transformation Model (LTM) and the Lean leap. After this analysis, the decision was made to implement the LTM in the first AR cycle. It was realised that Lean was not sustainable once the project finished (see chapter 4). Based on the learning process inducted by Action Research, additional literature was reviewed to study Lean Service critical success factors, with the aim to sustain Lean in the organisation. Thus, a different way was taken, and was defined and implemented a new theoretical approach during the second AR cycle. The purpose was to demonstrate how to apply the coined Lean Service System Approach in a real situation, and owing to the results monitored, it was proved that Lean was sustainable after the project finished.

Third phase – conducting the cycles – when starting the AR cycles, the focus was to understand the organisation context, particularly internal and external challenges. Those were analysed based on stakeholders' data, in meetings held with managers and workers and in documentation. After the problem identification, a root cause analysis was performed

and the strategy to conduct the journey was defined. The learning process gave important insights and helped to improve and accelerate new actions during Lean implementation.

Fourth phase – analysis of the findings – a discussion analysis was performed, where the research data management recorded all the data obtained during the investigation. Qualitative data from surveys and interviews was collected, as well as quantitative data from statistics was analysed, and a 'before' and 'after' result analysis was carried out. Findings were reached and detailed, and conclusions were taken, identifying research limitations and future research topics.

1.7 Research ethics

Following an Action Research approach within a constructivist research paradigm, this thesis had to take into consideration the literature identified ethical issues of this type of research and define a mitigation plan.

As the target of this research was a specific organisation, their focus groups and selected customers, all the gathered information was protected, where deontological and ethic legal codes were respected, particularly the internal organisational procedures and the Universidade Nova de Lisboa ethical code.

Moreover, and despite the fact that the data obtained during the investigation from interviews, observations, surveys and measurements was not in the aim of the General Data Protection Regulation (GDPR), all the data was anonymised. Additionally, in order to guarantee the 25th fundamental principle of the Constitution of the Portuguese Republic and the international codes, namely the Nuremberg Code, the board of directors agreed with the investigation, the focus group employees were informed of the research, and an informed consent was obtained.

Finally, it is relevant to mention that during the Ph.D period I have co-written three articles related to the work presented in this thesis:

1. Lean IT adoption: Success cases in Portuguese banks (Ferreira et al. 2018);
2. How Knowledge Management Practices Influence the Deployment of Lean Management: a Case Study (Lota et al. 2019);
3. Towards Lean Service Sustainability: A Systems Approach (Almeida M.H., Lota P. and Grilo A.)

Ferreira et al. (2018) received the best article prize in the case study category in the International Conference on Industrial Engineering and Operations Management (2018). This article, as well as Lota et al. (2019), were both published in the conference proceedings and are referenced in the thesis. The third article, which was submitted to a journal in April 2021, explains the Lean Service System Approach (LSSA) and demonstrates the application of LSSA in the financial services provider. Although this article was already accepted for peer review, it is still going through the revision process. This means that the submitted version will be subject to changes and thus, it will be different from the published one. In this sense, in May 2021 and for the purpose of this thesis it is not possible to cite this article. Therefore, and being the main author, I asked permission from the other two co-authors to use some parts of the submitted text in the present document.

1.8 Thesis structure

The present thesis is structured in six chapters: (1) introduction, (2) theoretical background, (3) research methodology, (4) Lean in information services provider, (5) Lean in financial services provider and (6) conclusions. All the six chapters start with a brief introduction and the first five finish with a summary.

In the first chapter, introduction, the purpose is to present the aim and the rational of the thesis with its explanation and the study justification, as well as the clarification of the research question, objectives and motivations. Followed by the presentation of the investigation process through phases. The chapter ends with a reference to the way that ethics was taken and how the thesis was structured.

In the second chapter, a Lean literature review is performed. It starts to reinforced the mentioned overview of Lean origins starting with Toyota Production System (TPS) and its pillars, with a special focus on Lean thinking and the importance of understanding the rationale behind the underpinning principles. Then, there is an explanation of the Toyota Production System House, as well as of the two Lean models used during the implementation: Lean Transformation Model and Lean Leap. Lean sustainability is highlighted afterwards, particularly Lean enablers and barriers. As the focus of the research was on the service sector, a literature review on Lean Service is presented and its critical success factors described. The chapter ends with an analysis of Lean application to services.

Chapter three explains the research methodology, where the chosen epistemological paradigm is explained with the advantages of a mixed method approach with qualitative and qualitative approaches. Research methodology of Action Research is presented, particularly the Canonical Action Research (CAR) method and the linkage between AR and Lean. Based on the research methodology and its combination with Lean theoretical background, the research question was formulated with the purpose of demonstrating how the literature was materialised in the investigation, and how the research question was deducted from (1) the body of knowledge studied, plus (2) the knowledge obtained from the first AR cycle.

The empirical validations through the Action Research cycles are presented in chapter four with Lean in information technology service provider (named Lean IT journey), which followed Lean Transformation Model, and in chapter five with Lean in financial services provider (named Lean FS journey), where LSSA was implemented. The discussion of findings and the learning through reflection are demonstrated at the end of both chapters.

The thesis finishes with the conclusions at chapter six, analysing the answer to the research question and the research gaps, as well as the findings of the AR cycles, where thesis limitations and future research topics are pointed out.

1.9 Summary

This first chapter presents the thesis aim, as well as the research rational, explaining the purpose of the investigation on exploring Lean Service in a holistic and systemic way. The researcher motivations were correlated with the research objectives and from the literature review, the research gaps were identified. The way to respond to them was expressed in the research question formulation: *how to sustain Lean Service within organisations*. The thesis methodological research four phases were described, and it was explained how the research ethics was addressed during the investigation, and how the thesis is structured.

Chapter 2 Theoretical background

This second chapter presents Lean theoretical background focusing on the Lean body of knowledge topics, which are relevant to the investigation. Lean's origin from the Toyota Production System (TPS), thus is highlighted the way Toyota Corporation pursued perfection through its continuous improvement path and respect for people system. Lean is described as a philosophy, where there is a *thinking* behind each Lean principle, combining Lean technical and social dimensions to support Lean as a system and its sustainability within the organisations. Literature points out several models to implement Lean. Therefore, the ones used during the investigation are briefly detailed. Being a Lean Service (LS) thesis, it is demonstrated how Lean philosophy is applied to services, with the tertiary sector singularities, as well as the LS critical success factors. The chapter ends with an overview of the target services of this thesis: Lean in information technology and Lean in financial services providers.

2.1 Lean: an overview

Lean has its origin in the Toyota Production System (TPS) from the Toyota Japanese automobile manufacturer. Taiichi Ohno created TPS, the result from decades of incorporating innovations and learnings (Ohno1998).

As mentioned in the introduction chapter (see section 1.2), for Ohno (1988) TPS had two major pillars: waste elimination and respect for people. Accordingly, Sugimori et al. (1977) also highlighted these two TPS concepts of just-in-time production (JIT) and respect for the human system. In JIT, the purpose is to provide customers with *the right product, with the right quantity and at the right time* (Womack and Jones 2003). TPS's respect for people, is about coaching, developing, supporting and valuing the workforce, which is the foundation of continuous improvement. In order to develop a culture of improvement, organisations have to continuously coach and develop their people to change their habits, making improvement a routine (Soliman 2020). Regarding waste, TPS introduced the concept of the three "M's" – *Mura, Muri, and Muda* (Womack and Jones 2003) in figure 2.1:

- *Mura* (unevenness) - variability in workflow caused by changes in volume (uneven demand), product/activity mix and quality;
- *Muri* (overburden) - excessive and unrealistic workload on workers and equipment;
- *Muda* (waste) - the activities that do not add value.

Figure 2.1. *Mura, Muri and Mud*a from Kaizen Institute adapted by Ferreira (2018)

For Bicheno and Holweg (2016) the three are interlinked: unevenness causes overburden, which in turn causes many other forms of waste. Periods of peak work cause stress, so *muda* can result in *mura* due to long lead times. Furthermore, as quality is uncertain, it can be circular: *mura* causes *muri*, which causes *muda*, which causes *mura*…These authors also described the TPS seven wastes: transport, inventory, motion, waiting, overproduction, over-processing and defects, which despite being originally used for manufacturing have also application in services.

Ohno's method pointed out four main points described by Bicheno and Holweg (2016):

1. Mentally force yourself into tight spots;
2. Think hard; systematically observe reality;
3. Generate ideas; find and implement simple, ingenious, low cost solutions;
4. Derive personal pleasure from accomplishing Kaizen (continuous improvement).

Although authors such as Hines et al. (2004) have described Lean history and Holweg (2007) its genealogy, Pinto et al. (2018b) described Lean manufacturing foundations, its main principles and wastes, this research highlights the importance of the singular Toyota's context when Toyota Production System (TPS) was created. As referred in section 1.2, the lack of Japan's natural resources and the consequences of Second World War, particularly financial and human resources, had a major influence in TPS. Thereupon, Toyota understood (1) the need to manufacture higher quality goods with added value and lower production costs, and (2) recognised its workforce competitive advantage (Sugimori et al. 1977). The company had specific workforce characteristics as explained by these authors and highlighted in section 1.2.

The Toyota Production System itself was designed to create continual challenges for leaders and team members, meaning that the Toyota's success is not rooted in its application of a standard methodology to manufacturing. Instead, it is rooted in its leaders, who saw self-development and trained others as the only possible path, not only for finding the right solution for the problem at hand, but also for constantly and consistently improving performance day after day (Liker and Convis 2012). As stated by these authors, Toyota valued hands-on knowledge and stepping up to challenges, meaning that the breakthrough was achieved not simply through single brilliant inspiration, but hard work, intensive focus, trial, error and perseverance.

Indeed, Toyota successfully developed leaders and culture even in America, especially in its manufacturing plants, where it was able to sharpen cultural differences between Japan and the United States (US), in particular the strong collectivism in Japan versus individualism in the US and long-term thinking in Japan versus short-term thinking in the US (Liker and Convis 2012).

As mentioned in section 1.2 to characterise Toyota system organisation and its production, John Krafcik (1988) coined the term Lean, popularised by Womack et al. (1990). As Lean is about growth and opportunity (Bicheno and Holweg 2016) its main goal is to provide customer value by doing more with less: less human effort, less equipment, less time, less space, less inventories and eliminating waste (Womack and Jones 1996). Thus, a simple definition of Lean is 'Doing More with Less' (Bicheno and Holweg 2016). To deliver customer value through people's respect and waste reduction, Lean advocates five principles: value, value stream, flow, pull and perfection (Womack and Jones 1996):

- Value – means the value (output of the organisation) that the customer is willing to pay. It is necessary to understand the perspective of both the internal/external customer as well as the product/service user, in order to identified what the customer values;
- Value stream – the process of value delivery (either a product or a service), aimed at identifying and minimizing/eliminating non-added value activities and the enabling of *flow* (see next); a single value stream can comprehend several products of services which share a similar delivery process. Value streams comprise the involved people, machines, information flow and operational procedures;

- Flow – the state where process steps in the value stream are performed with no interruption/waiting times in between, from the moment the value stream is triggered by customer until the organisation receives the benefit of delivering the requested value. Perfect flow means zero waiting time between all added-value activities;
- Pull system – the customer decides what is produced, therefore it "pulls" the production through the value chain;
- Perfection - pursuing perfection means continuous waste elimination.

In order to explain the mindset behind these five principles, these authors introduced the concept of *Lean thinking*. Thus, it is of paramount importance that organisations understand the thinking behind each principle, so for Womack and Jones (2003) the critical starting point of Lean thinking is to capture the definition of value by the ultimate customer. So, why is it critical to understand what value means? Because through the perceived value organisations can better answer customers needs. Hence, an intensive dialogue with customers to obtain the definition of perceived value of each good/service delivered is the key to have the correct information and the insights needed to pursue the other four principles in a Lean journey.

The last forty years of academic research (Ciano et al. 2019) have demonstrated that Lean has an evolving concept and it will continue to be so, from a concept of production toolkit into a Lean value system (Hines et al. 2004). For these last authors Lean has two levels:

1. Strategic, with a customer-centric thinking approach;
2. Operational, where tools are applied.

Furthermore, Malmbrandt and Ahlstrom (2013) defined Lean based on:

1. Principles - by which Lean is portrayed as a philosophy, not a collection of tools;
2. Practices – by shop floor techniques, tools or practices.

Summarising this Lean overview, and from my analysis of the mentioned literature review, the TPS pillars and Ohno's ideas and method are quite simple, taking into consideration the singular workforce context and contingencies of the Japanese company. Indeed, TPS is supported on basic points, with a focus on creating customer value, supported by a respect for people, with the purpose of reducing waste, overburden and unevenness to achieve perfection through continuous improvement. Indeed, TPS was ideated and created as a system before any TPS tool was created.

2.2 Lean system

For Ohno (1988), TPS is a production system, a management system and a business philosophy. Accordingly, Bicheno (2008) stated Toyota is a 'systems' company rather than a manufacturing one, where TPS can stand for Thinking People System (Bicheno and Holweg 2016). Thereupon, these authors argues that the essence of Lean is a systems approach with a holistic systems thinking.

Hence, as Lean can be framed as a holistic approach, the technical and social dimensions must be combined (Hadid et al. 2016), aiming at the integration of social and technical practices (Lathin and Mitchell 2001; Paez et al. 2004). For Trist and Bamforth (1951) the technical system is the combination of equipment, tools, techniques and processes, and

the social system is composed of people and their relationships. Niepce and Molleman (1998) recognised similarities between Lean and socio-technical systems, where Lean combines technological systems with people and organisational structures (Lathin and Mitchell 2001; Shah and Ward 2007; Tortorell et al. 2017).

Moreover, several Lean case studies demonstrated that both social and technical dimensions of Lean are required to achieve positive operational, health and safety impact (Longoni et al. 2013). Indeed, organisations realised that isolated application of Lean tools and techniques was not synonymous of sustainable improvement (Liker and Morgan 2006).

Over the forty years of Lean studies, the human dimension of lean has received limited attention from the academic realm (Magnani et al. 2019). Notwithstanding, recent studies started to focus their attention on the relation between Lean and human resources (Ciano et al. 2019) but most of the empirical works did not address the transition process from workers' perspective (Losonci et al. 2011). Magnani et al. (2019) literature review crossroad the technical part of Lean and its human-related issues, in the following different levels of analysis: (1) Lean's impact on working conditions and employee outcomes, (2) Human Resources practices as facilitators of Lean adoption, and (3) employee development as a moderator of Lean adoption. Therefore, these authors proposed a framework as a potential guide to include the human dimension of Lean in research.

Back to Toyota, considering their social dimension, the company developed its human system based on a flexible workforce where a creative thinking organisation was growing from employees' ideas and suggestions (Monden 1983). Workers could actively participate in defining how to perform and improve their work, as any worker could suggest improvements and everyone was thus able to demonstrate their full capabilities (Sugimori et al. 1977).

Furthermore, Bicheno and Holweg (2016) highlighted that Taiichi Ohno developed managers by the Socratic method – asking tough questions rather than providing answers – by giving the answer the person does not learn as much and is less committed compared with thinking it out (practices like Hoshin Kanri or Policy Deployment are examples of this assumption). Thus, this Socratic method encourages operators to think, question and learn, while persistent asking of the questions allows decentralisation to evolve (Bicheno and Holweg 2016).

Spear and Bowen (1999) explained (1) how Toyota trained its work force within the scientific method and (2) its internal training strategy. These authors captured Toyota's tacit knowledge in four rules summarised by Staats et al. (2011) as the essential aspects of the Lean system, and explained by Bicheno and Holweg (2016):

- Rule 1 - specified tasks – *work shall be highly specified as to content, sequence, timing, and outcome*. It means that, if all work is specified, it can be standardised and, should any problems arise, they can be easily identified and reduced. With this approach, the emphasis is on the process, where problems are raised and analysed, and interventions are planned so as to prevent them from occurring again.
- Rule 2 - streamlined communication – *every customer-supplier connection must be direct, and there must be an unambiguous yes-or-no way to send requests and receive responses*. This rule takes into consideration the communication route (which sometimes is too long and complex) and the way organisations face issues and solve them, particularly how the information is passed over the structure (example: when a problem is solved by a problem-solver, if this solution is communicated and passed to the rest of the organisation).
- Rule 3 - simple process architecture – *the pathway for every product and service must be simple and direct*. Value streams must be clear and go through the possible minimum number of steps. That is why the *spaghetti*

tool, as well as the *value stream mapping* are interesting to be applied, in order to count the number of process steps and to verify the added/non added value and the necessary activities.

- Rule 4 - hypothesis-driven problem solving - *any improvement must be made in accordance with the scientific method, under the guidance of a teacher, at the lowest possible level in the organisation*. The improvements must follow the scientific method: Plan, Do, Study and Act (PDSA) as an important way to reach learning. The proposed changes must be planned, on a hypothesis basis, then reflected and tested on the *gemba* and in the organisation, through direct observations to understand the problems and, using the Socratic method, asking why and not showing how.

Additionally, Spear and Bowen (1999) emphasized that these rules must be absorbed over time and the way to incorporate them is by questioning, that is to say, by going to *gemba* and asking questions:

- How do you do this work?
- How do you know that you are doing it correctly?
- How do you know that the outcome is defect free?
- What do you do if you have a problem?

From my experience, going to *gemba* and questioning workers indeed highlights problems and brings the opportunity to talk to those who execute the tasks. On the other hand, people like to be involved in discussing problems and finding solutions. Working directly with workers, allows identifying their needs regarding (1) technical competences, (2) soft skills, (3) wellbeing issues, as well as (4) workplace conditions. As pointed out by Bicheno and Holweg (2016) workers must enjoy the workplace, so the ergonomics (temperature, lighting, vision, comfort, lifting, risk of repetitive strain) must be as friendly as possible, as well as safety, in order to empower people's engagement. Moreover, from these *gemba* initiatives, insights are normally identified towards continuous improvement, and foster an environment of unity with the workforce, which is a powerful approach to create a respect for people system, as workers can be willing participants in the improvement process.

Alves et al. (2012) advocated that a Lean journey can transform *workers into thinkers*, and from the researcher perspective, it means Lean can contribute to workers' reflexivity. Lean can provide the conditions to review and improve workers' technical competences and soft skills, such as polyvalence, decision-making, the assumption of responsibility, self-learning and self-adaptation (Alves et al. 2012). In the same line, Emiliani (1998) argued that Lean behaviours can add or create value, the former being: self-awareness, humility, compassion, calmness, reflection, honesty, consistency and generosity.

Moreover, changing from a culture that values autonomy is very different from changing from one that values hierarchy authority (with roots in Fordism culture), thus, willing to incorporate Lean mindset, there is a need to become a learning organisation (Amaro et al. 2020).

Hence, this research also supports that creating the right conditions to workers' reflexivity, cultivating the add-values behaviours and attitudes, is an investment to the respect for people system, and it contributes to a better work environment, as well as to workers' commitment and motivation, which will help change the organisational culture and increase performance.

Lastly and regarding the technical dimension, there is a significant number of tools to support the Lean journey, being more than hundred Lean practices available and practised by industries (Jadhav et al. 2014). Thus, the table 2.1 presents a brief description of a set of tools (not all) used during this investigation.

Table 2.1. *Lean tools adapted from Ferreira et al. (2018)*

Tools	Description
VSM	Value stream mapping (VSM) draws for a family of products its value stream. Initially it represents the current stage, allowing the detection of waste and opportunities for improvement (Tapping 2003).
SIPOC	Analysis the entire value stream considering **S**uppliers, **I**nputs, **P**rocess, **O**utputs and **C**ustomers, making it easier to understand its connections.
A3 Thinking	Reports about problems and corrective changes that happened to the process. The method of filling a A3-sized canvas allows capturing the team thinking process and understanding the reason for their actions. In this way, there is a sharing and learning of documented knowledge.
PDCA	Systematic process improvement method consisting in four stages: (1) *Plan*, (2) *Do*, (3) *Check* and (4) *Act* or *Adjust* (Orzen and Paider, 2016): ***Plan*:** understanding of what is happening in the work process. ***Do:*** implementation of improvement actions in the process, elaborated in the previous stage. ***Check:*** establishment of a trial period to understand the development of the new process. It is entirely focused on confirming the ideas of the team. ***Act or Adjust:*** allows the team to react appropriately, building on the findings made in the previous stage.
Gemba	Japanese word that means current place (Tyagi et al. 2015) plus the people and the place where the work is done (Bell and Orzen 2011): For other authors, *Gemba* is the place where value-added activities take place (Orzen and Paider 2016).
Kanban	It is the control system for Just-In-Time (JIT) production (Sugimori et al. 1977); It also represents the visual mechanism that gives workers control of the process (Riezebos et al. 2009).
5S	*Seiri (sort) Seiton (set in order) Seiso (shine), Seiketsu (standardize) and Shitsuke (sustain).*
Standard Work	Critical activities are described through standardised procedures (Pinto et al. 2018c); Value creation by the employees with managers' support (Orzen and Paider 2016).
KPI	Measures the key results of the company; Provides feedback to ensure ongoing effectiveness of the processes and also to identify new opportunities for improvement; Additionally, it governs the operation of each process and contributes to the desired results across the value stream (Bell 2006).
Heijunka	Priority management; Creation of activities, as homogeneous as possible, aiming to use the available capacity and create a constant work flow; Absorbing sudden fluctuations in market demand by levelling the total volume of short-duration orders to establish the effects of changes in order to improve demand and responsiveness in a short period of time (Bannister et el. 2014; Womack and Jones 2003); Controls the variability of the sequence of work arrivals, in order to allow a higher usage capacity (Huttmeir et al. 2009); Levels the production volume and the product mix, using the same sequence of products for each production cycle (Matzka et al. 2012).

2.3 Sustaining the Lean adoption

As presented by Parmar and Desai (2019) in their literature review, future research directions on sustainable Lean are indicated. Moreover, studies recognised the role of Lean practices to sustain organisation development and competitiveness (Ciano et al. 2019). As mentioned, organisations sustainability can be measured in the economic, environmental, and social dimensions with the triple bottom line (TBL) of Elkington (1998). For Kamble et al. (2020), Lean practices are relevant in achieving sustainable operation performance, and Martensson et al. (2019) demonstrated the positive influence of Lean towards performance sustainability.

In addition to the interrelation between both topics (Lean sustainability and organisation sustainability with Lean support) this section focuses on how Lean theory addresses Lean sustainability, as nearly two-thirds of the Lean implementations are unsuccessful and less than one-fifth of those implemented have sustained results (Jadhav et al. 2014). These numbers must be a real concern to organisations that decide to start their journeys, as well as to researchers, practitioners and academics. It is important to understand the reasons why this low sustainability occurs and how to change it.

In order to address and overcome them, Lean theoretical background indicated several critical success factors (see sub-section 2.4.2) and identified barriers and enablers for Lean implementation and sustainability (Bateman and Rich 2003; Bhasin 2012; Hines et al. 2004; Leite et al. 2016). Enablers act by supporting the implementation and sustaining the long-term process (Leite et al. 2016), some examples are: strong organisational culture, management commitment and understanding and effective communication (Bateman and Rich 2003; Malmbrandt and Ahlstrom 2013). Barriers are the obstacles faced on a Lean transformation, such as resistance to change or organisational culture (OC).

Amaro et al. (2020) cited authors to point out that OC can be a barrier or inhibitor to Lean implementation, and that there are specific barriers related to organisation culture such as lack of: (1) top management support, (2) commitment and (3) training. Moreover, the Shingo Model (in figure 2.2) argues the importance of shaping the culture to drive organisational and operational excellence, where Shingo's principles are divided into three dimensions: cultural enablers, continuous improvement and enterprise alignment (Shingo 2021).

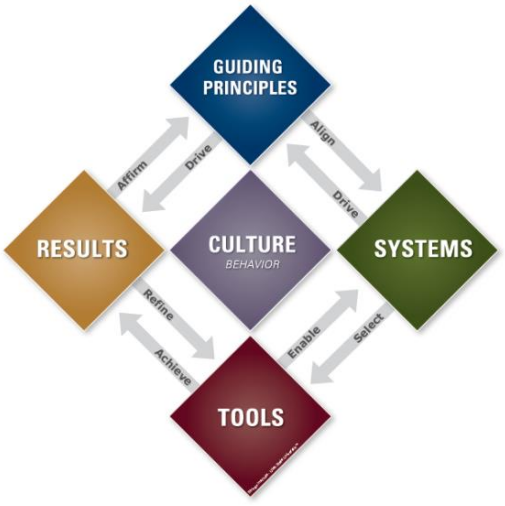

Figure 2.2. *Shingo Model (Shingo 2021)*

In Leite's et al. (2016) systematic literature review regarding the organisational classification of Lean barriers and enablers in cultural and technical aspects, the authors classified in seven organisational elements as of cultural and technical aspects, using an adaptation of the Lean Iceberg Model first developed by Hines et al. (2008). The three cultural aspects are (1) behaviour and engagement, (2) strategy and alignment and (3) leadership; the four technical aspects are (1) training, (2) resources, (3) process plus technology, and (4) tools.

Furthermore, these barriers and enablers of the study of Hines et al. (2008) present their *Lean iceberg model* (figure 2.3), with and interdependency among all elements. The cultural aspects with people's dependency are the base of the iceberg and the technical aspects supported by 'tools' are on the top, thereby addressing all these elements are essential in order to deliver a successful, sustainable lean transformation (Leite et al. 2016).

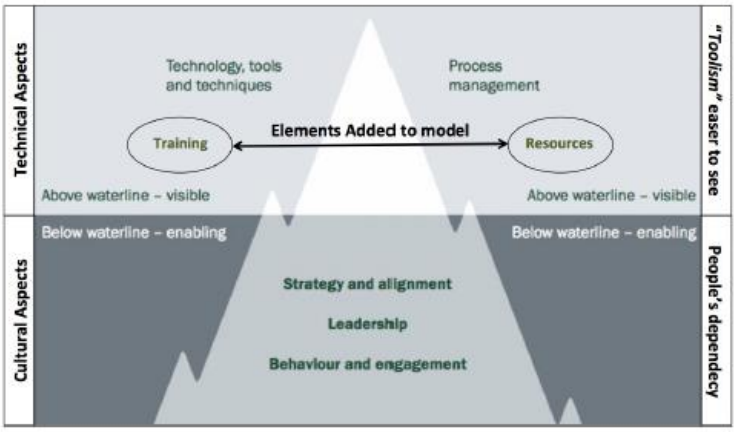

Figure 2.3. *Hines' et al (2008) Lean Iceberg Model adapted by Leite et al. (2016)*

Jadhav et al. (2014) argued that a successful Lean system demands an integrated structure of supporting practices, meaning that Lean practice bundles requires identification, analysis and discussion. These authors defend that TPS practices are an integral part of sustainable Lean implementation. Hence, organisations have to apply all TPS principles as a system in order to be effective, and the success of a Lean system demands an integrated structure of supporting practices.

Regarding these authors' position, the present research agrees that TPS principles should be all applied, but is not aligned with the idea of Jadhav et al. (2014) that Lean is sustainable only if the organisation implements the right Lean practices bundle. Back to TPS, which is not a toolbox (Liker 2004) but a system, the way Ohno sustained it was by creating a culture of continuous improvement through behaviours and attitudes, which was then supported, by a set of visual tools to cultivate it (Womack et al. 1990). For example, Toyota uses the coaching *kata* (Rother 2009) to coach people in the continuous improvement process so they are capable of meeting the targets and facing challenges, whereby early stages of the improvement *kata* should be practised under the mentor's watching eye (Soliman 2020). Additionally, and as explained by the *Lean iceberg model*, tools and practices (technical aspects) are just the surface of the iceberg and the cultural aspects with people's dependency are the iceberg bases.

As stated by Liker and Convis (2012), changing a culture is not as easy as establishing a training or communication program. As cultures evolve slowly, and changing them is even slower, replicating Toyota's technical systems without understanding their source was largely proved futile. While impressive gains from adopting some versions of Lean are common, they are almost never maintained. Why? The authors argued that tools and blitz events do not ingrain the leadership needed to coach and sustain a large process change within the existing company culture.

Unfortunately, when TPS was known the message to the western world was that its main goal was to remove wastes from the shop floor using some lean techniques and tools, but it was not clear that it required from Toyota a long process of leadership development and a high commitment to training and coaching their employees (Ahmed 2013). Meaning, for this author, that a failure to achieve and sustain Lean is a problem of both management and leadership as well as the improper understanding of the human behaviour, and the required culture to success. This need for culture change was difficult to be understood outside Toyota, and it explains why Lean was unsuccessful and unsustainable in several companies, as Lean must be addressed as a system, rather than a set or a bundle of tools and techniques. Early on, Taiichi Ohno refused to document or write the TPS down for fear that people would focus narrowly on the tools and the theories (Soliman 2020). Thus, few organisations see the connection between Toyota leadership and the company's exceptional results; they just see Toyota's methodical approach to everything it does and quickly leap to the conclusion that the technical system was the solution (Liker and Convis 2012).

Hence, in my opinion, the technical perspective of Lean, which is expressed in the majority of Lean studies as stated by Gupta's et al. (2016) literature review, contributes to those Lean sustainability devastating numbers. Accordingly, Ahmed (2013) argued that 7 out of each 10 Lean projects fail as companies try to use Lean like a toolkit, copying and pasting the techniques without trying to (1) adapt the employee's culture, (2) manage the improvement process, (3) sustain the results, and (4) develop their leaders.

As argued by Nagaraj et al. (2019) evidence revealed lean implementation worsens workers' life quality due to the fact that adopters only take Lean's technical practices into consideration and neglect the vital role played by human factors and ergonomics. These authors proposed to modify the value stream mapping (VSM) to incorporate a human factors module. The findings lead to the conclusion that an integrative approach enhances workers' life quality and operational performance.

Powell and Coughlan (2020a) identified in research reports that up to 90 % of Lean programs failed to succeed. The result of Powell and Coughlan's (2020b) investigation was that developing a learning-to-learn capability is a critical success factor for sustainable Lean transformation. Accordingly, Henrique et al. (2020) cited authors who argued that organisations, which constantly invest in training their employees in the continuous improvement method and lean techniques have a greater chance of sustaining lean implementations. Throughout the years, Lean leaders have become experts at improving processes, but in most cases, that is only a half-step, as true Lean leadership involves coaching and training people so the improved process maintains the ideal state (Soliman 2020).

In Costa et al. (2019) authors proposed a Decision-Making Trail and Evaluation Laboratory (DEMATEL) analysis applied to soft practices of sustaining continuous improvement (SCI), where the impact relations map shows that some soft practices are initiators and some others enablers of the SCI, and allowed to identify the most relevant critical success factors (CSF) and the interrelationships amongst them. Results showed that the key for a SCI is represented by a full engagement of the workforce, which must be triggered and supported by top management with the use of some leverages, such as an effective communication, training and use of Kaizen events.

Accordingly, Benkarim and Imbeau (2021) analysed an extensive body of literature that addresses the Lean Manufacturing approach and how it relates to employee commitment, emphasizing affective commitment as the main type of organisational commitment positively associated with Lean, and highlighted the management practices required to encourage this kind of commitment to promote the success and sustainability of Lean. Moreover, in Jorgensen et al.

(2007) it is suggested that sustainable Lean requires attention to both performance improvement and capability development.

Therefore, developing people should be organisation's highest priority, and focusing only on the process will often lead to system failure, in fact, people are more important than the process, and companies that put process before people will not earn sustainable results, as people are the ones who build, operate, modify and improve the process (Soliman 2020).

Bhasin and Burcher (2006), as well as other authors cited by them, emphasized Lean as a philosophy, which implies changes in the corporate culture. O'Reilly and Chatman (1996) defined culture as a system of shared values and norms, that define what is important and which members' attitudes and behaviours are appropriate. If culture is so important, how can you change it? Lean advocates this change by doing, because by doing people learn, organisation knowledge grows and mindset changes (Ingelsson and Martensson 2014).

As culture is all about execution (Chatman and Cha 2003), and based on case studies, Ferreira et al. (2018) pointed out that Lean justifies its permanence when it becomes part of the organisational culture. Accordingly, Lean changes culture when it becomes part of doing business (Turfa 2003), thus, the importance of reinforcing the human dimension and the integration of performance and culture (Duarte and Cruz-Machado 2020). Accordingly, Dorval et al. (2019) literature review stated that taking Lean implementation from a cultural perspective might facilitate an organisation's lean transformation journey.

Organisations must be aware that changing the organisational culture is a hard endeavour, demanding continuous effort and energy until it becomes a sustainable and natural Lean culture (Amaro et al. 2020). To develop a sustainable Lean transformation, Smalley (2005) argues organisations need to have 'Lean change agents' to guide the Lean process, thus, it is necessary to have dedicated resources to conduct the transformation. In the same sense, Womack and Jones (2003) also pointed out the relevance of having a change agent and a sensei on board since the beginning.

Due to the singular combination of organisational culture and people, each Lean journey is different, and establishing new or modified organisational culture is a long-term process (Ingelsson and Martensson 2014). Organisational culture is a key factor in successful Lean process implementation, meaning that before starting a Lean journey in an organisation, its culture should be analysed and understood, thus management must have sufficient insight into their culture to take an intelligent transition (Amaro et al. 2020). Thereupon, when initiating a Lean implementation, the challenge is to understand the organisation's unique culture and people.

To sustain a Lean journey as a system, it is important to have a guide, a model, therefore, regarding Lean models, is now explained the Toyota House and the models used in the research, particularly the Lean Transformation Model and the Lean leap.

The Toyota Production System House

Since Lean is a prescriptive philosophy, in literature there are several Lean models to support Lean implementations. Despite studies (Dahlgaard et al. 2011; Guimarães and Carvaglho 2014; Gupta et al. 2016; Leite and Vieira 2015; Malmbrandt and Ahlstrom 2013) demonstrating the development of different Lean frameworks and models, Jasti and Kodali (2015) literature review argued that there is a lack of testing and validation of the proposed frameworks/models by researchers. Hence, the purpose of this section is not to list the existing Lean background models/frameworks, which can be accessed in the cited studies, but to briefly explain the two models used during the research.

Thus, and before diving into those two Lean models it is relevant to go back to TPS. This system is graphically represented by a house - *Toyota Production System House* in figure 2.4. The house is a figure traditionally linked to the Japanese culture and nowadays to Lean.

