

APPLICATION OF LEAN THINKING TOOLS TO MUNICIPAL SERVICES

Inês Sofia Oliveira da Eira

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Supervisor:

Prof. Ana Lúcia Martins, Assistant Professor, ISCTE Business School, Department of
Marketing, Operations and General Management

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Abstract

Efficiency and effectiveness of services provided by public organisations have impact in customers' satisfaction. The current research has as main goal to analyse if lean tools create efficiency and effectiveness gains when applied to a specific set of processes from a public service. Accordingly, lean thinking background is considered.

The methodology adopted is based on a case study developed in the Education Department of the city council of Arruda dos Vinhos. Direct observation and informal interviews with staff members and customers are performed.

Three processes are analysed using Value Stream Mapping (VSM) tools: application for free school meals for students who apply for social benefits, application for "home-school-home" transport allowance, and money refund from transport expenses. The lean tools used are the VSM big picture map, process activity mapping, and spaghetti diagram. Processes' customers are identified and what they consider value is assessed. Wastes are identified and suggestions for improvement are developed.

Findings show that gains in effectiveness are expected if the suggestions provided are implemented, the process would be more accurate and the outcome would be obtained sooner and without mistakes resulting in more value for customers; regarding efficiency, based on the elimination of waste processes' total times reduction is expected in the three cases (useful time can be reduced by 29% in the first process, 47% in the second, and 34% in the last one), less human resources' time is required and shorter distances are covered.

Keywords: Lean thinking; Services; Process Activity Mapping; Municipalities.

JEL Classification System: M110 – Business Administration: Production Management; H70 – Public Economics: State and Local Government.

Resumo

A eficiência e eficácia dos serviços prestados por organizações públicas têm impacto na satisfação dos clientes. A investigação em curso tem como objetivo principal analisar se o uso de ferramentas *lean* cria ganhos de eficiência e eficácia quando aplicadas a um conjunto específico de processos de um serviço público. Neste sentido, são considerados os fundamentos do pensamento *lean*.

A metodologia adotada é baseada em um caso de estudo desenvolvido no departamento da educação da Câmara Municipal de Arruda dos Vinhos. São efetuadas observação direta e entrevistas informais com os empregados e clientes.

Três processos são analisados usando ferramentas de *Value Stream Mapping (VSM)*: requerimento de refeições escolares gratuitas para estudantes que solicitam apoios sociais, requerimento de subsídio de transporte para a rota “casa-escola-casa”, e reembolso do dinheiro das despesas de transporte. As ferramentas usadas são o *VSM big picture map*, *process activity mapping* e *spaghetti diagram*. Os clientes do processo e o que eles consideram “valor” são identificados. Os lixos são identificados e sugestões de melhoria são desenvolvidas.

Os resultados mostram que ganhos de eficácia são esperados se as sugestões apresentadas forem implementadas; os processos seriam mais precisos e o resultado seria obtido mais rapidamente e sem erros resultando em mais valor para os clientes; em relação à eficiência, baseado na eliminação dos lixos, é expectável a redução do tempo total dos processos nos três casos (o tempo útil pode ser reduzido em 29% no primeiro processo, 47% no segundo e 34% no último), é necessário menos tempo dos recursos humanos e as distâncias cobertas são mais curtas.

Palavras chave: Pensamento *Lean*; Serviços; *Process Activity Mapping*; Municípios.

Sistema de Classificação JEL: M110 – Business Administration: Production Management; H70 – Public Economics: State and Local Government.

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1. Introduction

Organisations perform operations and processes in order to create products or services which are valuable for customers (Allway and Corbett, 2002). Governments are also included in this definition, as they represent public organisations which provide services to citizens who are perceived as their customers.

Similarly to the private sector, people expect the best from the government. Public offices are shops where customers buy public services through the interaction with a customer-oriented employee (Teeuwen, 2011). Furthermore, citizens approve smaller governments but they also expect to maintain or improve the quality of the services received.

During the last few years, the efficiency and effectiveness of any organisation, regardless of the source of financing, has been tested as the economic constrains enforces the rationalization in the use of resources. Strategies must be redesigned and should emphasize not only cost reduction but also fulfilment of customers' expectations. Due to the competitive pressures organisations have to ensure the provision of products or services on time, accurately, in an accessible way and with superior quality.

Considering the modern view of the public sector, as well as, the challenges above mentioned, governments are becoming more concerned about the quality of the services provided and are embracing the management principles of the private sector, in an attempt to improve their services through innovative solutions (Janssen and Estevez, 2013).

Both, performance of an organisation and value creation are ensured by management tools which, when correctly applied and aligned with a global strategy, contribute to the wealth and efficiency of the organisation and have an ultimate impact in employees' motivation, customers' satisfaction and in the financial performance of the business (Fuentes and Díaz, 2012).

According to Teeuwen (2011), unlike the public sector, public organisations care about the equilibrium between the different interests of all citizens. The author also mentions that even when citizens are not the customers they might be interested in the result of public decisions. Teeuwen (2011) states also the concern of individuals with the efficient use of tax money in activities which they consider as value adding.

1.1 Problem Stating and Research Goal

Lean thinking approach is responsible for improvements in efficiency and effectiveness not only in manufacturing but also in services (Piercy and Rich, 2009).

Investigations as the ones developed by Radnor and Osborne (2013), Radnor and Johnston (2013), Radnor and Boaden (2008), Hasenjager (2006), Krings *et al.* (2006) and Barraza and Pujol (2010), are testing the implementation of lean thinking in public services. According to Radnor and Boaden (2008) and Radnor (2010), the application of lean thinking in this context requires some adaptations, however positive results can be found.

Notwithstanding the conclusions supporting lean, researchers such as Scorsone (2008) contest lean thinking in the public sector and defend that some specifications in this area, namely laws and the wide range of customers, do not allow the effective implementation of lean tools.

Thus, the results available in the literature are not entirely consistent and more research in the public sector is required in order to extend the range of examples and, consequently, clarify the results and corroborate, or not, the gains.

Currently, the public sector, and particularly local government, is struggling to maintain the level of quality in the services while the available resources are getting more limited. Radnor and Johnston (2013) suggest accuracy and timeliness as the major sources of customers' satisfaction. At the same time, Radnor and Walley (2008) and Jansen and Estevez (2013) mention public managers and politicians awareness of issues concerning efficiency and effectiveness is increasing as they try to realise how it would be possible to improve services and minimise the effects of economic constraints.

In this sense, the present work will focus on the application of lean tools in specific processes in municipal services, with the necessary adjustments in order to attest the potential of value creation. The aim of this thesis is *to analyse if the application of lean tools creates effectiveness and efficiency gains for a specific set of local government processes.*

The main purpose will be reached through some partial goals:

- 1) To select the criteria which will underlie the choice of the processes;
- 2) To choose the processes to be analysed within the municipal services;
- 3) To identify the customers of those processes and their perceptions of value;

- 4) To select the most appropriate lean tools to be applied;
- 5) To map and to analyse the processes;
- 6) To identify the resources, namely the time, used in each activity of the processes according to the mapping outcomes;
- 7) To identify the useful and the wasted resources in the processes;
- 8) To develop improved versions of the processes regarding efficiency and effectiveness gains.

1.2 Research questions

According to the problem stated and the purpose of this thesis, the research questions (RQ) are defined as follows:

RQ1: How executable is the use Value Stream Mapping tools in order to analyse municipal services?

RQ2: How are efficiency and effectiveness affected by applying lean thinking tools to public services?

1.3 Case study approach

Yin (2009) mentions that case study methodology is commonly used in studies regarding organisational and management processes.

Eisenhardt (1989) and Yin (2009) link the use of a case study approach with explanatory research which is iterative and highly connected to data. The data gathering methods in the case study analysis consist of interviews, archives, surveys and direct observation (Eisenhardt, 1989).

Due to its independence from previous investigations (Eisenhardt, 1989), case studies are also appropriate to investigate innovative areas in which the existent literature is limited. Moreover, case studies present superior benefits when dealing with heterogeneous situations requiring innovative and creative solutions (Delgado *et al.*, 2010).

Yin (2009) states three characteristics that should be presented in the research in order to apply a case study methodology: 1) a research question containing “how” or “why”; 2) the researcher has insignificant or no control of the events that are being analysed; 3) an investigation focused on contemporary events.

Considering the purpose and the research questions previously formulated, the goal of the present study is to disclose the possible impacts of lean tools in specific processes of

a public service through direct observation. Linking the aim of the investigation with the arguments for a case study implementation, it is perceived as the proper methodology to apply.

1.4 Scope of the study

In order to attain its purpose, this study will analyse a set of processes of a specific department in the municipal services of Arruda dos Vinhos, a town near Lisbon, Portugal.

Considering the interest of the city council, the processes to be analysed will be selected from the Education Department.

This research is only focused on the chosen processes which will be analysed using lean thinking tools. The results as well as the conclusions, regarding the improvements are valid exclusively in the field of this investigation (Yin, 2009).

1.5 Thesis outline

In order to answer the research questions previously defined, the thesis is divided into the following chapters:

- **Introduction:** the subject of the thesis was described and linked to the objectives, the research questions and the scope of the research;
- **Literature Review:** the theoretical framework is developed within the scope of lean thinking, so that the purpose of this research is sustained;
- **Methodology:** the methodology is revealed, the use of a case study approach is justified, as well as how the tools will be selected in the lean context;
- **Case study:** identification of the processes to be studied and analysis from a lean thinking perspective of the current performance levels, and of possible improvements in the specific processes of the municipal services;
- **Conclusions:** assessment of the research outcomes and definition of topics for further research.

2. Literature review

In this chapter, following the purpose of this research, a literature review of lean thinking will be provided. The key concepts, definitions and backgrounds are also expounded here as they represent the roots and support for the present thesis.

Thus, this chapter will start by introducing lean thinking as a management philosophy presenting its origin and evolution throughout time, including more recent and comprehensive influences. Then, the five lean principles, as disclosed by Womack and Jones (1996), will be addressed. Then, the application of lean in services environment, with particular emphasis in the public sector, is analysed based on the perspectives of several authors. Finally, a review about value stream mapping will be attempted.

2.1 Lean Thinking

2.1.1 Lean Thinking evolution

In order to understand the lean concept and its influence in an organisation it is essential to identify its origins. Henry Ford was the first manager coordinating a complete production process; producing high quantities without variety and aiming for lower costs. His system reformed the manufacturing paradigms and rationalized processes (Womack, 2002).

Later, due to the scarcity of resources and strong competition (Hines *et al.*, 2004), Toyota, a Japanese company, started developing an innovative production method combining small quantities, product flow and variety, as described by Ohno (1988).

The Toyota Production System focused on the total process instead of individual machines (Womack, 2002), thus increasing efficiency and eliminating waste. Womack (2002) and Hines *et al.* (2004) denote the Just-in-time production system, pull production, machines detecting defects and organised according to process sequence and employees' empowerment as responsible for achieving simultaneously cheap products, variety, quality as well as meeting customers' desires quickly.

This was the beginning of lean thinking - eliminating non-value adding activities, and using tools and techniques which would increase efficiency and effectiveness.

Hines *et al.* (2004) mention four different phases in the lean thinking evolution. More recently, new and wider perspectives have been disclosed by different authors, which might lead to a fifth phase. Table 2-1 summarizes these stages.

Application of lean thinking tools to municipal services

Phases	1980-1990 Awareness	1990-mid 1990 Quality	Mid 1990- 2000 Quality, cost and delivery	2000 – mid 2000 Value system	Mid 2000 + Performance
Literature Theme	Dissemination of shop-floor practices	Best practice movement, benchmarking leading to emulation	Value stream thinking, lean enterprise, collaboration in the supply chain	Capability at system level	Expansion to new areas of application; culture as an enabler of lean
Focus	JIT techniques, cost	Cost, training and promotion, TQM, process reengineering	Cost, process- based to support flow	Value and cost, tactical to strategic, integrated to supply chain	Measuring leanness; articulation of human resources and culture development aspects
Key business process	Manufacturing, shop-floor only	Manufacturing and materials management	Order fulfilment	Integrated processes, such order fulfilment and new product development	Integrated office and manufacturers; pure services management
Industry sector	Automotive – vehicle assembly	Automotive – vehicle component assembly	Manufacturing in general – often focused on repetitive manufacturing	High and low volume manufacturing, extension into service sectors	Entire supply chain; private and public services
Main authors	Shingo (1981, 1988); Monden (1983); Ohno (1988); Mather (1988)	Womack <i>et al.</i> (1990); Hammer (1990); Stalk and Hout (1990); Harrison (1992); Andersen Consulting (1993, 1994)	Lamming (1993); MacBeth and Ferguson (1994); Womack and Jones (1994, 1996); Rother and Shook (1998)	Bateman (2000); Hines and Taylor (2000); Holweg and Pil (2001); Abbas <i>et al.</i> (2001); Hines <i>et al.</i> (2002)	Baines <i>et al.</i> (2006); McCouston (2010); Bayou and De Korvin (2008); Piercy and Rich (2009); Radnor and Johnston (2013); Hines <i>et al.</i> (2008)

Table 2-1 - Lean evolution

Adapted from: Hines *et al.* (2004) and Stone (2012)

The development and dissemination of lean was not immediate; it took several years until other companies became aware of the reasons for Toyota's success. In the 1970s the first manuals about lean were written and one decade later they were translated into English (Hines *et al.*, 2004). Automotive companies learning about lean led the first period of its evolution.

According to Hines *et al.* (2004), the second and third stages spread lean thinking developed first as a concept applicable to other manufacturing areas and later to the entire supply chain. Ultimately lean principles (considered in sub-chapter 2.2) became the guideline to those implementing lean. The emphasis evolved from quality, exclusively, to quality, cost and delivery; and later, during the fourth stage, to customer value. Furthermore, lean grew as a management philosophy which could be applied in manufactures, and also in services regardless of their size (Swank, 2003).

