

Lean IT adoption: Success cases in Portuguese banks

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Abstract

Lean IT emerged as a fusion between Information Technology (IT) and Lean thinking. This paper aims to contribute to a better understanding on how Lean thinking may be applied to the IT sector, through the study of the outcome from the application of Lean IT in two Portuguese banks. The paper will analyse how the Lean IT approach addresses the challenge of increasing competitiveness; analyse the Lean IT implementation methodology adopted by the 2 banks; and how are the banks maintaining the Lean IT approaches. The implementation process was surveyed through a series of interviews which uncovered differences in terms of Lean IT practices and tools used by both organisations. Empirical evidence made clear that the Lean IT adoption by the banking institutions made them more competitive. Moreover, it was also important to notice that Lean IT became part of the organisational culture thus justifying its permanence. This research shows examples on how the use of Lean IT may help other organisations become more agile and valuable to their customers, thereby, increasing their competitiveness.

Keywords:

Lean IT, Information Technology, Waste, IT Models, Lean Tools.

1. Motivation

In the current economic-business context, organisations aim to be recognised as unique by their customers. Lean philosophy intends to address this challenge by focusing on creating customer value, eliminating waste, improving information flow, increasing internal processes effectiveness, as well as promoting the respect between all internal and external process agents. The application of Lean practices in Information Technology is called Lean IT.

Lean IT is a new phenomenon in Portugal, and there is a lack of knowledge and literature concerning Lean IT principles. This work intends to contribute for the body of knowledge of Lean IT, particularly in the Portuguese context. This paper will describe the research work and results on the effects that the application of Lean IT practices may have in companies, using two Portuguese banks as examples. The research questions of this study are

1. How can Lean IT make organisations more competitive?
2. What methodologies are being deployed by Portuguese banks implementing Lean IT?
3. How is Lean IT currently maintained?

The research methodology adopted in this study was the Case-Study.

2. Theoretical background

2.1. Lean IT Introduction

Lean IT is the application of the Lean principles for the management of Information Technology (IT) (Berrahal & Marghoubi, 2016). To Bell & Orzen (2011) Lean IT is a cultural and behavioural transformation that encourages everyone in the organisation to think differently about the role of information, in quality and 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, it is actually a philosophy that shapes and contributes to the organisational culture.

According to Bell & Orzen (2011), the success of Lean IT relies upon people, processes and technology (in this order). Therefore, the teams identify the causes of the problems in the processes, whilst the processes are improved through the simplification and articulation between technology requirements (Bell & Orzen, 2011). From a Lean IT perspective, information systems need coordination and the synchronisation of teams is crucial to all value flows. Communication plays an important role where the challenge is to be more agile and faster with higher efficacy.

One of the challenges of Lean IT is the fact that information is intangible which makes its waste less perceptible when compared to, for instance, production shop floor waste. Lean IT may be hard to maintain and implement at first because it requires time, reflection and discipline, but when its principles are applied, they end up influencing the behaviour of the entire company and becoming part of the organisational culture.

2.2. Comparing Lean and Lean IT Principles

The process of eliminating waste first requires knowledge about the main problems of the organisation. Thus, according to Womack & Jones (2003) and Bell & Orzen (2011), it is important that companies follow the principles of Lean.

Womack & Jones, (2003) advocate five Lean principles with the following sequence: *specify value, identify the value stream, flow, pull and perfection*. Bell & Orzen, (2011) also defend five Lean IT principles in a pyramidal structure, where the base supports the entire structure of principles: *foundation, behaviour, perspective, flow and capstone*. Table 1 has a comparative analysis between Lean and Lean IT principles, according to the aforementioned authors.

Table 1. Comparison of the Lean and Lean IT principles.

	Lean (Womack & Jones, 2003)	Lean IT (Bell & Orzen, 2011)
1st Principle	<p>Specify Value: Set value according to the customer's perspective, for a specific product, with specific resources and over a period of time.</p>	<p>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).</p>
2nd Principle	<p>Identify the value stream: Identify the entire value stream for each product or family product and find ways to eliminate waste.</p>	<p>Behaviour: Invest in proactive continuous improvement, solving problems through discipline and responsibility.</p>