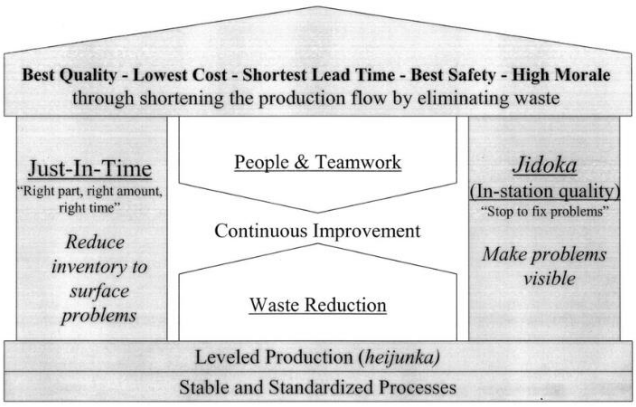

Figure 2.4. *The Toyota Production System House by Liker (2004)*

When Ohno wrote about TPS he presented as a house because a house is a system. If any structures that hold up the roof is taken away, the roof and entire system will collapse (Soliman 2020). Thus, at the top of the *Toyota house* is the organisation's goals: achieving maximum quality with reduced costs and short cycle times. The house has two pillars: Just-in-Time (aforementioned concept) and the *Jidoka*, which focuses on quality and automation with human intervention, by introducing anti-error systems (*poka-yoke*) and visual management, allowing the identification of problems addressed by the problem-solving process (Liker 2004). In the middle of the two pillars are (1) people and teamwork as well as (2) waste reduction, towards (3) continuous improvement. At the base of the house (its foundation) is levelled production supported by organisational and process stability and standardisation.

Lean Transformation Model

To respond to the challenge of maintaining Lean, aiming to support an organisational transformation, Shook (2014) introduced the Lean Transformation Model (LTM). Within this model, the author advocates that a Lean implementation should start with the identification of a concrete problem that the organisation is facing and seeks to solve. To better understand this position, and as mentioned before, in Lean more than planning its adoption it is important to implement it, because only by doing is it possible for the organisation to learn and, then, improve.

LTM graphically (figure 2.5) follows the *Toyota house*, meaning that this model is also a system, on whose roof are the organisation's objectives, purposes and assumptions. As each organisation has a specific context, the model argues that a concrete situation that the organisation intends to solve must be on the top. Then, the two pillars supporting the roof are (1) the processes improvement regarding what has to be done to improve and (2) the development of people's capacities, meaning which capacities have to be developed. Between these pillars and inside the house there is the leadership behaviour and the management system required. Finally, the thought, mentality and culture are at the foundation of the LTM house, thinking style supported by the techniques needed.

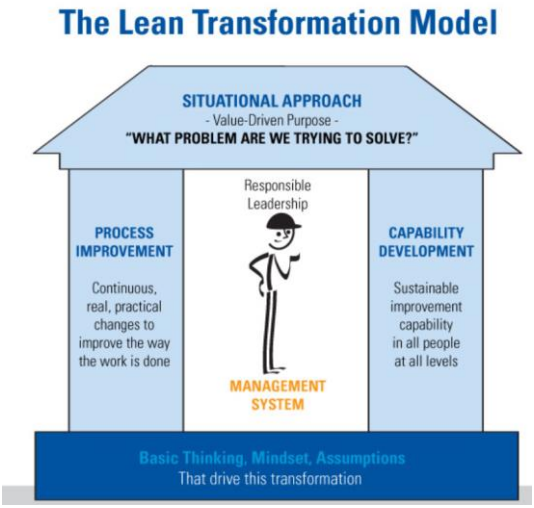

Figure 2.5. *The Lean Transformation Framework by Shook (2014)*

The organisational transformation through LTM implies the implementation of all the elements of the house. This model presents the following key questions for each of those elements (Shook 2014):

1. Roof - identification of the situation to be solved: *what problem are we trying to solve?*
2. Process improvement: *what is the work that we have to do to improve our delivery, in order to add value to the customer?*
3. Capability development: *what skills do we need to develop our human resources? How are we going to empower our resources? How do we develop people who can change the work correctly?*
4. Management system: *what are the leadership behaviours to adopt? What management system is needed?*
5. Basic Thinking, mindset and assumptions: *what is the mentality to adopt to make this transformation? What thinking style and tools plus techniques do we need?*

This model was used in the first AR cycle, with the Canonical Action Research in the Lean IT journey (chapter 4).

Lean leap

In order to start a Lean journey, Womack and Jones (2003) define an action plan for organisations, named Lean leap (figure 2.6), a five-year roadmap that establishes steps from thinking to action, materialised in four phases:

Figure 2.6. *The Lean leap by Womack and Jones (2003)*

1. Get started - the first six months;
2. Create a new organisation - from six months through year two;
3. Install business systems - years three and four;
4. Complete the transformation - by the end of year five.

The steps of each phase are shown in Womack and Jones (2003, p. 270) and they are now briefly explained.

First phase - *get started* – to initiate a Lean journey the first choice is to find an internal change agent to conduct the transformation and, when applicable, a Lean sensei as a mentor. Then, it is important to empower this role with the right Lean knowledge, particularly in Lean thinking. Thereafter, identify the implementation scope by finding an important gap or an issue to be a lever for the organisation and mapping the value streams to begin the 'radical' transformation through *kaikaku*. Finally, based on results, progressively expand the scope.

The second phase - *create a new organisation* – after the positive results, it is recommended to reorganise the processes by product family. Therefore, to support this transformation, it is advisable to create a Lean function. Based on the efficiencies obtained, it is important to devise a policy of excess people as well as a growth strategy, verifying if it is necessary to remove that authors named as 'anchor-draggers', and continuously instil a 'perfection' mindset.

The third phase - *install business systems* – with the organisation already reorganised, it is time to create a Lean accounting, in order to relate pay to organisation performance with the aim of rewarding the right Lean behaviours, attitudes and improvements, doing it in a transparent way. Additionally, it is crucial to initiate a policy deployment to reach agreement across the whole organisation regarding the Lean tasks to accomplish each year, providing the correct Lean learning program, teaching Lean thinking and skills to everyone, and finding the right-sized tools to adopt.

The last **four phase - *complete the transformation*** – having the organisation reconfigured with the appropriate business systems, it is important to develop a global strategy to continue the transformation. That is achieved by involving organisation's suppliers and customers, so they can be aligned with this transformation of creating value to customer whenever possible, where Lean thinking and the improvements are automatic, and bottom-up instead of just top-down.

After Lean leap described five years' commitment, the organisation is now prepared to the next leap, which is to be transformed into a Lean Enterprise. This means to do a final leap to transform the whole organisation towards the full implementation of Lean philosophy. In order to do so, the authors stated the need of having all the different streams working together, where the participants must treat each other as equals with *muda* as the common enemy, supported by the Lean functions, towards a complete and joint transformation.

This model was used in the second Action Research cycle, in the Lean journey in a financial services provider (chapter 5).

2.4 Lean Service

2.4.1 Lean Service overview

Starting in the automotive industry, Lean then moved on to other sectors such as construction, process industry, retail and distribution, financial services, healthcare and information technology (Ferreira et al. 2018). Thus, over the years, Lean has been adapted to several activity sectors, allowing a better understanding of the different realities. As Lean is considered a philosophy of transversal adoption (Kobus and Weber 2015) it is possible to apply Lean to any organisation and system, as long as there is a product or service flow that can be driven by the customer/user demand (Hicks 2007).

As service industries represent the tertiary sector, which encompasses all economic activities besides agriculture, industry and construction (INE 2018), looking at services employment figures (before the pandemic situation of COVID-19) in the world's biggest economies, a trend is observed. In the United States, the employment by major industry sectors from U.S. Bureau of Labour Statistics (2021) indicates 80.3 % of service employment in 2019. In China, the services

employment figure was 47.4 % in 2019 (Statistica 2021). The trend in the European Union (EU) since the second half of the twentieth century has been a shift to a service economy (INE 2018). In 2019 in the EU-28 countries (still including the United Kingdom) the employment in tertiary sector was 73.4 % (Pordata 2021a). In 2019, the employment figures in Portugal indicated 69.8 % in services (Pordata 2021b).

The adoption of production principles in service sector (Levitt 1972) became real with the transfer of those principles from manufacturing into service environments (Bowen and Youngdahl 1998), and LS history is described by Suarez-Barraza et al. (2012). Despite the observed trend worldwide, the first Lean study in service industries dates from 1998 by Bowen and Youngdahl.

Consequently, *Lean Service* is the application of Lean principles to services (Ahlstrom 2004) and several case studies described the applicability of Lean in the industry services (Leite and Vieira 2015; Ciano et al. 2019). Lean production has been successfully adopted in the services sector because its implementation improves process efficiency and resources management (Matos et al. 2016). The principles of Lean Service suggested by Womack and Jones (2005) are:

1. Completely solve the customers' problems by ensuring that all goods and services work, and work together;
2. Do not waste the customers' time;
3. Provide exactly what the customer wants;
4. Provide what is wanted exactly where it is wanted;
5. Provide what is wanted where it is wanted exactly when it is wanted;
6. Continually aggregate solutions to reduce the customer's time and hassle.

The evolution of LS by Gupta et al. (2016) is demonstrated in figure 2.7, which in my perspective, is still valid today.

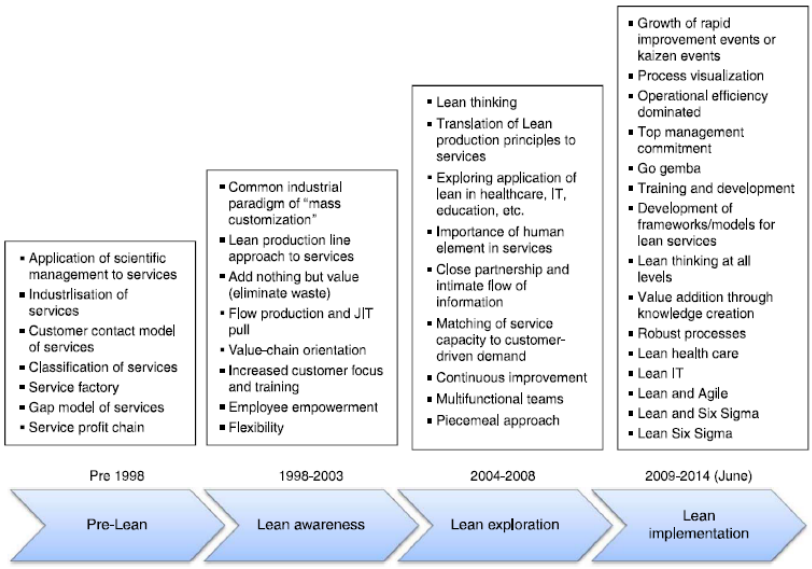

Figure 2.7. *Evolution of Lean Service from Gupta et al. (2016)*

Research is still needed in the service sector (Gupta et al. 2016). However, new research should be done not with a focus on one or two specific aspects of the Lean toolkit (Piercy and Rich 2009), but as a system, with new paradigms and pathways to achieve the balance in technical, economic, social and environmental priorities in the services sector (Caiado et al. 2018).

From literature review, services key characteristics are: intangibility, heterogeneity, perishability, inseparability, simultaneity, variability and labour intensity (Arfmann and Barbe 2014; Bowen and Youngdahl 1998). For Osborne et al. (2013) and Leite and Vieira (2015) the differences between goods and services are:

- Goods are tangible and services intangible;
- Goods are produced and consumed in separate moments, services are produced and consumed simultaneously; thus, the one who delivers the service is linked to its consumption;
- Customer experience transforms customers into services co-creators.

Considering the Lean principles and Lean thinking fundamentals, there are also differences between services and goods:

- In value principle, as well as in pursing the perfection principle, gathering customers' perceived value and the perfection mindset is similar in both services and goods.

  Regarding customers, as they are services co-creators, organisations need to work closely with them. Indeed, companies have to define strategies with customers' involvement, through constant feedback, co-creation projects and joined experiences, so as to understand the voice of the customer and increase customer-service experience and quality. Hence, services must have a deeper customer focus mindset, developing a collaborative and open approach, to better understand and deliver what customer value (Radnor and Johnston 2013). In order to carry out this co-production with customers/users of the service, Radnor and Osborne (2013) argue that it is important to know who they are, their expectations and needs, plus develop a relationship of confidence between service agents and customers, to assess the level of service from the user's point of view. In this sense, for these authors, Lean needs to incorporate the perspective that the user is the real beneficiary of this philosophy, being fully involved in the process and in services delivery.
- Regarding the pull principle, it is intrinsically in service nature, as services are provided when customers require;
- The principles of flow and value stream must take into consideration what was stated by Browning and Sanders (2012). According to them, traditional Lean is constant and routine, with high-volume production, stable workforce and a traditional learning curve. On the opposite side, services are more similar to novel and complex environments, generating unfamiliar processes, with low-volume production, high workforce turnover and a learning curve disruption.

Moreover, and regarding the Toyota three "M's" – *muda* (waste), *muri* (overburden), and *mura* (unevenness), in services these three forms of process inefficiency are constantly present:

- Waste (*muda*) - besides the seven production waste types there is also talent waste;
- Unevenness (*mura*) - in volume or complexity of customer demand;
- Overburden (*muri*) - in team capacity or time constraints to deliver.

Thus, for Bicheno (2008) the seven wastes (which can also be considered as waste causes) in customer service are:

1. Delays;
2. Duplication;

3. Unnecessary movement;
4. Lack of clarity in communication;
5. Wrong inventory;
6. Missed opportunities;
7. Mistakes.

Notwithstanding the divergences pointed out between services and goods, one should mention the commonalities between 'Lean manufacturing' and other sectors: Education, Information Technology (IT), Health Care, Public Sector, Financial Services and others (Freitas and Freitas 2020; Juliani and de Oliveira 2020; LaGanga, 2011; Leyer and Moormann 2014; Radnor and Johnston 2013; Souza 2009; Staats et al. 2011). These cited authors demonstrated the applicability of several Lean tools and practices originating from manufacturing to the tertiary sector such as voice of the customer (VOC), voice of the employee (VOE), process and work standardisation, value stream mapping (VSM), Kaizen, visual management, waste elimination and problem solving.

Furthermore, not being a mere transfer of Lean from the automotive industry to other industry in private and public sector (Radnor and Osborne 2013), Lean journeys must take into account the context of the target organisation (Bateman et al. 2014). For example, in the public sector, these authors argue that due to the singularities of this sector, Lean should be adapted and not adopted to its services. By Lean adaptation, Radnor and Walley (2008) study demonstrates that there are benefits in applying Lean to public services. In the same line, Bhatia and Drew (2006) show how Lean reduces costs and improves the quality of public services.

Hence, taking into consideration the service industry plus the context of each service organisation, it is then fundamental to identify the critical success factors, and the way to address them towards the success of the Lean journey.

2.4.2 LS critical success factors

In the literature there is an array of critical success factors (CSF) in Lean adoption, and despite there being a broad consensus about what needs to be done, organisations still struggle to implement Lean (Torbjorn and Netland 2016). A replication of another organisation's Lean process is not possible, since Lean is highly context-dependent, and the cultures, organisational pressures and supporting infrastructures are different among companies (Radnor and Osborne 2013). Hence, the identification of more abstract critical success factors for Lean adoption is relevant as it allows organisations to focus their efforts on translating such factors into their specific reality and thus enhance the probability of success (Laureani and Antony 2012).

In the same line to CSF, it is important to identify the aforementioned barriers and enablers to Lean implementation and sustainability, particularly the ones already identified in specific service industries. For example, in Grove's et al. (2010) study on health service Lean implementation, the following barriers were identified: high process variability; a lack of understanding of Lean; poor communication and leadership; issues in defining waste; and difficulty in determining who the customers is and the value from customer's perspective. These barriers were overcome with upfront planning, transformational leadership, good communication, identifying and sharing best practices and, above all, a shared vision.

Additionally, in Suarez-Barraza and Ramis-Pujol's (2010) research the enablers they pointed out were commitment to and wish for improvement; clear resolve to improve; focus on the simple, practical and active leadership.

According to Rockart (1979), critical success factors comprehend a number of specific aspects whose adequate coverage is highly correlated with successful competitive performance for the organisation Thus, CSF are crucial to the success of the project, meaning that if all associated objectives are not achieved, the project will fail. Boynton and Zmud (1984) and Brotherton and Shaw (1996) cited by Kundu and Manohar (2012) argue that CSF are the topics that must have a positive result to ensure success, which can be transformed into actions/activities or processes to be controlled by the management to achieve the organisation's purpose.

Kundu and Manohar (2012) research identified several CSF and respective authors (in table 2.2). Based on the mentioned studies, following a holistic and integrative manner, Kundu and Manohar (2012) grouped CSF into a number of generic factors such as: management leadership, management support, top management commitment, organisational culture, communication, training and skill building, financial capability and measurement framework.

Additionally, the results of Lins et al. (2019) LS literature review reveal 44 CSF. From these, the list of the most cited six factors were: **top management** support, **leadership** involvement, employee commitment, **organisational culture**, communication and employee involvement. Regarding **people**'s management, the adoption of: teamwork, multifunctional integration and autonomy, is considered relevant, since **organisational culture** and leadership can influence these factors. From the **customers**' point of view, the focus in on customer value creation, through the customer's involvement in the service **process**, the perception of quality under customer perspective and focus on their needs and desires. Hence, these selected CSF cover organisational aspects, people management, processes and customer.

From the aforementioned studies of LS critical success factors, I briefly point out two observations. First, most of the authors mentioned culture and leadership as a CSF, which is in line with Ohno's justification for Toyota Production System sustainability (see section 2.3). Secondly, and regarding CSF categories, Kundu and Manohar (2012) and Lins et al. (2019) grouped CSF in the following groups: organisational, people, and processes. Lins et al. (2019) added the customer group.

The CSF addressed on the second Action Research cycle are described in chapter 5.

Table 2.2. *Lean Critical Success Factors literature review from Kundu and Manohar (2012)*

Authors	Critical Success Factors (CSF)
Kettinger and Grover (1995) cited in Motwani (2003)	Presented the following CSF: Strategic initiative of top managers acting as leaders in defining and communicating the vision of change; willingness to learn; culture readiness; balanced network relationships; knowledge sharing; prescribed process management and change management practices.
Crute et al. (2003)	Considered five factors significant for lean implementation: change targeted and holistic strategy; effects of company culture; product focus; senior management commitment; timing for performance improvements.
Antony and Fregusson (2004)	Highlighted ten critical success factors for software industries: leadership engagement and uncompromising commitment of **top management**, **cultural** change, Six Sigma training, linking Six Sigma to business strategy, accountability, customer involvement, understanding of Six Sigma methodology, project management, project prioritization, and selection. Thus, the most critical success factors are: **leadership** engagement and uncompromising commitment of **top management**, **cultural** change, linking Six Sigma to business strategy and customer involvement.
Achanga et al. (2006)	Identified four CSF: **leadership** and management, financial capability, skills and expertise and **organisational culture**.
Czabke et al. (2008)	Considered three factors crucial for the success of Lean implementation: communicating the vision of the new initiative at every organisational level; necessary change in the **organisational culture**; consequently following the new practices and principles.
Scherrer-Rathje et al. (2009)	Lean implementation success depends on: the evidence of **management** commitment; employee autonomy to make decisions regarding business process changes; information transparency of lean goals; initial performance improvements and long-term sustainability of lean efforts.
Mefford (2009)	Identified the following four essential components for successful Lean implementation: belief that the new program will work; **managers**' commitment to implementing it; involvement of the whole organisation (employees, resources; partners) and long-term view of the results.
Kumar et al. (2009)	Considered the importance of the following CSF: **management** involvement and commitment; communication; link quality improvement to employee, business and supplier; **culture** change; education and training; link quality; improvement to customer; project selection; project management skill; organisation infrastructure; vision and plan; IT and innovation.
Skrudupaite and Jucevicius (2011)	Presented as CSF: business plan and vision; **top management** support (including funding); project management (including project champion, teamwork and composition). Plus, change management, **organisational culture**; effective communication, education and training, knowledge transfer, knowledge management (including skills and expertise); organisational structure; monitoring and evaluating performance and performance measurements.
Pedersen and Huniche (2011)	Highlighted the following CSF in public services: goals and values; complexity and importance, and the balance of **power**, resources and capabilities.

2.4.3 Lean in Information Technology services (Lean IT)

Lean IT is the application of the Lean principles for the management of Information Technology (IT) (Berrahal and Marghoubi 2016), where Lean intends to create value to customer by eliminating waste, improving information flow, increasing internal processes effectiveness, as well as promoting the mutual respect among all internal and external process agents (Ferreira et al. 2018).

In the same sense, Al-Baik and Miller (2014) stated, and I agree, that a Lean IT implementation does not translate into a "copy and paste" project of a Lean project in the automotive industry, so the context of the organisation is essential for its correct adoption.

The term Lean IT appears for the first time in the book '*Lean IT, Enabling and Sustaining your Lean Transformation*' by Bell and Orzen (2011), in which the authors argued the application of the Lean philosophy to Information Technologies (IT) with the necessary adaptations to the IT specificities. For these authors, Lean IT is a cultural and behavioural transformation that encourages everyone in the organisation to think differently about the role of information and about quality, plus customer value creation. Indeed, Lean IT is more than just a concept to eliminate waste and add value to activities or a set of tools and practices. On a wider perspective, Lean IT shapes and contributes to the organisational culture (Bell and Orzen 2011). Their concept of Lean IT is the mutual commitment of people using a framework with Lean principles, systems and tools to integrate and align information technologies with business, aiming at providing quality information and effective information systems, enabling and sustaining continuous improvement and process innovation. Underlying this definition and for these authors, Lean IT has two distinct perspectives:

1. External perspective - Lean IT supports business processes continuous improvement;
2. Internal perspective - Lean IT promotes performance improvement of IT processes and services.

In Bell (2013), the author considers that Lean IT concept evolved and that the splitting into these two perspectives increases the cleavage between IT and business (which should not exist), so he introduces a new definition. Lean IT is an adaptable learning practice, through collaboration and experimentation among business stakeholders, technical experts, suppliers and customers, for continuous improvement and innovation in the use of information, information systems and technological products and services, adding value to the end customer (Bell 2013).

For Kobus (2016), Lean IT encompasses more variables:

- Lean IT is a holistic management system, based on Lean philosophy, principles and tools;
- The objective is to systematically manage continuous improvement through the reduction of waste and variability, enhancing the value and the flexibility in all functions of an IT organisation.

From my perspective, the definitions above reflect the reality of Lean IT, however the human component should be mentioned due to its importance defended by 'original' Lean and TPS. In Poppendieck and Poppendieck (2003) description of Lean in software development, the authors referred the respect for people system. They argued it is critical (1) to provide people with the correct knowledge to take decisions and responsibility, (2) to invest in their skills and competences and (3) placing resources at the centre of the value creation. These are the foundation of Lean, and consequently of Lean IT, so I consider that the human component should be more considered in Lean IT definitions.

As mentioned beforehand, Womack and Jones (2003) advocate five Lean principles: value specification, value chain identification, creating flow, incentivising pull and pursing perfection. Bell and Orzen (2011) present Lean IT five principles in a pyramidal structure, where the base (foundation) supports the entire structure of principles: foundation, behaviour, perspective, flow and capstone. The table 2.3 has a comparative analysis between Lean and Lean IT principles, according to the aforementioned authors.

Table 2.3. *Lean principles vs Lean IT adapted from Ferreira et al. (2018)*

	Lean (Womack and Jones 2003)	**Lean IT** (Bell and Orzen 2011)
1.st Principle	**Value:** Set value according to the customer's perspective, for a specific product, with specific resources and over a period of time.	**Foundation:** Set value explaining a purpose through balanced leadership, with the participation of employees (respect) in order to contribute to the continuous improvement of the whole system (perfection).
2.nd Principle	**Value stream:** Identify the entire value stream for each product or family product and find ways to eliminate waste.	**Behaviour:** Invest in proactive continuous improvement, solving problems through discipline and responsibility.
3.rd Principle	**Flow:** Create value stream, ensuring that production takes place in a continuous stream. Respond to the real needs of workers in any situation.	**Perspective:** Focus on customer requirements, by involving with them. All imperfect work is removed and is not sent to the next stage. There should be a clear understanding of the overall value stream.
4.th Principle	**Pull:** To draw and provide what the customer wants. Reversal of the productive flow; let the customer *pull* value.	**Flow:** The system runs according to JIT. Waste elimination allows connecting activities (*pull* mechanism).
5.th Principle	**Perfection:** Looking for better results, trying to achieve perfection and continually removing waste as soon as it is identified.	**Capstone:** Maintain the values through attitudes and behaviours. The organisation is nothing more than the collective capacity of creating value.

Furthermore, there are singularities in IT regarding waste identification and elimination, with impact on operations. As some IT activities transfer immaterial knowledge and consequently do not produce physical waste (Al-Baik and Miller 2014; Staats et al. 2011), companies find it difficult to identify and understand waste regarding knowledge.

From the three concepts of Lean waste: *mura*, *muri* and *muda*, table 2.4 represents the adaptation of the seven aforementioned wastes to Lean IT by several authors: Bell and Orzen (2011), Bevilacqua et al. (2015), Martin (2010), Pham and Pham (2013), Vajna (2015) and Williams and Duray (2013).

Table 2.4. *Waste of Lean Thinking vs Lean IT adapted from Ferreira et al. (2018)*

Muda	**Lean**	**Lean IT**	
Wastes	**Thinking**	Developer views	User views
Inventory	Excessive products in stock implying the existence of outdated products.	Programming unnecessary functions. Creation of software code without understanding customer needs.	Excessive information causing unnecessary research, excessive delays and work accumulation.
Overproduction	Excessive goods and services compared to what is needed, so production does not keep up with market demand.	Production of software code in advance.	Too many emails, reports, unread system alerts. Excessive data processing to meet customer needs. Duplication of information.
Waiting/Delays	Execution of the work on hold, for resources or for decision making.	Lack of work due to many factors, such as delay between code creation and testing or waiting for documents.	System unavailability or slowness. Time wasted waiting for additional information.
Transportation	Unnecessary transport of materials from one place to another.	Transfer work from one team to another.	Information transfer through multiple intermediaries and through multiple systems. Security barriers in information flow.
Over processing	Adding excess value without request from the customer, that is, doing more work than the client wants.	Development what does not add value directly to the end user.	Redundant data, unnecessary transaction and reporting, software features that users do not need.
Motion	Any motion according to the activities performed, that does not add value.	Exchange among team members who do not create value to the process.	Unnecessary individual work activities, including searching for tools and information, writing data, frequently changing priority.
Rework/Defects	Defects that require corrections, reprocessing of work already done.	Software errors that need to be fixed. Bad software code.	Information that is incorrect, premature, confusing or leading to bad decisions.

Bridging mass production versus Lean production, Poppendieck (2002) mentions that IT organisations still have a mindset of mass production with (1) the massive creation of requirements, (2) numerous tests for quality validation software development, (3) steady control of project progress (4) and long project management times. Moreover, regarding Lean implementation in IT environments, Cheng et al. (2011) identified several types of resistance related to people, particularly: resistance to power loss, new routines, equity change and status quo bias.

Furthermore, Hines et al. (2004) argue that in IT the demand variability is a main inhibitor to the implementation of Lean, so, various contributors proposed Agile solutions, as van Hoek et al. (2001). The Agile school introduced an emphasis on dealing with customer demand variability, flexible assemble-to-order systems, creating virtual supply chains and use of IT tools (Hines et al. 2004). These authors citing Christopher et al. (1999) present the differences between Lean and Agile: Lean focus is on satisfying customers, by adding value and eliminating waste, working in long-term relationships with suppliers, with the purpose of smoothing workflows, as planning ahead allows reduching stocks. In Agile, customers' satisfaction is on configuring to order, and the output is measured through (1) quality, (2) cost and (3) delivery, therefore customers' demand unpredictability that is an important element of the Agile strategy.

In the Agile Manifesto (https://agilemanifesto.org/) are defined the four Agile principles: (1) individuals and interactions over processes and tools, (2) working software over comprehensive documentation, (3) customer collaboration over contract negotiation and (4) responding to change over following a plan.

Myself, being an IT manager, Lean and Agile practitioner (scrum master) these identified differences are indeed real, but a combination between Lean and Agile is an added value to teams and managers. Example, in development projects, it is necessary to combine internal customers' demands with end-user's expectations, as well as the IT members and managers needs, plus external software team members partners (when applicable). Hence, the real unpredictability of IT customers, who try to explain and expose their ideas but have difficulty in giving the details needed to IT, can be supported by Agile, which can manage demand unpredictability, as these projects are normally characterised by unpredictable and major/minor changes over the implementation.

In my perspective, it is also observed that Lean influenced Agile. Materialising this influence with a few examples, it is possible to point out that some tools used by one of the Agile methods, the scrum, were inspired by Lean practices. An example is the Kanban boards. In IT, Kanban is a visual display panel used to: (1) present the workflow, (2) limit the work in progress (WIP), (3) drive forward the productivity through awareness of what people are working on, and (4) continuously improve the process (Orzen and Paider 2016). This allows IT processes and their entire flow to be visible, permitting an efficient and regular flow of the work to be performed. Thus, attention is focused on imminent problems, avoiding unnecessary interruptions (Ferreira et al. 2018). Additionally, the Lean cell way of working influence in the Agile scrum method. In scrum, the scrum master works together with the other team members, sponsoring daily communication through short meetings with the aim of highlighting issues and giving constant feedback.

Finally, in the Agile Manifesto the respect for each team member is also present, as well as the mindest of customer engagement and involvement.

2.4.4 Lean in Financial Services providers

As mentioned in different studies, Lean is applied to different service industries such as Education, Information Technology (IT), Health Care, Public Sector, Financial Services (see section 2.4) plus other services activities. In this other services are included the internal support services like finance, human resources or call centre services. Hence, financial shared services providers can be categorised in this 'other services' group, and be identified as 'office activities'.

Additionally, as the tertiary sector has several services industries, to support the definition and implementation of the Lean Service principles and tools to specific service class, Schmenner (1986) created a fourth class's service matrix with manufacturing services, shopping services, mass services and professional services. Hence, the financial services providers can be classified in this last professional services class.

Furthermore, the professional services class has similarities to the Financial Services industry; despite the former are not a bank or an insurance organisation. Indeed, these services are also facing a strong competition due to globalisation, as services have a growing pressure to reduce costs, increase flexibility, improve quality and cut down on lead times (Suarez-Barraza et al. 2012). Financial service providers are adopting strategies towards a Lean organised work environment (Leyer and Moormann 2014) and nowadays, due to the pandemic situation of COVID-19, these efficiencies are even more important.

Hence, studies demonstrated that offices have been applying Lean practices, because Lean Service principles can act in control, autonomation, agility and continuous improvement, ensuring the process a considerable stability and continuity (Leite and Vieira 2015).

As service organisations are facing the demands of the customers for a service of better quality, and managerial demands of costs reduction, the application of Lean was suggested as an alternative to reduce costs and improve quality (Piercy and Rich 2009). Therefore, results of Lean in financial service providers showed that, if organisations want to become Lean, they must embed Lean thinking in the mind of their employees (Leyer and Moormann, 2014).

Regarding the three 'M's', *muri* and *mura* are in line with other Lean services, but in *muda* Bicheno (2008) identified fourteen office wastes: screening and research, inappropriate measurement, low load, high load, inappropriate prioritization, interference, inappropriate frequency, startup and end off, mistakes, errors or lack of appropriate knowledge, communication error, sub-optimization, wait, improper presence and inappropriate tradeoff.

Finally and as referred to by Abdi et al. (2006), the human element is a highly relevant variable in the services sector; thus, in a financial services provider people's critical success factors (see sub-section 2.4.2) are critical and must be taken into consideration.

2.5 Summary

Over the chapter, the Lean theory has been presented and reviewed in a 'critical way'. Starting with a brief history of Lean's origin, the Toyota Production System and the underlying mindset were revisited, with the aim of explaining how Toyota was able to create a systems company based on continuous improvement and respect for people. Its singular context due to Japanese culture, plus the social and economic constraints from the Second Word War were determinant factors in consolidating its strategy and organisational culture, where workers were committed with the company's goals to pursue perfection, and were at the same time respected by the organisation. The importance of such mindset behind Lean principles and the relevance of the corporate culture were not quite understood by the western organisations, which easily implemented Lean technical dimension (tools and techniques) but not the Lean social dimension. Although Womack and Jones (2003) stated Lean could be applied to any organisation outside Japan, several implementations were unsuccessful due to the lack of the social dimension. Literature points out Lean as a system, combining social and technical dimensions to sustain Lean in the organisation. Lean principles applied to services becomes Lean Service (LS) discipline, whereby the context of the tertiary sector must be taken into account in Lean adoption, particularly the social dimension, because services are highly dependent on people, as they are provided by people-to-people. Thus, Lean adoption initiatives in tertiary sector should select a Lean model, which takes into account critical success factors in Lean Service. When such initiatives are driven by academic research, as is the case, the research strategy must be aligned with the organisation in order to thoroughly cover the selected CSF towards a successful Lean journey. As service sector has several services industries, the two industries of this investigation were analysed. Briefly, studies explained that Lean applied to Information Technology (Lean IT) is also not just a set of tools and principles, but mainly a mindset that influences and shapes organisational culture, by inducing behaviours and attitudes. In the same line, adopting Lean in financial services providers (Lean FS) highlights the importance of the social dimension in the context of a Lean journey.

Chapter 3 Research methodology

This chapter explains the research paradigm and the methodology followed in this thesis. From the literature review, the four paradigms are briefly presented, as well as their linkage with the quantitative and qualitative research approaches. Then, the rationale of the paradigm selected in the thesis and the related approaches are explained. Supported on both, an overview of the Action Research (AR) methodology is given, particularly with the focus on the Canonical Action Research (CAR) method used in the investigation. Taking into account the theoretical background, and linked to section 1.4, it is explained how the thesis research question, the proposition and the research hypotheses were formulated. Finally, as the Lean implementations were performed in the same target organisation, and were chronological and sequential, for a better understanding of the CAR method, the first CAR principle as well as all the CAR principles criteria are described through the Lean IT journey (to respect the followed research sequence).