The last stage of lean evolution, as underlined by Stone (2012:120), is related to performance: “...attempting to increase the credibility of traditional measures of lean performance typically expressed in forms associated with quality, cost, delivery and safety”. Moreover, services not only in the private sector, but also in public organisations became dominant in the literature.

Thus, Wood (2004) brings forward a current definition of lean thinking as the tools, skills and values shared by the whole organisation to systematically eliminate waste and improve the processes' performance in order to deliver superior value to customers.

2.1.2 Leadership, culture and behaviour

According to Hines *et al.* (2004) the emphasis of the lean thinking approach is on waste reduction and value enhancement for customers.

In order to achieve this goal, the focus is often on how tools and techniques are applied; Bowen and Youngdahl (1998), Chaneski (2005), Krings *et al.* (2006) are examples of researchers who based their studies on the replication of those tools. However, during the last years, researchers such as Hines *et al.* (2008), Abdi *et al.* (2006), Hines *et al.* (2002), McCuiston (2010), Stone (2012), Bhasin (2012) and Smith (2013) have been supporting a different perspective and claiming that the effectiveness of lean depends not only of tools and techniques, but also of internal characteristics.

They defend that by applying *Kaizen Blitz* events quicker results can be achieved. Nevertheless, in the long term, there is likelihood to return to the initial state, hence to fail. This same perspective is held by Womack (2002) and Stone (2012). On the other

hand, when the focus is on a cultural and behavioural change, long term results are more consistent, the organisation is successful in lean implementation and will seek for continuous improvements (Hines *et al.*, 2008; Abdi *et al.*, 2006; Hines *et al.*, 2008a; Maleyeff, 2006; Stone, 2012).

The transformational process should start with the top managers and, according to Allway and Corbett (2002), Hines and Lethbridge (2008), Tischler (2006), McCuiston (2010) and Smith, (2013), leaders must believe in lean and support it.

Leadership should be innovative and inspiring (McCuiston, 2010) and establish a vision of the future aligned with lean, as well as define an effective strategy to achieve that vision and disclose it within the organisation (Hines *et al.*, 2008). Thus, employees should be engaged so that they feel involved in the lean transformation (Hines *et al.*, 2002; Hines *et al.*, 2008; McCuiston, 2010; Hines *et al.*, 2008a; McQuade, 2008).

Moreover Holmes (2007) and Fuentes and Díaz (2012) point that human resources commitment, vital to the organisation, is contingent on sharing values and ideas, motivations and goals. All employees need to be committed, understand how lean can benefit them, and how it enables teamwork and respect for people (Smith, 2013; Krings *et al.* 2006). Smith (2013) states the importance of active participation of staff in the search for the best procedures for their working areas.

Contrarily, the lack of stimulating leadership and the wrong cultural view are the main responsible for lean failure (Atkinson, 2010; Bhasin, 2012).

Figure 2-1 shows one of the most important contributions regarding the holistic approach of lean. Hines *et al.* (2008) compare the lean transformation process to an iceberg – the visible part includes the technology, tools and techniques, as well as, process management; the invisible part comprises the internal features that support lean and should be extended to all levels of the organisation namely, strategy and alignment; leadership; behaviour and engagement.

Per se the visible tools are not enough as the greater part of the transformation occurs before implementing the observable changes within the organisation amongst managers and employees. Lean implementation is only possible through the combination of methods. One part of the iceberg is not sustainable without the other.

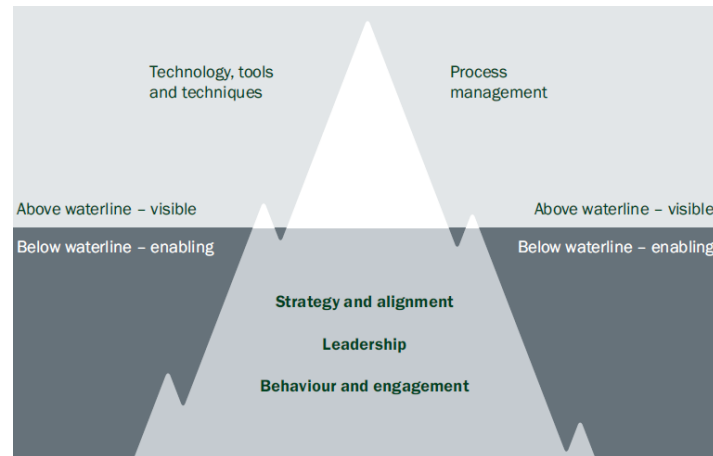


Figure 2-1 - The sustainable lean iceberg

Source: Hines *et al.*, 2008:9

2.2 Lean principles

Lean thinking is considered by Womack and Jones (2003) as the solution to eliminate waste, and to generate a sequence of activities without interruptions thus leading to value creation and greater efficiency. According to these authors, the application of lean allows an organisation to do more with less resources, while customers are closer to get exactly what they want (Womack and Jones, 2003; Atkinson, 2004).

In order to achieve these goals, Womack and Jones (1996) defined five fundamental principles to guide the lean thinking approach:

- 1) specification of the product or service **value** desired by the customer;
- 2) **value stream** identification for each product;
- 3) making the **product flow** through value adding activities;
- 4) introducing the **customer pull** between all the activities;
- 5) striving for **perfection** by continuous removing waste.

2.2.1 Value

Value is defined by customers according to their needs, expectations, desires and preferences at a certain moment (Hines *et al.*, 2002). Realizing what customers want and meeting these needs regarding attributes such as time, price or quality increases the perceived value of the product or service and therefore customers' satisfaction (Abdi *et al.*, 2006). Therefore, before starting a process, organisations should understand what customers anticipate of it (Womack and Jones, 2003).

The goal of lean thinking is the elimination of waste in order to enhance superior value for customers. In effect, rather than starting by applying lean at an operational level, using tools to waste elimination, one should begin with lean thinking at a strategic level, that is, understanding value (Hines *et al.*, 2004).

Creating value is not only about eliminating waste and cost reduction, there are new services and products' features that are valued by customers, adding those services will increase the perceived value of the whole process (Hines *et al.*, 2004).

According to Hines *et al.* (2004), organisations mostly consider quality, cost and delivery as key areas for improvement. Nonetheless, Hines *et al.* (2004:1004) clarify the concept of value as a “...wider and more complex range of tangible and intangible attributes such as brand, image, environmental issues and local production”. However, Bowen and Youngdahl (1998) consider that these intangible concepts make lean implementation harder as organisations need to realize customers' perceptions which are not directly observable.

In this sense, one of the greatest mistakes when defining value is the adopted perspective: value must be seen in the customers' outlook, rather than for the firms, functions or departments (Hines *et al.*, 2008). Ultimately, by considering the different tangible and intangible possibilities to design value, “...any concept that provides customer value can be in line with a lean strategy” (Hines *et al.*, 2004:1006).

2.2.2 Value Stream

Since the value of a product or service is determined according to the customers' perspective, it becomes necessary to consider the different stages of the value stream. According to Hines and Taylor (2000:4) this second principle of lean thinking comprises the identification of “...all the steps necessary to design, order and produce the product across the whole value stream...”.

Analysing the value stream, the activities required to produce a good or service are highlighted and it is possible to optimize the process in order to obtain the greatest value for customers (Abdi *et al.*, 2006).

Piercy and Rich (2009) refer that mapping the steps through *value stream mapping*, which lists all the activities as well as the resources consumed, is the best way to identify the waste and the improvement opportunities.

According to Hines *et al.* (2002) four types of activities can be found when analysing a process:

- **Value adding activities:** activities that make a product or service more valuable to customers (they agree to pay for them);
- **Future value adding activities:** activities that will make the product more valuable in a certain moment (such as marketing or the development of a new product);
- **Support activities:** activities that do not make the product more valuable but are necessary (the process would have to be completely transformed to eliminate them);
- **Waste or non value adding activities:** activities that do not make a product or service more valuable and are not necessary (customers do not agree to pay for them).

2.2.3 Product flow

Once value streams are planned and free of non-value adding activities, the next principle is assessed. In effect, for Abdi *et al.* (2006) and Hines and Taylor (2000) the flow is reached when the product or service is produced through the value stream without delays, interruptions, waiting times or backflows.

After eliminating waste, product flow is readily achieved through the reduction of the number of activities, thus resulting in a more fluid process. In fact, reducing waiting times, reviews and inventories of work in progress allows the process to run more smoothly (Teeuwen, 2011).

2.2.4 Pull of the customer

The fourth principle of lean focuses on producing only what is demanded by the customer (Hines and Taylor, 2000). Teeuwen (2011) emphasizes the importance of start a process only when an external customer or another department within the organisation ask for it. This producing method presents a number of advantages, such as, the ability to change when the customer wants a different product and to adapt the process and the final product or service to each customer or group of customers at a specific moment; the inexistence (or the existence of minimum amounts) of inventory; the clarity of the processes and easier error detection (Abdi *et al.*, 2006; Teeuwen, 2011).

2.2.5 Perfection

The last principle aims at completely eliminating waste and only performing value adding activities - the organisation tries to reach perfection (Abdi *et al.*, 2006).

There are infinite opportunities to improve and this fifth principle is the result of the application of the previous principles which should be incessantly applied in order to continuously improve the process. Moreover, Kocakulâh *et al.* (2011) refer that improvement in one process or department opens possibilities for improvement in others.

The results of lean thinking implementation are easily overlooked and there is a tendency to return to previous routines (Hines *et al.*, 2008); therefore commitment is necessary to maintain lean as an essential strategy in order to extend its positive effects and seek for perfection. Strategy alignment is widely spread within the organisation which leads to the long term success of lean through cost reduction and increased competences and skills which are able to overcome future challenges (Godsell, 2009).

Altogether perfection should be endlessly pursued however it will never be reached. As mentioned by Hines *et al.* (2002), after applying the five principles, the organisation should return to the first one and pursue new opportunities for improvement.

2.3. Lean thinking and services

Even though lean thinking started as a management tool applied exclusively to the manufacturing industries, during its evolution it was also applied to the services context. One of the first authors that agreed that services could benefit from applying manufacturing principles was Levitt (1972, 1976). However the majority of the literature at that time disagreed with this interpretation given that customers' demand for services had high variability and was difficult to forecast, so lean would not fit this area (Abdi *et al.*, 2006).

Recently the validation of lean thinking in services has been broadly studied by authors such as Allway and Corbett (2002), Demers (2002), Radnor (2010), Hines and Lethbridge (2008), Piercy and Rich (2009). They have reported evidence that the services sector can benefit greatly from this approach. Thereupon, in order to describe this expansion, a new concept was stated by Abdi *et al.* (2006): "*lean service*".

Despite the conclusions regarding the improvements introduced by the tools and techniques imported from the manufactures, it is relevant to notice the characteristics

which differentiate the manufactures from the services. As the presence of the customers during the process is frequent in services, and they might participate in the process, there is simultaneity of production and consumption (Abdi *et al.*, 2006; Bowen and Youngdahl, 1998; Wei, 2009; Bortolotti and Romano, 2012). Additionally, it is impossible to create inventory due to the intangibility and perishability of services - employees have to be available to respond to the heterogeneous, diverse and unpredictable demand (Bowen and Youngdahl, 1998; Maleyeff, 2006; Wei, 2009).

In order to deal with the simultaneity characteristic referred above, Heskett (1987) considers that a “*strategic service vision*” would be more effective in a pure services sector. The main idea is to establish a relationship between marketing and operations as employees are selling and executing simultaneously. Besides, customers’ satisfaction will depend on the staff’s actions and competences, and therefore it is important to focus not only in process efficiency, but also in how customers are served (Piercy and Rich, 2009a; Radnor and Johnston, 2013).

Another divergent point is human resources. Allway and Corbett (2002) state that in services, employees become more surprised and resilient to drastic changes. Furthermore, Hines *et al.* (2008a) highlight the difference in behaviour: unlike what happens in the manufacturing sector, in services any small improvement is highly celebrated while the concern with future achievement is low.

There are two distinct services inside an organisation: the internal and external service. Internal service delivers products or services to other departments or processes within the organisation (internal customers); on the other hand, external services deliver services to an external customer (Johnston, 2008). Considering Radnor and Johnston (2013), the quality of external services and the value delivered to external customers is greatly influenced by the quality of internal services. As a result, standardisation becomes central to guarantee uniformity within the services in the entire organisation (Allway and Corbett, 2002).

Maleyeff (2006) states that services are all about information, therefore customers value accurate, complete information. Hence, the first improvements when applying lean thinking should focus on information to ensure it is relevant, unambiguous, delivered fast and effectively (Maleyeff, 2006).

Service organisations, as revealed by Heskett (1987), have their emphasis on customers, ideas and information in order to customize the operations and meet the customers’ expectation.

2.3.1 The public sector

The public sector is a specific case within the service industry. Radnor and Osborne (2013) refer that in governments it is harder to define who the customers are and what they value, it is impossible to influence demand or business growth, and the focus is not only on efficiency and cost reduction but also on effectiveness and equity.

The lean thinking approach has arisen in the public sector as a tool to improve resources utilisation in order to maintain or improve the quantity and quality of the services delivered in a period of economic constraints and reduced budgets (Radnor and Osborne, 2013; Pederson and Huniche, 2011).

There are several authors, such as Hines and Lethbridge (2008), Kenworthy (2013), Arlbjørn *et al.* (2011), Radnor and Johnston (2013), Radnor *et al.* (2006), who present evidence that lean in the public sector brings benefits to the organisations concerning performance (namely quality), smaller leading times, efficiency, cost reduction and employees' motivation.

All improvements lead to increased customers' satisfaction (Radnor and Johnston, 2013; Radnor and Boaden, 2008). However, it is important to explore who the customers are and what they consider valuable.