	Lean (Womack & Jones, 2003)	Lean IT (Bell & Orzen, 2011)
3rd Principle	<p>The value stream: Create value stream, ensuring that production takes place in a continuous stream. Respond to the real needs of workers in any situation.</p>	<p>Perspective: Focus on customer requirements, though an involvement with these. All imperfect work is removed and is not sent to the next stage. There should be a clear understanding of the overall value stream.</p>
4th Principle	<p>Flow: To draw and provide what the customer wants. Reversal of the productive flow; let the customer <i>pull</i> value.</p>	<p>Flow: The system runs according to JIT. Waste elimination allows the connection between activities (<i>pull</i> mechanism).</p>
5th Principle	<p>Pull and perfection: Looking for better results, trying to achieve perfection and continually removing wastes as soon as they are identified.</p>	<p>Capstone: Maintain the values through attitudes and behaviours. The company is nothing more than the collective capacity of creating value.</p>

2.3. Waste classification

The basic insight of Lean is to deliver value to the customer through the systematic elimination of waste in the whole company's value stream. First, all activities are recorded, even those that do not create value (Bell & Orzen, 2011). Waste appears in unnecessary activities that add cost and time but not value (Tapping, 2003), (Al-Baik & Miller, 2014) and (Dennis, 2015). Since the non-value added activities have no interest to the customer and do not add value to the product or service, thus the customer is not willing to pay for them.

In IT there are gaps in the identification and elimination of waste, affecting a misalignment in operations. Some of the IT activities translate into the generation of knowledge at work and consequently do not produce physical waste (Staats, Brunnrr, & Upton, 2011) and (Al-Baik & Miller, 2014). Information technology transfers immaterial knowledge, from one point to another, and companies find it difficult to identify and understand that knowledge. For Lean authors there are three concepts to consider regarding waste: (1) *mura* (variability), (2) *muri* (overload) and (3) *muda* (waste) (Womack & Jones, 2003), (Bell S. , 2006), (Bell & Orzen, 2011) and (Berrahal & Marghoubi, 2016).

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

In Lean Thinking Muda is composed by seven types of wastes represented in

Table 2 and their adaptation to *Lean IT* (Martin, 2010), (Bell & Orzen, 2011), (Pham & Pham, 2013), (Williams & Duray , 2013), (Bevilacqua, Ciarapica, & Paciarotti, 2015) and (Vajna, 2015).

Table 2. Waste of Lean Thinking vs Lean IT.

Wastes	Lean Thinking	Lean IT	
		Developer views	User views
Inventory	Excessive products in stock implying the existence of outdated products.	Programming unnecessary functions. Creation of software code without understanding the needs of the customer.	Excessive information causing unnecessary research, excessive delays and accumulation of work.

Wastes	Lean Thinking	Lean IT	
		Developer views	User views
Overproduction	Excessive production of 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 works on hold, for resources or for decision.	Lack of work for many factors, such as delay between code creation and testing or waiting for documents.	Unavailability of the system or its slowness. Time wasted waiting for additional information.
Transportation	Unnecessary transport of materials from one place to another.	Transfer work from one team to another.	Transfer of information through multiple intermediaries and through multiple systems. Security barriers in the flow of information.
Over processing	Adding excess value without the client requesting, that is, doing more work than the client wants.	Development that 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 between 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 causes bad decisions.

2.4. Lean IT tools

Additionally, there are other challenges to consider regarding Lean IT:

1. How can a company add value?
2. How to identify activities that do not create value?
3. What strategies should be implemented to eliminate waste?

These challenges can be answered with the support of Lean tools (and it is understood that any tool that supports Lean can be considered as a Lean IT potential tool). In this way, some of these tools are presented through the triple Ms: *Muda*, *Mura* and *Muri*.

Table 3. Lean IT tools by *Muda*.

<i>Muda</i>		Elimination of Waste
Tools	Description	
VSM	<ul style="list-style-type: none"> • Used to draw the value stream mapping (VSM) for a family of products. Initially it represents the current stage, allowing the detection of waste and finally opportunities for improvement (Vorne, 2017); • The main elements of VSM are: (a) clients; (b) suppliers; (c) processes (which add value and information); (d) place of waiting for the product or service; (e) 	