3.1 Overview of research paradigms and approaches

At the beginning of the research, the researcher needs to decide the school of thought and the strategy to follow (Petersen et al. 2014). Research strategies can be chosen by exploring the paradigm concept (Santos and Travassos 2009). The research paradigm helps researcher to observe and understand the body of knowledge gaps and related challenges and find a lever for its contribution to such domain (Hathaway 1995). This author stated that this decision will guide (1) the way the researcher will consider the data, (2) their role during the investigation, (3) what is considered knowledge and (4) how reality is accessed. For Guba and Lincoln (1994) a research paradigm is characterised by three elements: ontological, epistemological and methodological. Healy and Perry (2000) summarised these three elements: ontology is the "reality" that researchers investigate, epistemology is the relationship between that reality and the researcher, and methodology is the technique used by the researcher to investigate that reality.

In the literature review, the following four paradigms are proposed: (1) positivism, (2) constructivism also known as interpretivism, (3) critical theory and (4) postpositivism, also known as realism or pragmatism, whose main characteristics are now presented (Guba and Lincoln 1994; Healy and Perry 2000; Magge 1985; Santos and Travassos 2009; Sechrest 1992; Stake 1995):

1. Positivism – argues that all knowledge must be obtained by observing facts, so events should be broken down into simple components that can be observed and studied. Knowledge is incremental, starting from the components for a whole, so the data are neutral and they are not changed by the fact that they are studied. It is often applied to controlled studies and not so as much in social sciences;
2. Constructivism, also known as interpretivism - defends the non-separation of scientific knowledge from the human context in which it develops. It focuses on understanding how people contribute to giving meaning to actions, so it is often applied to contextual studies, such as research in social sciences;
3. Critical theory – argues that the researcher and the object of study are interactively linked and that the values of the researcher always influence research, which is a political act given that knowledge confers power;
4. Pragmatism / realism / postpositivism – defends that all knowledge is incomplete to a certain degree and its value depends on the method followed. Knowledge depends on the utility it can have to solve a practical

problem and gives importance to reaching consensus to obtain objectivity. It emphasizes the practice and methods to achieve it versus abstract knowledge.

In order to point out the differences between paradigms, Magge (1985) cited Popper's classification of these paradigms in three 'worlds'. The first world, the positivist one, is totally objective and based on material things. The second world, constructivism and the critical theory, is based on constructions created by people's minds and it is subjective. Thus, world one and two are opposite. The third world, realism, is considered in-between the previous worlds. Despite being supported by abstract things and created by people's minds, it is independent of them (Magge 1985). Regarding the distinction between world two and three, Healy and Perry (2000) cited Stake (1995) to explain that this difference is related to the concept of intrinsic and instrumental case research. In an intrinsic case study, world two, the situation is the focus, and participants' perceptions are studied. In an instrumental case study, world three, the case is used to understand a wider spectrum, so the perceptions are studied because they provide knowledge to a reality beyond those perceptions (Healy and Perry 2000). Thereupon, since positivism is different from the other three paradigms, those are called non-positivism.

These four paradigms can be classified in two main research approaches (Santos and Travassos 2009):

- Quantitative [positivism] – the purpose is to measure and analyse the causal relationship between variables that represent the characteristics of the observed object. The goal is to identify the (dependent and independent) variables, reducing the complexity of the problem so that the hypothesis initially formulated can be addressed;
- Qualitative [non-positivism] – the purpose is to bring the researcher closer to the object of study, highlighting context details, using text and images (in addition to numbers), so the goal is for the researcher to understand the complexity of the problem instead of its abstraction.

Figure 3.1 demonstrates how these two approaches are related to the aforementioned paradigms.

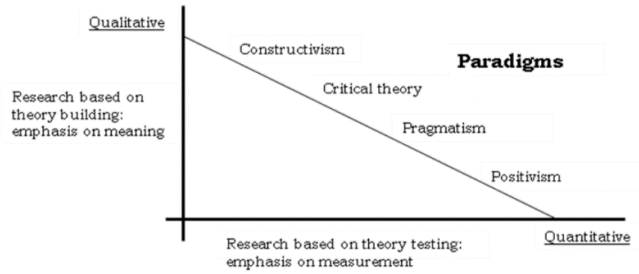

Figure 3.1. *Scientific paradigms and the qualitative and quantitative approaches (Santos and Travassos 2009)*

There is a conviction that mainly quantitative data are ultimately valid and of high quality (Sechrest 1992). In Guba and Lincoln (1994) several criticisms to the quantitative method are raised. Among others, the choice of the selected subsets of data that required appropriate control and randomisation, the lack of context ignoring the research purpose and the interdependency between theory and facts, as well as the issues with the applicability of general data to individual cases. Thus, these authors mention that starting with John Stuart Mill, the social scientists were incentivised to defend their positions, as the qualitative method could answer the issues identified with quantitative research.

Moreover, aiming to conquer high standards in qualitative research, Lincoln and Guba (1985) identified four approaches to assure rigour: (1) credibility, in the value of the findings; (2) dependability, with stability of the data; (3) confirmability with a focus on data accuracy, and the (4) transferability, to allow to transfer particular findings to similar cases. Arguing

that a qualitative research can have the same scientific excellence as a quantitative study, and aiming to help qualitative researchers, Houghton et al. (2013) proposed the following strategies to increase rigour to each Lincoln and Guba (1985) approaches:

1. Credibility – starting with the (1) prolonged engagement and persistent observation strategy, the authors defend that the investigator should be highly involved and engaged with the case, spend time in the field (and this time depends on the organisation), to deeply understand the context and the phenomena under investigation. In the (2) triangulation strategy, the focus is on the usage of several techniques to analyse the phenomenon, by confirming data and assuring that it is completed. Indeed, comparing data gathered from multiple data sources, using qualitative and quantitative methods and different perspectives brings data confirmation, increases data completeness and provides a better portrayal of the phenomenon, besides exploring an extent to which findings can be verified. In (3) peer debriefing strategy, some authors advocate to ask an expert or a colleague to do a peer review to support the credibility of findings. For Houghton et al. (2013) this strategy must be used with caution, due to the own characteristics of the qualitative research, which is the result of an individual and unique process between the researcher and the data. Finally, (4) member checking, which suggests data validation from the participants, by asking them to read and confirm the transcriptions of their interviews. In order to be effective, this strategy must take into consideration the moment in time when these members will be involved, being advisable to be right after the transcriptions, and not before the findings made by the researcher.
2. Dependability – the (1) audit trail strategy aims to outline the decisions made throughout the investigation to provide a rationale for the researchers' methodological and interpretative judgements. This strategy brings rigour to the study, because with an audit trail it is possible to track the path from the understanding context, passing through data sources analysis and the findings achieved. Using this trail, the audit can link decisions to data. The other strategy is (2) reflexivity - as the researcher is an important instrument of the research, it is relevant to have a research diary, a document to register the researcher's ideas, thoughts, decisions during the process of the investigation, which will support the investigation context.
3. Confirmability – the same two strategies suggested in dependability.
4. Transferability – The thick descriptions strategy, meaning that the investigation context must be adequately described so judgements can be made regarding transferability to similar contexts.

The following sub-section 3.1.1 explains why constructive paradigm, plus qualitative and quantitative approaches were adopted in the present research.

3.1.1 Thesis research paradigm and approach

Due to the characteristics of the present thesis (see chapter 1) a non-positivist paradigm was followed. From the three non-positivism paradigms, i.e. critical theory, pragmatism and **constructivism**, the last one was chosen. Guba and Lincoln (1994) characterised the constructivism paradigm, in the ontological element (see section above) with: the realities are apprehended in the form of multiple intangible mental constructions, socially and experimentally based. Being mental constructions, they are local and specific in nature, thus, these constructions depend on the personas or groups of individuals holding them. In the epistemological element, constructivism is subjective, because findings are

created as the investigator proceeds, and in the methodology element, it is dialectical due to its process of interaction between investigator and respondents.

Therefore, this investigation has a constructivist position by taking into consideration the context and the importance of the people's involvement, making the "mental constructions" through the research process, with the purpose of solving specific and practical problems of the organisation (see chapter 4 and 5). After finding the solution for the organisational problem, the research focus was on creating an approach that could be extended to other cases in the services industry, as well as on delivering insights to the community of practitioners, plus on contributing to an additional Lean approach to the academia.

Being the researcher an instrument of his own research, where the findings result from the mental constructions between him and the focus groups, the writing had a particular focus on describing how these constructions were built during the process of the investigation.

Regarding the research approaches, for Guba and Lincoln (1994) both qualitative and quantitative approaches may be used in any research paradigm. Studies demonstrated that the multi-strategy research is being used in a variety of studies, because combining qualitative and quantitative approaches, when applicable, adds value to the research (Bryman 2006). Due to the realities of both AR cycles in this investigation, the qualitative approach was applied in the first Lean IT cycle (see chapter 4). In the financial services provider cycle, its particularities and aim (explained in chapter 5) required a mixed-methods strategy, combining qualitative and quantitative approaches.

Due to the type of investigation, and adopting the constructivism paradigm of research (in opposition to the positivism one), I chose the Action Research methodology to guide the study on the target organisation. As in figure 3.2, my role as a researcher was to be a change agent in an immersed investigation. The aim of the research was knowledge in action, with theory built and tested in action. As stated by Coughlan and Coughlan (2002) in AR the type of knowledge acquired is particular, based on praxis and situational, and the nature of data validation is contextually embedded, and data validation is experiential.

	Positivist science	Action research
Aim of research	Universal knowledge Theory building and testing	Knowledge in action Theory building and testing in action
Type of knowledge acquired	Universal Covering law	Particular Situational Praxis
Nature of data	Context free	Contextually embedded
Validation	Logic, measurement Consistency of prediction and control	Experiential
Researcher's role	Observer	Actor Agent of change
Researcher's relationship to setting	Detached neutral	Immersed

Figure 3.2. Comparing of positivism with Action Research (Coughlan and Coughlan 2002)

Therefore, the Action Research methodology is detailed in the next section.

3.2 Action Research methodology

Doing a brief historical analysis of the methodology, Carr (2006) and Wallace (1987) argue that there are two important moments of this methodology during the twentieth century. The first one (1920 to 1950) coincided with the origin of AR in the United States with the work of Kurt Lewin and the studies of The Tavistock Institute in the United Kingdom.

Kurt Lewin is considered the 'father' of the term Action Research in which the author defends the combination of theory and practice applied to the study of social problems. For Lewin, the study of social events is linked to the social field as a whole and they should not be analysed as individual situations. In this sense, the researcher must know and interact with the context of the investigation. Through his experimental studies, Lewin was faced with the difficulty of investigating social problems through the positivist paradigm, due to the investigator's observer role. The need to combine theory with practice for a better understanding of the research object, led him to define AR.

As a result of his own personal experience, as a Jew who fled Nazi Germany to the United States, and in the aftermath of the problems caused by the Second World War, Lewin dedicated himself to the study of social problems, seeking to combine the existing theories with the context of the groups. The purpose was to understand in detail their attitudes, thoughts and constraints (Carr 2006; Wallace 1987).

For Lewin (1946), Action Research was generically characterised by:

1. Combining theory and practice for a better understanding of the target object of the study;
2. Assigning the researcher a role as a participant in the investigation itself, interacting directly with the object of study and not as a mere observer;
3. A spiral process with defined steps to obtain knowledge (figure 3.3).

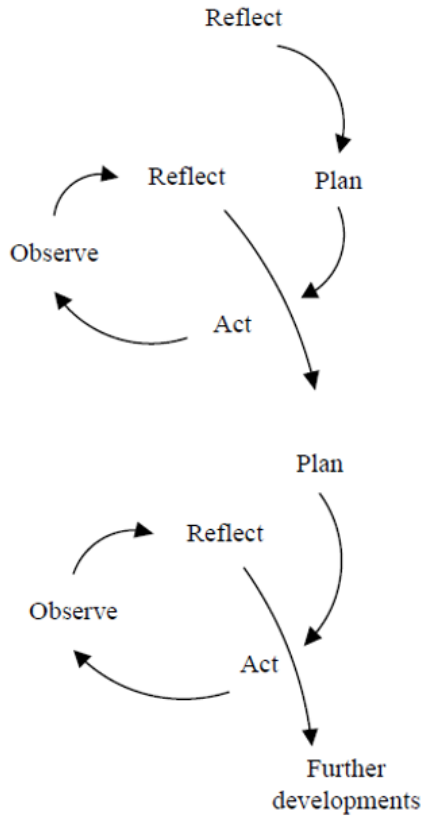

Figure 3.3. *Action Research spiral (Costa 2011)*

However, and as a result of the positivist strand that prevailed in the US in the 1950s, the American scientific community did not favour AR as a scientific methodology since its subjective and interpretive practices did not fit into the prevailing positivism, so AR encountered numerous barriers to its applicability. Only in the seventies and in the UK that AR did resurface with the second historical moment of this methodology, the 'teacher as a researcher' movement, according to

which the teacher should act as an investigator (Carr, 2006). Being both teachers and educators, theory and practice should be combined, so the positivist theory did not respond to the needs presented by this movement. In this sense, the constructivist/interpretive theory began to gain prominence in the social sciences, hence Action Research (Carr, 2006).

Due to the particularities of AR methodology, it is important that at the beginning of the investigation the researcher addresses the barriers and myths presented in the AR literature and the suggestions to overcome them. Viewed in this way, the choice of methodology is more informed and conscious and the researcher becomes more aware of the possible risks to overcome them. From the literature review, Avison et al. (2018) inquired two hundred and eighteen authors of Information Systems AR articles about the main barriers to the application of the methodology. Seventy authors answered:

- AR is difficult to publish in the most important scientific journals of Information Systems;
- AR requires a higher investment of resources and time;
- AR is inappropriate for Ph.D students;
- AR is considered less scientific than other methods.

To respond to these barriers, several authors presented suggestions to overcome them (Avison et al. 2018, p.7):

- Publishing AR studies, as a scientific methodology rather than consultancy, with scientific rigour;
- Demonstrating that in the theory construction process, the AR methodology can be an aid (1) in the field work for results validation and measurement, as well as (2) in the reflection phase of the investigation;
- Demonstrating that AR supports the impact and relevance of an investigation, within scientific rigour.

In addition, myths are presented by Klein (2012) and demystified by him:

1. AR is a solitary process – the author refutes arguing this methodology only works within a team between researcher and participants;
2. AR is a simple and easy way to do research - it is false because this type of research requires the same scientific rigour as the others;
3. AR is a scientific research method - methods are a set of data collection or data analysis techniques, such as interviews, questionnaires, etc. In this sense, AR cannot be considered a method, but a methodology that can include multiple methods;
4. AR is not a political process - AR implies change and all change means changing attitudes, behaviours, which implies a political component.

Coughlan and Coghlan (2002) conclude that AR is able to address the operational realities experienced by practising managers while simultaneously contributing to knowledge. As pointed out by these authors:

- AR focuses on research in action, rather than research about action. The central idea is that AR uses a scientific approach to study the resolution of important social or organisational issues together with those who experience these issues directly;
- As AR is participative, the members of the group that is being studied participate actively in the cycle process, and are not simple objects of the study;

- In AR, research is concurrent with action, meaning the goal is to make that action more effective while simultaneously building up a body of scientific knowledge;
- AR is both a sequence of events (it comprises iterative cycles of gathering data) and an approach to problem solving using the scientific method of fact finding and experimentation to practical problems, requiring action solutions and involving the collaboration and co-production of the Action researchers and organisational members;
- AR desired outcomes are: (1) the solutions to the immediate problems, (2) important learnings from outcomes and (3) a contribution to scientific knowledge and theory.

Currently, AR is used in several scientific areas, from social sciences to management, moving on to information systems, so it is a cross-sectional and widely used methodology (Baskerville 1999; Davison et al. 2012; Dick 2004). Thus, in the operational management domain, several studies are identified, such the study in the management of service parts inventories in the post-product life cycle. An action research was used to support the investigation to develop a methodology to help decision makers manage service part issues in the period following product discontinuation (Ferreira L. et al. 2018).

As this thesis had an IT services AR cycle, Baskerville (1999) highlights the need for the community of Information Systems (IS) to encourage the existence of practical studies that make the proper approximation between academia and industry, suggesting the adoption of AR in this domain. In the same sense, Petersen et al. (2014) mention the need to adopt a co-production model between software engineering researchers and their practitioners, in order to have more practical studies in higher education. Studies on AR in IT demonstrated a growing trend in the applicability of this methodology (Petersen et al. 2014). Indeed, in literature review of the AR in IS by Davison et al. (2012) from 1982 to 2005, sixty-three scientific articles were identified, and comparing these period to the period of 1982 to 2016 in Avison et al. (2018) one hundred and twenty articles were registered, so comparing both periods there was a duplication of AR articles.

In Information System, several variants of the AR methodology have appeared over the years. Baskerville and Wood-Harper (1998) described the characteristics of ten versions of AR that they identified: (1) Canonical Action Research, (2) Information Systems Prototyping, (3) Soft Systems, (4) Action Science, (5) Participant Observation, (6) Action Learning, (7) Multiview, (8) ETHICS, (9) Clinical Field Work and (10) Process Consultation. Subsequently, two more were identified by Davison et al. (2004): (11) Reflective Systems Development and (12) Collaborative Practice. Baskerville and Wood-Harper (1998) presented the genealogy of Action Research in Information Systems (in figure 3.4).

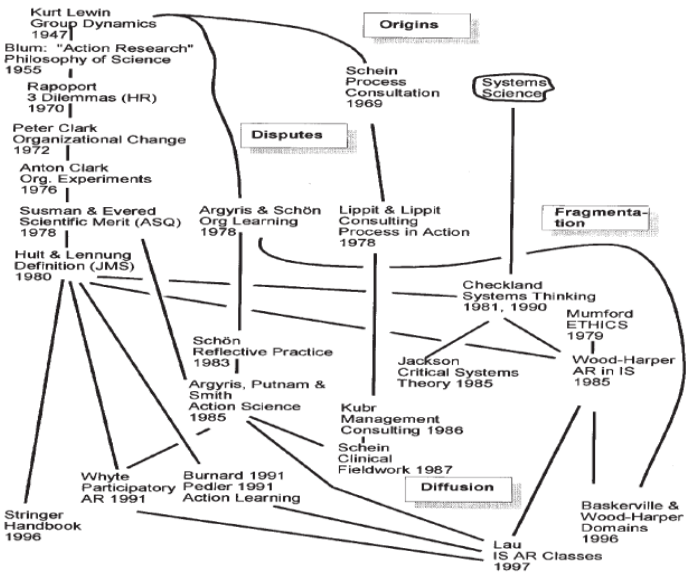

Figure 3.4. *Genealogy of Action Research in Information Systems (Baskerville and Harper 1998)*

Baskerville and Wood-Harper (1998) analysed the characteristics of these AR versions, and categorised them according to the following categories: (1) relation to the process model, (2) structure, (3) researcher involvement and (4) main goal. Each of these four categories has the following points:

- Relation to the process model - iterative, reflective or linear;
- Structure - rigorous or fluid;
- Typical involvement of research - collaborative, facilitator or experimental;
- Main objective - organisational development, systems design, generation of scientific knowledge or training.

Susman and Evered created the most used version in IT in 1998. These authors called it the Canonical version of Action Research (Canonical Action Research - CAR), which was later detailed by Davison et al. (2004). According to the categorisation of Baskerville and Wood-Harper (1998) the CAR has the following characteristics:

- Process model – an iterative process model;
- Structure – follows a rigorous structure;
- Typical involvement of the researcher - collaborative;
- Main objective – both organisational development and scientific knowledge.

Thereupon, CAR is now presented in the next section.

3.2.1 Canonical Action Research method

Canonical Action Research is a method of Action Research methodology. Davison et al. (2004) defined the five CAR principles and the criteria that the researcher must follow in each:

- **1.st principle: agreement between the target organisation and the researcher** – an understanding between the researcher and the target organisation of the study for a clear perception of the CAR method and respective

alignment with the way how the process is conducted, and managing expectations whether the methodology will resolve the problem of the organisation.

- **2.nd principle: Cyclical AR model (Cyclical Process Model, CPM)** - a model that includes five steps that must be performed cyclically: (1) diagnosis, (2) action planning, (3) intervention/action, (4) action results evaluation and (5) reflection and learning. When the first cycle has finished, a second one should be carried out, without a limit of cycles until the problem is solved.

  As identified in the second principle, CAR is conducted through a process model. The five steps CAR process model presented in the figure 3.5 demonstrated the iterative way steps should be carried out.

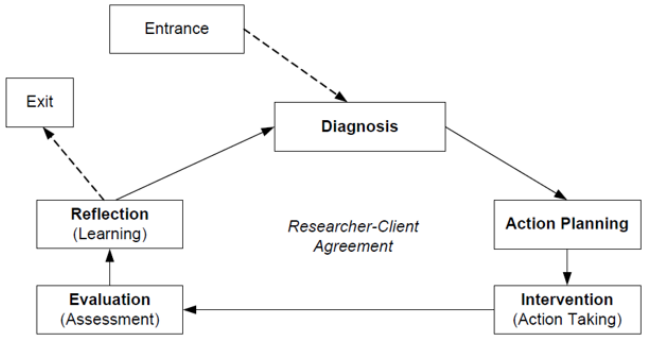

Figure 3.5. *Cyclical Process Model, based on Davison et al. (2004) and Susman and Evered (1978)*

The five steps of the CPM are briefly described by Santos and Travassos (2009):

1. Diagnosis - the first step of the model aims to understand and detail the object of study, throughh the perception of the (internal and external) actors involved and their expectations, as well as the context of the organisation. In this step, the research theme is defined and the problem to be solved is detailed, plus the scientific body of knowledge;
2. Action planning – with the goal of defining the actions to be carried out, accordingly to hypotheses based on the chosen theory, where assumptions are made about possible solutions and results;
3. Intervention - implementation of planned actions;
4. Evaluation of results - measurement of the results obtained and comparison with the previously chosen theory;
5. Reflection and learning - dissemination of the knowledge acquired with the study participants and with other departments of the organisation.

- **3.rd principle: theory** - the process must start from a theoretical basis and build knowledge about it, bringing research closer to academia from the beginning. To this end, an exhaustive review of the literature must be carried out to (1) better frame the research problem and to (2) outline what will be useful to keep the researcher focused whether the volume of information collected in the investigation is significant. Additionally, by taking as a starting point a theory published and accepted by the academy, this factor helps in the execution and communication of the methodology, both for the academic world and for the organisation.
- **4.th principle: change through action** - the essence of the CAR is to take action to change the current state of the organisation with a view to solve the problem. To this end, it is critical that the researcher and the

organisation have the same understanding of the problem in question and that both are aligned with the way how the CAR will be conducted. When facing the problem, the researcher must study the complications, interdependencies and the dynamics surrounding the problem, analysing it as part of a system, rather than in isolation.

- **5.th principle: learning through reflection** – according to the methodology, learning through actions performed is a way of building knowledge. This principle is key to the success of the CAR, so the researcher has a crucial role in its success. The organisation should be attentive to the results of the actions, and the academy to the knowledge generated from the interventions. It will be up to the researcher to manage this dichotomy and meet the needs of both, demonstrating the effectiveness of applying the CAR to a specific problem.

Thereupon, the researcher:

1. Needs to keep organisation and academia informed;
2. Guarantee the involvement of internal and external agents in the investigation, so that knowledge can be absorbed by the organisation and by the academy through the publication of articles. In this way, AR will contribute to the creation of a theory or to the development of an existing theory. Another relevant aspect of this principle is that it must take into account that the reflection and learning obtained must have consequences. To start with, it must be the basis for the next AR cycle (whenever it is necessary to re-run the cycle), followed by being applied in similar contexts of the chosen organisation.
3. Adding knowledge to the theory domain;
4. Continuing by helping to improve the CAR process itself;
5. Suggesting improvements to the target organisation and the existing literature.

The researcher must be careful to generalize the knowledge acquired for similar contexts, assessing the value of the theoretical models used and consider the transferability and the applicability to the existing theories and models. Since they will benefit with CAR contribution towards science evolution.

Finally, and as a result of the studies carried out by Davison et al. (2012) implementing the CAR model in organisations and from their literature review to IS studies with the CAR model, they presented four suggestions to improve it:

- Step 1: Diagnosis: there is a difficulty in carrying out a detailed analysis of the organisation's context, given that companies are complex and involve numerous actors. Suggestion: use prescriptive methods, such as performance evaluation metrics for the organisation and its processes, in order to make a consistent comparison to measure the results obtained after the actions taken;
- Step 2: Planning of interventions and actions - the researcher does not have a practical CAR guide at this disposal, which might help him know how to balance theory and practice when planning and executing the interventions that induce change in the organisation. Suggestion: in line with what was previously presented, incorporate quantitative metrics into organisational processes to measure the activities that have been subject to changes;
- Step 3: Evaluation of the action - after carrying out the action, it is necessary to make its evaluation, so it is critical to take into account the situation before the intervention. Suggestion: the researcher should bear in mind

the importance of choosing the theory, given that, if it turns out that the result described in the theory is not the one obtained after the intervention, then it is necessary to carry out a rigorous analysis of this variation to validate whether or not the theory was appropriate for the context. If it is confirmed that it was not, then it is necessary to return to the diagnosis step and start the cycle over again.

- Step 4: Theory (and its role in the CAR) - the choice of theory is more important for the researcher than for the organisation, however its choice (as mentioned in the previous point) is critical to the success of the CAR. Suggestion: to involve the company in the choice of the theory.

3.2.2 Action Research and Lean

Regarding Lean schools of thought, Hoss and ten Caten's (2013) study identified the following seven schools: systems engineering, systems architecture, operations research, organisational development, contingency systems, socio-technical systems and evolutionary systems. The authors conclude that the Lean evolutionary school under the interpretivist paradigm is the most appropriate for Lean. Furthermore, these authors stated that Action Research is the methodology that should be used since it is align with the referred paradigm assumptions.

As argued in this thesis, Lean journeys must combine technical and social Lean dimensions with a holistic thinking, reinforcing that leaders should work closely with their teams, participate in the transformation process by going to *gemba*, find support on Socratic thinking techniques by asking questions and following the scientific way of thinking. In the same sense, AR being a participative methodology (Coughlan and Coghlan 2002) it uses the scientific method of fact-finding and experimentation for practical problems, requiring action solutions and involving the collaboration and co-production of the Action researchers and organisational members. Furthermore, while introducing Lean tools and procedures, Lean leaders should take the organisation context, culture and people into account. In the same line, AR urges to combine theory with practice with an inherent systemic approach for a better understanding of the target object. This means arguing research in action, identifying solutions to the immediate problems and gathering important learnings from outcomes for a contribution to scientific knowledge and theory (Coughlan and Coghlan 2002). Thus, I argue this methodology is aligned with Lean, which stand for action in order to solve specific problems in the target organisation, incentivising the involvement of all organisational levels.

Moreover, Action Research is a spiral process (figure 3.6) with defined steps to obtain knowledge (Lewin 1946), starting with reflection to understand the context, followed by the intervention planning. The action is then taken, and observed. It finishes with a learning reflection step regarding the intervention and the knowledge obtained to plan a new cycle or further developments. The CAR method with its cyclical process model follows the same rational.

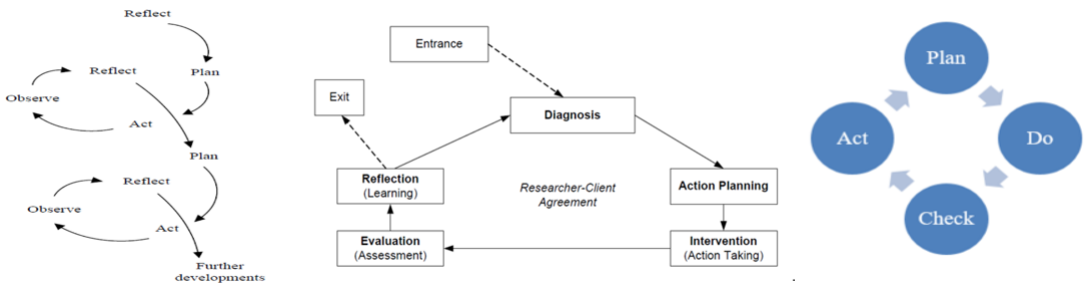

Figure 3.6. *Action Research and Canonical Action Research cycles versus Plan-Do-Check-Act method*

I argue that Action Research and CAR method have similarities with PDCA cycle created by Shewhart, popularised by Deming and widely adopted by Toyota and Lean. Being PDCA a four-step model, it starts with a *plan* step to analyse the context and define the action. The intervention is performed in the *do* step, followed by the action checking and finishing with the *act* step in order to learn and prepare the next improvement cycle, which will start with the *plan* step. Accordingly, Henrique et al. (2020) stated that PDCA is a well-structured method that uses scientific way of thinking and solve problems.

Although PDCA and AR purpose is different: PDCA focuses on operational continuous improvement and AR on science research, whereby the cyclical thinking behind both are similar, hence, in my perspective, AR methodology is indicated to be used in Lean journeys.

Analysing literature background regarding Lean and Action Research correlation, in addition to the aforementioned AR literature reviews and without the intent to do a systematic literature review, I concluded that in the last two decades, Action Research has been helpful as a research methodology in Lean studies. In the Scopus database (accessed in 17th of May 2021) from 2002 to 2021, 107 peer reviewed articles can be found with 'Lean' and 'Action Research' joint keywords. An analysis on these articles body of knowledge shows they originated from a variety of subject areas such as: Engineering (68), Business Management and Accounting (32), Decisions Science (21), Computer science (20), Medicine (14), Social Sciences (5), Biochemistry, Genetics and Molecular Biology (4), Health Professions (4), Environmental Science (3), Energy (2), Economics, Econometrics and Finance (1), Materials Science (1), Mathematics (1) and Neuroscience (1). Therefore, and based on a sample of these Lean articles with AR methodology, it is now exemplified how the AR can be helpful in Lean implementations.

Prado-Prado et al. (2020) applied Lean to the sleep unit of a public hospital in Spain and argued that adopting AR illustrated the usefulness of this participative methodology in facilitating Lean management implementation in this healthcare service. In the same sense, Matos et al. (2016) presented the implementation of Lean principles in a health-care environment using Action Research. The methodology promoted Lean principles in an surgery room and support warehouses, and was helpful in the description of the organisational culture change, which occurred with Lean adoption.

In the article of Kokkinou and Kollenburg (2020) regarding the role that the national culture plays in the successful implementation of Lean Six Sigma in multinational firms, the conceptual model proposed used Action Research to contribute to the improvement of managerial actions grounded in scientific research.

In another study, the need to increase employees' productivity in an online delivery services of a hypermarket led Martins et al. (2018) to combine Lean with AR to involve all the actors (the project team, decision makers, and designers) in the design of the delivery dashboards. It allowed a sharing process with the identification of the aspects that should be reported or improved. In the end, the dashboard enhanced that decision-making had a positive impact on operational monitoring.

The Vrijhoef and Dijkhuizen's (2020) refurbishment projects study demonstrated that (1) Lean tools could be helpful during the construction and preparation of projects, and (2) the design-based Action Research was important in shaping a preselected catalogue of the Lean toolbox, as tools were selected together with practitioners, to be applied in the case projects. Additionally, based on the methodology and after the refurbishment interventions, interviews were held to registers effects on critical success factors in the projects.

In order to make the process of changing production systems more efficient, an Action Research study was followed to support the research in a real company, changing process from a job shop production system to a manufacturing cellular

system (Pimentel and Martins 2015). Using simple but effective Lean practices and tools, the improvements achieved were substantial (Pimentel et al. 2019).

Costa et al. (2014) Lean production implementation in an elevators company used the Action Research methodology to support the research with the aim of improving the performance using Lean production tools. A key consequence from this project was the awareness of all stakeholders of the importance of sustaining the practices implemented, since continuous improvement strategies imply open minds, collaboration and commitment from everyone involved.

As a final example, and to draw on practical insights gained from the deployment of one program spanning multiple locations of a Norwegian multinational organisation (that has achieved quantifiable improvement over a five-year period), Powell and Coughlan (2020a) reflected on the implications for learning and continuous improvement of using Action Research as an approach to Lean deployment. In their further article (Powell and Coughlan 2020b) the authors adopted Action learning Research to generate actionable knowledge from a lean supplier development initiative over a three-year period. The authors found that network action learning has a significant enabling role in buyer-led collaborative Lean transformations.

3.3 Research study

Starting from a Lean literature review, particularly the mentioned literature gaps (see section 1.2) and the call for research of Lean sustainability (in 2.3), the investigation complemented the Lean information with an explanation of the research paradigms as well as the qualitative and quantitative approaches (in 3.1). Action Research (AR) methodology introduction was also done, particularly the Canonical Action Research (CAR) method. Finally, the correlation between Lean and AR was supported by Lean studies.

Assuming the above theoretical background, it is now explained how the thesis research question (RQ), the proposition and the research hypotheses were formulated, taking into account that this formulation process was influenced by AR methodology, thereupon, defined through a learning process.

As this investigation had two Action Research cycles which were performed sequentially, for a better explanation of the chronological sequence, figure 3.7 presents the investigation time frame with the respective milestones concerning the Lean journeys. The starting and ending periods of both AR cycles are indicated, as well as the Lean implementation assessments, with the purpose of verifying Lean sustainability.

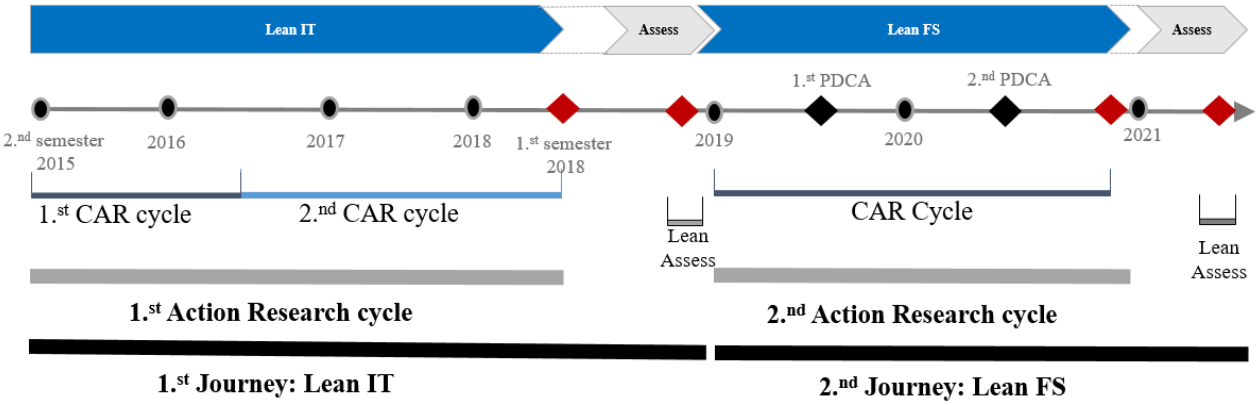

Figure 3.7. *Research time frame*

The Lean IT, the first AR cycle started in the last semester of 2015 and finished at the end of the first semester of 2018. The Lean journey assessment was done in the last two months of 2018. The Lean FS started in 2019 and ended in the last quarter of 2020. This Lean journey assessment was performed in the second quarter of 2021.