As public services perform mostly in a monopoly, citizens are unable to choose from where to receive a service, however not all citizens are customers of public services, and they must also pay taxes. According to Teeuwen (2011) there are seven different roles of citizens:

- **Customer:** similar to a customer in the private sector;
- **User:** someone who uses public facilities (parks or libraries for example);
- **Subject:** citizens have the right to live with order and authority under the laws and legislations of the government;
- **Voter:** citizens are represented by the elected politicians;
- **Taxpayer:** citizens expect tax money to be used in good projects;
- **Partner:** active and collaborative role in the progress of, for instance, the town;
- **Administrator:** citizens who become politicians and guide the future of the town.

Customer satisfaction depends not only of the final outcome, but also of how punctuality, accuracy, clarity, timeliness, employees' response and availability (experienced service) meet their expectations (Wei, 2009; Radnor and Johnston, 2013; Kenworthy, 2013; Teeuwen, 2011).

Despite the existence of literature supporting the extension of lean thinking to governmental institutions and the successful cases reported (see, for instance, Frater, 2005; Barraza and Pujol, 2010; Hasenjager, 2006; Barraza *et al.*, 2009), some authors have reservations about this issue. Scorsone (2008) introduces laws and legal constraints as limitations to the implementation of lean, but they can be seen as the equivalent of the laws for the private sector; additionally the author refers that the stakeholders of the value streams are not only the customers but also the citizens interested in the outcome of the service.

The processes should be focused only in activities that add value to customers; however Teeuwen (2011) and Kocakulâh *et al.* (2011) introduce a specific characteristic of public services, that is, it is possible to find unavoidable waste, as according to the law some activities (for instance some reviews) must be performed.

Technology is often a suitable solution for redesigning projects; however Frater (2005) denotes that, although technology is broadly applied, it is not always the best alternative. Governments facing tight budgets should start by using knowledge - plain processes give employees the opportunity to develop their own vision of the job and with the right tools they can unremittingly improve their jobs (Frater, 2005).

As mentioned in chapter 2.1.2, leadership and culture are fundamental to lean implementation, authors such as Kenworthy (2013), Bhasin (2012), Radnor and Walley (2008) or Radnor and Osborne (2013) indicate that in public services these areas maintain their relevance. Kumar and Bauer (2010) highlight the lack of profit motivation and resources limitations as challenges to extend lean to governments; even though it might happen, a stimulating leadership will engage and motivate people to be committed with lean. On the other hand, leaders in public organisations are often politicians, so it is difficult to ensure continuity as politics are short term (Krings *et al.*, 2006; Deming, 1986).

Radnor and Walley (2008) and Hines and Lethbridge (2008) highlight that starting lean implementation with events producing rapid changes is also a positive aspect to involve people, as they can see the results quickly and come back to perform their tasks without concerns regarding the future of their jobs or the management style.

Notwithstanding the unquestionable importance of culture and strategy, according to Radnor *et al.* (2006) the implementation of lean in the public services does not always follow this traditional approach. Lean in this area is not only about implementation but also about adaptation; it is seen as a set of tools and techniques, instead of a cultural transformation which contemplates the principles, strategy and alignment within the organisation (Radnor and Boaden, 2008; Radnor and Osborne, 2013).

In spite of the positive results, lean is failing in the emphasis. Radnor and Osborne (2013) mention that internal customers are assuming greater importance in comparison to external customers and effectiveness. In this sense, the authors refer that is harder to meet the expectations and add actual value to customers.

Actually, as highlighted by Radnor *et al.* (2012) the implementation of lean does not follow infrangible rules; it is dependent of the context.

Although this view might not be sustainable in the future, in the short term, due to the global crisis and economic restrictions, it seems more important for organisations to reduce cost than to understand customers and align the strategy with their definitions of value (Radnor and Johnston, 2013). Considering the long term, in this context, services are likely to get worse as the processes will not take the desires of the customer into account, so the effectiveness and efficiency will be lost (Radnor and Johnston, 2013).

In effect, lean in the public sector should begin with basic tools and techniques, focusing on customers, flow and reduction of waste, as underlined by Radnor and Boaden (2008). Even though lean in the services area should be implemented with some adaptations and might be considered a paradox, there are tangible (such as, cost and time reduction) and intangible (for instance, quality; employees' motivation and customers' satisfaction) effects that reflect enhancements in efficiency and effectiveness, as disclosed by authors such as Radnor and Johnston (2013), Radnor (2010) and Radnor and Walley (2008).

2.3.2 Using mapping tools in service organisations

The evidence regarding lean benefits is not only theoretical. Some researchers, as Piercy and Rich (2009), Hines *et al.* (2008a), Hines and Lethbridge (2008), Swank (2003), Chaneski (2005), have applied the concept outside manufacturing in order to demonstrate how lean could be suitable for service operations.

It has been observed that lean thinking can be applied to the value chain as a whole (from suppliers to customers) in all sectors (Fuentes and Díaz, 2012). Lamming (1996)

provides an example of this application in automotive and electronics industries and in the retail sector. Evidence of benefits when implementing lean thinking through the whole supply chain is also supported by Hines (1996).

Service	Examples of applications	Tools used	Main Authors
Financial/ Insurance	Redesign the policy application process.	Cycle and takt time; Value stream mapping	Swank (2003); Allway and Corbett (2002); Buzby <i>et al.</i> , (2002); Hammer (2004)
Food service/ Hospitality	Change food preparation and delivery processes.	JIT techniques; Value chain analysis	Bowen and Youngdahl (1998); Womack and Jones (2005)
Airlines	Change in-flight customer service.	JIT techniques	Bowen and Youngdahl (1998)
Healthcare	Standardization of abdominal hernias surgery; process of purchasing or supply chain inputs.	Mapping techniques and waste reduction	Bowen and Youngdahl (1998); Jones and Mitchell (2007)
Office	Streamline the orders' receiving process; quotation processes; restructure the creation processes since the order is received until it is transmitted to the plant.	Value stream mapping	Chaneski (2005); Vinas (2004); Wallace (2006); Chen and Cox (2012)
Call centre	Standardization of the dialog scripts; restructuring the work teams (at the entry, processing and end stages of the contacts).	Value stream mapping; Standardisation;	Piercy and Rich (2009; 2009a); Sprigg and Jackson (2006)
Legal sector	Identify the wastes during argument, definition and verdict stages.	Value stream mapping	Hines <i>et al.</i> , (2008a)
University	Restructure the admission process; processing inquiries about the university.	Value stream mapping	Hines and Lethbridge (2008); Tischler (2006)
Public Housing	Streamline the application process; Implement a just-in-time system to the warehouse; streamline the process of determination of the houses' value.	Value stream mapping; Six Sigma	Frater (2005); Kumar and Bauer (2010)
Local Government and other public departments	Simplify recruitment processes; tax collection processes; capital tax claims process.	Value Stream Mapping; 5S;	Hasenjager (2006); Krings <i>et al.</i> (2006); Barraza and Pujol (2010); Barraza <i>et al.</i> (2009)

Table 2-2 - Lean tools application in the services sector

Source: Own creation

Ellram *et al.* (2004) disclose the scope of the supply chain within the services context: it concerns management of information, performance and capital.

The *value stream mapping toolkit* was successfully used in some lean applications. This tool efficiently eliminates waste and enables improvements as it provides an overview of the material and information flow, fundamental to understanding the process and the inefficiencies in resources allocation (Abbas, 2001; Hines *et al.*, 2002).

As mentioned before, the application of lean thinking in services through the use of mapping techniques is a common practice among researchers in this area. Table 2-2 summarizes some relevant cases developed in the last years. Specific examples of the processes restructured in each sector are provided and linked with the applied tools, in order to demonstrate its feasibility across areas and processes displaying different characteristics.

2.3.3 Wastes in the service context

Identifying waste is one of the main steps in the implementation of lean thinking. Waste is defined by Hines *et al.* (2002) as everything that does not add value to the customer. There are seven types of waste considered by Ohno (1988) in the manufacturing industry: overproduction, waiting, transportation, inappropriate processing, unnecessary inventory, unnecessary motion and defects.

However, as mentioned by Maleyeff (2006:683), the manufacturing list of waste “...appears to relate specifically to manufacturing due to an implicit assumption that a tangible good is being processed as the main source of value”.

When analysing processes in the scope of services, authors adapt the traditional wastes in order to fit their research; for instance Hines *et al.* (2008a) interpreted waste in the legal sector. Maleyeff (2006) went further and provided a significant contribution for those studying lean thinking in the services context by interpreting the traditional wastes in the general context of services:

- **Delays:** documents waiting in a queue to be processed later or waiting for additional information from other departments;
- **Reviews:** inspection of work previously done by another member of staff in order to detect errors or omissions;
- **Mistakes:** errors or omissions which mean that the work has to be redone or, if found by the customer, will incur in reputation damages;
- **Duplication:** activities that are done twice in the same process;

- **Movement:** excessive or pointless moving of information, personnel, or equipment;
- **Processing inefficiencies:** resources allocated in an inefficient or ineffective way;
- **Resource inefficiencies:** result of inefficient management of people, equipment, materials or capital.

Despite the different nature of manufacturers and services, there are some similitudes between the wastes in both sectors. The wastes considered in manufacturers are related to the tangible aspects of the execution of the set of activities of the process, the same is true for the wastes in the services which might enable correspondence.

Attempting to link the classifications from both areas, it could be stated that delays would correspond to waiting since both concern periods of inactivity; regarding errors that are produced, defects and mistakes are comparable; considering the movement of people, products and materials, movement can be interpreted as similar to excessive transportation; unnecessary motion from the manufacturing area can be considered as a resource inefficiency since it concerns the excess of movement in the work place during the provision of services; processing and resources inefficiencies could correspond to inappropriate processing, as both concern the complexity of the processes or equipment used; reviews in the services area are used as inspections; and duplication might be perceived as an inefficient use of resources therefore it might be considered as an inappropriate processing. A summary of these correspondences is presented on Table 2-3.

Manufacturer waste	Service waste
Waiting	Delays
Defects	Mistakes
Inspections	Reviews
Inappropriate processing	Duplication
Transportation	Movement
Inappropriate processing	Processing inefficiencies Resource inefficiencies
Unnecessary motion	Resource inefficiencies

Table 2-3 - Manufacturing and service waste comparison

Source: Own creation

2.4 Summary

In this chapter the main theoretical and empirical contributions on lean thinking were revealed.

A description of the origin of lean in a context of economic and resources constraints is given; then the evolution throughout time is explored and the holistic approach based on performance and cultural change is brought forward as the current and future lines of research.

Next, the five principles are presented and a description of the importance of each one is performed since value, value stream, flow, pull, and perfection represent the fundamentals of lean thinking implementation and are ultimately the aim of the this transformational process.

A more thorough analysis in the services sector is provided in order to identify its distinguishing characteristics from the manufacturing area. Then, the public sector is described as a particular case in which lean is valuable in spite of the adaptations of the lean concept itself and its implementation.

Finally, further examples of lean thinking in services are provided, highlighting the importance of value stream mapping in order to achieve a reduction of waste and generate improvements. A reinterpretation of waste to suit the services is reported and a match between wastes from the manufacturing area and the services sector is attempted.

3. Methodology

This chapter aims to justify and contextualise the methodology used in the present thesis according to the problem stated and the proposed goals. The essential stages of the research are described.

In addition, the theoretical foundations are connected with the research questions in order to provide guidance to the development of the case study. The principles that justify the selection of the processes are described and a framework of lean thinking tools is presented in order to provide sustainable ground for the selection of the most appropriate mapping tool to be used in this research. This selection is based on the theoretical application of each one of the mapping tools and the context of the research.

3.1 Case study approach

According to the goal and the research questions previously mentioned, the methodology used in this thesis is the case study approach.

Yin (2009:18) describes a case study as:

“an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident”.

This characterisation matches the objective of this research whose purpose is to study the selected processes of a public service, concerning contemporary real-life events.

Moreover, a case study approach is suitable when there is little or no control over the events and the research question is formulated based on a “how” or “why” question (Yin, 2009).

3.1.1 Characterisation

According to Yin (2009), in order to answer the research questions the case study will have a descriptive nature since the processes will be mapped exactly as they happen in the real-life context.

Besides, the case is also considered exploratory; besides the description of the processes using lean thinking tools, some alternative solutions, based on a lean thinking approach, are advanced aiming at improvements in efficiency and effectiveness.

3.1.2 Design

Following Yin (2009), the present case study is structured as a single case study namely, a department of the municipal services, in which a specific set of processes will be observed and analysed.

3.1.3 Research ethics

An authorisation to perform the present thesis in the city council of Arruda dos Vinhos was requested and granted by the city council authority in September 2013.

One of the major issues during research, as mentioned by Yin (2009), is related to the behaviour of the employees who, due to the presence of an external observer, might perform differently since they might face the situation not as a study but as an evaluation. Consequently, their availability to provide information and share knowledge is expected to be limited.

In order to deal with this problem, an explanation about the scope, the goals and the theoretical basis of the present thesis will be provided to the employees, before starting the research.

3.2 Data gathering

The collection of information comprises different sources: analysis of relevant documentation such as agendas, reports, proposals or minutes of meetings; informal interviews with the mayor, those responsible for each process, as well as, the employees who perform the activities included in the processes; and finally, direct observation of the processes. These tools are aligned with Eisenhardt's (1989) recommendations.

The information necessary to select the process and the suitable lean tool will be gathered through informal interviews and direct observation, as well as, the analysis of documentation provided by the municipality. Mapping tools will be based on direct observation, and some informal interviews will also take place during this stage. Detection of waste, as well as, improvements will be based on the data gathered during the previous stages.

The data was collected in the city council office in Arruda dos Vinhos, Portugal, on September 2013 and between January and March 2014.