Tools	Description
	product or service flow; (f) information flow from the client to each operation and (g) value flow line (Bentley & Davis, 2010).
SIPOC	<ul style="list-style-type: none"> • Describes and understands existing processes in a value stream; • Analyse the entire value stream of the company (inputs, process and outputs), making it easier to understand its connections.
A3 Thinking	<ul style="list-style-type: none"> • Helps employees to take time and properly assess the causes of problems (Bell & Orzen, 2011); • It encourages behaviour that makes solving the problem a daily habit (Orzen & Paider, 2016); • Reports about problems and changes that happened in the process. The method of filling in the sheet 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	<ul style="list-style-type: none"> • Effective tool for conducting methodical learning and problem resolution. It is divided into four stages: (1) <i>Plan</i>, (2) <i>Do</i>, (3) <i>Check</i> and (4) <i>Act or Adjust</i> (Orzen & Paider, 2016): <ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> • <i>Gemba</i> in Japanese means current place (Womack J. , 2011) and (Tyagi, Choudhary, Cai, & Yang, 2015); • It means the people and the place where the work is done (not the information that represents that work) (Bell & Orzen, 2011); • For other authors, <i>Gemba</i> is the place where value-added activities take place (Orzen & Paider, 2016).

Table 4. Lean IT tools by Mura.

Mura		Decreased Variability
Tools	Description	
Kanban	<ul style="list-style-type: none"> • Control system for Just-In-Time (JIT) production (Sugimori, Kusunoki, Cho, & Uchikawa, 1977); • Visual mechanism that gives workers control of the process (Riezebos, Klingenberg, & Hicks, 2009); • From an IT standpoint, Kanban is a visual display panel used to: (a) present the workflow, (b) limit the <i>WIP</i>, (c) drive forward the productivity through awareness of what people are working on, and (d) continuously improve the process (Orzen & Paider, 2016); • IT processes and their entire flow are visible to all, which allows an efficient and regular flow of work to be performed. Attention is focused on imminent problems, thus avoiding unnecessary interruptions. 	
Standard Work	<ul style="list-style-type: none"> • Critical activities are described through standardised procedures; • Team members provide inputs for software requirements, documentation, training, testing and support (Bell & Orzen, 2011); • It ensures value creation by the employees with the support of managers (Orzen & Paider, 2016); 	

Tools	Description
KPI's	<ul style="list-style-type: none"> Measures the results of the company; Provides feedback to ensure ongoing effectiveness of the processes and also to identify new opportunities for improvement; Manages the operation of each process and contributes to the desired results across the value stream (Bell S. , 2006).

Table 5. Lean IT tools by Muri.

Muri	Increased flexibility
Tools	Description
Heijunka	<ul style="list-style-type: none"> Priority management; Creation of activities, as homogeneous as possible, in order to use the available capacity and create a constant work flow; It absorbs 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 (Womack & Jones, 2003) and (Bannister, Bickford, & Swanke, 2014); Controls the variability of the sequence of work arrivals, in order to allow a higher usage capacity (Huttmeir, Treville , Ackere, & Monnier, 2009); Levels the production volume and the product mix, using the same sequence of products for each production cycle (Matzka, Mascolo, & Furmans, 2012).

2.5. Aligning IT Models with Lean approaches

IT models can be combined with Lean IT. In this study three IT models are described: (1) ITIL, (2) COBIT and (3) CMMI. The combination of Lean IT and these models enables better performance in organisations. Models provide best practices for industry and services; Lean IT helps to implement these practices.