As AR central idea is to use a scientific approach to study the resolution of important social or organisational issues together with those who experience such issues directly (Coughlan and Coghlan 2002), at the beginning of the investigation (second semester of 2015), the problem presented by the target organisation induced to find a solution for an *effectiveness* problem. Figure 3.8 shows the first journey, meaning the first AR cycle, the Lean implementation in IT, whereas the Canonical Action Research method was followed through two CAR cyclical process models. The organisation context analysis was performed, as well as the study of Lean and Lean IT theory, plus the IT body of knowledge, particularly the maintenance and the development software processes.

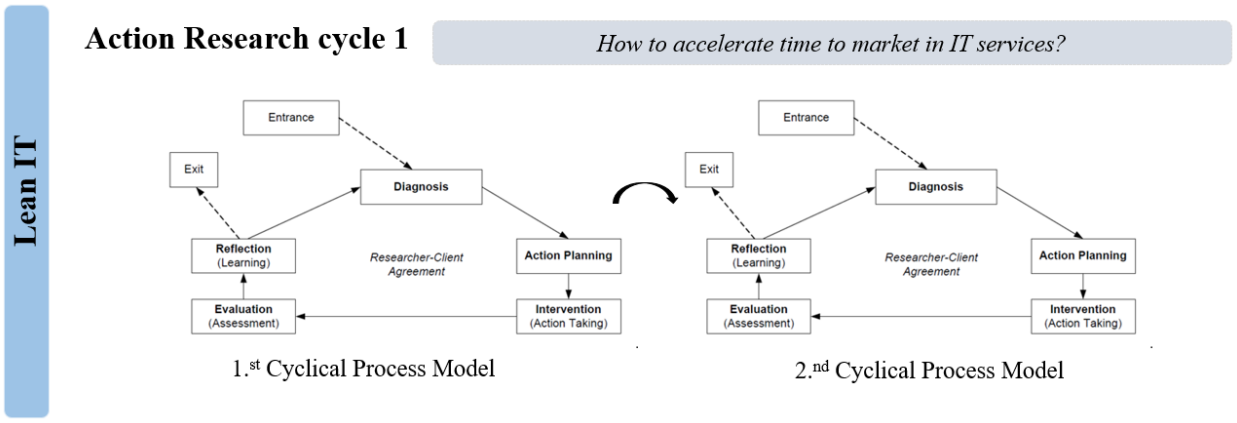

Figure 3.8. *Action Research cycle 1 in Lean IT with two Cyclical Process Models*

Based on the theoretical background combined with the organisation problem, context and their people, the following question was formulated: **How to accelerate time to market in IT services?**

Acknowledging the literature, IT is being pressured to deliver as soon as possible, with high quality and low costs. With the growth of technological applications and their massive entrance in the global markets through smart-phones and other devices, IT is now more accessible to consumers and customers in general, as well as business internal customers. Although it is a positive sign for IT to have users more willing to try/buy more technology, it also brings more challenges to IT service providers as technical information and partners' proofs of concept are more accessible to users. Thus, the users are more 'technological' comparing to their past position. They have now more information and want to play an active participation during the projects. As an IT manager, I think this new users' approach should be seen as an opportunity to reinforce collaboration between IT and business users/end users and to involve them throughout the IT projects.

With these assumptions, the following proposition was defined:

> **IT service providers need to be more agile, improve their procedures to pursue efficiency, be more collaborative and invest in networking with their customers and users since the focus must be on a customer centric strategy and on increasing effectiveness.**

While propositions emphasize the vision of the researcher and reflect research questions, hypotheses guide the researcher through subsequent investigations proposing explanations for a phenomenon, usually based on previous observations

and testable conditions (Costa 2011), thus based on the mentioned proposition, the following hypothesis was formulated: **Lean can improve efficiency and effectiveness in IT services.**

Following this hypothesis, the investigation started by answering the formulated question. Thus, Lean was implemented in IT services supported by the Lean theoretical model: Lean Transformation Model, following the CAR research methodology (with two CAR cycles), as demonstrated in figure 3.9.

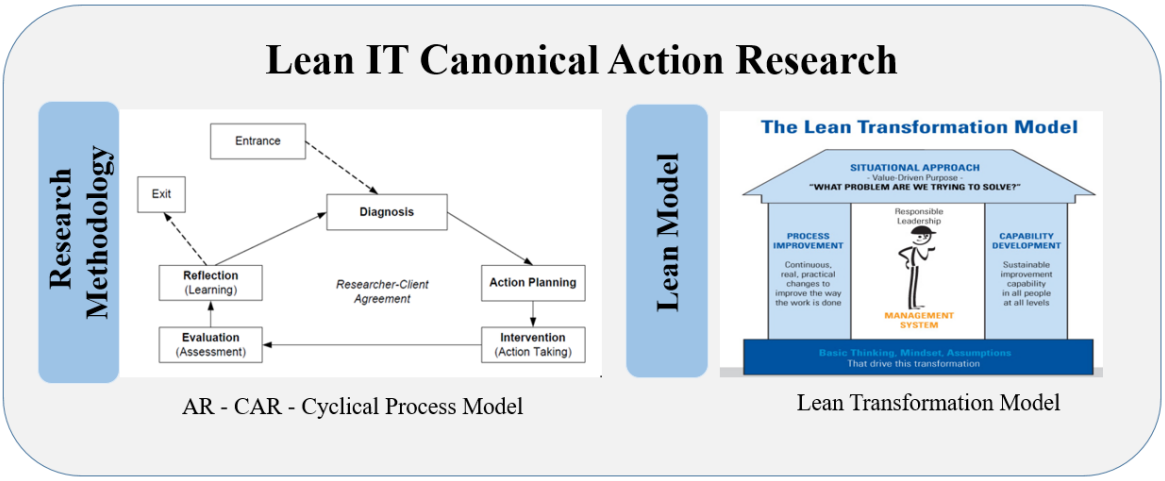

Figure 3.9. *Lean IT Canonical Action Research*

After three years of an immerse implementation experience, in each the researcher acted as a change agent with an active participation, the achievements reached were analysed. An international certification was obtained, with a positive impact on quality and time to market, as well as a different way of working through the set up of a new development process.

As explained in chapter 4, in spite of these positive results, four months after the project finished a Lean assessment was made and it was realised that Lean ended in the Information Technology department. Thus, the cycle insights were verified in the AR reflection step. It was concluded that the *tool thinking* approach had positive outcomes in the short term but Lean was not sustained within the organisation. Indeed, Lean is more than a set of tools. It is about organisational culture and it implies involving all – board of directors, directors from the different departments of the organisation, managers, teams and individuals, as part of an integrated system with common goals, purposes and shared values. People should be engaged in the transformation process bringing their own contributions, and becoming part of the changing process itself.

Research question, proposition and hypotheses

Based on this learning process a different approach was introduced for the following AR cycle (the second journey with a new scope and team). Although the Lean implementation in a financial service provider (second AR cycle) was performed in the same organisation, the first cycle added important information regarding the way it was conducted, so the researcher decided to adopt a different strategy. Switching from a *tool* thinking approach to a holistic and systemic thinking. Therefore, the research focus changed to Lean sustainability, although the effectiveness (time to market) was also present and addressed during this second AR cycle.

A new literature review was performed to deeply understand the topic of Lean sustainability, as well as Lean Service critical success factors, barriers and enablers, to gain a wider knowledge of the mentioned problematic. Lean theory background demonstrated the need for research regarding Lean sustainability due to the devastating numbers in

maintaining Lean within organisations (Jadhav et al. 2004) as studies demonstrated that Lean has a positive effect on operational performance (Kamble et al. 2020; Martensson et al. 2019).

Starting a new AR cycle (with one CAR cycle), the analysis of the context was done, particularly the department internal organisation and people. Thus, the thesis research question (figure 3.10) was formulated to: **How to sustain Lean Service within organisations?**

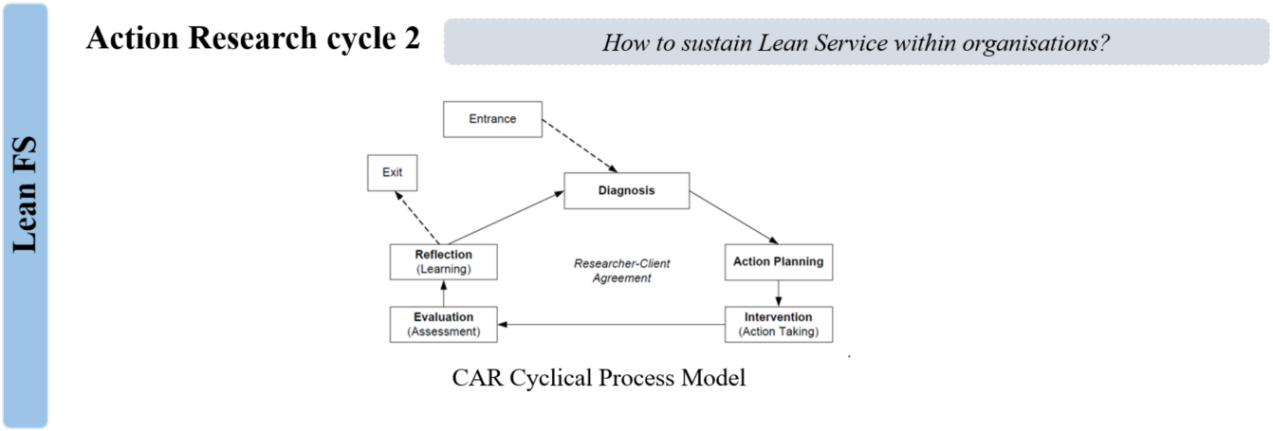

Figure 3.10. *Action Research cycle and research question*

Therefore, the following proposition was raised:

> **Lean requires a systemic and holistic thinking where social and technical dimensions must support a continuous improvement mindset, while relying on a management system and on sustainable organisational values.**

Based on this proposition, the hypotheses were defined:

- **Lean social and technical dimensions must be combined towards a holistic and systemic thinking;**
- **Lean Service System Approach can sustain Lean within an organisation.**

Towards Lean sustainability, an innovative approach to Lean in a financial services provider was performed. The result was positive and the innovate approach was coined as Lean Service System Approach (LSSA). It combines the standard roadmap Lean Leap of Womack and Jones (2003) with Lean Service Critical Success Factors (CSF) covered by the four perspectives of organisation, people, process and customer, through Plan-Do-Check-Act improvement cycles.

Therefore, this second AR cycle adopted a holistic and systemic thinking involving all levels of the organisation and the final customer. Following a mixed-methods strategy with quantitative and qualitative approaches, the Lean implementation in financial services was performed with the new Lean model LSSA through the CAR research methodology (as showed in figure 3.11).

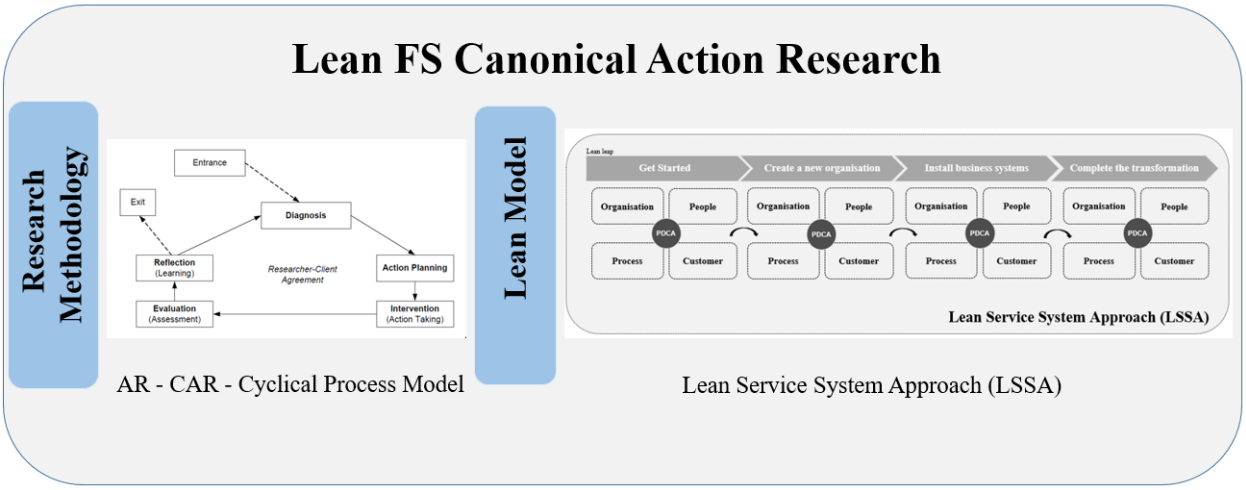

Figure 3.11. *Lean Financial Service Canonical Action Research*

This approach was able to anchor Lean in the organisation over time, as Lean did not ended when the project finished, thus, answered the research question of how to sustain Lean in a service organisation.

3.3.1 CAR principles applied to Lean research

Canonical Action Research (CAR) is an AR method used in services, particularly in Information Technology (IT) research, as well as in financial services studies. The five CAR principles proposed by Davison et al. (2004) are:

1. Principle of the Researcher-Customer Agreement (RCA);
2. Principle of the Cyclical Process Model (CPM);
3. Principle of Theory;
4. Principle of Change through Action;
5. Principle of Learning through Reflection.

In order to help the CAR method to be more prescriptive, these authors proposed several criteria for each principle. These criteria provide additional guidelines to support the researcher during the investigation and they were formulated in the form of questions. Towards a better understanding of the CAR principles and related criteria is now presented a brief description of each one, and already correlated with the Lean implementations, named Lean journeys, descripted in chapters 4 (Lean in information technology services provider) and 5 (Lean in financial services provider). The combination between CAR and Lean theory is now introduced, with the application of the aforementioned five CAR principles and Lean principles.

To simplify the reading of the CAR method and as a guide, table 3.1 identifies the chapters and the sections that presents each principle. Chapter 3, sub-section 3.3.1 presents the **researcher-customer agreement** (RCA) first principle, as well as an overview of the thirty-one criteria of the five principles. The **cyclical process model** (CPM), the **theory** and the **change through action** principles are demonstrated through the Lean journeys in information technology services provider (chapter 4, section 4.1) and in financial services provider (chapter 5, section 5.1). The **learning through reflection principle** is described in the reflection steps of both Lean journeys (chapter 4, section 4.2 and chapter 5, section 5.2).

Table 3.1. *Canonical Action Research principles presentation in the chapters and sections*

CAR principles	Chapters and sections
Researcher-Customer Agreement (RCA)	Chapter 3, 3.3.1
Cyclical Process Model (CPM)	Chapter 4, 4.1 and Chapter 5, 5.1
Theory	Chapter 4, 4.1 and Chapter 5, 5.1
Change through Action	Chapter 4, 4.1 and Chapter 5, 5.1
Learning through Reflection	Chapter 4, 4.2 and Chapter 5, 5.2

As mentioned, the referred Lean implementations were performed in the same target organisation. Therefore, they were chronological and sequential. Thus, the research started with the Lean implementation in the information technology (IT) services (as referred, named as Lean IT journey), and then, from the learnings obtained, the research evolved to Lean in the financial services provider (as mentioned, named as Lean FS journey). Due to this sequence, and for a better understanding of the CAR method, the RCA first principle as well as all the criteria are now described through the Lean IT journey (to respect the followed research sequence).

Thus, before presenting each CAR principle, it is important to characterise the target organisation (table 3.2):

Table 3.2. *Target organisation characterisation*

Business activity:	The organisation is a shared services provider: • Main services: Information Technology, Finance, Purchase and Human Resources; • Training, consultancy and other technical services associated with business processes.
Business structure:	Pyramidal /Hierarchical A 'silos' organisation
Type of organisation:	Based on Insights Discovery model (https://www.insights.com/) the studied departments were: • Information Technology Department: **earth green** (team work, sharing, encouraging) • Financial Shared Services Department: **fiery red** (competitive, demanding, determined)
Number of employees	300-350 Employees • Information Technology Department: 86 IT employees • Financial Shared Services Department: 92 employees [56 in the Shared Services]

First Principle: Researcher-Customer Agreement (RCA)

The first principle intends to reach a customer agreement between the researcher and the target organisation, according to the following six criteria (figure 3.12):

1a	Did both the researcher and the client agree that CAR was the appropriate approach for the organizational situation?
1b	Was the focus of the research project specified clearly and explicitly?
1c	Did the client make an explicit commitment to the project?
1d	Were the roles and responsibilities of the researcher and client organization members specified explicitly?
1e	Were project objectives and evaluation measures specified explicitly?
1f	Were the data collection and analysis methods specified explicitly?

Figure 3.12. *First principle criteria (Davison et al. 2004)*

1.st - RCA - criteria 1a.

The investigation initiated due to a request from the organisation board of directors. Their purpose was to accelerate the time to market in IT services, particularly the development cycle time. The IT department managers were challenged to propose solutions to address this request, which was raised by the internal customer and sponsored by the top management. After several meetings held with the IT management team, it was decided to start a project to analyse different proposals regarding the software development methods and to implement the selected one. During this period, there was the opportunity to apply for a call to an international certification, to have the organisation recognised as an IT centre of excellence. The department management decided to combine this external call with the internal challenge and submitted this bundle project to the board of directors. This proposal had the intension not only to implement the necessary improvements to respond to the required acceleration of the time to market (customer request), but also to certify the existing procedures and processes with the highest standards. This meant, granting best practices, quality and better services, supported by management tools, with a growing strategy regarding people's knowledge. This proposal was accepted, and I participated in the project team as the researcher. The project was coined with an internal project name, and not as a Lean IT journey.

Playing the role of researcher and Lean change agent, I had to go through an immersive experience that required intense involvement and participation. Thus, when analysing the scientific research paradigms, approaches and methodologies, it was a joint decision to follow the AR and CAR (within constructive paradigm) to guide the investigation during the knowledge construction process. Finally, as one of the CAR focuses is on solving an identified problem in the target organisation while knowledge is produced, this method was considered suitable for application.

Regarding the members of the organisation involved (named focus group) it was proposed and decided, to involve employees from different IT teams with the aim of joining a wider variety of experiences and to enrich the discussions.

From an ethical point of view, it was informed that personal information would not be published and that the treatment of data would defend their privacy, namely team members' opinions and iterations, in compliance with the General Data Protection Regulation, ethical codes of the academy and the organisation, as well as the Portuguese Constitution and the Nuremberg Code.

Having in mind the connection of the referred three knots of academia, practitioners and community (as mention in section 1.4), to combine the practitioner and academia knots during this journey the researcher agreed with the organisation to receive two Nova School of Science and Technology | FCT NOVA students who worked with the researcher in this journey at different periods of time. Both students delivered and presented their dissertation projects with a positive result.

- The first student focused her dissertation on the international certification process, meaning: (1) describing how the teams were able to achieve this milestone, (2) their learning process and growth, plus (3) the quality management process. The student also participated in the Key Performance Indicators project, working together with the internal team.
- The second student's scientific work had a theoretical purpose, focusing on studying Lean IT background and describing two Portuguese Lean IT cases, particularly how these two were able to sustain Lean over time.
- During the second AR cycle, a third FCT NOVA student worked in the investigation. His research focus was on combining Kaizen practices with Knowledge Management principles. Thus, the student participated in the

first and second invoice verification measurement and set up the statistical model (the third measurement was conducted by me).

Lastly, the third knot of the community was also addressed due to the assignment of the researcher as a member of the Lean Academy in the Lean IT chapter. The researcher had the possibility to take several *gemba* walks in other organisations, which were very important to consolidate knowledge and to make the linkage between theory and practice. This experience brought additional insights and shared experiences from other Lean IT practitioners, highlighting issues and critical success factors based on their lessons learned.

Moreover, the participation in Lean IT forums, as well as being a member of the Lean Summit 2019 organisation, were excellent opportunities to network with experts from all over the world, learn with them and even share doubts and concerns regarding this investigation, asking and listening to experts' advice based on their experiences. To all of them, I will always be grateful.

1.st - RCA - criteria 1b.

The investigation was formally authorised by the board of directors, meaning that the research project as well as the outcomes were clear and explicit to the top management. Thus, the scope and its objectives were also transmitted to all elements of the project.

1.st - RCA - criteria 1c.

The authorisation of the board was given based on their project request and then acceptance; thus, this was an explicit commitment. During the journey, several progress meetings were held and the project always had the board support.

1.st - RCA - criteria 1d.

The roles and responsibilities of the research and the different levels of the organisation were specified in the project documentation and the 'frontiers of action' were defined.

Davison et al. (2004) stated there is a risk of subjectivity that can lead to the investigation when the researcher is part of the target organisation, and they advise measures to mitigate this situation. A similar warning is made in Petersen et al. (2014) on the risk of possible bias in the investigation. As this investigation followed the constructivism paradigm and the researcher has a in-depth of the organisation and of all the members who participated in the focus group, to mitigate this risk of a potential bias in the investigation, the project management was assumed by an organisation member. Therefore, the responsibilities between the researcher and the 20 members of the focus group were defined, assuming that they were all part of the same team, with an equal level of responsibility. To coordinate this project, a twenty-year professional experience resource with a Lean IT certification was chosen, because she was knowledgeable of the organisation, as well as of the problem identified and knew the rest of the team members. To assist the person, two more resources were identified to support the logistical processes of the interventions, particularly the group sessions.

1.st - RCA - criteria 1e.

The project objectives and evaluation measures were explicitly specified and were monitored during the project to have an impact analysis of the implemented actions. An after and before analysis was made, based on the literature recommendations and IT best practices. Additionally, the strategic objectives of this Lean IT project were aligned with the research investigation goals (presented in section 1.5). Regarding key performance indicators, based on the Balanced Scorecard theory by Kaplan and Norton (1996) the following indicators were defined: (1) action indicators to induce action and (2) result indicators, to demonstrate past actions results.

In order to materialise them, some examples are now presented:

Action indicators:

1. Number of meetings with internal customers to share and capture knowledge;
2. Number of interviews with team elements of the focus group.

Result indicators:

1. Number of IT processes documented;
2. Number of training hours.

To manage this information, a business intelligence dashboard was created to follow the defined key performance indicators, which were maintained by the owners of the IT processes. Due to the fact that this Lean journey was the lever to obtain an international centre of excellence certification, the results evaluation was also audited by an international entity.

1.st - RCA - criteria 1f.

The data collection and analysis methods were explicitly specified, because on the one hand they were used by several teams, and on the other hand, they were subjected to an audit process. During the journey the international entity performed three audits. The auditors had access to all the existing and produced information and were able to trace it.

Hence, several data sources were identified:

- Public documents of the organisation;
- National and international service industry reports;
- Public documentation from various entities such as OCDE, European Union, INE;
- Scientific documentation as a result of the literature review;
- Reference authors' books;
- Unstructured information regarding the organisation context and focus group information, which was collected through various conversations and iterations;
- Structured information from the researcher's database, with the primary data of the research. This data resulted from the planned interviews conducted by the researcher with the stakeholders of the project.

Second Principle: Cyclical Process Model (CPM)

This second principle contains the aforementioned cycle process model, which reflects the Lean journey itself. The CPM details will be explained in the next chapter. However, at this point it is important to review the seven criteria of this second principle (figure 3.13):

2a	Did the project follow the CPM or justify any deviation from it?
2b	Did the researcher conduct an independent diagnosis of the organizational situation?
2c	Were the planned actions based explicitly on the results of the diagnosis?
2d	Were the planned actions implemented and evaluated?
2e	Did the researcher reflect on the outcomes of the intervention?
2f	Was this reflection followed by an explicit decision on whether or not to proceed through an additional process cycle?
2g	Were both the exit of the researcher and the conclusion of the project due to either the project objectives being met or some other clearly articulated justification?

Figure 3.13. *Second principle criteria (Davison et al. 2004)*

2.nd - CPM - criteria 2a.

The first criteria asks whether there were any suggestions or variations of the five CPM stages and if so, they should be justified and mentioned explicitly in the project report (Davison et al. 2004). As the project followed the cyclical process model defined by CAR, there was no variation.

2.nd - CPM - criteria 2b. to 2e.

As stated by Davison et al. (2004) these four criteria are related to specific stages of the cyclical model. The researcher starts the process with a thorough diagnosis of the current organisational situation, while the customer identifies one or more problems. The researcher has the responsibility to conduct an independent diagnosis, confirming the nature of the problem(s), and determine its/their causes. As informed, the cyclical process model (CPM) will be described and detailed in the next chapter.

2.nd - CPM - criteria 2f.

The reflection from the first CPM was an input to the second CPM. In total, this Lean IT journey had two cyclical process models. Therefore, the several outcomes produced in each CPM were evaluated and scrutinised by the project team and the organisation, the results of which were presented in internal and external sessions.

2.nd - CPM - criteria 2g.

The project goals defined at the beginning of the project were all met and the outcomes produced were the deliverables of the accomplished objectives. Hence, the Lean IT project had a positive impact on the organisation. Despite this good result it was just for a short period of time, as Lean finished when the outcomes were delivered and the project ended.

Third principle of Theory

The focus of the third principle is theory. As CAR intends to produce kwnoledge through action, it is relevant to choose the right theory to conduct the transformation. The following five criteria (figure 3.14) are now answered:

3a	Were the project activities guided by a theory or set of theories?
3b	Was the domain of investigation, and the specific problem setting, relevant and significant to the interests of the researcher's community of peers as well as the client?
3c	Was a theoretically based model used to derive the causes of the observed problem?
3d	Did the planned intervention follow from this theoretically based model?
3e	Was the guiding theory, or any other theory, used to evaluate the outcomes of the intervention?

Figure 3.14. *Third principle criteria (Davison et al. 2004)*

3.rd - Theory - criteria 3a.

This first AR cycle was based on Lean IT theory, thus the transformation project was guide following the Lean principles applied to Information Technology. As described in chapter 2, Lean implementation to IT requires several adaptations, which were taken into consideration (see chapter 4). The five Lean principles, plus the Lean model selected and the tools implemented provided a positive result, monitored by key performance indicators.

3.rd - Theory - criteria 3b.

As the Lean Transformation Model (LTM), which was applied during the journey, starts by defining the problem and understanding its causes, based on the literature reviewed (academia) plus the insights gathered from the Lean community, the formulated proposition was correct. **IT service providers need to be more agile, improve their procedures to pursue efficiency, be more collaborative and invest in networking with their customers and users since the focus must be on a customer centric strategy and on increasing effectiveness.**

This reflects that the problem identified by the customer regarding their need to accelerate the IT services *time to market* reflects the worldwide IT effectiveness challenge, mentioned by the researchers' community and peers from other organisations.

3.rd - Theory - criteria 3c.

Regarding the causes of the observed problem, the LTM guided this analysis, starting with the context analysis and the support of Lean tools, such as the Voice of the Employee, root cause analysis, 5Whys, SIPOC, VSM helped to clarify the causes, the historical information and the impacts of the problem.

3.rd - Theory - criteria 3d.

Through Lean IT principles and following the LTM combined with CAR cyclical process model, the interventions were planned and the investigation was supported by theory, whereby information, data and insights were collected to learn through action and to adapt further interventions based on the lessons learned.

3.rd - Theory - criteria 3e.

To evaluate the experience, Lean has itself several tools to measure its journeys, particularly the use of metrics. Hence, the key performance indicators which were defined and measured after and before the interventions were an important tool to reach conclusions (see chapter 4).

Fourth principle: Change through Action

Davison et al. (2004) stated that the fourth principle reflects the indivisibility of action and change, with intervention seeking to produce change. A lack of change in the unsatisfactory conditions suggests that there was no meaningful problem, that the intervention failed to address the existing problem, or that the existing situation could not be altered because of political or practical obstacles that were neglected when the project was established. The six criteria of this principle (figure 3.15) are now answered.

4a	Were both the researcher and client motivated to improve the situation?
4b	Were the problem and its hypothesized cause(s) specified as a result of the diagnosis?
4c	Were the planned actions designed to address the hypothesized cause(s)?
4d	Did the client approve the planned actions before they were implemented?
4e	Was the organization situation assessed comprehensively both before and after the intervention?
4f	Were the timing and nature of the actions taken clearly and completely documented?

Figure 3.15. *Fourth principle criteria (Davison et al. 2004)*

4.th - Change through Action – criteria 4a.

As mentioned, the effectiveness of IT services is a common challenge to IT departments. Therefore, the organisation was motivated to improve the situation and I, as researcher, was also motivated. The proposal was to help the organisation improve their IT services *time to market* by using a different approach. Thereupon, was followed a bottom-up approach rather than a top-down one, and involve a wider number of IT workers from different teams, in order to engage and motivate them in this transformation project.

4.th - Change through Action – criteria 4b. to 4e.

As stated by Davison et al. (2004) changes may operate at both personal and organisational levels. Individuals in the organisation may experience changes in roles and responsibilities and be required to develop new skills. These authors cited Dickens and Watkins (1999) mentioning that an intervention will also commonly transform the structure and systems of the organisation rather than merely perform a few half-hearted actions or 'tinkering' with the environment. Therefore, this implies a need for a comprehensive assessment of the organisational situation both before and after the intervention. Moreover, Davison et al. (2004) argued that a comparison of critical and measurable dimensions of performance is essential but not sufficient to determine the outcome of the actions that were taken; thus, Action researchers should not become overly committed to a particular course of actions. Flexibility is needed so that the plan of action can be adapted to emerging or changing circumstances. Hence, in the following section and through the Lean journey it is explained how these criteria were materialised in practice.

Fifth principle: Learning through reflection

The last CAR principle is related to learning through reflection, and its seven criteria are presented in figure 3.16.

5a	Did the researcher provide progress reports to the client and organizational members?
5b	Did both the researcher and the client reflect upon the outcomes of the project?
5c	Were the research activities and outcomes reported clearly and completely?
5d	Were the results considered in terms of implications for further action in this situation?
5e	Were the results considered in terms of implications for action to be taken in related research domains?
5f	Were the results considered in terms of implications for the research community (general knowledge, informing/re-informing theory)?
5g	Were the results considered in terms of the general applicability of CAR?

Figure 3.16. *Fifth principle criteria (Davison et al. 2004)*

5.th - Learning through reflection – criteria 5a.

During the investigation, several presentations were held with top managers, managers and members of the teams. As one of the outcomes was an international certification, the progress of this project was also presented in external IT seminars. Additionally, the proposals to improve the development cycle time were also presented and discussed.

5.th - Learning through reflection – criteria 5b.

As this journey had two CAR cyclical process models, the researcher and the customer had the opportunity to reflect at the end of the first CPM, to learn with it and to plan in advance the further cycle and respective actions. Furthermore, a lessons learned initiative took place at the end of the second CPM.

5.th - Learning through reflection – criteria 5c.

The research activities, as well as the outcomes were reported to the organisation in several forums. Moreover, and previously mentioned, two academic dissertations were published and one scientific article, the Ferreira et al. (2018) paper was presented in the Industrial Engineering and Operations Management (IEOM) international conference at Bandung, Indonesia. This proceedings conference paper is indexed in Scopus and received two distinctions: first place in the case studies category and third place in the posters competition.

Additionally, in the second Action Research cycle, one academic dissertation was published, as well as one scientific article, the Lota et al. (2019) paper was also presented in the IEOM conference at Pilsen, Czech Republic.

5.th - Learning through reflection – criteria 5d. to 5g.

Regarding the results obtained in the different aforementioned terms of these criteria, it is important to highlight what was learned within the CAR method applied to the target organisation. As stated by Baskerville and Wood-Harper (1998) CAR findings must be generalised through the evaluation of the value of the theoretically based model employed, and (whenever possible) with the transferability and applicability of the relevant theories and models. Therefore, chapter 4 explains the main findings of this Lean IT AR cycle and the learnings obtained with this first Action Research cycle, as well as the way how the knowledge obtained influenced the second AR cycle. Additionally, it is also mentioned how this learning can contribute to the existing Lean theory, particularly Lean models, in order to advance knowledge.

3.4 Summary

By means of the four paradigms theory background, this chapter explained why the present thesis followed the position defended by constructivism, which engages participants and supports researcher's mind constructions of the phenomenon. Thus, the purpose of finding an approach to solve a practical problem of a specific organisation context, inferred the choice of the paradigm, and the strategy of combining both quantitative and qualitative approaches. Indeed, this mixed-strategy proved to add value in this research. Action Research was chosen to guide the researcher in the field work, and due to the type of services studied the Canonical Action Research method was selected. As the essence of CAR is to take actions to change the current state of the organisation with the purpose of solving a problem, it supports the researcher to understand the organisation's context, analysing the identified problem and to solve it. Based on the research methodology selected, a literature reviewed was made regarding the relation between Action Research and Lean theory. It concluded that several aforementioned studies used AR in Lean investigations.

From the Lean literature review (chapter 2) plus research paradigm and methodology selection (in this chapter), it was then demonstrated how the thesis research question, propositions and hypotheses were formulated. Aiming to solve the problem identified by the target organisation within the Lean IT cycle, the first formulated question was: *how to accelerate time to market in IT services?* Due to the learning and knowledge process inducted by this first Action Research cycle, as well as the results and insights obtained from it, I realised that the research focus should not be on

effectiveness but on Lean sustainability, so the thesis' RQ was formulated to: *how to sustain Lean Service within organisations?*

Towards a better understanding of the CAR method, and being a sequential research, the first Customer-Agreement principle was detailed through the Lean IT journey, highlighting what have to be agreed with the organisation before initiating the research. As each principle has several criteria to be accomplished, it was also described, as an introduction to the chapter 4 journey, how the thirty-one criteria were responded. The following chapters materialised both cycles, explaining the learning process inducted by Action Research in this Lean Service investigation and the results obtained.

Chapter 4 Lean in information technology services provider

After the introduction of the CAR criteria and its materialisation in the Lean IT first Action Research cycle, this chapter presents how the journey was conducted following the CAR cyclical process model (CPM), combined with the chosen theory of Lean IT (principles and tools) and through the selected Lean model: Lean Transformation Model.