3.3 Process selection

The processes to be analysed will be chosen from the Education Department and will be based on different criteria:

- 1) Importance of the processes for the municipal department under analysis – the process should be one of the most important in the department (based on the information gathered through the informal interviews), share resources and compete for their availability; the customers' vision of quality and efficiency regarding the analysed department should be influenced by the process.
- 2) Information should be the main asset and it should be transmitted across different departments as, according to Maleyeff (2006), the services sector is based on information, and therefore it should be the basis of the process during its performance. The final outcome should concern information too. The transmission of information is important as it is seen as a source of waste and inaccuracy by employees and customers.
- 3) Existence of waste – given that the goal of lean thinking is to create value through waste elimination, the process selected should be one in which customers and employees involved in acknowledge the presence of waste.

3.4 Lean tools selection

At the beginning of the investigation, an effective understanding of the processes will be accomplished with an overview of the situation (Hines *et al.*, 2002). The waste within the processes should be straightforwardly recognised by looking to the picture of the value stream, as defended by Hines (2002).

After an overview of the process, a detailed analysis should be performed. As stated in chapter 2.3.2, the value stream mapping toolkit has been applied in several investigations as it provides a list of all the activities and enables the identification of waste. As mentioned in Table 2-2 (sub-chapter 2.3.2), in the services context this tool was applied by authors such as Chaneski (2005), Vinas (2004), Chen and Cox (2012), Piercy and Rich (2009; 2009a), Hines *et al.*, (2008a), Hines and Lethbridge (2008), Tischler (2006), Hasenjager (2006), and Krings *et al.* (2006).

The selection of the most suitable tool depends on the type of waste that the organisation faces – different wastes are easily revealed through different tools (Hines and Rich, 1997; Hines *et al.*, 2002).

Hines *et al.* (2002) considers five mapping tools: process activity mapping, production variety funnel, quality filter mapping, demand amplification mapping, and process costing. The authors developed a matrix linking the seven wastes with the mapping tools (Table 3-1). The ability of each tool to detail each waste is evaluated through a “yes, maybe, no” scale.

The wastes used to build the matrix are the ones described by Ohno (1988) as applied to manufacturing. As this study is focused on services, the most suitable description of waste is the one provided by Maleyeff (2006) – delays, reviews, mistakes, duplication, movement, processing inefficiencies, and resource inefficiencies. Notwithstanding the differences between manufacturing and services a connection between the types of wastes may be put forward and the matrix is still valid. The links between the different wastes are suggested in sub-chapter 2.3.3.

	Process activity mapping	Production variety funnel	Quality filter mapping	Demand amplification mapping	Process costing
Overproduction	Maybe	No	Maybe	Maybe	Yes
Waiting	Yes	Maybe	No	Maybe	Yes
Excessive transportation	Yes	No	No	No	No
Inappropriate processing	Yes	Maybe	Maybe	No	Yes
Unnecessary inventory	Maybe	Maybe	No	Yes	Yes
Unnecessary motions	Yes	No	No	No	Yes
Defects	Maybe	No	Yes	No	Yes

Table 3-1 - Matching between Value Stream Mapping toolkit and types of waste

Source: Hines *et al.*, 2002:35

Depending on the main types of waste initially identified in the processes selected for analysis, and based on Table 3-1, the most adjusted mapping tool will be identified.

3.5 Steps of the research

In order to meet the aim of the research, the use of lean thinking tools will take place as in the various stages described below:

- 1) Selection of the processes to be analysed;
- 2) Definition of the processes' customers and their perceptions of value;
- 3) Selection of the lean tool to be used;
- 4) Application of the selected mapping techniques to the processes;
- 5) Analysis of the processes to detect waste and to assess the efficiency and effectiveness;
- 6) Development of suggestions to improve the processes using lean thinking ideas;
- 7) Critical evaluation of the impact in efficiency and effectiveness, and comparison of the processes' performance before and after the transformations.

4. Case Study

In order to answer the research questions and reach the goals stated in Chapter 1, this chapter provides an analysis of a set of processes of a city council department. The processes will be analysed based on the lean thinking concepts presented in the literature review (Chapter 2), and follow the methodology described in Chapter 3.

Firstly, a succinct description of the municipality, as well as, the specific department under analysis will be attempted.

Afterwards, the processes will be selected based on the criteria defined in the sub-chapter 3.3. Taking into account the chosen processes, the customers will be revealed and the value will be identified in accordance to their perspectives.

Subsequently, the types of waste prevailing in the processes will be linked with the criteria from sub-chapter 3.4 in order to select the most suitable mapping tools.

Hereafter, the processes will be described and the mapping tools will be applied aiming at detecting waste. Within the scope of lean thinking, opportunities for improvement regarding efficiency and effectiveness will be considered and the processes will be redesigned using the mapping tools to highlight the improvement proposals. Finally, comparing the current processes and the improvement suggestions, the possibility to conclude whether the use of lean tools in local government creates gains in efficiency and effectiveness will be assessed in order to reach the purpose of this thesis.

4.1 City Council of Arruda dos Vinhos – Description

Arruda dos Vinhos is a town near Lisbon with a population of about 13 000 inhabitants. Rural life coupled with some city characteristics provides a great quality of life which has attracted citizens from urban centres to relocate, thus increasing the expectations regarding public welfare and consequently the demand for quality (Marques, 2003).

The responsibility to ensure people's satisfaction in a wide range of areas lies in the city council. According to informal interviews with the city council authority, this institution develops a sustainable strategy taking into account the environment, the economy and the society.

In order to accomplish its mission, different departments answer to one of the council members or, ultimately, to the mayor.

The departments perform tasks required by customers or by other sectors within the municipal service. The main units are responsible for areas such as: environment, energy and sustainability; urbanism and private building; legal issues; accounting;

treasury; cultural issues; education; social welfare; civil protection; human resources management; water supply and waste management; public works.

Taking into consideration the interest of the city council, as well as the availability to welcome an external observer, the department in which the processes will be analysed in detail in this study is the *Education Department*. The employees of this unit are responsible for the management of the schools and students. There are three educational centres with about 1000 children whose ages range from 3 to 10 years old.

The city council is accountable for tasks such as the management of the employees in the schools, the supply of meals and the supply of cleaning products. Furthermore, they often have to visit the educational centres in order to ensure their correct functioning and to identify areas for improvement. Regarding students, the municipal service manages their enrolment in home to school transport and their application for free school meals. It is also responsible for assessing the requests for children social benefits from families with financial problems. Moreover, Education Department is accountable for managing and enrolling students in extra-curricular activities (sports and arts).

Older children attend a privately managed school; however some issues concerning the students, such as the transport allowance is processed in the Education Department of the city council.

The *Education Department* reports to the director of the *social and cultural department* and is under purview of one of the city council authorities.

4.2 Process selection

Considering the criteria defined in the sub-chapter 3.3 three processes were selected for a detailed analysis. In order to decide which processes would better meet the criteria, information was collected through direct observation and informal interviews with the city council authorities responsible for the Education Department and the staff.

A justification matching the defined criteria with the specific processes is provided below:

1) Application for free school meals for students who apply for social benefits

The process is one of the most frequent in the Education Department; it requires a careful analysis of some indicators and deals with the sensitive issue of family income. The duration, as well as the accurate outcome of the process, influences customers' opinion regarding the quality of the public service. The process is fully based on information which is moved across different departments (general

service, education department, city councilmember office): any mistake during the transmission of information may lead to an inappropriate result. The informal interviews identified the existence of delays, reviews, processing and resources inefficiencies which may indicate the existence of waste.

2) Application for “home-school-home” transport allowance

This is a core process which consumes a lot of time and human resources. Information is crucial during the whole process, but the way it is transmitted across departments causes some disturbances reported in the informal interviews. These were delays, duplication of tasks, inefficient processing and accumulation of requests in a previous department before being transmitted to the next one.

3) Money refund from transport expenses

Refunding the money to citizens is an important task in a public service. In the Education Department the same customers require this service every month; which, due to its routine characteristics, should be performed as quickly as possible. In this process the information is passed on between several departments (general services, education department, accounting, treasury); despite having money being the final outcome, information is core to the whole process. During the initial observation and the informal interviews delays, reviews, processing and resources inefficiencies indicating waste were reported.

4.3 Customers and value identification

Considering the customer as an entity that obtains and benefits from a good or a service provided by an external part, different types of customers in the processes selected above (sub-chapter 4.2) can be identified – external (final) customers who benefit from the outcome of the process; internal customers, different departments which take part in the process but are not the final customers.

The external customers are the citizens who require a service and who, at the end of the process, obtain an outcome. In the specific case of the processes in city council Education Department, the external customers are the students and their legal representatives who applied for the use of the public service.

The internal customers are the several departments within the city council which are involved in the process. They are considered as customers since their activities are based on the activities developed by the department that had previously taken part in the process. As a result, there are expectations regarding quality and efficiency that should be met in order to ensure the excellency of the whole process.

The ultimate goal of the processes under analysis is the satisfaction of the external customers. Through the observation of the processes and the informal interviews with some of these customers, some characteristics which impact on their satisfaction, and are perceived as value creators, were identified:

- Timely and accurate registration of the application and correct registration of the personal data of the applicant;
- Accurate analysis of the application;
- Employees knowledge and availability to clarify any questions regarding the process;
- Obtaining an outcome of the process as soon as possible and without mistakes.

In the case of the internal customers, the value is related to the accuracy of the work previously done, in order to perform the next activities efficiently; the celerity of the handoffs between departments, avoiding delays and inventories of work-in-progress is also valuable.

Furthermore, society is composed by citizens who are tax payers and who might be considered as a customer since they value the efficient use of their tax money. For this customer, leaner and more efficient processes will encompass fewer costs and increase the perceived value. The effectiveness of processes is also valuable since any citizen may need to use a public service and, as final customer, would value quick results with high quality.

4.4 Types of waste and mapping tool selection

Bearing in mind the information gathered through the informal interviews with staff members involved in the process as well as the initial observation of the processes, some of their features can be highlighted as they might be seen as waste in these municipal services processes:

- The unnecessary transportation of information in physical support is a cause of lack of accuracy and delays. This type of activity is present in the processes and

will be studied in the present research in order to attest its contribution to value creation. Reducing the transportation will impact on waiting times and work-in-progress;

- Both waiting times and the work-in-progress inventory prevent the flow of requests through the activities. In the processes under analysis, the documents wait a long time before being transferred to the following department;
- In the public services some revisions are mandatory by law, however this research will analyse which of them could be avoided since they might not create value;
- The duplication of tasks makes the process slower and more time consuming; repeating the same activity in different departments or doing it in different formats of work (electronic and in paper) is not considered as value adding, it is instead an inefficient use of resources;
- Information is the main asset in service operations (Maleyff, 2006); however it is not always treated in the most efficient and/or effective way. Exploring how to obtain complete and accurate information from customers or other departments will increase the value of the service provided.

In order to achieve an effective understanding of the processes the analysis will start with an overview of the situation through the use of a *spaghetti diagram* and a *value stream mapping*.

The spaghetti diagram registers the informational and physical flows, revealing their complexity (Hines *et al.*, 2002). Through the analysis of this map the wasteful movements are noticed and the process can be improved.

The value stream mapping uses icons to disclose the actual sequence of activities that are performed in order to produce a good or a service (Gahagan, 2007). In this map, the informational and physical flows are designed and data about the wasteful time, useful time and lead time is recorded. The waste within the processes is straightforwardly recognised by looking at the value stream picture.

After understanding the process through the previous presented tools, a detailed analysis will be performed using one of the tools from the value stream mapping toolkit.

According to the types of waste identified above and taking into account Table 3-1 in the sub-chapter 3.4, *process activity mapping* is the most suitable value stream mapping tool to access the processes.

Process activity mapping identifies lead times and opportunities to improve the efficiency of physical and informational flows (Hines *et al.*, 2002).

This tool consists in mapping all the activities that are performed, registering the time taken in each one of them, the number of people involved, the area where they are performed, the distance travelled, and classifying them as value adding, non-value adding or support activities.

The process activity mapping will be applied in the three processes before the waste removal in order to realise the current state of the processes. Afterwards, it will be used again to map a possible improvement state providing a basis of comparison of the effectiveness and efficiency of the processes when using a lean perspective or not.

The structure of the process activity mapping is common to the three processes.

The maps have thirteen columns. The first column indicates the number of the activity. The second column contains a brief description of the activity. The third column refers to the type of activity (T.A.), which might be value adding activities (V.A.), non-value adding activities (N.V.A.) or support activities (S.A.). The fourth column identifies the department (Dep.) in which the activity is performed (general services – G.S.; education department – E.D.; city councilman office – C.C.O.; accounting department – A.D.; treasury – T.). The fifth and sixth columns refer to the total time. The seventh and eighth columns display the useful time. The ninth and tenth columns indicate the wasteful time considering the duration (Dur.) and the interquartile interval (I.Q.) respectively in the first and second column of each topic. The eleventh column contains the distance travelled (D.T.). The twelfth column displays the number of people involved (N.P.I.). Finally the thirteenth column adds a space to additional comments.

Regarding the measurement of the time, fourteen observations of each one of the three processes were performed, allowing the calculation of the median as the duration, and the interquartile interval as a measure of dispersion.

Differences between total time and the sum of wasteful time and useful time are due to the use of the median.

During the whole analysis, it is considered that one day has eight hours, as those are the number of working hours in the municipal service.

4.5 Process 1: Application for free school meals for students who apply for social benefits

4.5.1 Process description and mapping

The goal of the process is to analyse if students are entitled to benefit from social support when having their meals in the school's canteen (free school meals). The process starts when the legal representative of a student comes to the municipal services and applies for the previously mentioned benefit. There are two possible endings for the process - benefit refusal or benefit allocation and consequently enrolment in the canteen.

In order to get an overview of the process, a value stream mapping (Figure 4-1) and a spaghetti diagram (Figure 4-2) are presented.