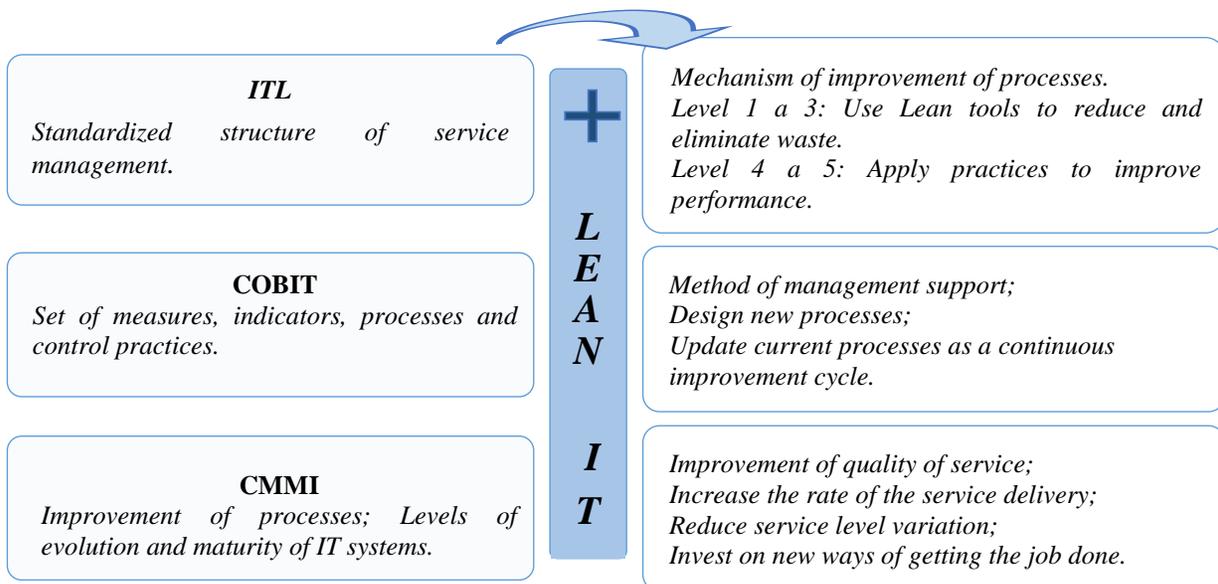


Figure 1. IT models in the Lean IT context.

3. Case Study Analysis

Each organisation has a different reality and the application of Lean IT must adapt to it. Although the two cases studied in this work are from the banking sector, they are indeed different. The companies required anonymity and hence are

identified by A and B. Both are model organisations, not only for the way they implemented this philosophy, but also, and above all, for the way they maintain Lean IT (they were awarded prizes by independent entities). The following table gives an introductory overview of both of the interviewed organisations.

Table 6. Introductory synthesis of the interviewed organisation.

	Company A	Company B
Business activity:	Assist organisations in: <ul style="list-style-type: none"> • Service delivery and conception; • The development of solutions in the field of information systems; • The provision of consultancy services; • Training and other technical services associated with business processes. 	<ul style="list-style-type: none"> • Manage the information systems of the organisation; • Support the organisation's business; • Transform the processes in information technology to make them more efficient and effective.
Business structure:	Pyramidal /Hierarchical	Pyramidal/Hierarchical
Implementation of Lean IT:	Year: 2007 With the support of a consultant.	Year: 2010 With the support of a consultant.
Methodology adopted:	1) Management Systems; 2) Operating Systems; 3) Behaviours and Competencies.	1) Organisation and planning; 2) Team management; 3) Processes improvement.
Goal to apply Lean IT:	<ul style="list-style-type: none"> • Increase efficiency and operational effectiveness; • Ensure the maintenance of the improvements achieved; • Measure KPIs. 	<ul style="list-style-type: none"> • Increase teams' productivity; • Improve management; • Improve planning; • Standardise management tools; • Measure productivity via KPIs.

From a critical and comparative perspective of the cases, it can be stated that the implementation of company A is more common than the ones found in literature, and therefore more conventional. Due to its operational challenge, company A implemented a set of tools, based on the original Toyota Production System model, taking into account its correct usage.

Company B had different issues to address: planning and the management of its teams. It therefore implemented *Lean IT Leadership* focused on performance management, rather than on the operational component of the work performed by the teams. To solve these specific issues, the application of the tools and their respective indicators are management oriented.

3.1. Case studies and the Lean IT Principles

In both cases the culture of the organisations was crucial throughout the implementation of Lean IT. Both banks motivated their employees to follow the same direction, supported by the senior management.

With Lean IT a higher sharing of information arose, which allowed the creation of value. The sharing of information, experiences and perceptions of each individual will contributed to the development of all, as may be verified by the base of the pyramid of Bell & Orzen, (2011): respect for people and sharing.

Having people at the base of the pyramid, allowed the rise of awareness that organisations are made by people and are they that allow the organisation to grow and evolve. To this end, it is necessary to instruct the resources with the values and principles of each company, that is, to reinforce the cultural patterns and the daily behaviours.

It was found that these case studies share the same extremes of the pyramid, but the path from base to top was different, given that they have different scopes. This lead to divergence in the tools applied to eliminate and reduce waste.

3.2. Case studies and the Lean IT Tools

The concept regarding the use of tools and its classification according to *Muda, Mura e Muri* is in the interviewed organisations.

Table 7. Application of tools within each organisation by *Muda*.