4.1 CAR cyclical process model – Lean IT journey

This Lean IT journey was performed during three years (as mentioned in section 3.3, in figure 3.7). The journey started in the last semester of 2015 and finished at the end of the first semester of 2018, through two cyclical process models (figure 4.1), which were both correlated, as the second cycle derived from the first CPM. Indeed, when the first cyclical process model assessment was accomplished the pertinence of carrying out a second cycle arose, especially as a result of the reflection and the learnings gathered within the first CPM.

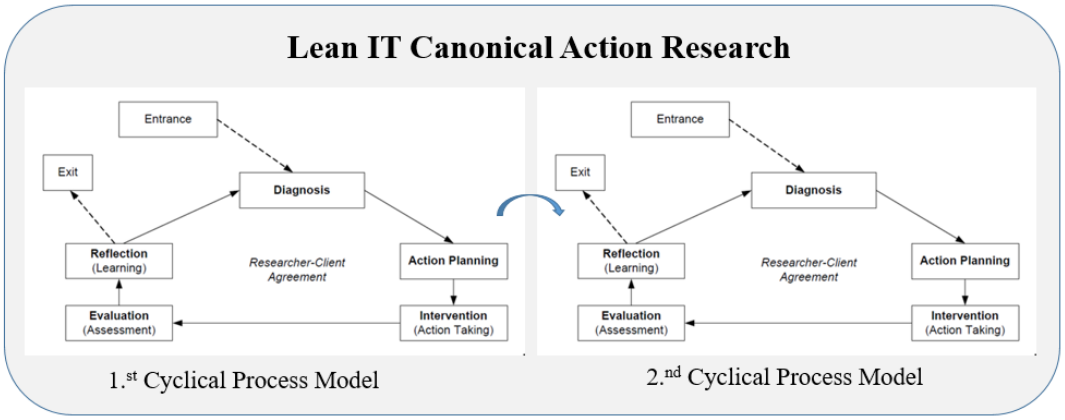

Figure 4.1. *Lean IT Canonical Action Research method with two Cyclical Process Models*

As presented in chapter 3, the CPM followed steps:

- Step 1 – Diagnosis;
- Step 2 – Action planning;
- Step 3 – Intervention (action taking);
- Step 4 – Evaluation of results (assessment);
- Step 5 – Reflection and learning

The purpose of this section is to present the two cyclical process models of this Lean IT journey in detail. Both CPM are part of the first AR cycle of this thesis, so having in mind to make this section easier to read, the number of the cycle and the step are indicated in the body of the text, as for example: 1.st CAR cyclical process model - Step 1 - Diagnosis.

1.st CAR cyclical process model - Step 1 - Diagnosis

Starting with the diagnosis step, the CPM implies the analysis of the following points:

1. Organisational context;
2. Actors involved (internal and external) and their expectations;

3. Understand and detail the problem to be solved;
4. Identify the scientific domain (area) of the investigation.

Organisational context

The present investigation was performed in a Portuguese services organisation. Although the organisation is not identified, it is possible to mention that it is organised by business, corporate and support functions. The investigation was carried out in the business functions, particularly in two different departments: information systems and financial shared services. The first department delivers services application solutions development and maintenance, namely management of technological environments, application development and consultancy services. The financial shared services departments deliver accountability, training and customer management services.

Despite the idiosyncrasies of the Portuguese culture, as well as the internal organisational culture, from the literature review of the services sector characteristics (see chapter 2), this organisation faces the same challenges of the international service context. The (1) digitalisation and digital transformation, (2) the need for human resources requalification, and (3) improving internal processes, inducting innovation plus (4) delivering services with added value by listening to the voice of the customer.

Hence, this investigation was conducted within the scope of two departments, meaning two different kinds of services: information technology (IT) and financial shared services. Both services are delivered to internal customers (users from other departments of the organisation and users from the same department, but from a different team) and external customers (the end-users); thus, the financial shared services department is one of the internal customers of the information systems department. Therefore, during the course of the Lean IT investigation, regarding their internal customers, the focus was on this financial shared services department, with the purpose of having the perspective from the IT side (which delivers the services) and then, the perspective from the business side (which receives the services).

Combining the Lean theory with this first point of the diagnosis of the cyclical process model (CPM), the Lean Transformation Model applied in the first AR cycle, seeks to identify and understand the organisation problem to be solved. Therefore, several meetings were held with managers and team members to deeply understand the context.

Actors involved (internal and external) and their expectations

The ‘first’ actors involved were the (1) top management with their specific request (accelerate time to market), the (2) IT department’s director and (3) their managers. The director maintained his support all over the journey, by authorising the interventions previously aligned with him and providing the necessary conditions for the project to move forward. The board, the department director and managers all expected more effectiveness in regard to the IT services selected in the project scope. Additionally, they all expected to achieve an international certification, to improve the efficiency and then the effectiveness of the IT chosen services.

As an actor and researcher, I expected to help the organisation to implement Lean IT and by means of adopting an Action Research methodology, to learn with it, to bring science to action and contribute to the Lean IT body of knowledge.

Then, the leading actors, i.e. the team members from the five different department teams. They expect to work in a better way, by delivering faster and in a more organised way, learn new IT models and experience a different approach.

External actors such as partners and stakeholders were indirectly involved based on internal organisation documentation, which provided relevant information about this service industry and IT tendencies. Those documents were taken into consideration by the IT managers in their proposal to top managers concerning the development process scenarios.

Additionally, as this department had internal and external customers and in order to mitigate what Radnor and Osborne (2013) identify as an error in the implementation of Lean, that is, the non-involvement of the end user of the services, investigation aimed to involve both. Thus, the financial shared service department was involved as the internal customer. Their expectations were to receive a better and faster service. Regarding the customer, the Lean most important actor, they were unfortunately not involved due to internal constraints.

The 'invisible' actor was the organisational culture. Acknowledging the organisation context, I come to realize, and this conclusion was confirmed by the aforementioned actors, that this journey will imply change and, as normally, will have internal pressures. From networking with peers from other organisations, it was possible to assert that in the majority of Lean implementations there are similar pressures and this is also confirmed in literature (Womack and Jones 2003). Back to the theory, and mentioned in chapter 2, in the Lean Service critical success factors the organisational culture is one of the most cited factors, and is indicated in the iceberg model. Indeed, not all will be aligned with the transformation. The organisation, as well as the project team, must be prepared to handle this situation. Hence, being an AR researcher with a management background, I started to review studies regarding the change management and organisational culture topics (some cited in chapter 2) and learn more about group dynamics. Thus, in the studies of Lewin (1947), who conjugated group dynamics theory with the AR methodology, the author argued the importance of distinguishing two issues in the change process:

1. The current change or the lack of it;
2. The resistance to change.

To address it, the Action researcher has to relate directly to the group, understand its dynamics and define a system to represent the forces that influence a group (Lewin 1947). Thus, this learning empowered my knowledge about group dynamics and alerted me about the internal pressures of the organisational culture (OC), meaning the resistance to change, and the unexpected forces that could freeze the transformation process. The OC impact is detailed in the reflection step in section 4.2, as it was one of the main factors for this unsustainable Lean IT journey. Notwithstanding, the journey started, taking into account the organisational context and culture, and be aware of the 'frontiers of action'. With thve internal customer involvement, having the support of the top management and the department director and managers, and working with the 'shop-floor' workers, the researcher was ready to start.

To do so, and based on the group dynamics theory, which highlights the importance of choosing the right technique to study the group, another literature review was performed on the existing theory. The purpose was to learn which methods could be applied in this kind of immersive research. From the methods analysed, the **focus group** method defined by Morgan (1996) was chosen, as the focus group is an investigation technique that obtains data through the iteration with a group regarding a determined subject. Based on selection and segmentation of the focus group method described by Kontio et al. (2004), from the 86 employees of the chosen department, **20 workers** were chosen to the focus group with the following roles and experience:

- 1 program manager with twenty years of experience;
- 4 managers with twenty years of experience;

- 6 senior analysts with fifteen years of experience;
- 1 senior programmer with fifteen years of experience;
- 1 programmer with seven years of experience;
- 7 analysts with five years of experience.

These employees were chosen with the agreement of the IT managers. The selection criteria was based on (1) the type of IT services they were delivering it was aligned with the project scope and (3) the outcomes of the project, particularly the international certification goal.

As stated by Lewin (1947) in the group dynamics theory, it is necessary to understand the dynamics of the group's life, in order to ascertain the current level of constancy in the face of the forces of change. Hence, I combined the group dynamics with Lean theory to obtain this level of constancy of the twenty employees (a sample of the department group's life). The Lean tool voice of the employee (VOE) was used to capture relevant information and insights regarding the department group's life.

Understand and detail the problem to be solved

As mentioned, the problem was related to the IT services delivery time, meaning the development cycle time: the entire time since the customer needs until the usage of their requested service, the so-called *time to market*. As previously mentioned, this problem was not exclusive of the organisation under study, it is subject of discussion in IT forums as well as in Lean IT international summits. Therefore, in the diagnosis phase some important encounters with peers from other organisations were sponsored. Meetings and *gemba* walks were empowered by the organisation with the involvement of the department director, managers, the researcher and the senior members of the project team. It was a good opportunity to understand how peers were addressing this problem in their organisations and how Lean could help.

In parallel, Information Systems, Lean and Lean IT studies were reviewed, and two dissertation projects were supported with FCT | NOVA students. Moreover, a Lean IT training course took place for all project team members plus other IT workers and, at the end of this course, five decided to apply for the Lean IT certification and they all succeeded. On top of it, additional Lean training sessions were given by the researcher. Thus, the team was well prepared, and informed about Lean and Lean IT theory and aware of their organisational culture.

As mentioned, in the project was suggested to the board to adopt a bottom-up approach, inducting change in and with the focus group, thus, promoting change in the 'shop-floor'. Then, through the engagement of those, change could be conducted to the different levels of the IT organisation, and involving the internal customer in this transformation process. Due to the lack of the external customer, it was assumed what was stated by Radnor and Johnston (2013), that in literature it is common to accept that the quality of an internal processes or service positively contributes to the quality of an external service.

In order to detail the identified problem as a Lean journey, the research combined CAR with Lean theory and followed the Lean Transformation Model (explained in chapter 2). The tools that could be useful to detail the time to market problem were identified. It was decided to start with the continuous improvement pillar, specifically with the waste identification through the Value Stream Mapping (VSM) tool and the Supplier, Input, Process, Output and Customer (SIPOC) technique, to visually map the value stream. The aim was to expose current wastes in the process and define strategies to improve the flow by eliminate wastes.

A group session was held to recap the three types of IT wastes, the concepts of *muda, mura and muri* and the referred tools. Then, the team started to design the VSM and the SIPOC to describe the entire development value stream: starting with the customer need - example: a new functionality in the Enterprise Resource Planning (ERP) solution until its usage. When the team started this exercise, they knew that the development process was shared with the customer, meaning that activities such as defining requirements, testing and authorising the go live were customer activities and responsibilities and should be portrayed in the VSM and SIPOC. Unfortunately, the team was not able to describe in more detail those customer activities, their information flow and times. Thus, an issue was highlighted: IT did not have the information about the customer side of operations and this was foreseen as a critical issue: there was a cleavage between IT and their internal customers. Hence, it was not possible to design a full VSM and SIPOC and under the current organisation culture it was not possible to involve the internal customer in this exercise.

In parallel, I started to study the Delphi technique and participate as an expert in an ISEG master student project with Professor Ana Lucas. So, based on the reality and being a focus group with IT experts, I proposed that the team (the referred focus group with 20 workers) should apply a technique inspired in Delphi, to ascertain what the main wastes were. Two rounds were carried out and two questionnaires were used, answered by each of the twenty-team members. In the first round, it was requested to identify the three main *muda* wastes from the list of eight Lean IT wastes (motion, waiting time, over processing, inventory, over production, transportation, talent and rework and defects). These results were then shared, and with the purpose of reaching a consensus, a second round was done, with the same question about the selection of the three main *muda* wastes. The final *muda* score is presented in the table 4.1.

Table 4.1. *Muda wastes score*

***Muda* wastes**	**Score**
Motion	3
Waiting time	17
Over processing	4
Inventory	7
Over production	5
Transportation	3
Talent	7
Rework and defects	14

To verify this score, an Analytical Hierarchy Process (AHP) was applied. Introduced by Saaty (1980), the AHP is a methodology for structuring, measurement and synthesis, and a general theory of measurement, widely used to handle multi-criteria decision-making problem (Espadinha-Cruz 2012). The AHP methodology is based on the well-defined mathematical structure of consistent matrices and their associated right-eigenvector's ability to generate true or approximate weights, consisting in three parts (Espadinha-Cruz 2012):

1. Making the hierarchy structure of the decision problem;
2. Evaluating the weights of the answers by pairwise comparison;
3. Calculating global weights.

The AHP is a decision-making model that deals with subjective information, and through a pairwise comparison make possible to judge criteria and alternatives through a relative scale of importance (Espadinha-Cruz 2012). Hence, The AHP model was used to make a pairwise comparison between the wastes scored, in order to establish a final ranking.

The researcher followed the methodology and the pairwise comparisons were made by the team members (the 20 focus group members). The pairwise comparisons were made according to the following importance matrix (table 4.2), comparing the pairs of criteria, quantifying through the Saaty scale from 1 (equally important) to 9 (extremely important).

Table 4.2. *Importance matrix*

Wastes	**Motion**	**Waiting time**	**Over processing**	**Inventory**	**Over Production**	**Transport.**	**Talent**	**Rework**
Motion	1,00	0,11	0,50	0,33	0,50	1,00	0,33	0,13
Waiting time	9,00	1,00	8,00	5,00	6,00	9,00	5,00	3,00
Over processing	2,00	0,13	1,00	0,50	0,50	2,00	0,50	0,14
Inventory	3,00	0,20	2,00	1,00	2,00	3,00	1,00	0,20
Over production	2,00	0,17	2,00	0,50	1,00	3,00	1,00	0,20
Transportation	1,00	0,11	0,50	0,33	0,33	1,00	0,33	0,13
Talent	3,00	0,20	2,00	1,00	1,00	3,00	1,00	0,20
Rework/defects	8,00	0,33	7,00	5,00	5,00	8,00	5,00	1,00

Then, the importance matrix was normalised in table 4.3.

Table 4.3. *Importance matrix normalised*

Wastes	**Motion**	**Waiting time**	**Over processing**	**Inventory**	**Over Production**	**Transp.**	**Talent**	**Rework**	**Av. value**
Motion	0,03	0,05	0,02	0,02	0,03	0,03	0,02	0,03	**0,03**
Waiting time	0,31	0,44	0,35	0,37	0,37	0,30	0,35	0,60	**0,39**
Over processing	0,07	0,06	0,04	0,04	0,03	0,07	0,04	0,03	**0,05**
Inventory	0,10	0,09	0,09	0,07	0,12	0,10	0,07	0,04	**0,09**
Over production	0,07	0,07	0,09	0,04	0,06	0,10	0,07	0,04	**0,07**
Transportation	0,03	0,05	0,02	0,02	0,02	0,03	0,02	0,03	**0,03**
Talent	0,10	0,09	0,09	0,07	0,06	0,10	0,07	0,04	**0,08**
Rework/defects	0,28	0,15	0,30	0,37	0,31	0,27	0,35	0,20	**0,28**

The three wastes with the highest average value (priority vector) were:

1. Waiting time - 39 %;
2. Rework and defects - 28 %;
3. Inventory - 9 %.

The consistency of the scores attributed with the comparison of the amounts between pairs of criteria were confirmed by calculating the Consistency Index (CI). The Principal Eigen value was firstly calculated, which translated the sum of the products of each element with the priority vector (the average value) for each of the values in the columns of the normalised matrix. Table 4.4 shows the CR calculation.

Table 4.4. *Calculation of the Consistency Ratio*

Consistency Index	
Principal Eigen value (λ_{max})	8,24
Consistency Index (CI) [$\frac{(\lambda_{max}-n)}{n-1}$, $n = number\ of\ criteria$]	0,03
Average consistencies (RI), for 8 criteria	1,41
Consistency Ratio (CR)	**2 %**

The Consistency Ratio (CR) was 2 % resulted from the consistency index (CI) divided by the average consistencies (RI):

$$CR = \frac{CI}{RI} = \frac{0{,}03}{1{,}41} = 0{,}02$$

Comparing the CR result with the average of the CI of random matrices (in table 4.5) as CR (2 %) is less than 10 %, it was concluded that the scores attributed by the focus group were consistent.

Table 4.5. *The average Consistency Index of random matrices (RI) (Saaty 1980).*

Size	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
RI	0.00	0.00	0.58	0.9	1.12	1.24	1.32	1.41

Hence, another session was made to discuss this ranking. During the session the focus group provided relevant information and insights, and several lines of investigation were captured (particularly one related to the talent waste). In Lean studies, was encountered evidence that these three wastes waiting time, rework and defects and inventory, are correlated with an effectiveness problem (Hicks 2007). The next step was to understand their causes and how to eliminate them.

Therefore, after a further analysis in Lean theory, another Lean tool was used: the root cause analyses, which uses the asking why technique (5 Whys) by asking five times, moving forward each time to discover the root cause of the problem. To capture the causes, the approach was to ask the group to think about the main constraints of their IT services. This initiates with an open question, without focusing on the effectiveness of the IT services. Plus, the Ishikawa diagram was also used to support it.

From the information gathered, the next step was to get further information about the identified causes, as well as asking team members for solutions. Thus, with the pillar of respect for people, a different approach was followed, instead of a group session, the researcher proposed and was accepted, to applied semi-structured interviews to the elements of the focus group.

An investigation protocol was defined to conduct these interviews:

- When - interviews conducted at lunchtime;
- Where - outside the work environment, in a restaurant (in a relaxed environment);
- How - lunch held between the researcher and two elements of the focus group.

Regarding the option of having lunch with two elements (instead of one to one) was to avoid the inhibition of the participants and to encourage the iteration among all. When one shares its opinion, the other feel more comfortable also sharing, because some elements were more introverted than others. The team made the 'lunch pairs' based on the rationale of: (1) the team, the member belongs and (2) the introverted/extroverted profile of each one.

During these semi-structured interviews there were only two open questions:

1. What are the causes of the constraints?
2. What solutions do I propose?

During lunch (and with the members consent) notes were taken and later transposed to a text database of the researcher. From the suggestion of Davison et al. (2004), the content transcribed to the data base was validated by each member to guarantee that it was in accordance with the conversation, so that there was no doubt about its content. To treat the information collected a context analysis technique was applied. This exercise resulted in a list of possible causes for the identified wastes.

Following the questioning process, several constraints were pointed out, and it was interesting to realise that there was a consensus regarding an effectiveness problem in the services they were delivering. Hence, the constraints were recorded in the researcher database and another consensus was present: the root cause of the identified constraints was the identified organisational cleavage with the customer.

Thereupon, another group session was performed to discuss the causes. Then, to converge to a ranking of causes about the three identified wastes (waiting time, rework and defects and inventory), each element was (individually) asked to vote and select the main causes of waste, using the dots technique from the Management of Value model (AXELOS 2011). It was interesting to realise that there was a consensus in the group regarding the main cause for all the three wastes: the lack of feedback and joint work with the (internal) customer.

Regarding this main cause and its relation with the three referred wastes, the arguments were:

- Reworks and defects - without working together with the customer and without their feedback, the direct implications are: both IT and customers are not engaged together in the development cycle, as customers needs can be misunderstood and the solution delivered may not be aligned with their requirements. This will conduct to change requests or bugs (rework and defects).
- Waiting time – if there is no direct flow with the customer, several intermediates will appear in the value stream and bottlenecks will be created. As described by Spear and Bowen (1999) this is against Toyota's tacit knowledge, particularly rule number two, *every customer-supplier connection must be direct and there must be an unambiguous yes-or-no way to send requests and receive responses* and rule number three, *the pathway for every product and service must be simple and direct*. Moreover, without the customer feedback and without knowing both delivery plans, the customer will wait for IT and the same will happen to the technical teams. Thus, without the voice of the customer, it is not possible to implement the Lean philosophy.
- Inventory – if the customer is not aware of the IT referred delivery plan, he will not be prepared to accept the developments. This will cause waiting time but also cause 'code and functionalities' stock which are waiting to *go live*. This has major implications in software development due to the fact that several coding objects are shared by different functionalities and programs, causing technical issues and adding risks to the software.

Due to this main and common cause, the researcher aimed to confirm with the IT department managers in practice, if there was any customer feedback mechanism and process in place (survey, meetings, forums…) which effectively did not exist and was not even planned.

Indeed, this fact is not exclusive of this organisation. In academia knot, the Caemmerer and Wilson (2010) study argued that customer feedback mechanisms at an organisational and business unit level need better integration. According to their study, in order to gather customer feedback that enables more meaningful decision-making to improve services, middle management needs to have a stronger involvement in the design and implementation of customer feedback mechanisms. Thus, for these authors central efforts have to be placed on the support of management in the interpretation and use of data that is gathered through organisation-wide feedback initiatives.

In the knot of the Lean community, when networking with Lean IT experts, this issue is pointed out several times. The co-founder of the Lean Institute France, Marie-Pia Ignace, stated in Lean Summits that this is one of the problems of the IT. The cleavage between IT and their customers, and the fact that IT 'lives well' with this situation and does not understand that is one of the IT major problems. As mentioned in chapter 2, Bell (2013) forced himself to evolve his own concept of Lean IT to avoid the split between IT internal and external perspectives, as the author realised it will increase the gap between IT and their customers. Indeed, and going back to the Lean principles theory (Womack and Jones 2003), if the customer is not listened, how is it possible for the organisation to capture what is considered value to the customer? This is even more critical in a service organisation. If the customer is not engaged and involved, he will not pull the system, so the technical teams will start to push the system (teams need to work, otherwise they will stop), so they will start coding, and this 'code' will be software inventory waste. Thus, the flow and the value stream without a customer centric approach will generate waste over waste, and the mindset of continuous improvement and pursuing perfection will be just a theoretical exercise.

Finally, to verify if this diagnosis step was concluded, a last theory verification was done. From Davison et al. (2004) study (referred in chapter 3) a final point was raised. These authors suggested that in this first CAR step, before starting the second step with planning the intervention, the researcher should use prescriptive methods such as key performance indicators (KPI) and process metrics to obtain data in order to compared with further results after the actions. This is not applicable in this case as it was confirmed with the IT managers that there was not a customer feedback process and mechanism. Hence, this lack was a powerful insight, and reinforced the top management request and the issue raised by the internal customer, which is translated in the question: **How to accelerate time to market in IT services?**

To pursue an answer to this question, the following hypothesis was formulated in this first Action Research cycle: **Lean can improve efficiency and effectiveness in IT services.**

Taking into consideration this hypothesis and following the cyclical process model, the team started to plan the intervention.

Identify the scientific domain/area of the investigation

The last point in the diagnosis step is to identify the scientific domain of the investigation. Being a Lean IT journey, this CAR had its scientific domain in Engineering, as well as in the Operations Management. Moreover, being Lean IT, meaning Lean principles applied to IT services, was important the intersection of two additional scientific areas: Information Systems (IS) and Software Engineering (SE). On the one hand, according to Laudon and Laudon (2004) an information system can be defined as a set of interrelated components that process, store and distribute information that aid the decision process. In a broader sense, the authors O'Brien and Marakas (2011) define an information system as

any combination of people, hardware, software, communication networks, data resources, policies and procedures that store, retrieve, transform and disseminate information in an organisation. On the other hand, Software Engineering according to Boehm (1976) is the practical application of scientific knowledge in the development and construction of computer programs and the associated documentation with a view to their development, operation and maintenance. Thereupon, during this CAR implementation, several scientific domains were consulted, but this research mainly contributed to Lean and Lean IT body of knowledge, in the Engineering and Operations Management domain.

1.st CAR cyclical process model - Step 2 – Action planning

Customer feedback

In the previously diagnostic step and through interviews with the team members, it was identified that the IT services were not evaluated by the customer, thus, the technical teams did not have the feedback from their customer. The absence of this voice of the customer was considered by the team members as the main cause of the three identified wastes: waiting time, rework and defects and inventory.

From the diagnosis information, it was confirmed that the question (*how to accelerate time to market?*) was correctly formulated and now it was important to verify the hypothesis, meaning if Lean could be helpful to address the need to collect IT customers feedback and start working with them.

With the purpose of planning the intervention towards defining the process of customer feedback in these IT services, the researcher initiated a literature review about this topic, analysing different research perspectives and approaches:

- Customer relationship process (Chen and Popovich 2003);
- Feedback techniques (Caemmerer and Wilsone 2010);
- Capturing customer perceptions (Lee and Lin 2005);
- Analysing customers' thinking and the interpretation of their feeling (Pang and Lee 2008).

Such approaches were discussed within the team and it was decided to pursue the feedback techniques from Caemmerer and Wilson (2010). In this study, the authors explore the antecedents and consequences of the implementation of different customer feedback mechanisms regarding their contribution to organisational learning that impact on service improvement. These authors concluded that, in relation to service improvement, the organisational learning is influenced by the interplay between the way data are gathered through customer feedback mechanisms and their implementation at a business unit level, which depends on attitudes of management towards such mechanisms.

So, they argued the importance of the middle management involvement in the customer process feedback and listed various mechanisms to obtain it. They were all analysed and it was decided to choose the *management one-to-one assessment with the customer*, therefore a feedback meeting with the internal customer manager was decided.

Besides this theoretical information support, during this step the internal customer context was also studied, based on the organisational internal documentation, and information about the target customer manager was collected through IT managers' information.

During this preparation phase and with the purpose of preparing the meeting with the customer manager, following the Lean theory, the Voice of the Customer technique was selected as the best tool that could help in this topic. The team members did several exercises imagining 'the target manager customer persona' with the goal of describing her

expectations and issues and understanding her position. The purpose of these exercises was to prepare the meeting (the action).

Several options were discussed in the preparation of the meeting. If it should follow closed questions with a Saaty scale, taking into consideration several studies in academia with 'template' questions or an opposite strategy with only open questions, or even a mix with close and open questions. The team concluded that to collect customer perception, the best strategy was to choose open questions to know their opinion about the IT services quality and effectiveness. Thereupon, the meeting agenda and content were prepared. The customer manager was contacted and briefly introduced to the purpose of the meeting and then, an electronic invitation was sent with the meeting agenda.

Finally, regarding the suggestion of Davison et al. (2004) to incorporate in this step quantitative metrics into organisational processes (to measure the activities that have been subject to changes), and as already explained, since this customer feedback was a new process to the organisation, this was not applicable.

Development process scenarios

In parallel, the team analysed different software development methods, such as: (1) Water-Flow, (2) V-model, (3) Prototype, (4) Spiral model and the (5) Agile, particularly the scrum method. After this analysis, several preparation meetings were held with IT managers and director.

Afterwards, and based on a joint proposal, a presentation was prepared taking into account the organisational context, and a meeting was scheduled with the board of directors.

1.st CAR cyclical process model - Step 3: Action taking

Based on the previous action preparation step, the customer feedback meeting took place. The meeting was taken between the customer manager and the researcher. As previously referred, the strategy was to conduct the meeting through open questions, so, the agenda had the following two open questions:

1. What is your opinion about IT services provided to your team?
2. What can be improved in IT services? Are there any proposals of combined co-creation strategies with the aim of reducing the development cycle time?

The customer presented several fact examples to explain the issues pointed out with the IT services, particularly (1) the fact that IT maintenance corrections were not informed in time to do the change management required with the internal team and the final users. Plus, (2) they required additional time to perform their tests when IT delivers new functionalities, and (3) there was no process in place from IT to business to explain the new functionalities. Additionally, (4) the importance of having constant feedback regarding the IT delivery plans, as (5) these delivery plans were critical to plan the time that was required to do the change management with external customers. Regarding the new functionalities, it was also mentioned that (6) the information provided in the release notes were too technical. Moreover, there (7) was a lack of a template to communicate between IT and business teams and finally (8) the long IT time to market.

Hence, the customer suggested that a way to accelerate the IT services was to address the identified issues and agreed on the existing organisational cleavage between them and IT, pointed out that this action was a good example towards a better communication. The summary of the meeting was transcribed to the investigation database and researcher's diary.

Development process scenarios

In order to respond to the board of directors' request about the development process scenarios, a meeting was held between the IT director and managers and the top management. The guidelines of the different software development methods were presented and the IT proposal was shared. It was decided to adopt the Agile, specifically the scrum method and it started with a pilot in an IT Team.

1.st CAR cyclical process model - Step 4: Evaluation

After carrying out the action, its evaluation was made and the following conclusions were highlighted, taking into account the situation before the intervention:

1. It was verified that the mechanism introduced, *management one-to-one assessment with the customer*, was a good starting point for a future procedure for collecting customer feedback;
2. The evaluation was immediately positive, because the initiative was praised by the customer;
3. For the investigation, it was equally important because it allowed obtaining customer information, which was the base information of the second CAR cyclical process model.

Therefore, after reflecting on the results obtained, the department managers decided to:

1. Put in place the chosen customer feedback mechanism with this internal customer, so as to collect their constant opinion about the IT services provided. Weekly meetings with IT and business peers started to take place in the main projects, to discuss projects progress and other combined topics thus enabling constant feedback;
2. Analyse the inefficiencies highlighted by the customer and propose to the board of directors three different scenarios regarding the development process, with the aim of accelerating time to market. One scenario was chosen, so the management (supported by the project team) presented suggestions to the internal customer about how best to operate this new way of working with their involvement. An agreement was reached and actions started to be planned (described in the next cyclical process model);
3. Take the opportunity to apply for an international certification. This opportunity was considered a lever to IT, because if reached, it (1) would be an important organisational achievement, (2) the opportunity to introduce internal improvements to answer customers pain points, and (3) to motivate the IT teams towards a better service, (4) to empower IT teams in the organisation. Thus, a new cyclical process model was defined to accomplish it;

Making a quantitative evaluation of this action:

1. Key performance indictors – before the action was confirmed there was no such mechanism in place, thus after this action a mechanism was tested and approved and started to be in place;
2. Customer feedback process – before the action there was no formal process, but after the action, the process was defined with the customer.

Additionally, it was verified how this action affected the team members and other IT workers:

1. IT team members – they expressed they were satisfied for being involved in contributing with the proposed customer feedback mechanism and for having the possibility of listening to customer feedback, particularly about their own IT inefficiencies, which they were not aware of;

2. IT workers – some embraced the change and were willing to be part of it, but others demonstrated resistance to the proposed changes and had difficulties to understand the need for changing.

Regarding the research, in this first CPM of the Canonical Action Research, it was important to point out:

1. As stated by Dickens and Watkins (1999) an intervention also commonly transforms the structure and the systems of the organisation rather than merely perform a few half-hearted actions or 'tinkering' with the environment. Through the assessment of the organisational situation made in the diagnostic phase, the 'before analysis' highlighted an important cleavage between IT and their customers. This resulted in long delivery cycle times and in inefficiencies, where no customer feedback mechanism was in place. Comparing with the 'after action', it was realised that the initiatives taken (defining a new development process and formal interaction with the customer) had the purpose of minimising the identified cleavage, thus this action inducted the beginning of a transformation in IT way of working (next CAR cycle) and its relationship with the selected internal customer;

2. Acknowledging Davison's et al. (2004) topic that individuals in the organisation may experience changes in roles and responsibilities and be required to develop new skills. Indeed, the project team members gained Lean IT theoretical knowledge, and with it, they were able to put this knowledge in practice over this first CAR cycle, adopting several referred Lean tools and pursuing the best solution regarding the identified problem. However, and based on the LTM, in this evaluation phase of the first CAR cycle, under capability development question: *what skills do we need to develop our human resources?* it was also realised that it was important to readjust some IT roles and responsibilities, and this was a relevant insight to the second CAR cycle.

In figure 4.2, it is possible to summarise the main findings of this first CPM Lean IT Canonical Action Research.

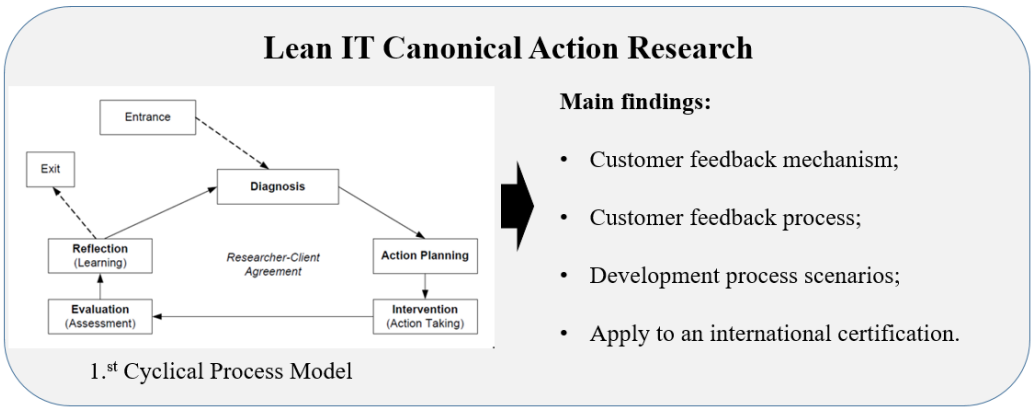

Figure 4.2. *Lean IT Canonical Action Research 1.st Cyclical Process Model main findings.*

1.st CAR cyclical process model - step 5: Reflection

In the last step of this 1.st CAR cyclical process model, the dissemination of the knowledge acquired with the team members as well as with other IT teams was taking into consideration. Additionally, in this step I also reflected concerning the learnings obtained under the organisation, research and theory perspectives.

Organisational perspective

Under the organisational perspective, the following learnings were pointed out:

1. IT managers were able to collaborate with each other to analyse, discuss and propose to top management different scenarios about the development process and consequently the guidelines for a different way of working;
2. Team members acquired Lean and Lean IT knowledge principles, tools and methods through training courses and then, were able to implement the selected tools in the field;
3. Team members were able to improve their communication skills as they were responsible for conducting several presentations to other IT workers explaining the proposed development process scenarios. Thus, these IT workers were also informed of the changes performed, and were invited to be involved in the transformation process;
4. Regarding the customer feedback process and mechanism, and back to theory, Caemmerer and Wilsone (2010) argued that a central effort must be placed on the support of middle management in the interpretation and use of data that is gathered through organisation-wide feedback initiatives. Hence, it is not just about performing the action, it is also a question of analysing the data collected and defining actions based on it.