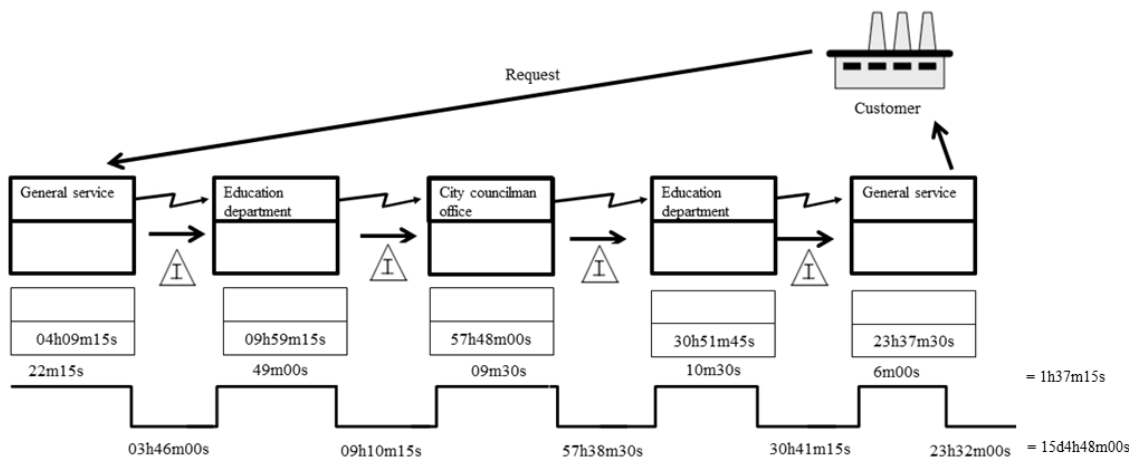


Figure 4-1 - Process 1: Value Stream Mapping

The value stream mapping highlights the departments involved in the process sequentially. Despite the intervention of just three different departments, two of them receive the process twice. Information flows are transmitted both manually and electronically. The flow between activities is disrupted, especially in the transitions between departments, due to delays and waiting times of employees' availability.

Regarding the time line, the difference between wasted and useful time is particularly noticeable.

The spaghetti diagram shows the physical development of the process between the three floors of the municipal services building – first, the physical documents are received in the first floor, then analysed in the third and second floors and finally returned to the first floor, where the final customer is informed of the outcome.

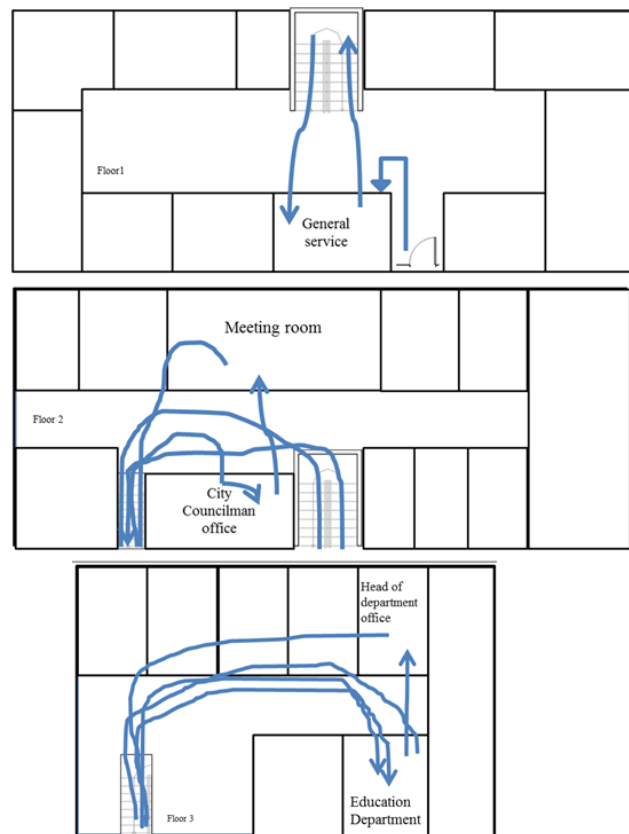


Figure 4-2 - Process 1: Spaghetti Diagram

The process activity mapping, visible in Table 4-1, was obtained through the direct observation of the process.

In order to analyse its duration, the process was observed fourteen times. According to Marôco (2011), based on that number of observations the median should be calculated as a measure of central tendency and the interquartile interval as a measure of dispersion.

As mentioned above, the process starts when the customer goes to the city council general services; the employee fills in a specific form with personal data, receives the documentation necessary to analyse the request and photocopies the identity cards of the student and the legal representative (activity #1).

At this point, the request is kept in a “work-in-progress” portfolio and waits until the end of the day- when the general services are closed to the public - to be resumed (activity #2). At the end of the day, the employee signs and stamps the form confirming its reception (activity #3).

Application of lean thinking tools to municipal services

N.	Activity	T.A.	Dep.	Total time		Useful time		Wasted time		D.T.	N.P.I.	Comments
				Dur.	I.Q.	Dur.	I.Q.	Dur.	I.Q.			
1	Employee fills the specific request form with customer's personal data and receive the documentation	V.A.	G.S.	00:13:15	00:03:30	00:11:15	00:02:00	00:01:00	00:04:15		1	
2	Waiting until close the service to the customers	N.V.A.	G.S.	03:42:30	02:25:00	-	-	03:42:30	02:25:00			
3	Confirm the receive of the request	N.V.A.	G.S.	00:00:30	-	00:00:30	-	-	-		1	
4	Register the request in the system	N.V.A.	G.S.	00:08:00	00:02:15	00:08:00	00:02:15	-	-		1	
5	Send the physical request to the education department	N.V.A.	G.S.	00:05:00	00:00:23	00:02:30	-	00:02:30	00:00:23	100m	1	
6	Waiting for employees' availability	N.V.A.	E.D.	02:57:30	01:45:00	-	-	02:57:30	01:45:00			
7	Confirmation of reception	N.V.A.	E.D.	00:01:00	-	00:01:00	-	-	-		1	
8	Check the entitlement for social benefits	V.A.	E.D.	00:30:30	00:11:30	00:30:30	00:11:30	-	-		1	If not granted, send a letter. The process is over.
9	Send the request to head of department	N.V.A.	E.D.	00:03:45	00:02:00	00:01:00	-	00:02:45	00:02:00	5m	1	
10	Waiting for head of department's availability	N.V.A.	E.D.	06:07:30	04:47:30	-	-	06:07:30	04:47:30			
11	Read, if necessary add information, and sign	N.V.A.	E.D.	00:15:00	00:04:30	00:15:00	00:04:30	-	-		1	
12	Send the request to city councilman	N.V.A.	E.D.	00:04:00	00:00:30	00:01:30	-	00:02:30	00:00:30	60m	1	
13	Waiting for approval	N.V.A.	C.C.O.	10:00:00	07:41:15	-	-	10:00:00	07:41:15			
14	City councilman agrees on the request	N.V.A.	C.C.O.	00:03:00	-	00:03:00	-	-	-		1	
15	Waiting for the executive meeting	N.V.A.	C.C.O.	45:35:00	17:35:00	-	-	45:35:00	17:35:00			
16	Approval in the executive meeting	N.V.A.		00:05:00	-	00:05:00	-	-	-		7	
17	Documents waiting to be transported	N.V.A.	C.C.O.	02:00:00	02:13:45	-	-	02:00:00	02:13:45			
18	Send the request to the education department	N.V.A.	C.C.O.	00:05:00	00:02:00	00:01:30	-	00:03:30	00:02:00	60m	1	
19	Waiting for employees' availability	N.V.A.	E.D.	03:02:30	03:05:00	-	-	03:02:30	03:05:00			
20	Register the student in the specific software	V.A.	E.D.	00:05:00	00:01:08	00:05:00	-	00:00:00	00:01:08		1	
21	Send the request for the student card	V.A.	E.D.	00:01:00	-	00:01:00	-	-	-		1	
22	Waiting for the card	N.V.A.	E.D.	27:37:30	02:33:45	-	-	27:37:30	02:33:45			
23	Reception of the card	V.A.	E.D.	00:02:45	00:01:11	00:02:00	-	00:00:45	00:01:11		1	
24	Send the card to general service	S.A.	E.D.	00:03:00	00:00:15	00:02:30	-	00:00:30	00:00:15	100m	1	
25	Waiting for the customers	N.V.A.	G.S.	23:30:00	14:00:00	-	-	23:30:00	14:00:00			
26	Deliver the card and confirm it on the system	V.A.	G.S.	00:07:30	00:03:00	00:06:00	00:02:15	00:02:00	00:02:30		1	
	TOTAL			126:25:45	56:38:26	01:37:15	00:20:15	124:48:00	56:20:26	325m		

Table 4-1 - Process 1: Process Activity Mapping of the current situation

T.A.-type of activity; V.A.-value adding activities; N.V.A.-non-value adding activities; Dep- department; S.A.-support activities; G.S.-general services ; E.D.-education department; C.C.O.-city councilman office; Dur.-duration; I.Q. - interquartile interval; D.T.-distance travelled; N.P.I.-number of people involved.

Next, the employee registers the request in the city council computer system (SGD) - all the data that was gathered on paper is copied to the computer, the documentation provided by the customer is scanned and the department which will analyse the request afterwards is specified (activity #4). The physical form is also sent to the education department, where the process will follow (activity #5). From this point onwards the process is developed in both physical and electronic format simultaneously; but an activity will only start when the physical request gets to the department.

The process does not continue immediately, a delay of about three hours is common (activity #6).

In the education department, firstly the employee signs the form in order to confirm its reception (activity #7). Subsequently the documentation provided by the customer is analysed and verified, according to the Portuguese law it is then decided if the citizen should, or should not, receive the social benefits; the conclusions are written in the paper form and are registered in the computer system (activity #8). If the customer is not entitled to get the social compensation a letter is sent (there is a template which is filled in with the information about the customer and the request) informing the customer of the refusal and the process is over.

If the customer is entitled to social compensation, the employee carries the request form to the head of the education department (activity #9); in the electronic system the request is also sent to the head of department.

Another delay of about six hours is usual at this point, while the request waits for analysis (activity #10). The head of department reads the employee's conclusions and adds the information if something relevant is missing; finally the document is signed (activity #11).

The request proceeds to the city councilman office (activity #12) and, while it is waiting for the city councilman availability, there is a delay of about ten hours (activity #13). The city councilman reads the conclusions written before and signs the form agreeing with the decision (activity #14).

Since the request concerns social benefits, it is mandatory according to the Portuguese law to present and vote it in the executive meeting. These meetings take place once every two weeks, therefore the waiting time depends on the day that the process arrives at the city councilman department; the maximum delay is ten working days (activity #15).

In the executive meeting the case is presented and the members vote on it (activity #16). The requests are analysed based on the law and only the ones which meet the requirements (analysis performed on activity #8) continue to the next stage of the process, therefore in the executive meeting the council members have to mandatorily accept to pay for the student's meals.

The positive response is registered by the city councilman both on paper and in the computer system. After the meeting, the approved process waits some hours before being sent back to the education department (activity #17 and #18).

In the education department there is another delay before the employee starts working on the request (activity #19). After that, the employee registers the student in the specific software (Sistgere), introduces the personal data collected in activity #1 and selects the school and the student's academic year (activity #20). Then, a request to produce a magnetic student card, which will be used in the school canteen, is sent to the external company responsible for this area (activity #21). The process is on hold during the production of the card by the outsourced company; it takes approximately three days (activity #22). After that time, the employee receives the student card in the education department and registers it in the computer system (activity #23). The card is immediately sent to the general services (activity #24) where it will wait to be collected by the customer. In this case, the waiting time depends on the customers: some go to the municipal services very often, while others go there seldom or a long time after requesting the service, therefore this delay is highly variable (activity #25).

The process finishes when the customer goes to the general service of the city council; the student card is confirmed, it is activated in the computer system and delivered to the customer (activity #26).

4.5.2. Initial efficiency and effectiveness

Regarding the efficiency of the process, the total time to perform all the activities adds up to 15 working days, 6 hours 25 minutes and 45 seconds (with an interquartile interval of 7 days, 38 minutes and 26 seconds). Only 1 hour, 37 minutes and 15 seconds (with an interquartile interval of 20 minutes and 15 seconds) were spent in value added activities, the majority of the time – 15 days, 4 hours and 48 minutes (with an interquartile interval of 7 days, 20 minutes and 26 seconds), was spent on wasteful activities which do not contribute to the value provided to the final customer.

Considering the delays caused by the waiting for the executive meeting (activity #15 in Table 4-1), which depends on how long the last meeting took place, and the waiting for the customer to get the card (activity #25 in Table 4-1), which depends on an external entity, the total internal time may vary between a minimum of 9 days, 2 hours 50 minutes and 45 seconds and a maximum of 21 days, 6 hours 50 minutes and 45 seconds. The process amounted to 26 activities, 23% of those were value adding activities and 73% could be considered wasteful (Figure 4-3).

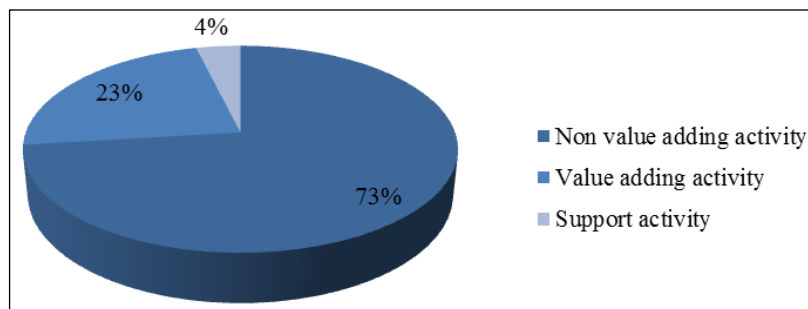


Figure 4-3 - Process 1: Proportion of each type of activity in the current situation

The measurement of effectiveness is not as direct as the efficiency. In the sub-chapter 4.3, were defined some conditions that should be taken into consideration when evaluating effectiveness – the sources of value creation for the customers. According to the direct observation of the process, and also the reactions of the customers, the registration of the request and its analysis were properly performed, which meant that the process was effective for both the internal and the final customers.