Tools	Company A	Company B
	<i>Application of Lean IT in an operational area.</i>	<i>Application of Lean IT in the Management of steps, adopting the tools to their needs.</i>
<i>Muda – Elimination of waste</i>		
<i>VSM</i>	<ul style="list-style-type: none"> • (When used in infrastructure) Employees had a complete perception of the process flow; • It allowed to understand the added value of the tasks and to eliminate some activities considered as waste. 	-
<i>A3 Thinking</i>	<ul style="list-style-type: none"> • Applied in the scope of problem management; • It helps to capture the team’s reasoning in communication. 	-
<i>PDCA</i>	<ul style="list-style-type: none"> • Assists in identifying the root cause of problems and identifying their root cause. 	-
<i>Gemba</i>	<ul style="list-style-type: none"> • Introduced small improvements that have already made a difference in the employee experience. • Reduced the difficulty of linguistic communication. 	<ul style="list-style-type: none"> • Reduced the difficulty of communication between directors, team managers and employees.

Table 8. Application of tools within each organisation by *Mura*.

Tools	Company A	Company B
	<i>Application of Lean IT in an operational area.</i>	<i>Application of Lean IT in the Management of steps, adopting the tools to their needs.</i>
<i>Mura – Decreased variability</i>		
<i>Kanban</i>	<ul style="list-style-type: none"> • Employees can have a glimpse at the information flow and control it. 	<ul style="list-style-type: none"> • Strong communication component, inside and outside the team.
<i>Standard Work</i>	<ul style="list-style-type: none"> • It allowed the alignment between IT models (ITIL and COBIT). • Improvement in response times and quality deliveries. 	<ul style="list-style-type: none"> • It allowed the alignment between IT models (ITIL and CMMI). • Creation of resource pools. • Allow the structuring of tasks, inside and between teams, to uniformly crosswise the processes.
<i>KPIs</i>	<ul style="list-style-type: none"> • Help to get an overview of the process. 	<ul style="list-style-type: none"> • Provide management support indicators. KPIs allow control and

	Company A	Company B
Tools	<i>Application of Lean IT in an operational area.</i>	<i>Application of Lean IT in the Management of steps, adopting the tools to their needs.</i>
Mura – Decreased variability		
	<ul style="list-style-type: none"> Present concrete facts in the target areas for improvement. 	<ul style="list-style-type: none"> planning of the teams and each resources.

Table 9. Application of tools within each organisation by Muri.

	Company A	Company B
Tools	<i>Application of Lean IT in an operational area.</i>	<i>Application of Lean IT in the Management of steps, adopting the tools to their needs.</i>
Muri – Increased flexibility		
Hoshin	<ul style="list-style-type: none"> Assist in the strategy of the pyramidal hierarchy. Greater strategic alignment between top management, directors, coordinators and teams. Increased flexibility of response to the organisational problems. 	-

3.3. Case studies and waste

This sub-section deals with the identification of waste still existing within the organisations.

Table 10. Waste identified within the organisations according to the 7 principles of Muda.

	Company A	Company B
Over processing	<ul style="list-style-type: none"> Excess of indicators. 	<ul style="list-style-type: none"> Long cycle times to accept software generates higher effort; Additional features developed; Features accepted but not used.
Waiting/ Delays	<ul style="list-style-type: none"> Excessive formalism, which occurred between people, affected waiting times. 	-
Rework/ Defects	<ul style="list-style-type: none"> Deficiencies on deliveries occurred despite the effort to reduce them. 	<ul style="list-style-type: none"> Customer requirements did not match what was actually developed; Software product had defects.
Inventory	-	<ul style="list-style-type: none"> Software development projects that were waiting for approval.

3.4. Case Studies and IT Models

Both cases use Lean IT with other IT models. Since company A needed to report a set of measures in terms of operational risk and internal control (both nationwide and internationally), it implemented COBIT which provides a set of control practices. Therefore, the organisation began to outline a clear policy in accordance with the intended goals which helped deciding the level of security and control needed to safeguard the set of values of the entire organisation. COBIT is applied to assess and control the levels of maturity inside company A. Through Lean IT tools,

it allows the organisation to focus on processes in a perspective of continuous improvement by eliminating and reducing waste as well as creating value for the client.

For Company B, CMMI defined goals and priorities for process improvement through its standardisation, enabling it to measure the maturity of processes. The combination of this model with Lean IT was linear because CMMI does not impose a way to perform work by both teams and management. Lean IT addressed this issue by providing guidance for a better management.

4. Cross Case Study Analysis

4.1. How can Lean IT make organisations more competitive?

Considering the outcome of the analysis carried out to both organisations (which includes access to information that we may not disclose in this paper), their position in the IT market in Portugal, as well as the prizes they have already been awarded, it is possible to state that they both have become more efficient and competitive with Lean IT. Both organisations were able to respond more effectively to the problems identified, thus adding value to their customers.