Research perspective

Under the research perspective, I also learned the following with this first CPM:

1. The importance of the theory to support the Action researcher – the methodology induces that the researcher constantly needs to find theoretical background to support his interventions. It is important because in doing so, the researcher becomes knowledgeable of the different perspectives of the literature review, and can be better informed to choose the one that is most adequate to his study context;
2. The engagement of the several actors – the group dynamics knowledge provide a good background to study the focus group, combined with the chosen Lean/Lean IT theory, nevertheless it is crucial to have the engagement and the involvement of all the actors, as only a joint effort between the researcher and the organisation can produce positive results;
3. The influence of the coined invisible actor, the organisational culture – during this first cycle, this actor was always present and despite the efforts of all the mentioned actors, it was a challenge to conduct this research. Hence, I learned the importance of this invisible actor and prepared myself, based on theory and in the insights from the Lean community, to start a new cycle with this constraint.

Theory perspective

Under the theory perspective, there were several learnings to be referred:

1. This first CPM demonstrated the possibility of combining different topics from several domains. The combined learnings from group dynamics and Lean theories provided complementary information, which was helpful to study the focus group. Moreover, I also highlighted the joined between the Management of Value dots technique with Lean root cause analysis, as well as the adaptation of the Delphi model to identify the main wastes.

2. Regarding suggestions to the CAR cyclical process model, I proposed that the diagnosis step should include the stakeholders perspective regarding the problem. In this Lean IT journey those were indirectly involved through organisation documentation, particularly the stakeholders annual survey.

2.nd CAR cyclical process model - Step 1: diagnosis

The second cycle started as a result of the first, therefore, the diagnosis defined previously was mainly the same. However, the following points should be highlighted:

1. The team was more knowledgeable thus it was able to propose several initiatives in order to render the new development cycle;
2. The team was highly motivated due to the possibility of achieving an international certification;
3. Other IT members, who did not participate in the focus group over the first cycle, some asked to be more involved;
4. The IT director and managers maintained their support to the initiatives;
5. Organisation culture invisible actor was still a risk to be mitigated.

Under the research perspective, it was now necessary to implement the Lean Transformation Model, as well as all the supported tools for the new development process. Once more, a theoretical background was made to verify similar case studies, meaning other Lean implementations, which put into practice implemented LTM. The goal was to learn with them.

Regarding the organisational culture and its constraints, Bell and Orzen (2011) represented the five Lean IT principles in the form of a pyramid, reinforcing the idea of what one wants to achieve in the fifth and last principle: culture. Since it evolves over time, this principle represents the sharing of values through the attitudes and behavior of all stakeholders, given that an organisation is the collective capacity of everyone to create value (Ferreira et al. 2018). Therefore, and as mentioned before, these authors stated that, being Lean a philosophy, it can influence and change the organisational culture, inducting behaviours and attitudes. Therefore, the formulated hypothesis in the first Lean IT Action Research cycle: **Lean can improve efficiency and effectiveness in IT services**, was also applicable for this second cyclical process model.

2.nd CAR cyclical process model - Step 2: Action planning

In the aforementioned meetings with IT managers and the team, the purpose was to align the plan to operationalise the (1) render of the new development process with the aim of changing the way IT teams were working and (2) obtain an international certification. Having accomplished both, it was necessary to accelerate the time to market, the problem identified by the organisation. Despite the organisational culture constraint (the cleavage between IT and business and the resistance to the transformation process), the team was able to define a proposal with the internal customer involvement. Therefore, in this planning phase two interrelated lines of action were defined:

1. The new development process – with customer involvement towards effectiveness (accelerating IT time to market);
2. The international certification process – with IT teams' involvement towards efficiency.

Another literature review about Lean IT tools was done to find the most suitable one to support these lines of action: the new development process and the certification process.

The new development process

Regarding this first line of action, as the Lean IT theory is centred in the customer, it was important to recap the Lean principles with the team. Regarding Lean tools and with the aim of answering the issues revealed by the internal customer (during the first CPM action) several tools were studied, particularly the (1) visual management, with the (2) Kanban boards (the white boards) combined with the (3) feedback dialogue and the (4) stand-up meetings. Finally, key performance indicators started to be defined to have a before and after analysis.

Moreover, as this new development process will imply change, and change means innovation, during this planning phase a Design Thinking course was schedule for all the first cycle team members plus the ones who had the initiative to join the team. Additionally, to promote the linkage between IT and the internal customer, the business team was also invited to have the same training. Thus, in this phase, almost fifty people from IT and business teams attended a Design Thinking course. This was also a good opportunity for 'ice breaking' as workers could work together in several pilot initiatives.

Certification process

In parallel, the international certification planning phase started with meetings with the top management and the external certification entity. The internal suppliers of the Information System department, the Infrastructure Technologies and Communications (ITC) department also joined this initiative, thus preparation meetings took place to define the scope, the team, the effort and duration as well as the project logistics. As both departments had a similar context regarding the Information Technology Infrastructure Library (ITIL) implementation, it was easy to align the strategy to plan the project. As IT models can play an important role in aligning IT challenges with business (Ferreira et al. 2018), Lean IT can help in the operationalisation of these models, enhancing organisational transformation (Bell and Orzen 2011).

Furthermore, as this certification project took place over one year and had to respond to the demands of the international certification entity, it was decided to allocate one person full time to this project and it was also agreed to have a FCT | NOVA master student working on it, who described this project in her dissertation project. Due to the anonymisation of the organisation, this reference is not cited.

A one-year roadmap was established with the certification entity with agreed milestones. Training and workshops were performed in order to inform all about the certification process. Thus, four quality areas were defined to be addressed:

- Business Continuity;
- Business Process Improvement;
- Integration Validation;
- Protection of Investment.

To each quality area the respective scope and related processes were defined (figure 4.3), and then, quality managers were assigned.

QM Area	Scope & process
Business Continuity	Business Process & Interface Monitoring Job Management Data Consistency Management Root Cause Analysis System Monitoring & Admin Data Volume Management
Business Process Improvement	Business and IT Alignment Business Satisfaction Transparency & Value of IT
Integration Validation	Operations Handbook Project Validation & Q-Gate Management Transport Management Technical Risk Mitigation
Protection of Investment	Service Portfolio Management Change Request & Control Management Custom Code Management Test Management Release & Upgrade Management Incident & Problem Management Security

Figure 4.3. *Quality areas and processes*

2.nd CAR cyclical process model - Step 3: Action taking

As both lines of action (the new development process and the international certification process) were the major projects of the IT transformation process, each of them was complex and had numerous subprojects. As a researcher I had the possibility to be an active participant in both and each of them had enough subject matter to be master dissertation projects (as mentioned, the international certification was one). Hence, I decided not to describe this CPM with the same level of detail of the first CPM because this thesis would become too extensive, and I considered it is more important to demonstrate the main interventions of both line actions within the CAR cyclical process model. Thereupon, the applied Lean tools are just mentioned, as the projects themselves were already described in (1) scientific documentation, (2) were presented in different forums, and (3) detailed in the organisational documentation.

Hence, in this step the most important interventions taken in both lines of action are pointed out, with the purpose of given the right information to similar contexts, as both projects were fundamental pieces of the IT transformation process towards the acceleration of the IT services time to market.

The new development process

The new development process had the purpose to change the way IT teams were performing their work, delivering customer value, with their involvement and engagement, with the aim of accelerating IT services time to market.

Thereupon, several initiatives were defined with the support of the Lean IT theory:

1. The Agile scrum method was defined in the development projects rather than the water-flow. This change implied training and the assignment of different roles in the teams (ex. scrum masters). This Agile adoption started within a pilot team, with positive results.
2. The forecast and the delivery plans with the internal customer were defined, as well as a progress and feedback meeting. In this regular meetings the scrum delivery sprints were defined with the customer;
3. The visual management was implemented. Thus, the Kanban White boards were assign to each team, which defined their own board based on their needs. Figure 4.4 presents two teams' white boards.

Figure 4.4. *The white boards from two teams.*

4. The performance management was decided by managers and key performance indicators were defined;
5. The Project Management Office was set up for the main projects with top management support. The progress of the main projects were monthly analysed by IT, business managers as well as the board of directors.
6. For the three main wastes (waiting time, inventory, rework and defects) managers defined and implemented initiatives to mitigate and eliminate those, as for example: (1) sharing delivery plans with the customer, (2) setting up the coding traceability to reduce inventory, or (3) the introduction of an application to support the development approval process with customer involvement.
7. Concerning the other five wastes identified, several actions were taken. As an example concerning the talent waste (and based on the LTM, the resources capability development), the researcher used the sampling technique to validate whether the waste of talent was actually a reality. The researcher made a matrix of competences of the respondents who answered talent (the questionnaires, according to Delphi, are not anonymous) comparing their competences versus the work they were perform, having verified a direct relationship with not using all their abilities (this matrix was shared with the team). Hence, several activities were planed to mitigate this talent waste, such as: redefinition of roles and responsibilities, assignment to different projects and providing additional training.

Certification process

Taking into account the complexity of this one-year project, which also created additional and related sub-projects, and in order to focus on the description of the cyclical process model, I decided to highlight the following main interventions:

1. ITC and IT departments combined work in order to align the 14 ITIL (Information Technology Infrastructure Library) processes and describe each one following the guidelines of the certification entity. This intervention created a sub-project in the Knowledge Management area to update existing documentation, adding further required information and data due to the certification.
2. During the audit assessments, the required documentation was verified. Figure 4.5 demonstrates the operation handbooks status at the second assessment (subtitle: the bold squares mean that the operations book were finished).

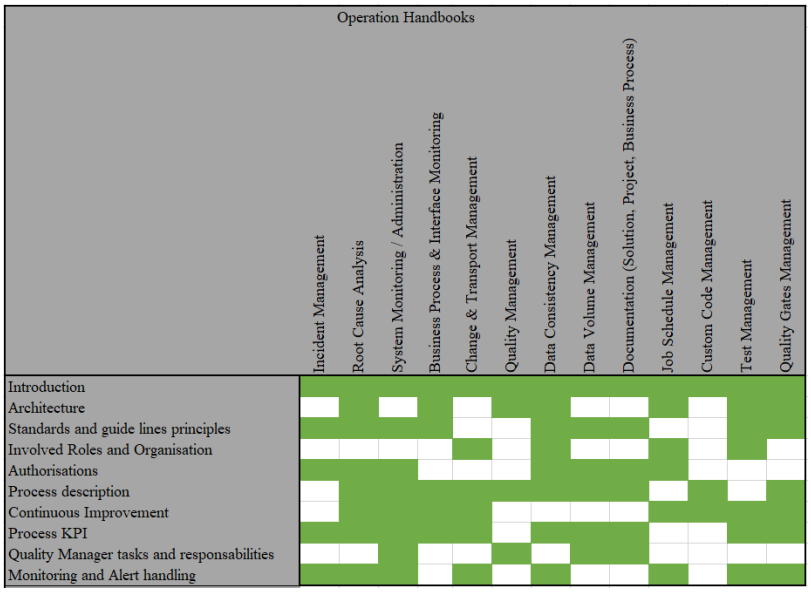

Figure 4.5. *Operation Handbooks status in the 2.[nd] assessment.*

Regarding the data required by each process (ex. incident management) figure 4.6 shows one example of the entity' summary assessment report in the second assessment.

Incident Management & Exception Handling: **L2** /Root-Cause-Analysis: **L3**		Available Comment (2nd Assessment)
Summary / Lessons Learned from last serious incident		Please provide one example to clarify how a lessons learned has been conducted in the past
Technical KPIs		Please provide 1-3 example while using KPIs from daily business or from KPI workshop
Screenshots from message handling		Please provide one example to clarify how the message handling is conducted
Examples for incident reporting		Please provide incident reporting shared business from last reporting period (weekly, monthly quarterly basis)

Figure 4.6. *Audit assessment summary in Incident Management.*

For each process, several key performance indicators were then defined and monitored by the identified quality managers. As an example, figure 4.7 presents the defined KPI for the Protection of Investment (POI) quality area and related processes.

	Focus Area / Process	KPIs - Mesures
POI	Service Portfolio management	- # of adopted services; - # of usage of offered service; - Frequency of service delivery; - # of cost reduced services; - end user satisfaction.
	Change request and control management	- % of changes that cause incidents - # of emergency changes - % of unplanned outage/unavailability due to changes - % of unauthorized implemented changes - % of implemented changes without impact analysis
	Custom Code	- % of custom code objects not complaint to documentation standard - Ratio of completed analysis projects in custom code clearing - % of unused objects still in the system
	Test management	- % of discovered that have been successfully corrected and tested - % of coverage of test cases - % of reported bugs that were not in test scope - % of reported bugs that passed to quality gate for production
	Release & upgrade management	- Frequency of master release plan updates - Distance from current release, EhP, and SPs
	Incident and problem management	- Average time for incidents solved by 1st level support - % of incidents solved with knowledge database - % of messages solved by 1st level
	Security	- % of profile changes for users in one year - # of incidents caused by wrong/missing roles - # of security reviews in one year - # of security alignment meetings

Figure 4.7. *KPI for Protection of Investment processes.*

3. Quality Management (QM) training having achieved eighteen (QM) team members' certification. This intervention also created an additional sub-project in the quality management domain with the redefinition of roles and responsibilities (where a RACI matrix was developed).

4. Key performace dashboard definition to monitor the indicators with the purpose of comparing before and after measures. This intervention implied a business intelligence sub-project, with the dashboard definition, data sources and respective extract, transform and load process;

5. Training session to IT managers and members regarding the certification process and its implications, as well as to the internal customer, due to the adjustments required in the new development process.

2.nd CAR cyclical process model - step 4: Evaluation

The evaluation of these two lines of action was performed and the following conclusions were reached:

1. An international certification was achieved, after three audit international assessments. The centre of expertise was a reality one year after the project kick-off of the 2.nd CPM. The organisation was the first to gain such distinction in Portugal and was presented as a reference in several external forums;

2. The procedures and processes to support the new development process were defined and implemented. A joint effort of several IT teams was made, aimed the internal alignment among all, and with the internal customer;

3. Regarding all the eight issues raised by the customer (in the course of the first cycle) all of them were addressed and improved;

4. The Infrastructures department (the internal supplier of the IT department) was also involved in the transformation project, whereas in the certification process and in IT procedures were agreed between both departments.

Making a quantitative evaluation of this action:

1. Key performance indicators – from the list of all the KPI identified and audited by the external entity, it was possible to verify the improvement obtained after the action taken;

2. Internal processes – the 14 ITIL processes were documented, and the internal controls were defined, as well as the quality managers of each one. Thus, quality management started to be monitored after this intervention.

Additionally, it was verified how this action affected the team members and other IT workers:

1. Team members – new roles and responsibilities were reviewed (also to address the talent waste), and all team members went through a quality management certification to gain competencies to respond to their new functions. Hence, they went through a learning process over the journey and were motivated and even proud to be part of a centre of excellence. Internally, they were recognised by the top management;
2. IT workers – the ones who embraced the change took the opportunity to collaborate and work with other teams, having access to new content and tools, and several changed their roles and responsibilities. Those ones, who decided to resist and maintain their way of working represented a challenge for the managers. For all, the organisation made significant investment in training: technical content, IT and Lean models, soft skills and innovation courses were given. In fact, the IT department made an effort to create the right conditions to support this transformation, despite the organisational context and culture.
3. IT managers – it was a challenge to be part of the IT transformation process and they realised, in practice, the importance of the linkage between IT and the customers, and the need of collaboration and networking with peers;
4. Top management and IT director – reached the objectives of doing an IT transformation process, obtained a certification and an international recognition, which accelerated IT services time to market.

In the figure 4.8 is summarised the main findings of this second CPM Lean IT Canonical Action Research.

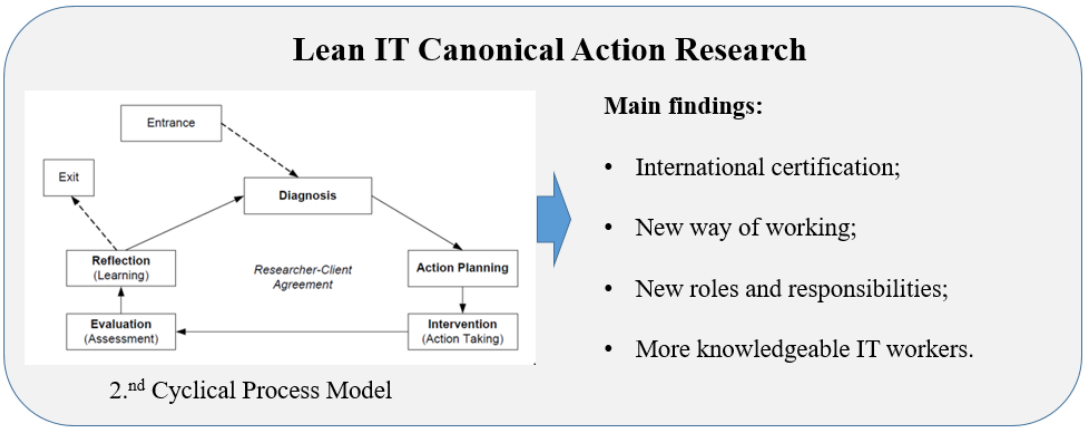

Figure 4.8. *Lean IT Canonical Action Research 2.nd Cyclical Process Model main findings.*

2.nd CAR cyclical process model - step 5: Reflection

Following the same approach of the first CPM, this reflection step was under the perspectives of: organisation, research and theory.

Organisational perspective

Under the organisational perspective, there were several learnings to be referred:

1. IT and business team workers can work and cooperate together when the organisation creates such conditions and sponsors combined initiatives;

2. People aim to be involved and engaged in a transformation process, which will impact on their daily life, as well as on their way of working, and are willing to be part of a winning strategy, when the purpose is well defined, and the goal can be obtained through their effort and dedication;
3. IT needs to move forward into a more collaborative attitude with their internal and mostly with external customers in order to include their 'voice' in their deliveries, and be aligned with the purpose of creating value to the customer. Customers also must be available to make a joint effort to flexibly co-create with IT teams and address their need in a more participative way.

Research perspective

Under the research perspective, I learned with this second CPM:

1. The FCT | NOVA master project about the certification project, where the student worked closely with the team members, added important theoretical information, particularly about key performance indicators, which allowed to take decisions based on the theoretical models;
2. The Lean IT master dissertation (Ferreira 2018) as well as the Lean IT article (Ferreira et al. 2018) were relevant to acquire valuable theoretical information, providing literature background, which was applied over this second CPM.

Theory perspective

Under the theory perspective, several learnings should be referred:

1. Lean IT can support Agile implementations in the software development process, as described in chapter 2. In this second CPM the linkage between Agile and Lean and the benefits of such combination were demonstrated.
2. IT standards, such as ITIL can be combined with Lean IT theory. Theoretical background foresees advantages of such combination and in this second CPM it was demonstrated how Lean theory can support ITIL standard processes through work standardisation, performance management and quality management with a continuous improvement mindset.
3. Regarding the Lean model, the Lean Transformation Model (table 4.6) proved to be a useful model to support both lines of action. The Lean tools made it possible to address the several challenges.

Table 4.6. *The Lean Transformation Model evaluation regarding the Lean IT journey*

LTM components	***Observations***	***Evaluation***
Situation approach	The problem: *'how to accelerate time to market*?" was understood and answered through the journey.	*Accomplished*
Process improvement	IT work was improved and value was added.	*Accomplished*
Capacity development	The talent waste was addressed but not in a consistent way. The internal customer was partial involved and the external customer was not.	*Partial Accomplished*
Management system	The management system was unable to manage the organisational culture barrier.	*Not Accomplished*
Basic Thinking	IT workers mindset changed towards Lean Thinking, but the rest of the organisation did not change.	*Partial Accomplished*

4.2 Discussion – learning through reflection

This section discusses CAR learning through reflection principle, based on the two demonstrated CPM.

As stated by Baskerville and Wood-Harper (1998) CAR findings must be generalised through (1) the evaluation of the value of the theoretically based model applied, and (whenever possible) with (2) the transferability and applicability of the relevant theories and models. Moreover, the main findings of this Lean IT cycle and the learnings obtained with this first Action Research cycle are now explained, as well as the way how the knowledge obtained influenced the second AR cycle. It is also pointed out how this learning can contribute to the existing Lean philosophy, particularly Lean models, in order to advance knowledge.

Practical knowledge – main findings

As Lean defends 'the go to *gemba'* the investigation followed this approach and suggested that the organisation adopted a bottom-up approach rather than a top-down one. The evaluation of both CAR cycles demonstrates that this approach benefited the organisation, as it was possible to verify through key performance indicators that the IT services time to market was accelerated. Indeed, the involvement of shop-floor workers provided the opportunity to involve them in the IT transformation process. This active participation provided important insights to research and organisation. Additionally, the IT director and managers, plus the top management achieved the goals of gathering customer feedback and with their important suggestions towards a new development process (first cyclical process model), as well as the implementation of the suggested new development process, and the achievement of an international certification (second cyclical process model). Figure 4.9 presents the mentioned main findings of both CAR cycles.

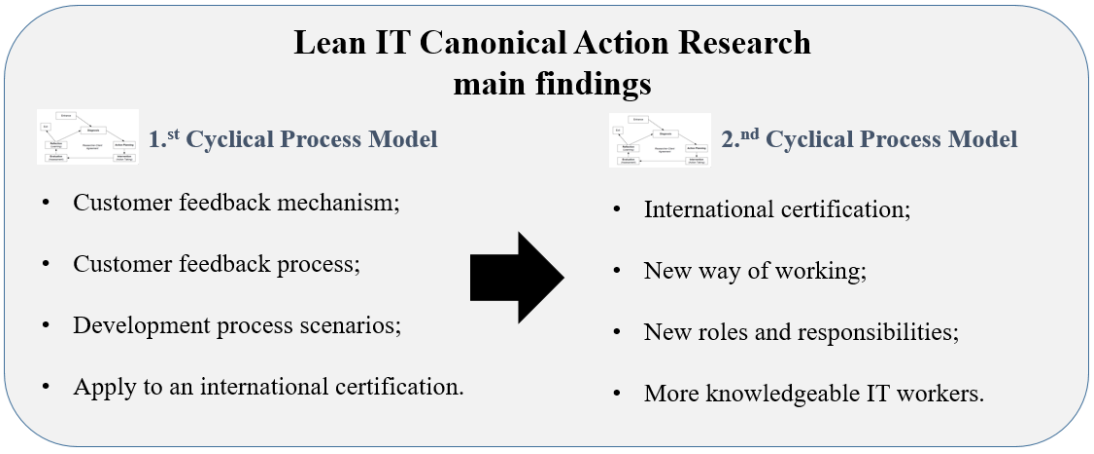

Figure 4.9. *Lean IT Canonical Action Research main findings of both Cyclical Process Models*

The 'voice of the employee' Lean tool, complemented by the strategy inspired on Delphi method, identified the top three wastes: waiting time, inventory and rework and defects, acknowledged by the AHP decision model. Combining the root cause analysis through the 5 Whys technique, plus Ishikawa diagram and semi-structured interviews, the main root cause was identified: IT services' lack of customer feedback. This cause analysis highlighted an important insight related to the existing cleavage between IT and their internal customer. From the literature review, an action was planned, and then the intervention to test a customer feedback mechanism was taken. Through this action, important feedback was collected, which provided a deeper understanding about the IT services time to market organisation problem. Therefore, a new development process was suggested by the IT managers and the second CPM was planned.

Over this first CPM, the organisation was willing to understand their internal issue about the existing cleavage between IT and business and, being aware of it, was able to take decisions and manage them in the best possible way. Despite the good results achieved, a main insight was pointed out: the identified cleavage between IT and their internal customer was anchored in the organisational culture (OC). The OC played a critical role over the CPM, and was the most critical success factor in this first Action Research cycle.

Hence, in spite of the bottom-up approach, and the efforts of the team members, who were highly motivated in inducting this IT transformation, Lean IT ended in the short-term, meaning that Lean end when the project finished. Thus, with a new board of directors, in the known context, the solution was to perform a restructuring process to mix IT and business teams to mitigate the cleavage.

Theoretically based model assessment

Starting from the research question, the referred hypothesis demonstrated that Lean was effective over this CAR method. During the research process, the theory provide the right principles, tools and models to address the practical challenges. Using Lean I was able to guide the investigation combining practice to theory. The Lean principles centred the importance of the customer and the joint effort between the organisational teams through the value chain. Raised the relevance of delivering that is considered value to the customer and support the research to identify critical insights.

Moreover, the Lean Transformation Model (LTM) was useful because it intends to respond to an organisational problem. Indeed, since the beginning of the journey this model focus had been to understand the organisation problem and to define solutions to solve it. The LTM states that the management and leadership system to sustain the transformation is in the middle of the house. It was concluded over this CPM that the IT transformation process and even the achieved certification encountered several challenges from the organisational culture. One of the LTM question is *what leadership behaviour and management system are required?* From the research point of view, this question should be answered before the IT transformation process started.

Furthermore, over the second CPM, the investigation was able to understand the LTM systems thinking, which was inspired in the 'Toyota house' (see chapter 2). Thus, when reflecting on the results, despite the knowledge and learnings obtained, another conclusion was reached: this Lean IT journey followed a *tool thinking* rather than a holistic thinking. Tools were helpful in supporting the transformation process but did not allow making the transformation required. As stated by the customer in the first action CPM, IT had internal inefficiencies that had to be addressed through tools, but the cleavage anchor on the organisational culture was a powerful insight towards a required systemic and holistic thinking.

From my researcher's perspective, I learned the following from this Lean IT CAR:

1. Over the research it was relevant to have a diary and a research database as the data and information gathered were significant, and thus helped to structure and document the research;
2. The Lean IT master dissertation, the Lean IT article, as well as the master dissertation on the certification project were valuable contributions to acquire the right theoretical background, which was applied over this first Action Research cycle;
3. Furthermore, the supervisor chats were important as well as the conversations with other knowledgeable professors from the FCT | NOVA Department of Mechanical and Industrial Engineering. In fact, it was relevant

to network with Ph.D students from the UNIDEMI and the Universidade Nova de Lisboa Doctoral School, who based on their own investigation projects, were able to give valuable contributions over this first AR cycle.

Thereupon, from the researcher perspective, the achievement of these positive results was also obtained due to this strategy of connecting the knots of community, organisation practitioners and academia.

Theories and models transferability and applicability

The IT services industry has several IT standards, such as ITIL to support its operations. Nevertheless, these standards are mainly descriptive, thus, Lean can support IT standards in their implementation. Indeed, during the second cycle (certification process) it was possible to successfully combine ITIL with Lean.

This investigation demonstrated that Lean principles, tools and LTM can be applied to IT services. Due to the need of rending the organisation anonymous, it was not possible to detail the interventions. However, the information provided can be valuable to support identical cases because, as referred, the identified problem and further internal constraints did not occur exclusively in this organisation, were confirmed by practitioners'-peers, and are subject in international Lean summits. Therefore, it is possible to generalise it to similar contexts, taking into account the learnings and the theory assessment pointed out.

Hence, a conclusion is taken from this investigation: if all the CAR principles are addressed over the research, as well as all the mentioned principles criteria, it is possible to apply CAR to Lean/Lean IT journeys, following the recommendation of cited authors about measuring before and after results for comparison reasons and to study the impact.

Contribute to Lean and Lean models

As highlighted in the diagnosis step, several scientific domains were consulted, but this first Action Research cycle mainly contributed to Lean and Lean IT body of knowledge, in the Engineering and Operations Management domain. In fact, the contribution was materialised in three scientific documents, with two master dissertations and one scientific article in such domains.

4.3 Summary

The chapter described the first Action Research cycle of the thesis, explaining how the Lean IT journey was conducted through the Canonical Action Research (CAR) method. The cyclical process model (CPM) was detailed, as well as the principles of theory and change through action. At the end of this first cycle, the researcher and the organisation agreed that a second CPM should be performed in order to respond to the first cycle assessment. Based on the fifth principle of learning through reflection, it was also described in this chapter the application of the CAR method, reflecting upon the theory that was applied and its transferability into similar contexts, as well as the contribution to the research domain.

Chapter 5 Lean in financial services provider

This chapter presents the second Action Research cycle in the chosen organisation. After the reflection and analysis of the first cycle, it was realised that the *tool thinking* provided positive results but not Lean sustainability. As the main focus was just on tools, processes and procedures (technical dimension), it was observed that the results achieved were short-term and that Lean adoption ended when the implementation project finished. Therefore, a new way was proposed to address the organisation Financial Shared Services department problem, with the aim of maintaining Lean to support operational performance over time. This different path resulted in an innovative approach coined as Lean Service System Approach, which is now presented. The study was developed within the IT internal customer department of the previous Lean IT journey in the mentioned Portuguese organisation, which delivers to their customers financial services supported in IT solutions (which are provided by the IT department).

5.1 CAR cyclical process model – Lean FS journey

Starting this new cycle in the same Portuguese organisation, but in a different department, the first step was to do a reflection regarding the first AR cycle. As referred in section 4.2 the first cycle provided important learnings under the organisational, research and theory perspectives. Summarising these perspectives, it was relevant to gain knowledge in (1) how to adopt the AR methodology, particularly the Canonical Action Research method, (2) acquiring research experience in the methodology and gaining competences in applying science to action. Additionally, (3) it was an opportunity to network with other Lean practitioners, work with master students, learn with professors and Ph.D students, plus (4) gather learnings from the Lean IT journey.

Concerning the organisational goals, all were achieved and were important to the organisation. After the accomplishment of the IT transformation process, it was decided by a new board of directors to do an IT organisation restructure, with the purpose of moving IT roles into the internal business functions. Thereupon, the IT team members (the ones who were involved in the first AR cycle) became part of the mentioned internal customer. This change helped to consolidate the path started with the IT transformation process, meaning mitigating the cleavage between IT and the customer. There were several benefits derived from such reorganisation, namely the fact that the main cause for previously wastes was addressed and therefore the organisation could then focus on delivery based on customer value. Nevertheless, the IT internal Lean way of working, when merged with the business teams was not adopted. Although the internal customer participated in IT presentations and combined actions over the IT transformation (during the first AR cycle), the Lean mindset was not correctly transmitted. Additionally, business does not have a focus on technological particularities, so such a situation was understandable. Thus, IT workers encountered the former way of working (before the IT transformation), as well as some of the identified issues that the IT had already overcome with the new development process.

Despite the goals achieved in the new development process and in reaching the certification, the message transmitted over the first AR cycle was Lean as a compilation of tools. This diffuse message was indeed related with the *tool thinking* adopted during the Lean IT journey. In fact, from Lean studies I realised that it is normal to make this mistake when implementing Lean. The majority of studies have a focus on the adoption of a set of Lean tools. This also happened to me and to the team. Hence, this was a collective learning. Our inexperience in Lean implementation plus our expertise in IT took us to the vertigo of adopting Lean tools to achieve quick-wins. Thus, all the team members

had to go through this *tool thinking* experience to realise what was really achieved. Indeed, after the project finished and with the 'come back to the former way of working' was brought to light that the real change was not in adopting tools but in the new mindset of pursuing perfection, by doing the right things at the right time.

Hence, the organisation evolved in new competencies and tools, reaching an international recognition and above all, IT workers had a new mindset. Notwithstanding, this was not empowered by the organisation. As referred, the *tool thinking* adopted in the first AR cycle was helpful (allowed to achieve the defined goals), but concerning the organisation it did not produce the required impacts.

As a researcher, this provided me with a fundamental insight, which allowed me to deeply understand the 'Toyota People System' mindset and the concerns pointed out by Ohno (1988) regarding a *tools way of thinking* versus a systemic one. Indeed, the centre of excellence certification had positioned IT in an internal relevant position, which the organisation was not even prepared to manage and to incorporate due to its culture, context, leadership and management system. In fact, this important achievement, which was a lever for IT workers motivation and IT department in general, also created a kind of IT "peninsula" or even an IT "island" within the organisation, which was not at all intended.

As mentioned by Womack and Jones (2003) a deep organisational transformation must be initiated with a starting activity, process, team or department, however, the adherence to this transformation must be done by the whole company, otherwise the change will not be adopted, and can be even disruptive with the current status quo.

Womack and Jones (2003) proposed a Lean leap (presented in chapter 2) which starts with a five-year roadmap with four phases, and when accomplished, a second and final leap towards a Lean enterprise. Authors argued that Lean produces its full potential when the whole organisation adopts the Lean thinking. Therefore, organisations should start their journeys with the first leap, following a step-by-step approach.

Based on the learnings of the first Action Research cycle, and supported by Lean body of knowledge, a new AR cycle (with a new scope and team) was started in the Financial Shared Services department.

CAR cyclical process model – Step 1 – Diagnosis

After the AR reflection step, this second cycle started to be planned in the first semester of 2019. Therefore, the Lean models were studied again and Lean studies were reviewed. Although the Lean Transformation Model (from the first AR cycle) was an important support model over the Lean IT journey, due to the intention of having Lean in the whole organisation, in this second AR cycle, I decided to apply another Lean model, the Womack and Jones (2003) Lean leap.

As previously referred, the first Lean leap is a five-year roadmap, with four phases, where organisations should start to incorporate the Lean thinking into their organisation in order to sustain Lean and then, to improve their operations performance. This is an evolutionary leap, where each phase must be consolidated before starting the next one. Through the phases shown in Womack and Jones (2003, p. 270), and as this investigation accounted for a two-year journey, wherein Lean leap phases one (get started) and two (create a new organisation) were accomplished and are now described.

Additionally to the Lean leap model, and from the learnings of the first AR cycle, I did a deeper literature review about the Lean Service critical success factors. As referred in sub-section 2.4.2, culture, management and leadership

were always present in the several studies. Moreover, from the review regarding Lean sustainability, the Lean Iceberg Model from Hines et al. (2008) provide relevant information concerning the enablers of a Lean journey, particularly the culture aspects: strategy and alignment, leadership and behaviour plus engagement. Furthermore, Bittencourt et al. (2021) literature review about industry 4.0 and Lean thinking raised the fact that management, processes and people were the most cited words by the analysed papers, reinforcing the role of these key players in the companies' transformation. Hence, as this second AR cycle was performed in the same organisation of the first cycle, these identified factors were all relevant to take into consideration.