The outcome of the process (to obtain the student card and the social benefit) were achieved without major mistakes, however the expectations regarding the timeliness were not completely fulfilled as the final customers want to start using the meals service as soon as possible and the time needed to complete the process is regarded as excessive. The weight of the time spent in value adding activities in the total time supports this idea, since only 1.28% of the total time was spent in activities which added value to the final customers.

Considering the internal customers' perspective, the process is effective since there is no evidence of mistakes which could influence the work in the following departments. The delays in the handoffs of information, as well as the inventories of work-in-progress, reflected the lack of efficiency for the customer.

Citizens as customers value the appropriate use of economic resources; therefore in their view the process is not as efficient as it should be because the wastes, such as duplications and processing inefficiencies, slow the process and increase costs.

4.5.3 Waste identification

After analysing the process, it is noticeable the excess of activities which do not add value.

The information is central for this process; however there are disruptions to the flow. All the delays make the process time consuming and consequently inefficient.

Furthermore, subsequent reviews are unnecessary if the employee who performs the task is well trained and able to correctly evaluate the subjects. One of these situations is when the head of department reads and completes the documentation (activity #11, Table 4-1); he is politically appointed and he trusts in the ability of the staff who analyse the requests, so this activity does not add value to the customer, it is just a formality.

The approval by the city councilman and by the city council members at the meeting can also be considered activities without value for the final customers (activities #14 and #16, Table 4-1). However, as mentioned above in sub-chapter 4.5.1, according to the Portuguese law, they must be performed.

During the whole process, duplication of tasks is visible. The employees work with both the electronic system and the documentation in paper. The information is registered twice and unnecessary movement is created since the employees transport the physical documents between the different departments (the spaghetti diagram – Figure 4-2 – highlights these movements).

The employees receive the electronic version before the paper version, however they only start working on a request after receiving the documentation which contributes to further slowing the process.

4.5.4 Improvement opportunities and redesigned mapping

After the identification of waste, the process should be redesigned in an attempt to create value for the customer through waste elimination.

Beginning with the reception of the request in the general service, some alterations to improve the service are needed. At the current state, the process requires an entire day in this department and most of that time is waiting. A possible option would be to

register the information in the electronic system when the customers are in the service providing their data and making their request (instead of filling in the form in paper). Thus, waiting time would be eliminated, as well as, the duplication of tasks.

With this change the request would be immediately ready for the employee in the education department to start working on it.

After checking the entitlement to social benefits, the current process includes a verification activity. As explained above, in sub-chapter 4.5.3, this review does not add value to the customer; therefore it is an activity that should be eliminated. Empowering the employees and increasing the number of training sessions would be necessary in order to guarantee the accuracy of the analysis in the education department.

When the card is prepared to be delivered to the external customers, there is a long waiting time until it is collected (activity #25, Table 4-1). Even though the delay is originated by the applicant, the process contributes to it since the customers are not notified that the outcome of their request is ready. Introducing a new activity consisting of a phone call, a text message or an email to the customer informing that the application was successfully completed and that they should collect their card to conclude the process would presumably reduce the delay. With this new step, the process would be enhanced by waste reduction resulting in more efficiency; effectiveness would be improved since the customers would value the quicker conclusion of the process, as well as, the reduction of the number of trips to the services in order to collect the card.

Considering the wastes identified and the possibilities of improvement presented above, as well as the current legal requirements, a redesigned process according to the lean thinking tools is proposed (Table 4-2).

In this improvement proposal, the process would start in the general service with the registration of the request in the electronic system and the scanning of the documentation (activity #1). Then, the employee in the education department, who receives the request immediately, would analyse it and record his conclusions on the computer (activity #2). For requests which do not meet the requirements a refusal letter would be sent and the process would be over. In the cases meeting the requirements, the city councilman would read and digitally sign the request (activity #3).

The process would suffer a delay (activity #4) due to the schedule of the executive meetings (as explained in sub-chapter 4.5.1 when describing the current process). At the

meeting the application would be read and approved by the council members (activity #5).

Next, in activity # 6, the employee in the education department would register the student in the specific software (Sistgere). The student card would then be requested to the external company (activity #7). An unavoidable delay of about three days would occur, while waiting for the student card to be made (activity #8). Then the employee in the education department would receive the card and register it on the computer system (activity #9). Subsequently, the employee would contact (phone call, text message or email) the customers in order to inform them that the application had been concluded and that the student card was ready for collection (activity #10). Then the card would be sent to the general services (activity #11) where it would wait to be collected by the customer (activity #12).

Finally, the student card would be confirmed and activated upon collection (activity #13).

N.	Activity	T.A.	Dep.	Total time		Useful time		Wasted time		D.T.	N.P.I.	Comments
				Dur.	I.Q.	Dur.	I.Q.	Dur.	I.Q.			
1	Employee registers the request and the data in the electronic system and scan the documentation	V.A.	G.S.	00:11:15	00:02:00	00:11:15	00:02:00	-	-		1	
2	Check the entitlement for social benefits	V.A.	E.D.	00:30:30	00:11:30	00:30:30	00:11:30	-	-		1	If not granted, send a letter. The process is over.
3	City councilman agrees on the request	N.V.A.	C.C.O.	00:03:00	-	00:03:00	-	-	-		1	
4	Waiting for the meeting	N.V.A.	C.C.O.	45:35:00	17:35:00			45:35:00	17:35:00			
5	Approval in the executive meeting	N.V.A.		00:05:00	-	00:05:00	-	-	-		7	
6	Register the student in the specific software	V.A.	E.D.	00:05:00	-	00:05:00	-	-	-		1	
7	Send the request for the student card	V.A.	E.D.	00:01:00	-	00:01:00	-	-	-		1	
8	Waiting for the card	N.V.A.	E.D.	27:37:30	02:33:45			27:37:30	02:33:45			
9	Reception of the card	V.A.	E.D.	00:02:00	-	00:02:00	-	-	-		1	
10	Call, email or message to the customer informing the card is	V.A.	E.D.	00:03:00	-	00:03:00	-	-	-		1	
11	Send the card to general service	S.A.	E.D.	00:02:30	-	00:02:30	-	-	-	100m	1	
12	Waiting for the customers	N.V.A.	G.S.	11:30:00	07:00:00			11:30:00	07:00:00			
13	Deliver the card and confirm it on the system	V.A.	G.S.	00:06:00	00:02:15	00:06:00	00:02:15	-	-		1	
	TOTAL			85:51:45	27:24:30	01:09:15	00:15:45	84:42:30	03:08:45	100m		

Table 4-2 - Process 1: Process Activity Mapping of the first improvement proposal

T.A.-type of activity; V.A.-value adding activities; N.V.A.-non-value adding activities; S.A.-support activities; Dep. – department; G.S.-general services ; E.D.-education department; C.C.O.-city councilman office; Dur.-duration; I.Q. - interquartile interval; D.T.-distance travelled; N.P.I.-number of people involved.

The times used to redesign the process activity mapping were based on the useful times of the current process. In the case of activity #12, according to the informal interviews with employees and customers, it was considered that informing the customers (activity #10) would reduce the waiting time by half.

This improved process would amount up to 10 days, 5 hours 51 minutes and 45 seconds. 1 hour 9 minutes and 45 seconds of those would be useful time. Considering the variation in the waiting time for the executive meeting (activity #4) and the waiting time for the customer (activity #12) the process might range between a minimum of 5 days, 1 hours 16 minutes and 45 seconds and a maximum of 15 days, 7 hours 16 minutes and 45 seconds.

Thus, process useful time would decrease by 29%. As this is a proposal which was not implemented, it is not possible to analyse possible wastes in special delays through the process. Nonetheless, if those were to occur, they would be considered as non-value adding activities.

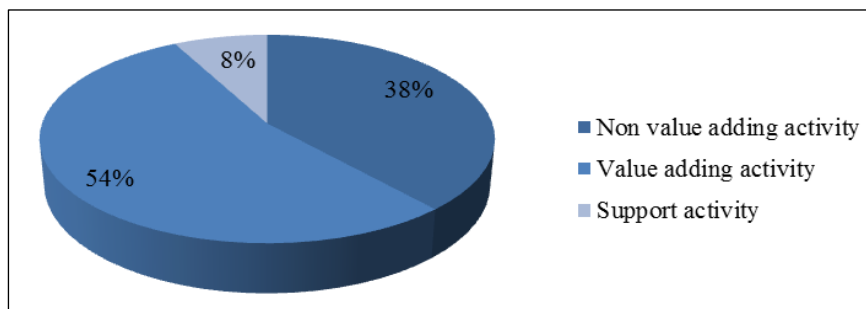


Figure 4-4 - Process 1: Proportion of each type of activity in the improvement proposal

The distance travelled would be reduced from 325 metres to 100 metres. The number of activities would be reduced in 50%, from 26 to 13. From those 13 activities, 54% would be value adding (Figure 4-4) while in the current process only 23% are value adding activities (Figure 4-3).

The previous proposal was developed according to the Portuguese law and respecting the procedures and limitations. Another way to rearrange the process might be to consider the possibility of changing the legal requirements, thus eliminating the obligatory approval by the city councilman and by the executive members at the meetings, and also investing more in equipment (Table 4-3).

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N.	Activity	T.A.	Dep.	Total time		Useful time		Wasted time		D.T.	N.P.I.	Comments
				Dur.	I.Q.	Dur.	I.Q.	Dur.	I.Q.			
1	Customer registers the request online and attaches the documentation.	V.A.		n.a.	n.a.	n.a.	n.a.	-	-			The customer does it at home.
2	Employee checks the entitlement for social benefits	V.A.	E.D.	00:30:30	00:11:30	00:30:30	00:11:30	-	-		1	If not granted, send a letter. The process is over.
3	Register the student in the specific software	V.A.	E.D.	00:05:00	-	00:05:00	-	-	-		1	
4	Employee produces the student card	V.A.	E.D.	n.a.	n.a.	n.a.	n.a.	-	-		1	
5	Call, email or message to the customer informing the card is ready	V.A.	E.D.	00:03:00	-	00:03:00	-	-	-		1	
6	Send the card to general service	S.A.	E.D.	00:02:30	-	00:02:30	-	-	-	100m	1	
7	Waiting for the customers	N.V.A.	G.S.	11:30:00	07:00:00	-	-	11:30:00	07:00:00			
8	Deliver the card and confirm it on the system	V.A.	G.S.	00:06:00	00:02:15	00:06:00	00:02:15	-	-		1	
TOTAL				12:17:00	7:13:45	00:47:00	00:13:45	11:30:00	07:00:00	100m		

Table 4-3 - Process 1: Process Activity Mapping of the second improvement proposal

T.A.-type of activity; V.A.-value adding activities; N.V.A.-non-value adding activities; S.A.-support activities; Dep.- department; G.S.-general service; E.D.-education department; C.C.O.-city councilman office; Dur.-duration; I.Q. - interquartile interval; D.T.-distance travelled; N.P.I.-number of people involved; n.a. – not available.

The process would start when customers, at home, registered their requests on the city council's website and attached all the necessary documents, which would be described in a list available online (activity #1). Afterwards, the employee at the municipal services would analyse if the customers were entitled to get the social support (activity #2). If they were not, the employee would send them a letter informing of the decision and the process would end at this point (the same that happens in the current situation and in the first proposal).

For the students who get the benefit, the employee would register them in the special software (activity #3). Instead of requesting the card to be produced by an external company, the city council could invest in the equipment and training necessary to produce the card in the education department (activity #4) and avoid the three day delay.

Then, the employee would inform the customers that they were eligible for the social benefit of free meals, and the card was ready for collection (activity #5). This information would be transmitted by email, phone call or text message, according to the data provided by the customers in activity #1.

The card would be taken by the employee to the general services (activity #6) where it would wait to be collected (activity #7). Upon the customers' arrival, the process would finish with the employee confirming the card, activating it and handing it to the customers (activity #8).

As this is a proposal which was not implemented, and there are large differences when comparing to the current situation it is not possible to measure the time spent in some activities (namely activities #1 and #4). For other activities the time used in the process activity mapping is based on the useful time of the current situation. Once this proposed solution is implemented, waiting time between activities is probable to occur, nonetheless it is not possible to estimate its duration at this point.

Despite the impossibility of accurately measuring the total time, useful time and wasted time, a great reduction in the total and wasted times is expected, since the waiting activities for the executive meeting and for the production of the card were eliminated (meaning a reduction of about 9 days considering the time spent waiting in activities #15 and #22 of table 4-1). The useful time in the current situation is 1 hour, 37 minutes and 15 seconds; in this solution the useful time would amount to approximately 1 hour (activities #1 and #4 were not measured but take approximately 15 minutes to be performed).

The process would comprise only eight activities, six of them value adding. All the reviews, including the one by the city councilman, were eliminated as they do not add value.

This second suggestion would increase the value for the final customers as the process would be faster and produce the same results as these customers would not need to waste time going to the municipal services since they would register their requests online.

4.5.5 Discussion

Bearing in mind that analysing the possible gains in efficiency and effectiveness by applying lean tools is the purpose of the present thesis, various enhancements are identified when comparing the efficiency and effectiveness between the current process and the improvement suggestion.

The wastes specified in the informal interviews are confirmed by the process activity mapping. The delays are a consequence of wasteful periods in which the requests are on hold for further analysis; those stoppages are due to inefficiencies in the process but

may also be considered the responsibility of the employees who are not aware of the importance of creating a flow without disruptions between the activities. A possible solution for this issue would be to increase the number of training sessions and highlight the importance of efficiency, effectiveness and the losses caused by flow interruptions.