These case studies also showed that implementing Lean IT helped the two banks in creating *healthy habits* that became part of their culture. Once this happens, certain rules and procedures become intrinsic and natural to workers, leading to a decrease in the effort required to accomplish routine tasks. This translates into an increase in efficiency and reliability, ultimately contributing to an increase in the homogeneity of processes. Consequently, it will help when it comes to:

- Consolidates the concepts that are being acquired;
- Creating interdepartmental procedures and quicker response times;
- Combining with other IT models.

Both bank institutions implemented key performance indicators to control and monitor results by reporting weekly, monthly, quarterly and yearly figures. Therefore, it was possible to verify an increase of their competitiveness by comparing KPI results (prior and after Lean IT adoption). These case studies identified, on average, an increase of 20% on their effectiveness and efficiency, thus in their competitiveness.

4.2. What methodologies are being deployed by Portuguese banks implementing Lean IT?

In company A, Lean IT implementation was structured in four stages: (1) diagnostic, (2) design, (3) implementation and (4) analysis of results. In the first stage, processes were analysed using a VSM tool in order to measure the cycle timings of activities and to understanding the whole process. Secondly, the organisation did the definition of future (To Be) value flows with VSM, and then the To Be implementation. Finally, results were analysed based on performance indicators.

The implementation in company B was performed in three stages: (1) diagnosis and presentation of the Lean program, (2) implementation of initiatives (visual management, planning and coaching) and (3) consolidation. The first stage was comprised of working sessions for the presentation of concepts for all team elements. In the second phase, which was followed by the direction board, each team shared its current stage of implementation, identifying obstacles and ways to overcome them. The last stage focused on the presentation of results from each team with a continuous monitoring from management.

Both organisations used a *waved approach* (three months duration) starting with a reduced number of teams and a team of Navigators (internal consultants responsible for Lean IT adoption). Navigators were trained first (by the external consultant) so then they could train others to implement Lean IT in their own departments under the Navigators' supervision and support.

4.3. How is Lean IT currently maintained?

It was important to realize how both organisations maintain Lean IT. There are several factors that contribute to ensure a successful ongoing Lean IT strategy. We identified as the key factor the ability to embed Lean IT in the organisational culture so that it is no longer questioned. We also identified a set of factors that contribute decisively to a successful maintenance of Lean IT:

- Support from senior management: management contribution to strengthen the philosophy and remove emerging obstacles;

- A dedicated team (Navigators): human resources full dedicated to Lean IT;
 - Additionally, in company B Navigators report Lean IT information to management whilst in company A Navigators implement new tools.
- Willingness to embrace Lean IT throughout the whole organisation;
- Promotion of transparency: clarify with employees the goals of Lean IT adoption;
 - Company A made it clear that Lean IT was not meant to fire people.
- Effectiveness in communication.

Any organisational culture evolves; therefore, another important factor to take into account, regarding maintenance of Lean IT, is its ability to adapt to evolution. Considering this, company A implemented an operational Lean IT and defined the following strategy to maintain it:

- Introducing new tools from Toyota Production System;
- Creating new waves to implementing Lean IT in other bank departments.

Considering that company B is oriented towards management, they are taking the following actions:

- Planning to apply an agile methodology in combination with Lean IT;
- Motivating team managers to identify IT internal waste.

5. Conclusions

Over the years, Lean has been adapted to several activity sectors, allowing a better understanding of different realities. Starting in the automotive industry, it then moved on to other sectors such as: construction, process industry, retail and distribution, financial services, healthcare and information technology. Each sector is defined by different types of stream value and all the knowledge that may be obtained from those sectors is relevant to adapt Lean to the IT industry (Bell S. , 2013). It is therefore 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 client/ user demand (Hicks, 2007).

Lean IT is still underdeveloped in Portugal, namely the adoption of its principles by organisations. Nevertheless, it was interesting to see how Lean is applied to information technology and how it is useful for organisations, as it generates benefits that maximize their effectiveness and efficiency. Through key performance indicators it was identified, in both cases, an increase of 20% in their effectiveness and efficiency and thus in their competitiveness. Despite the challenges of implementing Lean IT, these bank institutions were able to embed it in the organisational culture and therefore they are still maintaining Lean IT.

Due to the relevance of the present study and because it is not yet developed by most Portuguese companies, it would be interesting to extend it to a significant sample through the application of questionnaires to other companies. This would allow a better nationwide understanding of the application of Lean IT.

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