In the research, from the several critical success factors identified in the LS literature, eleven were chosen to cover the four perspectives alluded above with the following CSF listed in Lins et al. (2019):

- **Perspective 1** - **Organisation**: *top management support, organisation culture and leadership involvement*;
- **Perspective 2** - **People**: *employee empowerment, employee involvement and knowledge management*;
- **Perspective 3** - **Process**: *performance management, simplify process and continuous improvement*;
- **Perspective 4** - **Customer**: *customer involvement and customer engagement*.

The selection of these eleven CSF was due to the following reasons:

Perspective 1 - I stated that understanding and transforming organisation culture is key to success, which requires top management support and leadership involvement. Management needs to influence the organisation's way of doing business and its people, by starting to change how people work and consequently, how people think (Gupta et al. 2016).

Perspective 2 - Toyota's strategy of developing people is making people before making products, and since TPS also means Thinking People System, its employees discover how to perform their work and procedures through experience by iterative questioning and solving problems, instead of learning it from someone (Alves et al. 2012). Thus, it requires peoples' empowerment and involvement, and joint initiatives supported by knowledge management to help workers' reflexion.

Perspective 3 - The researcher also focused on simplifying process, analysing and respecting people's work, proposing changes to working procedures based on performance management. Improving performance, communicating and sharing key performance indicators helped to achieve a new mindset through programs of changing and learning by doing, following a continuous improvement strategy. I resorted to Lean technical dimension to demonstrate with quantitative measures the impact of the adopted procedures, and the feedback from workers (captured as in qualitative data) helped to consolidate the new mindset.

Perspective 4 - In tertiary sector, as customers are co-creators, I argue that customers' experience allied with their engagement and involvement are important.

In a nutshell, applying Lean leap with the four perspectives, aimed at creating a transparent and learning environment to escalate Lean as part of the organisational culture and consequently to sustain it, in order to support organisational development and competitiveness.

CAR cyclical process model – Step 2 – Action Planning

To sustain Lean, Henrique et al. (2020) pointed out the relevance to have a template with a step-by-step to be followed within each of the phases of the method before starting the implementation. Hence, in this **plan** phase of the second

AR cycle, following a systemic approach with the purpose of sustaining Lean in the organisation, the research coined Lean Service System Approach (LSSA) described as followed and graphically depicted in figure 5.1:

- Combines a standard roadmap, the Lean leap, with a list of Lean Service critical success factors (CSF) comprising the organisational, people, process and customer perspectives;
- This combination is performed cyclically through improvement cycles following the PDCA method.

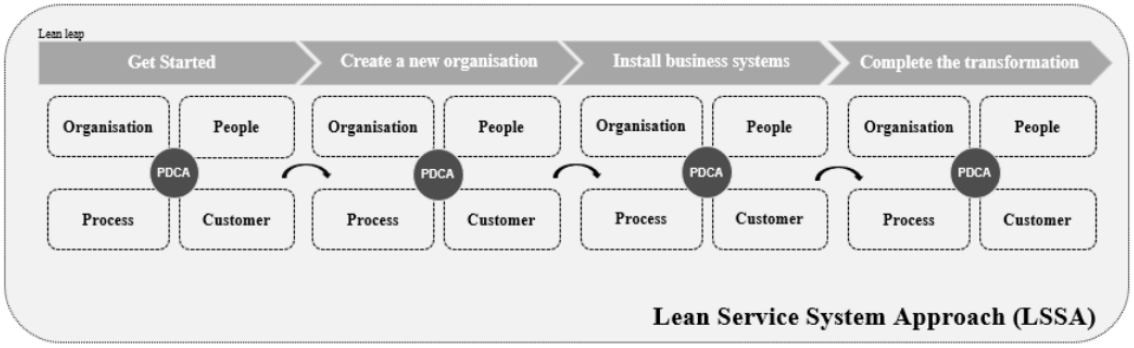

Figure 5.1. *Lean Service System Approach (LSSA)*

Lean Service System Approach (LSSA)

The novelty of the LSSA is the combination of the Lean leap phases with the four perspectives of organisation, people, process and customer within a PDCA cycle to pursue Lean sustainability for operation performance.

To start with, as LSSA follows the four main phases of the standard roadmap Lean leap, it is important to obtain knowledge of these mentioned Lean phases and then, to understand the need to perform the final leap. Therefore, it is recommended to do the *Lean Thinking* (Womack and Jones 2004) book reading and training. This book explains in detail the phases, the actions required in each one, and provides real and practical examples to accomplish them.

Regarding the aforementioned timing of each phase:

1. Get started - the first six months;
2. Create a new organisation - from six months through year two;
3. Install business systems - years three and four;
4. Complete the transformation - by the end of year five.

From my perspective, these timings are indicative and should be adjusted to the organisational context, as each organisation is unique and has its own organisation culture and people. Thus, I state that it is more important to sustain and consolidate Lean in each phase, rather than focus on accomplishing the timing phases.

Therefore, to implement the LSSA, three steps must be performed:

1. Obtain a deep knowledge of the organisational context through the four LSSA perspectives: organisation, people, process and customer - to support this action, a list of suggested questions are presented according to each perspective;

2. Identify the organisation critical success factors (CSF) - after obtaining the relevant organisational context information, work closely with the organisation to identify their CSF (for each perspective) and then, define strategies to mitigate the CSF;
3. Over the Lean journey, continuously verify if the CSF of the four perspectives are addressed.

Therefore, it is important to obtain a deep knowledge of the organisational context, stakeholders and market, as well as its culture and people. Hence, to gather all the relevant external and internal organisational information and based on the method used by Davinson et al. (2004) to describe the criteria of the Canonical Action Research method, several questions addressing each of the four LSSA perspectives are now presented in order to obtain the required organisation information. The purpose is to gather the organisation crucial information at the beginning of the journey and then, to identify in each perspective its critical success factors. Thus, these suggested questions are not exhaustive, but indicative, and can be complemented with other related questions.

Perspective 1 - Organisation

Under this first perspective, it is important to obtain the organisation relevant information, thus, it is suggested to answer the following questions:

a) What is the organisation core-business?

b) What is the organisation sector? What are its market characteristics? What is its market position/share?

c) How is the organisation business structured? And its organisational culture? Describe it (suggestion: use the Insights Discovery model).

d) Who are the organisation shareholders? Describe each one.

e) Is the Lean project sponsored by the board? Are the internal key decision players involved in the Lean journey?

f) Is it a top-down or a bottom-up implementation? Or both (top-down plus bottom-up)?

After answering these questions, it is important to identify the organisation critical success factors (CSF). As mentioned, this exercise should be performed with the organisation. Therefore, it is proposed to use the Lins' et al. (2019) Lean Service CSF list.

For the CSF selected by the organisation, it is important to define strategies to mitigate each one in the *plan* step of the PDCA cycle. During the improvement cycle these selected organisation CSF must be addressed with concrete actions, which will be materialised and measured over the *do* step. The results must be verified over the *check* step. Finally, and if needed, new or redefined actions should be decided under the *act* step.

Perspective 2 - People

Supported by the previous organisation information, it is now important to answer the following suggested questions to deeply understand the internal context and the organisational culture:

a) How many employees has the organisation?

b) Are the individual profiles identified? Insights Discovery model (https://www.insights.com/) can be used.

c) Does the organisation have a Lean team or a Lean function?

d) Is there a Knowledge Management process in place?

e) Are the team roles identified? Belbin (www.belbin.com) can be used to describe team roles.

f) Are the resources available for a Lean transformation?

g) Are mechanisms in place to obtain employee feedback?

h) Are people able to contribute with suggestions? What is the process?

i) Are people used to working in multifunction teams?

j) Is there a training program and plan?

k) What is the relation between the shop-floor employees and their team leaders, managers and board?

After obtaining this information, and from Lins' et al. (2019) Lean Service list, it is important to analyse and identify with the organisation the CSF which are most suitable to its people's context. As from the organisation perspective, strategies, actions and measures must be defined to accomplish the challenges of the selected people CSF during the improvement cycles.

Perspective 3 - Process

From the process perspective, it is important to answer the following suggested questions:

a) What is the major process that needs to be improved? An AHP / TOPSIS model can support this choice.

b) What kind of data approach should be followed? Qualitative, quantitative or both?

c) Are the relevant data sources available? Are all the data tools needed available?

d) Can the Lean team performed a *gemba* walk?

Having the organisation and people information and involving the organisation team members, after answering these process questions, the CSF must be identified. Lins' et al. (2019) LS CSF can support in identifying the relevant CSF.

From this process perspective, to address the selected CSF and for a comparison reason, over the PDCA cycles it is advisable to measure the actions with a 'before' and 'after' result.

Perspective 4 - Customer

Finally, in customer perspective, the suggested questions to be answered are:

a) Who are the customers and the end users? Describe them.

b) Who are the internal customers? Describe them.

c) Are mechanisms in place to obtain customer feedback? When and how is the voice of the customer obtained?

With all the internal and external information, the customer CSF must be identified with the organisation team members and then, the improvement cycle can start the Lean transformation by addressing the customer CSF over the journey.

Deploying the LSSA in the Lean journey

To deploy the LSSA and based on the AR methodology was followed a 'before' and 'after' result, with a mix of qualitative and quantitative data. To strengthen the research validity and the reliability of the results, several data sources were consulted and data was analysed from the four perspectives.

Under the organisational perspective, the purpose was to understand the department context as well as its culture, and to capture stakeholders' feedback. As in the first AR cycle, investigation also analysed stakeholders' annual report survey, meaning information collected from investors, suppliers, partners, employees and customers. Institutional information was collected and meetings were held with management to understand internal organisation, culture, issues, motivations and expectations. As stated before, it was important to have a people-centric approach to capture culture during the journey.

In order to do so, based on the dissertation project of a FCT | NOVA student, a literature review was done regarding the knowledge management (KM) domain (one of the CSF chosen). The purpose was to combine Lean with KM to support the journey; thus, in combination with the voice of the employee Lean tool (already used in the first AR cycle), KM techniques were applied, such as storytelling, peer assistance and knowledge café (further explained).

Thereby, under organisation perspective, was combined the technique of storytelling with the root cause analysis plus the five whys to understand the organisation and department context and its culture, listening to management and employees' issues, perspectives, motivations and expectations. This initiative brought insights to highlight needs, pain points and problems. To consolidate this qualitative information, as mentioned several data sources were consulted as stakeholders' annual survey, institutional information as well other organisation/department data.

Regarding people, as the studied department had business and IT employees (the IT workers from the first AR cycle) the focus of this study was on having the workers (also nominated as operators) deliver financial services directly to customers. Therefore, the team members of the first AR cycle were not involved in this second cycle. Hence, the sample was 59 'business' workers and from these, an additional focus group was studied with 19 of the 21 operators responsible to deliver the service activity chosen by the study.

From the group dynamics theory learnings (first cycle) it was decided to adopt the same strategy of the focus group. Thereby, over this second AR cycle, several initiatives were conducted as (1) focus-group sessions; (2) on-job training; (3) direct observations; (4) surveys and (5) semi-structured interviews. Different data sources were used and merged, such as: skills and knowledge matrix, observation reports, meeting minutes, as well as the combination with knowledge management initiatives, such as Belbin team roles and Insights Discovery model (aforementioned).

Under the process perspective and as pointed out by Womack and Jones (2003) to conduct a lean transformation it is important to: (1) start as soon as possible, (2) choose a specific activity, and (3) to involve all: the direct work group, managers and senior managers, as well the change agent and its sensei (if applicable). This means to choose one important activity with low performance and high potential for improvement. Two decision models were applied to choose one activity from the department service catalogue. The selection was made in two steps as follows:

1. Table 5.1 below illustrates the application of the same decision model, the Analytic Hierarchy Process (AHP) to each service activity with three management criteria: internal knowledge, demand orders' volume and number of internal experts (expertise).

Table 5.1. *Three management criteria (Lota et al. 2019)*

Criteria	Indicator	KPI	Observation
Internal knowledge	Percentage of workers who have the minimum knowledge to perform the process.	$100 \times \sum_{x=A}^{x=AX} x \times \begin{cases} 1 \; if \; the \; worker \; "x" \; executes \\ 0 \; if \; the \; worker \; \text{x} \; does \; not \; executes \end{cases} / \sum_{x=A}^{x=AX} x$ The variable x represents all collaborators, from collaborator "A" to collaborator "AX".	The smaller the number of employees who know how to execute a process, the more critical it is for the organisation.
Demand orders' volume	Percentage of annual orders.	$\frac{100 \times Number \; of \; annual \; orders}{Total \; number \; of \; annual \; orders}$	The greater the volume of requests for a process, the more critical it is for the organisation.
Number of internal experts	Number of process specialists.	Number of process specialists.	A process that has no specialist is much more susceptible to problems that arise in the process.

The pairwise comparisons were made by the department managers (in table 5.2), comparing the pairs of criteria, quantifying through the Saaty scale from 1 (equally important) to 9 (extremely important).

Table 5.2. *Pairwise criteria (Lota et al. 2019)*

Pairwise comparisons	***Most important criteria***	***Importance points***
Demand orders volume *versus Expertise*	*Demand orders volume*	5 points
Demand orders volume *versus* internal knowledge	*Demand orders volume*	4 points
Internal knowledge *versus Expertise*	*Internal knowledge*	2 points

Afterwards the AHP method was applied following the same steps described in section 4.1 (meaning: building an importance matrix, then normalised, and at the end, calculating the principal *Eigen value).* The result corresponds to the following percentages, which were assigned to each of the three criteria:

- Demand orders' volume – 68 %;
- Internal knowledge – 20 %;
- Expertise – 12 %.

Finally, to verify the consistency of the scores attributed with the comparison of the amounts between pairs of criteria, the Consistency Index was calculated. Hence, it was concluded that the scores attributed by the managers were consistent.

2. Then, was add the decision model: Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) to select the service activity. According to (Olson 2004), TOPSIS minimizes the distance to the ideal alternative while maximizing the distance to the nadir (Olson 2004). So, a relative advantage of TOPSIS is the ability to identify the best alternative quickly (Espadinha-Cruz 2012).

Hence, after the AHP method, and in order to select the activity, the TOPSIS decision model was applied based on *m* alternatives and n criteria. This model prioritizes the alternatives, which in this case are the service catalogue (m = 60 processes), selecting those that have the smallest distance from the positive ideal solution and the greatest distance from the negative ideal solution (Chen et al. 2016). The method was applied and is explained in the mentioned master dissertation (not cited due to confidentiality reasons). Thus, it was concluded that from the department service catalogue, the one that presented a relative approximation value closer to 1, was the invoice verification with 0.937.

Based on the results, the invoice verification service was chosen, which belongs to the order to pay business process. It handles an average of eighty thousand per year in continuous production. The invoices originate from customer demand orders, which include accounts payable documents the customer gets from its suppliers. The service expected outcome is having invoices correctly posted in the department ERP system. The four steps of its invoice verification activity are:

1. Analysis – understanding the request implicit in customer order upon receiving;
2. Verification - confirming the data sent by the customer (if all the required information to post the invoice was provided);
3. Posting – registering the invoice in the ERP solution;
4. Response - answering and closing customer demand order (informing the invoice IT document number).

Due to the demand order variability, for activity input was chosen to measure arriving invoices instead of demand orders as customers can send more than one invoice per demand order. Thus, two variables were selected to be evaluated: (1) invoice verification execution time and (2) activity quality, both measured in three different moments:

- 1.st measurement – 19 workers, 20 invoices, 380 observations (19x20);
- 2.nd measurement – 3 workers, 10 invoices, 30 observations (3x10);
- 3.rd measurement – 9 workers, 11 invoices, 99 observations (9x11).

A research protocol was created and according to which, invoice execution time was studied in *Statistica* software through several tests and sample sizes were confirmed by G-Power program. To measure execution times, the following initial and final operations cuts (when each activity starts and ends) were defined (table 5.3).

Table 5.3. *Steps operations cuts (Lota et al. 2019)*

Steps	Initial	Final
Analysis	The worker opens the order.	The worker makes the first click on the ERP solution.
Verification	The worker makes the first click on the ERP solution.	The worker access to the posting transaction.
Posting	The worker access to the posting transaction.	The worker clicks on the responses box of the Financial Service (FS) solution.
Response	The worker clicks on the responses box of the FS solution.	The worker completes the order.

To measure process quality, invoices were scrutinised with a conformity index (CI) defined by management, comprising the following three criteria:

1. Accounting: verifying if the invoice was correctly posted;
2. Reversing: whether invoice was reversed due to the operator;
3. Demand order number: checking if the demand order number was entered in a specific IT field when posting the invoice.

As these three criteria had different value to the customer, a final AHP (described in the mentioned master dissertation) was applied with the managers to make a comparison pairwise among criteria, which resulted in the following percentages:

- Accounting – 76 %;
- Reversing – 15 %;
- Demand order number – 9 %.

Based on these percentages, the Conformity Index result in the following equation:

$$CI = 0.15 \times \frac{N.º\ invoices\ not\ reversed}{sample\ size} + 0.76 \times \frac{N.º\ invoices\ correctly\ posted}{sample\ size} + 0.09 \times \frac{N.º\ invoices\ with\ demand\ order\ n.º}{sample\ size}$$

This equation was applied to the 509 invoices evaluated during the three mentioned measurements batches.

Finally, under the customer perspective, the two types of customers considered by Lean were studied:

1. End-customer (who consumes the service) – the sample was: (1) the top-ten end customers in volume and complexity and (2) the top-ten customers registering iterations to service completion due to customers' lack of information;
2. Next-in-line customer (internal customer) – the sample was nine employees, whose work depends on invoice verification activity.

After planning the intervention, the next step of this second AR cycle was to perform the intervention through the Lean Service System Approach. Following the Lean leap first phase, *get started*, a Lean team (LT) with three members was created to conduct the journey, playing the role of internal change agent.

This Lean implementation had no external consultants, so, this internal team was created: a master student, myself and one worker from the department. The constitution of this team, with high internal organisational involvement, wanted to answer the literature-identified issue that lean projects done by externals, usually finished when the external project ends (Womack and Jones 2013).

Due to its members' different background and experience, I gave training to the other two elements about business concepts, organisation main value chains, Lean mindset and tools, followed by a pilot to verify if the training has been effective. Following *getting Lean knowledge*, the team initiated a deep organisation analysis, studying internal and external data sources and stakeholders' information to understand the pain points.

After meetings held within the department managers, the root-cause of its main problem was found to be related to high employee turnover. This situation caused several issues such as: (1) lack of standard procedures, (2) different

solutions to the same customer problem, and (3) incorrect responses to customers' inquiries. It was also verified (4) focus on activities rather than business value streams, (5) working in silos, (6) overburden of the few internal experts, responding reactively to unpredicted demand from colleagues, (7) critical information being shared by electronic mail in an unstructured way, with the inherent difficulties in searching and obtaining data. Moreover, the lack of internal shared knowledge promoted a 'closed' culture with no sharing, no growth and no innovation, with out-of-date and low quality documentation, and with no time to update it due to the intense 'fire-fighting'.

Due to the problem of sharing knowledge and closed culture, as referred a literature review was performed in Knowledge Management (KM) domain, with the support of the master student from FCT | UNL. Over the research, the KM Wiig definition was followed (Wiig 2000, p.12): *"Knowledge Management is the systematic, explicit, and deliberate building, renewal, and application of knowledge to maximize an enterprise knowledge-related effectiveness and returns from its knowledge and intellectual capital assets."*

Moreover, Lean and Knowledge Management synergies were identified (table 5.4) and demonstrated in the Lota et al. (2019) conference paper.

Table 5.4. Synergies between Lean and KM (Lota et al. 2019)

	Lean	***Knowledge Management***
Goal	Make the company more competitive (Womack et al. 1990).	Make the company more competitive (O'Dell and Grayson 1998).
Relation with products/services	Intends to improve products and services quality, by identifying waste (Womack and Jones 2003).	One strategy includes knowledge incorporation in products and services to create value (Skyrme 2001).
Relation with processes	Seeks to simplify, standardise and rationalise processes (Womack et al. 1990).	Encourages identification and sharing of best practices (Skyrme 2011).
Best practices (identification)	Gemba walk, where work takes place (Womack et al. 1990).	Internal and external benchmarking (O'Dell and Grayson 1998).

Thereupon, during this Action Research cycle, several aforementioned KM tools were combined with Lean. Such as (1) storytelling, tacit knowledge shared through a story, (2) communities of practice, groups of people with a common interest, with the purpose of sharing and learning within the group, and (3) mentoring and peer assistance, an expert person who shares insights and knowledge regarding a specific topic (Lota et al. 2019).

Hence, these were the challenges to be addressed by the Lean team in combination with workers and managers supported by LSSA and AR. Being a financial service provider, the organisation is highly dependent on people and on their knowledge, so it was facing a business risk.

CAR cyclical process model – Step 3 & 4 – Action Taking and Evaluation

After the action planning, following LSSA, in combination with Lean leap first phase *get started*, the first PDCA improvement cycle was initiated, addressing the identified critical success factors. Meetings were held with internal customers, aiming to map the value streams, particularly the order-to-pay process.

1.st PDCA - Plan

To deeply understand the issues previously identified, the team asked one manager and two workers to describe the process and show how to post one invoice in the ERP system, while observing and confirming the available documentation.

This simple exercise provided two insights:

1. What people say they do is not exactly what they really do;
2. Although the activity and its steps were standardised, procedures and practices were not; thus, it was observed that the same type of invoice was posted in three different ways, with divergent supporting documents.

Based on these insights, to map the value streams the LT realised the need to perform a broader study at the *gemba*, together with operators responsible for posting invoices. Pursing department problem of a closed culture and the inherent impact on customers' quality of service, the going to *gemba* followed Fuiji Cho's words, *"go and see, ask why, show respect"*, using the questions described by Spear and Bowen (1999) presented in section 2.3.

The purpose was to design a value stream mapping, by verifying how workers were performing the business process, particularly the invoice verification activity. For this purpose, we surveyed the four steps described above through direct observation capturing procedures, practices, information flows and documentation used. As mentioned, a research protocol was defined: (1) how to approach workers, (2) which resource materials to use: a mobile chronometer to record time and an observation list with the rules to register this data in a spreadsheet, and (3) how to evaluate the activity output using the conformity index.

Through the lens of people's perspective, the research protocol defined how to approach the individual worker. From the simple instruction of addressing each person by his/her first name (the Lean team was amazed with the number of people that did not know their co-worker's name) to a more complex strategy by crossing information from core competencies, soft skills and profile information (obtained in previous KM surveys).

Furthermore, and with a customer focus, during this planning phase, the management analysed two years of demand orders and identified two top-ten customers categories according to the criteria described in the action planning step.

1.st PDCA - Do

This phase initiated with management conducting meetings with both top-ten customers. In meetings with top-ten customers in 'volume and complexity' category, the invoice verification activity was explained in detail, particularly their overly customised service specifications. In meetings with the top-ten customers in the 'number of iterations' category, the recurring incompleteness information in their demand orders and its impact on the service were demonstrated with real cases. Customers' managers seemed generally uncomfortable for causing such situations and vouched to improve their own internal process and avoid incomplete service orders.

Regarding the internal customers (the next-in-line customers), meetings were also held where they explained the impacts of incorrectly posted invoices in business service quality.

Additionally, *gemba* observations started as a means to: (1) measure invoice execution time, (2) measure activity quality and (3) capture operators' working procedures. Hence, the LT began individual conversations by sitting next to workers at their workstation, their 'comfort zone'. Starting by explaining the initiative and its purpose, and supported by the storytelling KM technique, operators were asked to tell their story regarding the service activity. As in the first cycle, the LT gathered the voice of the employee (VOE), as well as a deeper understanding of department culture. These insights were crucial to guide the journey.

Following research protocol, each operator was asked to post 20 invoices while the Lean team member was recording the time of the four steps (analysis, verification, posting and response) and consequently, registering the total execution

time. As workers knew they were being measured with a timer, their full attention was focused on performing the activity, posting the invoice and then responding to the demand order, avoiding separate conversations, while the LT member was recording time and observing the worker's procedures and practices. With a sample of 20 invoices, at the end of the observations it was possible to highlight and reach conclusions regarding each operator's procedures. Workers' suggestions for improvements were also collected, and several inefficiencies were immediately identified during the observations:

- When answering and closing each demand order with the invoice ERP document number (in the response step), some workers were manually writing the same information in each demand order ('*the document was posting with the number xxx'*) and sometimes with spelling mistakes. When asked why they were doing it, they said there was no template and they liked to write. However, it was also observed that other colleagues had their own responses templates and were copy-pasting those instead of writing. When asked why, they said the purpose was to speed their response time and to avoid mistakes;
- A lack of rules among operators while posting invoices in the software system, particularly when filling some required fields, which would probably cause duplicating invoices and further reverses;
- Processing time delays were pointed out by operators as caused by the ERP system as well as some non user-friendly ERP required actions;
- Rework caused by missing or incorrect information in the demand orders;
- No standardisation in support documentation for postings – the document named fleet was out of date and there was not a single template with invoice accounting rules. Meaning that each operator had their own document, causing disparate procedures among them;
- Talent waste referred to by the operators - their education skills versus registering invoices in a manual way.

1.st PDCA - Check

Results from the *do* phase were analysed and the spreadsheet data with 380 invoices execution times (by each invoice step) were introduced in *Statistica* software. The conclusions were the following (Lota et al. 2019):

- The average execution time of all operators (of the four steps) posting a single invoice was 5 minutes.
- As execution times seemed to vary significantly from operator to operator, ANOVA was run and it proved that execution times did depend on the operators.
- Based on ANOVA data, the effect was calculated by using eta-squared (Cohen 1988) and it was concluded that 55.1 % in the variability of the execution time was due to workers' effect, which is considered a large effect.
- A Fisher least significant difference (LSD) test was done, to compare workers performance within a ranking, and results were crosschecked with observations reports. Top performers were the ones identified in the *gemba* as having good practices, particularly the ones when closing and answering the demand order informing the ERP invoice document number were using their own responses templates being on average 30 % faster compared to the ones that were writing the same information manually.

This result indicated that: if Lean could improve this operators' performance through their working procedures, invoice verification execution time would decrease and the overall department compliance with service level agreement would increase, as invoice verification represented 45 % of the total amount of demand orders volume.

Besides the execution time, Lean team had another important focus: activity quality. Thereby, each single invoice was scrutinised based on the conformity index and the average of the 19 concerned operators was 94.7 % of conformity. Even with this good result, improvements were identified, particularly the issue of having the same type of invoice with different postings.

Indeed, execution time and quality results gave objective information to improve customer service.

Under the customer perspective, the following actions were taken:

- Top-ten customers in volume and complexity - 3 customers took the responsibility of posting invoices, which was a positive achievement as their overall demand orders decreased (only complex situations were sent to the department);
- Top ten customers in number of iterations - only 1 customer made improvements, so, this action was unsuccessful. As a lesson learned, the LT suggested to conduct a pilot, an on-site observation with one customer.

1.st PDCA - Act

In this last phase, was started *kaikaku* (meaning: fundamental and radical changes). First, Lean Team sent the suggestions from workers to the IT team and some of them were implemented and scrutinised during the second PDCA cycle. Based on statistical results and issues identified in the *gemba*, particularly the lack of standard support documentation and incorrect postings, the LT started an initiative with internal customers aiming at creating 4 standard documents to support invoice verification. These documents were referred to as standards: (1) generic accounting rules, (2) specific accounting rules, (3) standard-responses and (4) fleet information.

From the observations and due to department culture, the LT assumed it would be difficult to change old habits and introduce unified standards. So, department management made an important action in encouraging standards, explaining benefits, and defining a starting date for its adoption. Two weeks later this start date, workers were surveyed, with the aim of checking if (1) they were using standards and asking them (2) to evaluate each standard with a Likert-scale ranging from 0 (not useful) to 5 (totally useful). Results showed:

- 1 operator was not using the general accounting-rules document;
- 3 workers were not using the specific accounting-rules document;
- 8 operators were using all the standard documents;
- 11 workers were not using the standard-responses document;
- All (19 operators) were using the fleet document.

As a final score, the average assessment of the use of the four standards was 3.3, while standard-responses usage scored the lowest result with 1.7.

Based on these unsuccessful results, the LT reflected and took additional actions. First, they urged workers to get involved in improving the 4 standards with their own experience. Improvement proposals did come up and after a verification by experts (the next-in-line-customers) new versions of the standards were published. In parallel, a 5S

initiative (to: sort, set in order, shine, standardise and sustain) was executed with workers and managers to reorganise document repositories (network file shares). Workers were involved in writing user manuals, procedures, working instructions, as well as in the definition of its maintenance rules. Additionally, aiming to share good practices, knowledge sessions were done to eliminate identified wastes, increase the flow and improve value stream. Finally, operators helped to design a technical solution for advanced search to help customers and internal users to find support documentation.

After one month of such changes, the Lean team decided to make a second measurement, a pilot with 3 operators, randomly selected from the group of 8 workers who were now using all the standards, but were not using responses templates in first measurement. The purpose was to verify implemented practices impact on execution time and activity quality. Results showed:

- The execution time decreased 27 % on average, mostly due to the use of the standard-responses document;
- On average, the quality increased 6 %, meaning that, in similar initial conditions, these operators used the procedure indicated in the general accounting rules standard.

Hence, these results gave a good sign of the standards and practices implemented.

Additionally, and regarding activity quality, the LT learned with this initiative:

1. Quality check could not be done manually. Five working days were needed to verify Conformity Index (410 invoices = 380 + 30);
2. Operators should be able to evaluate their own performance quality in a simple way.

Therefore, the LT expanded the scope, and a project was designed to automate activity quality verification, combining Business Intelligence technology with Lean thinking.

The last initiative of this cycle was a pilot at one customer site. An initiative was taken with the purpose of observing customers posting invoices and understanding their issues with this service delivery and their interactions with the department. The LT conducted this observation directly with customer workers (not managers) and difficulties were pointed out, particularly with department user-manuals and working-instructions, as well as customers' lack of system and accounting knowledge. Thereby, the LT had the opportunity to present the general accounting rules standard, which was considered very useful. Important insights were gathered, giving LT a strong conviction of the importance of '*go see, ask why, show respect'* at customers location.

Fortunately, during the journey, organisation had the possibility to incorporate most of the subcontractors' workers as head-count, and hire them with long-term contracts, which brought more stability and motivation to the department, and attenuated the employee turnover and decrease 'fire-fighting'. Nevertheless, the impact of several years of 'destroying' internal knowledge and the installed 'closed' culture had to be overcame. Hence, from this first improvement cycle, several insights were gathered to prepare the second one.

2.nd PDCA - Plan

After one year, in the first semester of 2020, the second cycle started, with a lesson learned and deep analysis of the first cycle. Since the LT wanted to capture workers feedback regarding the journey and the Lean team's work evaluation, a semi-structured interview template with five questions was prepared:

1. How the worker felt during the Lean journey with a Likert-scale from 0 (not comfortable) to 10 (totally comfortable);
2. If the worker was available for a further observation (yes or no);
3. How the worker evaluated the Lean team's work with a Likert-scale 0 (not good) to 10 (excellent);
4. Worker quality self-evaluation with a Likert-scale 0 (not good) to 10 (excellent);
5. The importance of receiving quality feedback in a Likert-scale from 0 (not important) to 10 (very important).

Due to the pandemic situation, this cycle had to be adjusted to the context, so all the communications with operators were done using a corporate digital application. Semi-structured interviews were done to the same 19 operators, with the following results:

- 1.st question – workers scored the Lean journey with 8.0. They shared a positive feedback, recognising Lean benefits to their work: the way standards faced accounting doubts and brought a sense of an 'official' support when posting invoices; the benefits of using a standard-responses document avoiding misspelling errors with the benefit of customers receiving and reading the same response; the support they felt from experts (internal customers); and the sense of dealing with a 'secure environment' to share knowledge;
- 2.nd question – 17 workers confirmed they felt comfortable about being measured once again;
- 3.rd question – the LT work was scored with 9.3, where the main qualities mentioned were a clear explanation of the initiatives, the listening skill and the respect demonstrated for their work;
- 4.th and 5.th questions – the quality self-evaluation was scored with 7.8, and the importance of receiving quality feedback, 9.0.

2.nd PDCA - Do

Based on the previous information, the LT conducted a third observation, with 11 invoices and 9 workers randomly selected from the 17 (available for a further measurement) following the same research protocol.

Regarding customer perspective, from the insights gathered in customer on-site observation, a co-production action with the customer started, intending to improve invoice verification user-manual, where notes and information were shared.

2.nd PDCA - Check

The third measurement of invoice execution time was analysed in *Statistica* software:

- It confirmed that execution time followed a normal distribution;
- The average execution time (four steps) posting a single invoice, was down to 3 minutes.

Regarding activity quality, and for comparison reasons with the first measurement, the Conformity Index (CI) was applied not just to the 9 workers, but to all 19 operators with 20 invoices also randomly selected. CI was analysed with a Business Intelligence tool and within a few hours (another improvement), the average of 99.21 % of conformity was obtained.

2.nd PDCA - Act

Based on the results obtained in both criteria (time and quality), the LT decided to repeat the standards survey, with the following results:

- All the 19 operators confirmed they were using the 4 standards;
- The average usability score (using the same Likert-scale from 0 to 5) upped to 4.4 (compared to previous 3.3) and the standard-responses document scored 4.1 (against the prior 1.7).

During this second year, and in order to *create a new organisation* (Lean leap second phase) it was important to stablish the Lean function. With the eleven CSF accomplished, fortunately, there was no need to remove anchor-draggers and based on the efficiencies obtained, employees excess time was directed to different activities.

Last action started in the last quarter of 2020 (and still in progress), is concerning people and the *growth strategy*. With the purpose of **learning by doing**, a knowledge sharing program is conducted, involving all 59 workers responsible for providing financial services. Hence, mentoring and coaching programs, as well as on-job training and knowledge transfer sessions are being conducted by managers and workers. The internal customers have now the opportunity to explain the impact of incorrect postings and engage operators in quality check. As stated by Alves et al. (2012) only people can perceive and develop solutions for improvements. Thus, people must be trained in problem solving to address customers' issues plus requirements and be aware of their needs. This on-going initiative is sharing tacit and explicit knowledge, explaining why to do it and allowing workers to try. Therefore, the LSSA approach is helping to transform the department's closed culture into an open and transparent environment and instil a 'perfection' mindset.

5.2 Discussion – learning through reflection

CAR cyclical process model – Step 5 – Reflection

The last step of this second Action Research cycle is related to reflection. The purpose is to reflect under the same themes of the first AR cycle, meaning the main findings of the journey and the learnings obtained concerning (1) the practical knowledge, as well as (2) the applicability and transferability of the LSSA, plus (3) the contribution to the existing Lean theory body of knowledge.