The reviews should also be considered as waste, as they are not adding value. Furthermore, reviews decrease the motivation of the employees as they might consider that their work is unreliable; moreover as the work is to be confirmed, they do not feel the need of put the maximum effort on the tasks since employees' motivation is related with empowerment, recognition and autonomy (Houston, 2000).

As mentioned during the interviews, using both paper and electronic format, results in inefficient processing and inefficient use of resources because the computer system is a resource whose potential is not being properly exploited.

By removing these wastes it would be possible to increase efficiency and effectiveness since the outcome would not lose accuracy and the lead time would decrease, thus increasing the value for customers.

Nevertheless, to implement the second proposal, it would be necessary to change the law in order to eliminate the need for approval by both the city councilman and the executive members at the meeting. In a lean thinking perspective, this would be a positive change as customers value the timeliness of the process which would then become quicker.

4.6 Process 2: Application for “home-school-home” transport allowance

4.6.1 Process description and mapping

Similarly to the first process described, this is an application process as well. Students living in the town who wants to benefit from transport subsidies needs to apply at the municipal services.

This process is directed at children who attend one of the schools existent in the county: from kindergarten to the 4th grade, the elementary and secondary schools in Arruda dos Vinhos or in exceptional situations a school outside the area of influence of the city council.

The value stream mapping (Figure 4-5) displays the flows of information during the process. Just like in process 1, information is transmitted between departments both manually and electronically causing duplication. The delays between each department

are long and the inventories of work-in-progress are large causing disruptions in the flow.

The spaghetti diagram (Figure 4-6) provides a general idea of the movements throughout the process. The request is received on the first floor, then it is moved to the education department on the third floor, it returns to the second floor to the city councilman office and finally goes back to the education department on the third floor - excessive transportation between floor 2 and floor 3 is evident.

The direct observation of the process led to the execution of the process activity mapping presented below (Table 4-4).

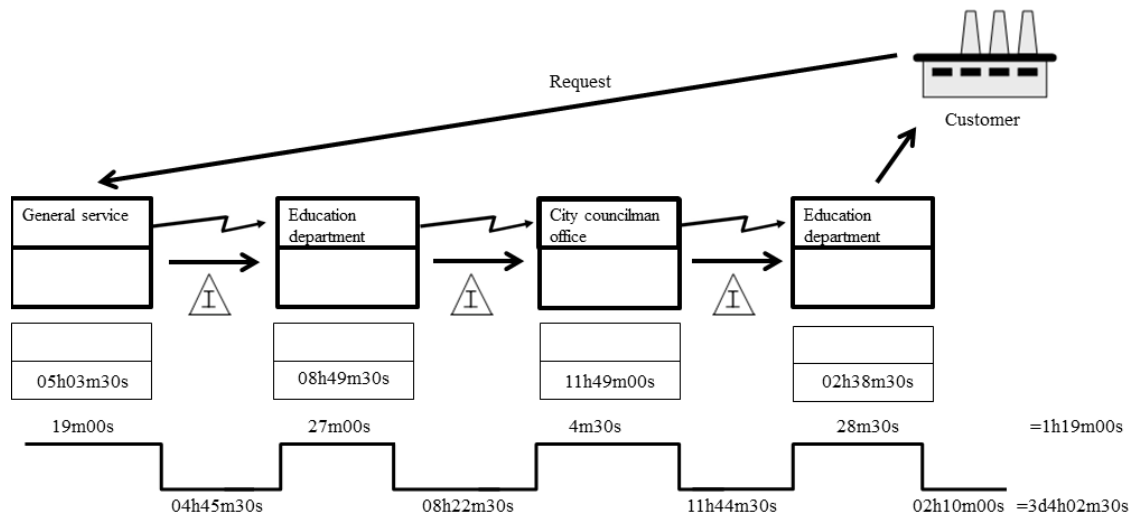


Figure 4-5 - Process 2: Value Stream Mapping

Considering the number of observations of the process (fourteen) the median should be calculated as measure of central tendency and the interquartile interval as a measure of dispersion (Marôco, 2011).

The process starts when the external customer (the legal representative of a student or the student himself when older than 18 years old) goes to the general services of the city council in order to apply for transport service.

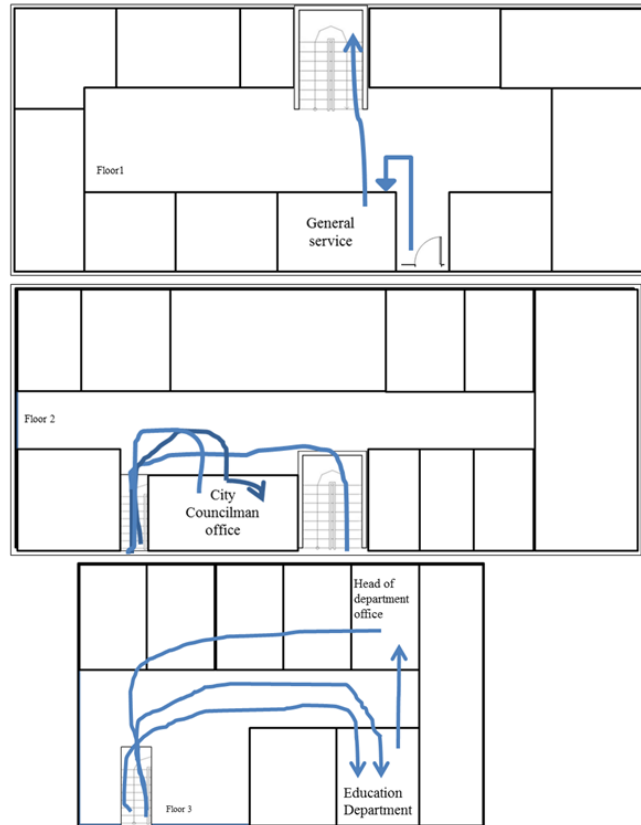


Figure 4-6 - Process 2: Spaghetti Diagram

The employee fills in a form with the request's necessary information , photocopies the identity card and the voter identification card or any other document that is proof of the customer's address, as well as, proof of school attendance (activity #1).

Then the documents are kept until the end of the day when the employees organise the requests received on that day and divide them between the different departments (activity #2).

When the process is resumed, the employee signs and stamps the document in order to confirm its reception and enters the data in the system (activity #3). All the information previously written down in the paper form is copied onto the electronic system (SGD) and the documentation is scanned (activity #4). The paper form is taken to the education department (activity #5).

Then the request waits during some hours (activity #6); afterwards the employee will analyse the request and will check if the applicant will, or not, qualify for the benefit; the conclusions are written both in physical documents and on the computer (activity #7). When the customer is not entitled to benefit, the employee sends a refusal letter and the process ends at this point.

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N.	Activity	T.A.	Dep.	Total time		Useful time		Wasted time		D.T.	N.P.I.	Comments
				Dur.	I.Q.	Dur.	I.Q.	Dur.	I.Q.			
1	Employee fills the specific request form with personal data and receives the documentation	V.A.	G.S.	00:10:30	00:03:45	00:09:00	00:02:00	00:02:00	00:03:00		1	
2	Waiting until close the service to the customers	N.V.A.	G.S.	04:37:30	03:21:15	-	-	04:37:30	03:21:15		1	
3	Confirm the receive of the request	N.V.A.	G.S.	00:00:30	-	00:00:30	-	-	-		1	
4	Register the application in the informatic system	N.V.A.	G.S.	00:08:30	00:04:00	00:07:00	00:02:15	00:02:00	00:02:00	15m	1	
5	Send the physical request to the education department	N.V.A.	G.S.	00:06:30	00:04:30	00:02:30	-	00:04:00	00:04:30	100m	1	
6	Waiting for employees' availability	N.V.A.	E.D.	02:52:30	01:36:15	-	-	02:52:30	01:36:15		1	
7	Analyse if the applications meets the requests	V.A.	E.D.	00:13:30	00:03:30	00:13:30	00:03:30	-	-		1	If not granted, send a letter. The process is over.
8	Send the request to head of department	N.V.A.	E.D.	00:03:30	00:01:08	00:01:00	-	00:02:30	00:01:08	5m	1	
9	Waiting for head of department's availability	N.V.A.	E.D.	05:25:00	01:58:45	-	-	05:25:00	01:58:45		1	
10	Read and if necessary add information	N.V.A.	E.D.	00:11:00	00:03:15	00:11:00	00:03:15	-	-		1	
11	Send the request to city councilman	N.V.A.	E.D.	00:04:00	00:02:00	00:01:30	-	00:02:30	00:02:00	60m	1	
12	Waiting for approval	N.V.A.	C.C.O.	09:05:00	03:00:00	-	-	09:05:00	03:00:00		1	
13	City councilman agrees on the request	N.V.A.	C.C.O.	00:03:00	-	00:03:00	-	-	-		1	
14	Documents waiting to be transported	N.V.A.	C.C.O.	02:37:30	01:18:45	-	-	02:37:30	01:18:45		1	
15	Send the request to the education department	N.V.A.	C.C.O.	00:03:30	00:01:30	00:01:30	-	00:02:00	00:01:30	60m	1	
16	Waiting for employees' availability	N.V.A.	E.D.	02:10:00	01:07:30	-	-	02:10:00	01:07:30		1	
17	Analyse which kind of transportation will be used	V.A.	E.D.	00:12:30	00:05:15	00:12:30	00:05:15	-	-		1	
18	Inform the applicant about the final decision	V.A.	E.D.	00:12:00	00:02:30	00:12:00	00:02:30	-	-		1	
19	Storage of documentation	N.V.A.	E.D.	00:04:00	00:02:00	00:04:00	00:02:00	-	-		1	
TOTAL				28:20:30	12:55:53	01:19:00	00:20:45	27:02:30	12:36:38	240m		

Table 4-4- Process 2: Process Activity Mapping of the current situation

T.A.-type of activity; V.A.-value adding activities; N.V.A.-non-value adding activities; S.A.-support activities; Dep.-department; G.S.-general services; E.D.-education department; C.C.O.-city councilman office; Dur.-duration; I.Q.-interquartile interval; D.T.-distance travelled; N.P.I.-number of people involved.

Next, the documents that are considered for the benefit are sent to the head of the education department's office (activity #8) and there is usually a delay of about five hours and thirty minutes until the documents are dealt with (activity #9). Afterwards, the employee reads the request, writes down the conclusions and, if necessary, adds extra information (activity #10).

The process continues onto the city councilman office (activity #11) where it waits for approval (activity #12). Then the city councilman reads and signs the documents approving the benefit (activity #13).

After some hours, when the city councilman’s assistant is available, the request is sent back to the education department (activities #14 and #15).

A delay of about two hours and ten minutes is usual (activity #16) before the request is analysed again by the employee in the education department; the goal of this analysis is to identify what kind of transport the student will use and how he will get the benefit (activity #17).

Finally, a letter is sent to the customer giving feedback about his application, information about what transport will be used, and how and when the city council will support it (activity #18). The request is then stored in both a physical archive and on the computer (activity #19).

4.6.2. Initial efficiency and effectiveness

Considering the efficiency of the process, the lead time amounts up to 3 days, 4 hours, 20 minutes and 30 seconds (with an interquartile interval of 1 day, 4 hours 55 minutes and 53 seconds), of which 3 days, 4 hours 2 minutes and 30 seconds (interquartile interval of 1 day, 4 hours 36 minutes and 38 seconds) are wasted performing non-value adding activities. The time spent in value added activities is only 1 hour and 19 minutes (interquartile interval of 20 minutes and 45 seconds), representing 4.6% of the total time.

The process comprises 19 activities, 79% of those classified as non-value adding (Figure 4-7). The distance travelled, which is another efficiency indicator, is 240 metres. In terms of effectiveness, when comparing the reality with the expectations of the external customers, the process is accurate and no mistakes were registered; despite the positive evaluation, the length of the process is excessive, considering the time actually needed to perform it.

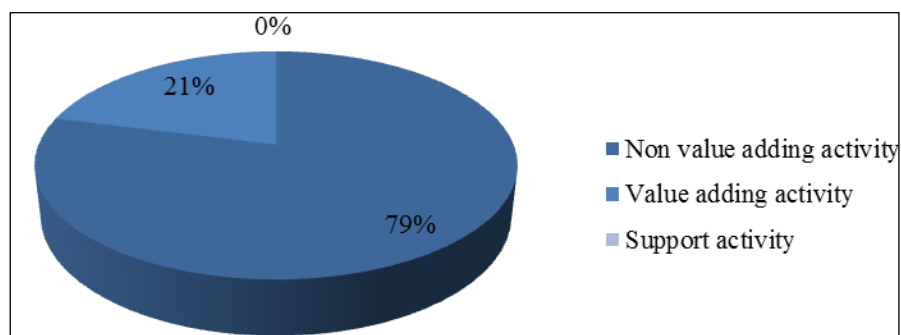


Figure 4-7- Process 2: Proportion of each type of activity in the current situation

Regarding the internal customers, the handoffs of information are slow and it is common to find in one department several documents already verified, waiting to be taken to the next department which does not add value to any of the customers involved. For the other customers of the process, the tax payers who are not applying for this service, there are also problems of efficiency and effectiveness. During the processes there are wastes which consume resources and increase costs. As they value the quality of the process in case of future need, the issues identified for the final customers are valid for these customers too.

4.6.3 Waste identification

In sub-chapter 4.2 delays, duplication and inefficient processing were identified as some of the wastes that would be expected to be found in the process, according to the information collected through the informal interviews with those involved in the process.

The delays are obvious in the entire process; there are stoppages due to employees' unavailability, documents waiting to be moved and waiting periods of time resulting from the design of the process. In order to be efficient and effective a process should allow a flow of information without disruptions, therefore we can consider that these delays are responsible for restraining the value provided by the process.

Since the municipal services work simultaneously with the computer system and physical documents, all the activities are performed twice which confirms the existence of duplication.

Repeating the tasks uses human and time resources in an inefficient way; furthermore, there are activities which should not be performed; the combination of these situations leads to inefficient processing.