Practical knowledge – main findings

There were several organisational achievements during this journey, which allowed reaching the conclusion that the hypotheses formulated helped to address the problem identified (figure 5.2).

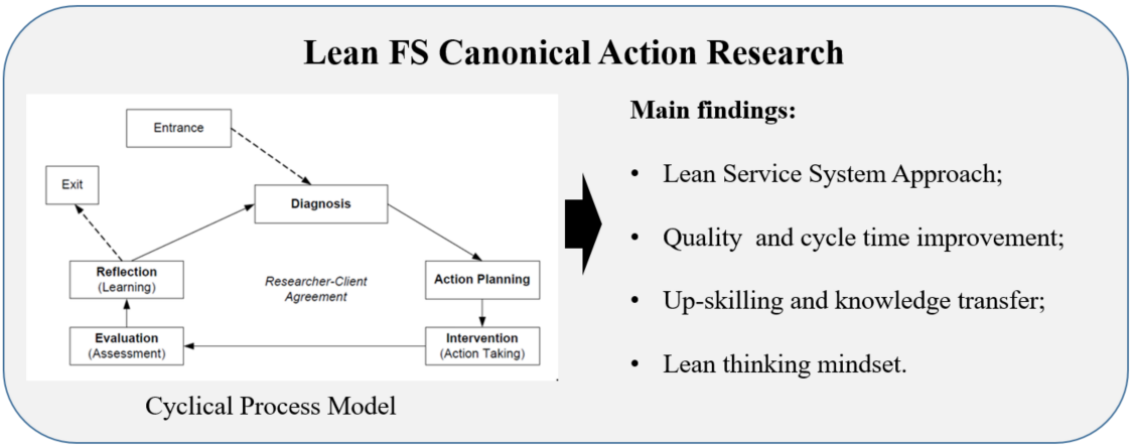

Figure 5.2. *Lean FS main findings*.

Indeed, the findings provided relevant information regarding the relevance of implementing a Lean Service System Approach (LSSA) to sustain Lean within the organisational culture. In order to list the most relevant ones, five topics are highlighted under each perspective, which allowed addressing the chosen eleven critical success factors and demonstrating the LSSA.

Under the **organisational** perspective:

1. Involving all stakeholders to understand organisation culture and strategy, where suppliers and partners were involved via surveys data, and customers and employees through direct actions;
2. Assuring communication flows and information transmission between hierarchical levels as defended by Malmbrandt and Ahlstrom (2013);
3. Commitment and support from top management during the journey;
4. Engagement of department management and its managers, demonstrating an 'open' mindset to try and adopt a different approach;
5. Breaking down silos between workers and managers.

Under the **people's** perspective:

1. Understanding employees' context, their story and commitment;
2. Up-skilling workers, as their knowledge of daily working activities combined with Lean mindset and technical dimension as work standardisation, 5S and VSM, allowed to increasing value stream performance;
3. Transforming people into active agents, as operators improved their own service performance and presented suggestions to improve working procedures. Managers also changed their behaviour, switching to team coaches;
4. Blending people data sources, to understand each person, mixing hard and soft skills with profiles and team roles;
5. Empowering a mindset of a learning organisation, combining Lean with knowledge management initiatives.

Under the **process** perspective:

1. Explaining and measuring all initiatives;
2. Communicating and sharing key performance indicators in a transparent way;
3. Conducting pilots with randomly selected workers to evaluate actions;
4. Learning with unsuccessful initiatives;
5. Beginning with one critical business activity, with faster and impacting results.

Indeed, when comparing invoice verification execution time in an 'after (first measurement) and before (third measurement)' using a Box & Whisker plot, a decrease of 40 % in execution time is visualised in figure 5.3.

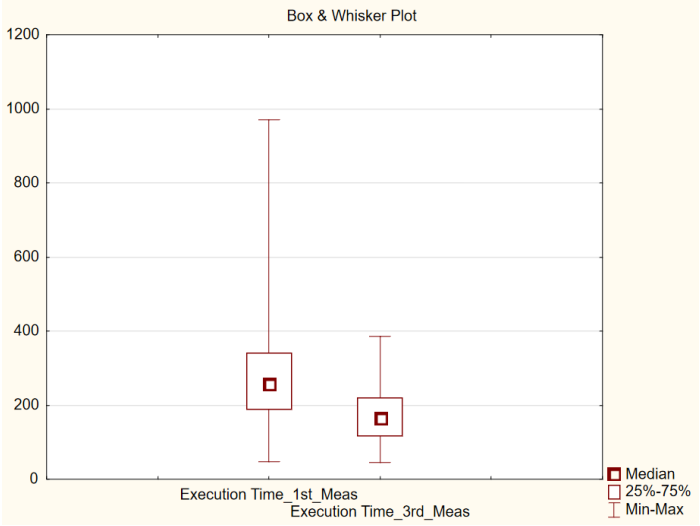

Figure 5.3. *Box & Whisker plot comparing 1.st to 3.rd measurement from Statistica*

In figure 5.4, using descriptive statistics with the two dependent variables (first and third measurement execution time) it is possible to verify that variance, standard deviation and coefficient of variance all decreased in the last measurement, meaning that invoice verification becomes more standardised.

	Descriptive Statistics (Operators_Process Time_1st and 3rd Measurement)						
Variable	Valid N	Mean	Minimum	Maximum	Variance	Std.Dev.	Coef.Var.
Execution Time_1st_Meas	380	284,5158	48,00000	970,0000	21261,97	145,8149	51,25018
Execution Time_3rd_Meas	99	175,9797	45,00000	386,0000	5845,30	76,4545	43,44510

Figure 5.4. *Descriptive Statistics 1.st and 3.rd measurement from Statistica*

Additionally, running a Wilcoxon matched pairs test, with the hypothesis:

$$H0: \mu_{sample\ of\ exec.time\ of\ 1.st\ and\ 3.rd\ measures} = \mu_{sample\ of\ exec.time\ of\ 1.st\ and\ 3.rd\ measures}$$
$$H1: \mu_{sample\ of\ exec.time\ of\ 1.st\ and\ 3.rd\ measures} \neq \mu_{sample\ of\ exec.time\ of\ 1.st\ and\ 3.rd\ measures}$$

Results in figure 5.5, demonstrate for $\alpha = 0.05$ and ρ-value < 0.05 that the null hypothesis (H0) is rejected.

	Wilcoxon Matched Pairs Test (Operators_Process Time_1st and 3rd Measurement) Marked tests are significant at p <,05000			
Pair of Variables	Valid N	T	Z	p-value
Process Time_1st_Meas & Process Time_3rd_Meas	98	1038,000	4,916713	0,000001

Figure 5.5. *Wilcoxon matched pairs test results from Statistica*

Consequently, the sample of execution time of the third measurement was significantly different from the first measurement and the result of ρ-value proved that the invoice verification decreased its execution time. To test if there were significant differences between operators' execution time the following hypothesis was formulated:

$$H_0: \tau_{operator1} = \tau_{operator2} = \tau_{operator3} = \cdots = \tau_{operator19} = 0$$
$$H_1: \tau_i \neq 0, \text{ for at least one operator } i$$

The τ_i is equal to the parameter of operator effect *i* in invoice execution time, therefore to verify this effect, another test of variance (ANOVA) was run. In figure 5.6, ANOVA results confirmed the rejection of the null hypothesis for an α = 0.05 and ρ-value < 0.05, meaning: (1) statistical significant differences still exist in execution time among operators, and (2) invoice verification maintains its dependency on worker.

Univariate Results for Each DV (Operators_1stMeasurement_3rdMeasurement)
Sigma-restricted parameterization
Effective hypothesis decomposition

Effect	Degr. of Freedom	Process_Time_3rdMeas SS	Process_Time_3rdMeas MS	Process_Time_3rdMeas F	Process_Time_3rdMeas p
Intercept	1	3065915	3065915	1029,824	0,000000
Operators	8	304898	38112	12,802	0,000000
Error	90	267941	2977		
Total	98	572839			

Figure 5.6. *ANOVA results from Statistica*

Therefore, for comparison reasons, the size of this effect was calculated again.

$$\eta^2 = \frac{SS_{effect}}{SS_{total}} = \frac{304898}{572839} = 0.532$$

A decrease was verified compared to first measurement. Hence, after the introduction of practices and standards, invoice verification activity becomes less dependent on operators. Regarding quality, to perform a 'before' and 'after' result between first and third measurements another 380 invoices from the same 19 operators were scrutinised and an increase of 4.5 % was achieved.

Thereby, it was demonstrated that LSSA was able to decrease in 40 % the invoice verification execution time and increased quality up to 99.21 %.

Under **customer** perspective it was important to:

1. Understand customers' perceived-value through voice of the customer, to obtain their feedback, requirements and wishes;
2. Analyse surveys and hold meetings to gather information;
3. Work closer with customers in their context, side-by-side, visualise faces and comprehend issues and difficulties with on-site observations;
4. Empower co-creation projects to share experiences;
5. Conduct shared pilots for joint learning and growing.

Additionally, it is relevant to point out that the organisation culture played a secondary role over this AR cycle, as actions were taken without any pressures and constraints. The cleavage between business and IT was not identified

and was even relevant regarding the scope of this AR cycle. Thereupon, the team was able to pursue the organisation goals without this important barrier.

Theories and models transferability and applicability

Action Research methodology demonstrated to be an important support during the course of the investigation. As mentioned before, the requirement of supporting the action taken through theory requires a constant literature analysis and a constant study, linking theoretical background to practice. Despite its benefits, it requires a substantial investment of time and effort from the researcher and then, from the team members who have to incorporate new knowledge over the cycle. This requires an open mind to study, correlate and adequate the existing theories to the current reality, being in several situations, a challenge for the researcher.

Regarding the experience acquired from the first AR cycle, due to its complexity and constant constraints (from the organisation culture), this experience proved to be beneficial for this second cycle, as the researcher was better prepared and more confident using the AR methodology and in implementing Lean. Moreover, being a second cycle conducted in Financial Shared Services department (the previous IT internal customer) it also gave me an excellent opportunity to deeply understand the business point of view. Considering both AR cycles, the issues pointed out in the first cyclical process model were more clear. Thus, the learnings gathered during the Lean IT journey were important inputs to conduct this last AR.

Taking into account the described department context, the identified problem and particularly its main root-cause, from the literature review, it was conclude that the studied organisation did not have a unique context in the professional services industries. Thus, the LSSA can be applied in other similar contexts. In order to transfer this model, it is critical to conduct a deeper situation assessment to understand the four mentioned perspectives (organisation, people, process and customer) with the aim of selecting the right critical success factors to address in each perspective. Additionally, it was demonstrated in practice what was argued in theory, that a continuous improvement cycle (PDCA) can be combined with AR methodology (see sub-section 3.2.2). Hence, it is possible to reach a successful implementation with evidence supported in performance measurement with a before and after analysis, as suggested by Davison et al. (2004).

Additionally, and with the purpose of transferability and applicability to similar contexts, it is relevant to point out that during this second AR cycle the combination between Lean tools and Knowledge Management (KM) practices was also demonstrated.

For Zhang et al. (2020) KM plays a key role in the application of Lean tools, as study conventions positively regulate the relationship among Lean tools, Knowledge Management and Lean sustainability. Being essential for enterprises to develop Lean sustainability, both learning and understanding the knowledge of lean tools become necessary. The authors stated that Lean tools display a positive effect on Lean sustainability via the mediating role of KM.

Hence, the journey adopted several KM tools such as: (1) storytelling, (2) communities of practice and (3) mentoring plus peer assistance (Lota et al. 2019). The introduction of KM practices during this Lean journey had also the purpose of accelerating the Lean thinking mindset, to transform an organisation from a closed culture to one that is willing to learn, try, allow for the errors, but essentially to one that is willing to share and invest in people capabilities. All these factors are pointed out in the literature as critical factors towards Lean sustainability (as referred in section 2.3).

Contribute to the existing Lean philosophy and Lean models

This second AR cycle showed that the first two Lean leap phases were accomplished and they provided important insights for the future leap phases towards the second last leap, which is to create a Lean enterprise.

As showed in section 3.3 (figure 3.7, the *research time frame*) after this Lean FS journey was finished (in the second quarter of 2021), an organisation assessment was made and it was confirmed that Lean is sustained. It was confirmed that the Lean practices, tools and procedures were being used and most of all, the mindset was changed. Aiming to understand it, 9 department workers were inquired: the department manager, 2 middle-managers, 2 internal customers and 4 workers randomly selected. Thus, the main reason for this Lean sustainability was due to the change of the mindset. Nowadays, the continuous improvement mindset to deliver a better service, incorporating the voice of the customer in the daily activities, is now incorporated.

Under the customer perspective, the annual customer survey (result from February 2021, about the year 2020) indicated an increase in the satisfaction rate despite the pandemic situation, as operations never stop and Service Level Agreement were accomplished, with high quality due to the practices adopted.

Additionally, in process perspective, the standards revealed to be a critical achievement. From March 2020 until today, people are working from home and they were able to maintain the same way of doing their activities supported by the implemented standards (started in 2019). Moreover, in September 2020, ten workers were hired and were trained based on the implemented Lean practices and the new mindset, they were able to enter in the department *learning by doing* program, and start their job without any constraints and negative impacts in department's operations.

Under people perspective, the workers also mentioned that they are more motivated for being involved in the department transformation and are engage to embrace future challenges. Therefore, the LSSA demonstrated that can be a suitable model to sustain Lean throughout an organisation transformation.

Furthermore, in Henrique's et al. (2020) Lean sustainability framework (applied in healthcare services), the authors indicated three main areas to sustain Lean: people involvement, Lean methods and Lean tools. Following these three areas and stablishing the related parallel to the application of the LSSA:

1. People involvement - *identify the key people to be involved and at all stages of implementation* (Henrique et al. 2020) - LSSA through its four perspectives and related CSF selected was able to involve the leading actors over the journey as mentioned under people's perspective.

2. Lean methods - *have a detailed step-by-step to help to guide the transformation* and *reflect and learn with the lessons learned from other experiences* (Henrique et al. 2020). LSSA uses the standard roadmap (Lean leap) to conduct the organisation transformation in four phases. Additionally, LSSA with its cyclical process supported on the PDCA method, was able to incorporate the reflections from previous journeys (supported by AR).

3. Lean tools - *have the right combination of Lean tools* (Henrique et al. 2020). The LSSA does not define which tools or bundle of tools to adopt. Indeed, this technical dimension must be decided according to the systemic and holistic thinking supported on the four perspectives of: organisation, people, process and customer. Meaning that one tool or practice can be effective in one particular situation but not in another one. Thus, for similar contexts it is possible to replicate tools, but always taking into consideration possible deviations, as each organisation has its unique culture and people.

From Costa et al. (2019) proposed Decision-Making Trail and Evaluation Laboratory (DEMATEL):

1. People engagement - *the key for a sustain continuous improvement is represented by a full engagement of the workforce supported by Top Management* (Costa et al. 2019). The importance of having on board all the hierarchy levels as well as the stakeholders (even with indirect actions) was demonstrated with LSSA.
2. Usage of leverages - *to sustain continuous improvement it is crucial to use some leverages, such as an effective communication, training and use of Kaizen events* (Costa et al. 2019). In LSSA, and as mentioned in the second PDCA improvement cycle, a *learning by doing process* was launched with the purpose of sharing knowledge involving all workers responsible for providing financial services.

Hence, it is possible to summarise that LSSA can contribute to other Lean models, with its systemic and holistic thinking within a cyclical process, addressing the critical success factors identified by the target organisation in the four perspectives, combining social and technical dimensions.

5.3 Summary

The chapter described the Lean implementation in the Financial Shared Services department of the target organisation. Towards Lean sustainability, the Lean Service System Approach was applied as the Lean model through one Canonical Action Research cycle and two PDCA improvement cycles. Relevant achievements were accomplished in the organisation and after the project ended, Lean is still maintained, meaning the success of the journey concerning Lean sustainability.

Chapter 6 Conclusions

This last chapter summarises the conclusions reached with this research. Starting to discuss how the research question, proposition and hypotheses were addressed and materialised on the Action Research cycles results, and then, responding to the identified research gaps. The chapter finish with the research limitations and the proposed suggestions for future work.

6.1 Research question, proposition and hypotheses

As detailed in section 3.3 the present thesis started with a first Action Research cycle, asking a question concerning effectiveness, in order to respond to an organisation problem (*how to accelerate time to market in IT services?)* this need was related to how to deliver faster IT service to answer customer needs.

Over the first AR cycle, the proposition stated was confirmed: *IT service providers need to be more agile, improve their procedures to pursue efficiency, be more collaborative and invest in networking with their customers and users since the focus must be on a customer centric strategy and on increasing effectiveness.* Nowadays, this proposition is even more effective owing to the acceleration of the 'age' of digitalisation due to the pandemic situation.

The hypothesis formulated in the Lean IT AR cycle (*Lean can improve efficiency and effectiveness in IT services***)** was demonstrated through the Lean Transformation Model implementation. After implementing two Canonical AR cyclical process models (CPM) the learnings through reflection step provided important insights. It was demonstrated that the *tool thinking* was able to achieve relevant goals: in (1) the methodology applied (Action Research), as well as in (2) the philosophy (Lean) chosen and in (3) the organisation goals. Although the project goals were achieved, and time to market accelerated, this was an unsuccessful journey because Lean was not sustainable within the organisation to support its operational performance over time.

As mentioned, the fifth principle of Lean IT (the capstone) is about maintaining the values through attitudes and behaviours (Bell and Orzen 2011), thus, over this first Action Research cycle the investigation learned that in order to sustain Lean within the organisation, there must be a common purpose. As these authors argued, the organisation is nothing more than the collective capacity of creating value.

Hence, as people were the leading actors in this first cycle and the organisational culture had an important role, acknowledging the used of the *tool thinking* insights, and the fact that the second AR cycle was in the same organisation, I decided to change the investigation focus towards Lean sustainability. Therefore, I started to study the Lean sustainability theoretical background, where a new AR cycle was applied as shown in figure 6.1.

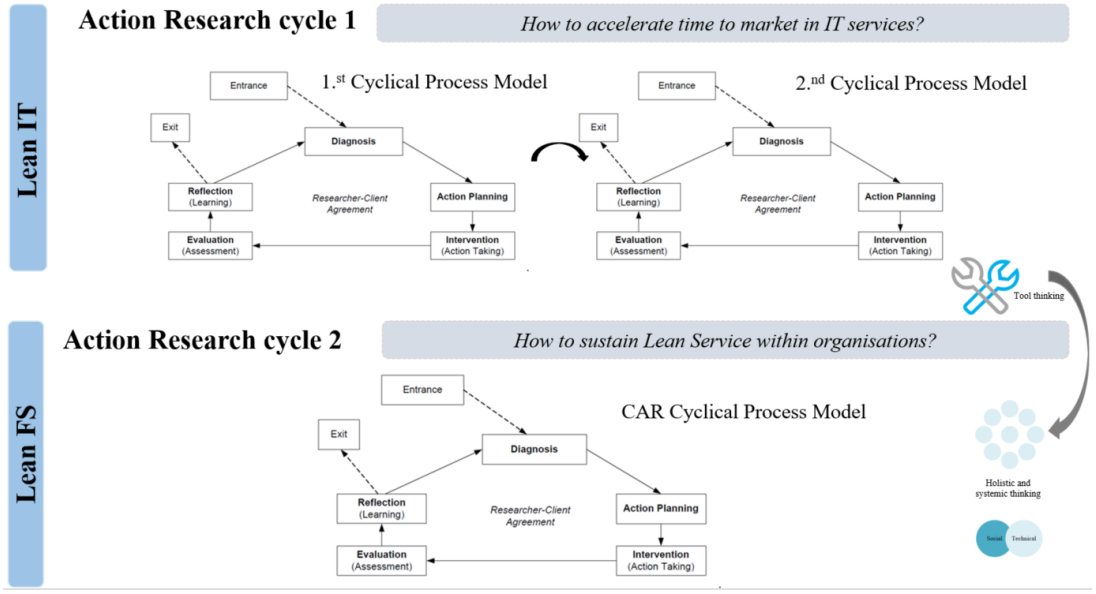

Figure 6.1. *Action Research cycles*

Due to the mentioned literature numbers of Lean implementations (see chapter 2), I realised the importance of contributing to the existing body of knowledge concerning Lean sustainability, formulating the research question (*how to sustain Lean Service within organisations?*), towards Lean sustainability, responding to the call of further research in this topic.

From the research question, the related proposition was validated through the AR cycle: *Lean requires a systemic and holistic thinking where social and technical dimensions must support a continuous improvement mindset, while relying on a management system and on sustainable organisational values.*

The cycle also demonstrated the two hypotheses formulated: (1) *Lean social and technical dimensions must be combined towards a holistic and systemic thinking.* Since its beginning, Ohno (1988) defined TPS as a system, where the continuous improvement mindset must be aligned with the management and leadership system and the respective people system. As demonstrated over this cycle, the right mindset and these joint dimensions were crucial to achieve the mentioned results. Regarding the hypothesis (2) *Lean Service System Approach can sustain Lean within an organisation,* it was verified that this approach was helpful to guide this Lean FS journey, by addressing the identified organisational barriers and their critical success factors through a cyclical continuous improvement process based on a systemic and holistic thinking, which are crucial towards Lean Service sustainability.

6.2 Literature research gaps

Regarding how the investigation responded to the literature research gaps identified in section 1.2:

- **Gap 1** - *The lack of the human system pillar in Lean implementations and the inherent constraints in Lean adoption, particularly in services* – from the theoretical background overview, services are highly dependent on people and their related topics are indicated as being part of the mentioned critical success factors. During my investigation, this pillar was constantly involved in Action Research cycles and was essential to the obtained results. Indeed, over the research all the people involved from board of directors, directors, managers and workers to customers (suppliers and partners were indirectly involved), have a particular role

hand were relevant to the achieved result. From the investigation, I learned that when people feel their work is contributing to a collective effort towards creating value they are available to embrace change, network and collaborate with others. Moreover, and despite the adverse organisational culture, this research also showed that people are willing to try and go further if they believe the organisation and their work will gain with the final result. Thereupon, the LSSA suggested approach demonstrates the applicability of Lean to the immaterial nature of the tertiary sector, and it emphasizes and addresses a common shortcoming in many unsuccessful Lean implementations in western organisations, by not considering the human factor as a fundamental pillar in such transformations, in stark contradiction with the Japanese original. Therefore, I stated that without this people pillar it is not possible to achieve a successful transformation; thus, during my investigation, people was a crucial pillar.

- **Gap 2** - *The majority of Lean studies focusing only on the technical dimension (in a set of techniques and procedures) rather than on Lean as a socio-technical system featuring systemic and holistic thinking that combines Lean social and technical dimensions.* – When starting a Lean journey, particularly if the team has no experience, it is important to have a sensei (an expert with Lean experience), otherwise the easiest way to start is to implement any kind of Lean tool. A tool, being something new, it motivates the teams, and managers gain a sense of operations control. However, after its implementations and when it is no longer new, it is realised that its benefits do not translate into changing the mindset, and it becomes another organisational tool. Accordingly, Amaro et al. (2020) stated that implementing Lean tools is not synonymous of implementing Lean thinking, meaning that it is possible to implement isolated Lean tools but only with marginal gains. These authors pointed out that only with a global approach is it possible to achieve sustainable results, but this demands an organisational culture change.

  As mentioned, during the first Action Research cycle the organisation culture played a crucial role, thus in similar situations and following the Lean Transformation model question concerning the management system (*what are the leadership behaviours to adopt? What management system is needed?)* I argued that it is relevant to assess if the organisation has the necessary leadership and management systems to continue the transformation. If not, I advise to stop and reflect if the transformation should proceed or not, discussing the different scenarios. During the first Lean journey, this was also a legitimate question, which was formulated over the implementation. The organisation decision was always to move on, with the argument that it is better to do something and run the risk of not achieving the required goal, and then to learn with it, rather than to stop the process. However, if the decision was to stop, I stated that the organisation would also gain with it, because in that case the organisation had the opportunity to learn with the unsuccessful experience.

  From the first Action Research cycle lesson learned, the second AR cycle was able to manage organisation culture in a different way as it was supported by the LSSA (addressing the identified organisational critical success factors). Therefore, the second AR had a different approach, thus the first cycle was crucial to change the mindset, from a tool to a systemic and holistic thinking. Meaning, not worrying about the tools to implement, but focusing on understanding the context, the group dynamics, particularly the group forces and their shared values, aiming to cultivate a secure and trustful environment, with and through people. Having an open mind to combine domains of knowledge (example: Lean and Knowledge Management) with the purpose of achieving operational performance over time, being supported by the LSSA to conduct the

transformation. Accordingly, for Bhasin (2012) a well-structured method can drive people to create a Lean culture and thus have success in the journey.

Hence, I stated the importance to join what is already intrinsically integrated in Lean: its social and technical dimensions.

- **Gap 3** - *The sustainability of Lean adoption in organisations*. – As highlighted during the thesis, studies proved that Lean could support organisations operational performance over time. As an example, in Silva et al. (2013) results showed that Lean increased the productivity and the efficiency of the manufacturing processes. It was identified a positive relationship between Lean implementation and employee satisfaction as well as a positive impact on the company financial strength. These two aspects together indicated that implementation of Lean could lead to an increased sustainability of the company. Nevertheless, literature review also demonstrated that Lean sustainability figures are very low, thus it was relevant to perform research about this topic.

  Theoretical background demonstrated that there are several frameworks and approaches to address Lean sustainability, particularly in Lean Service body of knowledge. However, as far as I know, the LSSA is the first approach within a cyclical process, which tackles the two mentioned Hines et al. (2004) Lean levels of strategic (customer-centric thinking approach) and operational (where tools are applied) approach, through the organisational critical success factors. Additionally, LSSA not only takes into consideration the CSF that the organisation identifies at the beginning of the journey, but also incorporates them in the implementation roadmap (the Lean leap), by continuously covering the four perspectives of: organisation, people, process and customer through the PDCA continuous improvement cycles.

  Although having a guide (such as LSSA) is relevant as it is one of the mentioned factors to sustain Lean (Henrique et al. 2020), I argued that the most important factor is the right mindset. Hence, this thesis argues that Lean sustainability depends on following a systemic and a holistic thinking.

6.3 Lean Journeys

The thesis presents two Action Research cycles through the CAR method, supported by the application of Lean theory to two types of services: information technology services (IT) and financial services (FS).

The first AR cycle (with two CAR cycles) in the information technology provider (Lean IT journey) achieved its goals, but was unsuccessful regarding Lean sustainability. The *tool thinking* demonstrated that the short-term results are possible to reach and can be positive, corresponding to an increase in quality and time to market performance, but its transformation is not sustainable in the long term. Hence, it was concluded that, despite the positive results, this *tool thinking* approach is unsustainable.

Being Lean more than a set of tools, as it is also about inducting change, and therefore about organisational culture, the Lean journey must involve everyone – managers, teams and individuals. All must be part of an integrated system with common goals, purposes and sharing values, where people should be engaged in the transformation process bringing their own contributions, and becoming the change agents themselves. Summarising, Lean is a systems approach, so the focus should be on the organisation as a whole before paying attention to the parts. Although this is simple in theory, it is difficult to operate in practice due to culture and to the need of collaboration, combined efforts

and team work. Indeed, most managers and workers have been brought up and educated in vertical silos, where it is difficult to change this way of working (Bicheno and Holweg 2016).

Based on the insights learned from the Lean IT journey, a different approach was introduced in the second AR cycle (with one CAR cycle). The result was positive and the innovate approach followed was coined as Lean Service System Approach (LSSA). This cycle demonstrated the relevance of implementing this approach to sustain Lean within the organisational culture.

The journey started from a problem pointed out by the organisation management - a closed culture, with no knowledge sharing, few experts and intense 'fire-fighting' (*muri*), with long cycle times and variability (*mura*), as well as with inefficiencies (*muda*) in service delivery to external and internal customers. After two years, Lean thinking was introduced in the *gemba* with positive results. The system approach supported by Lean leap roadmap and PDCA, addressed the chosen eleven CSF.

Under **organisation** and **people** perspectives, the involvement of all hierarchical levels empowered employees who became active change agents. Under **process** perspective, research started with the most important service activity delivered by the studied department, invoice verification, where a 'before' and 'after' result showed through statistical results a decrease of 40 % in execution time and an overall impact on service level agreements, as this activity represented 45 % of all demand orders. During the journey, invoice verification quality increased 4.5 %, achieving an average of conformity 99.21 %, where learning and changing by doing increased flow, improved value stream performance and eliminated waste.

Figure 6.2 summarises the main findings obtained in the investigation through both AR cycle and respective Lean models.

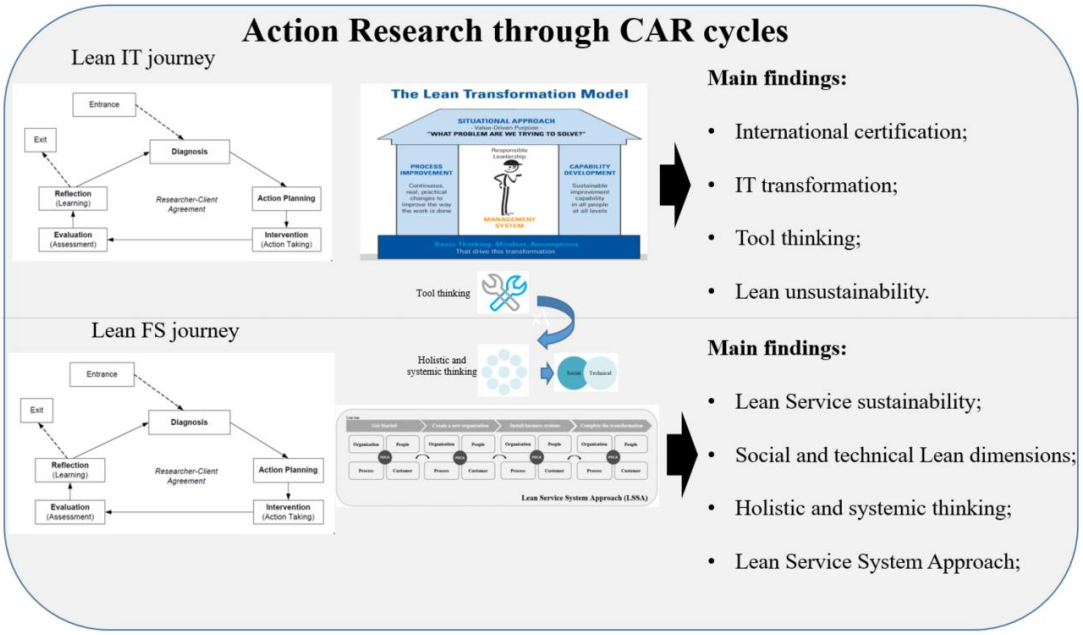

Figure 6.2. *Action Research cycles main findings*

As mentioned before, Radnor and Johnston (2013) stated that is common to accept that the quality of an internal process or service positively contributes to the quality of an external service. Notwithstanding the importance of internal operations improvement, it is critical to have a market driven approach focusing on the customer, thus, there

is a need to focus on both process and customer (Radnor and Johnston 2013). Therefore, the research answered to the customer perspective through customers combined actions, which brought a deeper commitment between organisation and customers.

Hence, the investigation emphasized that success does not depend on which tool or technique to implement, but on adopting a holistic thinking, combining Lean technical and social dimensions. When all are involved, pursuing perfection is possible when a *go and see, respect* attitude is applied. As explained by Hayes (1981), Japanese companies achieved their level of manufacturing excellence by doing simple things very well and slowly improving them all the time. This Lean journey was conducted step-by-step, doing simple but well. LSSA allowed Lean to become part of the culture and be sustainable within the company, so as to support operation performance over time.

6.4 Limitations

Following the constructive research paradigm with the Action Research methodology, the type of academic writing used in this thesis was aligned with the constructivism paradigm. Being the researcher an instrument of his own research, where the findings result from the 'mental constructions' (Guba and Lincoln 1994) combined knowledge between him and the focus groups, the writing had a particular focus on describing how these mental constructions were built during the process of this investigation. Hence, these mental constructions were created based on the experience gained over the journey in combination with the supported body of knowledge. Therefore, as a constructive thesis it has subjectivity, in spite of the mixed strategy adopted to combine qualitative and quantitative approaches.

The information provided and shared had the purpose of explaining, in as much detail as possible, the approach followed, with the aim of providing information for the transferability as well as the applicability to similar contexts. However, being a single organisation AR investigation, as its inherent limitations.

Regarding the Lean sustainability, as explained in 5.2, as this organisation with LSSA implementation has only two Lean leap phases accomplished, it is not possible to have now the information about all the four phases of the leap, although the results currently obtained give positive information concerning the future. Therefore, the further phases must be performed, continuing the adoption of Lean thinking over the five-year roadmap and then, the last and final leap towards a Lean enterprise.

Hence, change management must be always present. From the reported experience, performing changes will always face barriers in the organisation. The purpose will be to transform the invisible organisation culture actor into a 'secondary' actor as it will always be present, as well as leadership, strategy and management in the transformation process. Thus, this continuous improvement path must continue a step-by-step process and involve all.

6.5 Future work

To pursue a systemic and holistic thinking, the Lean leap phases supported by the Lean Service System Approach has to continue in the organisation. Therefore, with the aim of pursuing the Lean leap four phases, further Action Research cycles will be planned in other departments with new improvement cycles, addressing the critical success factors of the four mentioned perspectives.

Regarding the studied Financial Shared Services department, new customers' co-creation projects will be set up, as well as organisation and people initiatives. Under process perspective, it will be useful to measure the impact of the *learning by doing* actions in progress. In further actions will be relevant to integrate the department IT members (due to their previous Lean IT experience) as they are well positioned to embrace the Lean transformation.

To consolidate the effectiveness of LSSA towards Lean sustainability, additional models will be studied and then applied to verify if Lean is sustainable over time. Thus, a regular assessment to Lean sustainability will be set up. Not with the goal of achieving a specific level of the use of a set of Lean tools, as most lean assessment methods do, but of acknowledging that Lean is based on on-going continuous improvement process (De Treville and Antonakis 2006).

Therefore, the journey will continue, as Lean is an ongoing process (Bicheno, 2008) and should be seen as a direction, rather than a target to be reached after a certain time (Karlsson and Ahlstrom, 1996).

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