Another waste identified in the process is the reviews. The head of the education department verifies the work previously performed by the employee; afterwards the city councilman reads and approves the information which consists in another inspection. In regard to the first one, by the head of the department, there is no objective reason to perform this review. The employees should be able to perform their job accurately, without mistakes, thus exempting the need for reviews in every request.

The second inspection, by the city councilman, is mandatory by law, but as the employee in the education department analysed the requests and removed the ones in which the customers were not entitled to benefits (activity #7), the city councilman only

receives the requests that got a positive answer previously, therefore he does not perform any analysis, only does the obligatory approval. Despite complying with the law, from a lean thinking perspective, this review does not add value to the customers.

When observing the process, is visible the existence of several requests on which the activities from one department were already performed but that are waiting to be transported; also the excessive movement between departments is disruptive increasing the lead time and generating a great deal of work-in-progress.

4.6.4 Improvement opportunities and redesigned mapping

After identifying the wastes, a new process activity mapping (Table 4-5) is created in an attempt to eliminate waste.

N.	Activity	T.A.	Dep.	Total time		Useful time		Wasted time		D.T.	N.P.I.	Comments
				Dur.	I.Q.	Dur.	I.Q.	Dur.	I.Q.			
1	Employee registers the request and the data in the electronic system and scan the documentation	V.A.	G.S.	00:09:00	00:02:00	00:09:00	00:02:00	-	-		1	
2	Analyse if the applications meets the requests	V.A.	E.D.	00:13:30	00:03:30	00:13:30	00:03:30	-	-		1	If not granted, send a letter. The process is over.
3	City councilman agrees on the request	N.V.A.	C.C.O.	00:03:00		00:03:00		-	-		1	
4	Analyse which kind of transportation will be used	V.A.	E.D.	00:12:30	00:05:15	00:12:30	00:05:15	-	-		1	
5	Inform the applicant about the final decision	V.A.	E.D.	00:04:00	00:02:00	00:04:00	00:02:00	-	-		1	
	TOTAL			00:42:00	00:12:45	00:42:00	00:12:45	-	-	0m		

Table 4-5 - Process 2: Process Activity Mapping of the improvement proposal

T.A.-type of activity; V.A.-value adding activities; N.V.A.-non-value adding activities; S.A.-support activities; Dep.-department; G.S.-general services; E.D.-education department; C.C.O.-city councilman office; Dur.-duration; I.Q. -interquartile interval; D.T.-distance travelled; N.P.I.-number of people involved.

The alterations suggested focus on the elimination of delays, resulting in an improved flow of activities. The unnecessary reviews are also removed and it is considered that the whole process should only be dealt electronically in order to avoid useless movements. The process is re-arranged in order to enhance the value adding activities.

In the improved process, when the customer goes to the general services, the employee, instead of writing the request down in a paper form, would register the information on the computer system and would scan the necessary documentation (activity #1).

The process would be instantaneously received in the education department to be analysed by one of its employees (activity #2).

These initial alterations would eliminate five wasteful activities which are performed in the current state, and create a leaner process – simpler and with more value.

After the analysis in the education department, the cases which did not meet the requirements would be informed by a refusal letter and the remaining would wait for approval by the city councilman (activity #3). As in the current situation, this is a non-value adding activity; the city councilman only confirms that he approves the analysis previously performed by the employee in the education department.

Then, the process would be analysed in the education department in order to decide what type of transport the customer would use, when the benefit would start and how it would be paid (activity #4).

The process would end by sending a letter to the customer informing about the decisions (activity #5).

The times used in the redesigned process activity mapping are based on the useful times observed in the current process.

The improved process would only have five activities, just one of them non-value adding (Figure 4-8). As this is a proposal and was not implemented, it is not possible to analyse possible delays through the process. Nonetheless, if those were to occur, they would be considered non-value added.

Considering the useful time, the improvement from the current process to the proposal is about 47%.

The distance travelled would be reduced from 240 metres to 0 metres – all the movement would be eliminated.

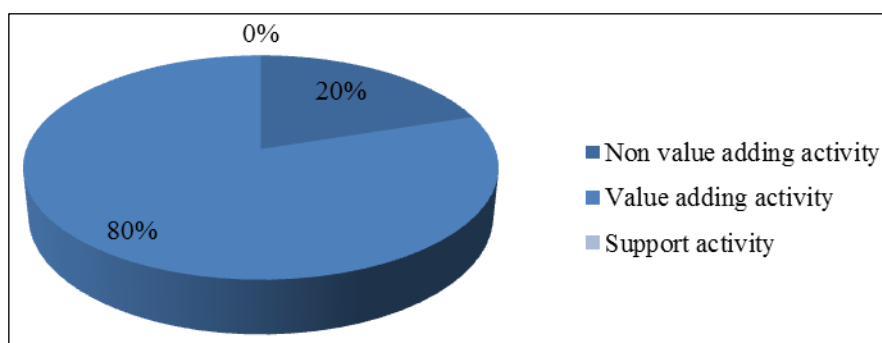


Figure 4-8- Process 2: Proportion of each type of activity in the improvement proposal

As suggested in process 1, more improvements would be possible if the legal requirements changed and investment in new software was made. With a new computer programme the customers would be able to make their request online at home. The employee at the education department would analyse if the application met the necessary requirements (if not, a refusal letter would be sent to the final customer) and which kind of transportation the child would use. Finally, the final customer would be informed about the decision. The approval by the city councilman would be eliminated. The process would consist of four activities, all of them value adding.

4.6.5 Discussion

The current process presents several opportunities for improvement as exemplified in the proposal in sub-chapter 4.6.4.

The delays, which restrain the flow, are due to inefficiencies in the process that cause long periods of waiting before performing the next activity. Rearranging the activities and training employees to avoid disruptions would reduce the problem.

As it can be seen in the process, reviews are common practice in the municipal services. Those activities do not add value since the ones who perform them do not add any new information or repeal the prior analysis; they only read and corroborate the ideas.

As the process involves physical documents and an electronic system simultaneously, there is duplication which results in a great number of requests waiting to be analysed or to be transmitted. Instead of repeating tasks, it would be more efficient and effective if the employees were focused on performing the activities that are relevant to answer the request of the customer and avoid inventories of work-in-progress.

Also, the wastes identified during the informal interviews with staff members (mentioned on sub-chapter 4.2) were confirmed.

The efficiency and effectiveness would increase through the elimination of wastes and a redesigning of the process in order to move the emphasis to the customers and what they value.

Reducing the lead time and the number of activities would be valuable by the external customers of the process; it would improve the flow of work between departments increasing the value for internal customers; moreover, it would decrease costs, which creates value for citizens whose tax money is used in the municipal services.

4.7 Process 3: Money refund from transport expenses

4.7.1 Process description and mapping

When process 2 results in granting transport benefits, those students who had requested them must go to the municipal services every month to get the refund of the money spent with transport. This refunding process is now studied in detail.

After buying the monthly travel card, citizens go to the municipal services where they show the receipt so that they can get a refund from the city council.

The big picture of this process is illustrated in the value stream mapping (Figure 4-9). Inventories of work-in-progress and delays are usual between departments and duplication occurs when transmitting information both manually and electronically. The movements of the process inside the building are noted in the spaghetti diagram (Figure 4-10). The process starts on the first floor, then some activities are performed on the second and third floor and it finishes in the accounting department and treasury (back on the first floor).

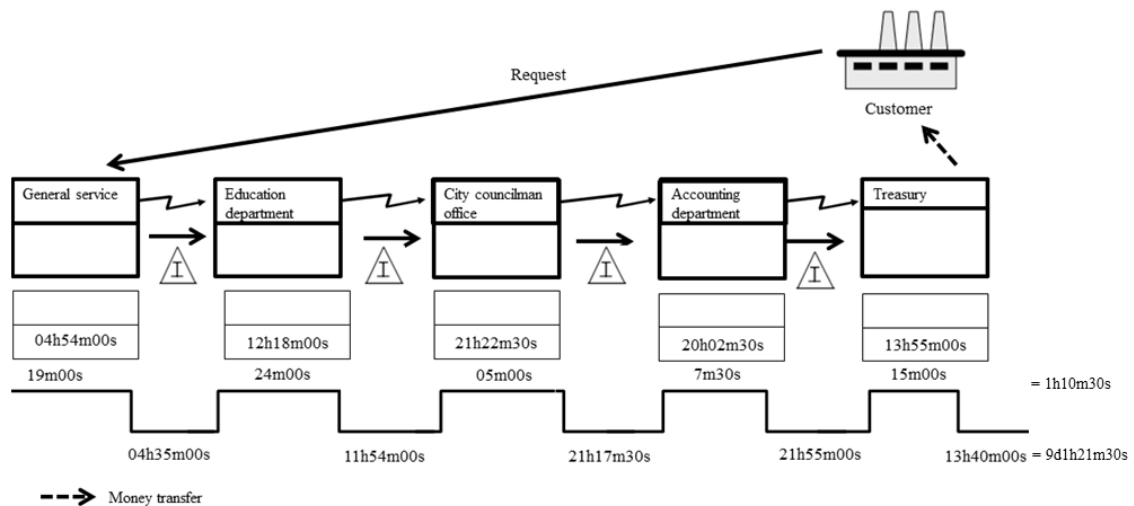


Figure 4-9 - Process 3: Value Stream Mapping

The process activity mapping (Table 4-6) was designed based on direct observation of the process.

The process was observed fourteen times; according to Marôco (2011), for this number of observations the median should be calculated as a measure of central tendency and the interquartile interval as a measure of dispersion.

Whenever an external customer who got granted transport benefits (process 2) wants a refund of the money spent in the monthly travel card, he goes to the general services

where the employee fills in a specific form and collects the receipt of the monthly travel card (activity #1).

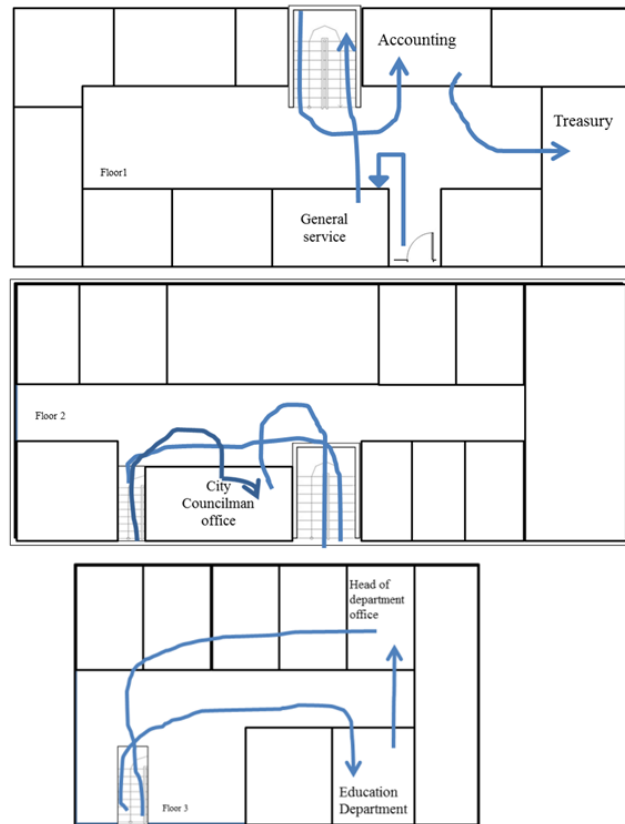


Figure 4-10 - Process 3: Spaghetti Diagram

The request is filed in the “work-in-progress” portfolio until the end of the day (activity #2). Then, the employee signs the form, stamps it and confirms its reception (activity #3).

At this point the full request is registered in the electronic system (activity #4): the employee copies the data from the paper form onto the computer and scans the receipt. As the next step takes place in the education department, the request is moved to that office (activity #5) and a stoppage of about three hours and a half is usual in this department before the process is resumed (activity #6).

Next, the request is analysed (activity #7): first there is an analysis of the physical documents which were filed in process 2, the employee confirms what was done before in process 2 – verifies the proof of enrolment in the school; if the request was approved; if the transport indicated at that time was the right option. Then the employee confirms if the student is using the transport indicated by the municipal service in the enrolment process and if the receipt is from the months for which the benefit was granted. It is

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decided if the customer should, or should not, be refunded and the amount of money to be refunded. These are registered on paper and electronically.

N.	Activity	T.A.	Dep.	Total time		Useful time		Wasted time		D.T.	N.P.I.	Comments
				Dur.	I.Q.	Dur.	I.Q.	Dur.	I.Q.			
1	Employee fills the specific request form and receives the receipt	V.A.	G.S.	00:09:30	00:03:15	00:08:30	00:02:30	00:01:00	00:02:00		1	
2	Waiting until close the service to the customers	N.V.A.	G.S.	04:32:30	01:56:15	-	-	04:32:30	01:56:15		1	
3	Confirm the receive of the request	N.V.A.	G.S.	00:00:30	-	00:00:30	-	-	-		1	
4	Register the request in the system	N.V.A.	G.S.	00:07:30	00:01:30	00:07:30	00:01:30	-	-		1	
5	Send the physical request to the education department	N.V.A.	G.S.	00:04:00	00:02:00	00:02:30	-	00:01:30	00:02:00	100m	1	
6	Waiting for employees' availability	N.V.A.	E.D.	03:27:30	01:43:45	-	-	03:27:30	01:43:45		1	
7	Analyse if the applications should be refunded	V.A.	E.D.	00:15:00	00:04:30	00:15:00	00:04:30	-	-		1	If not granted, send a letter. The process is over.
8	Send the request to department's responsible	N.V.A.	E.D.	00:03:30	00:01:15	00:01:00	-	00:02:30	00:01:15	5m	1	
9	Waiting for head of department's availability	N.V.A.	E.D.	08:22:30	03:36:15	-	-	08:22:30	03:36:15		1	
10	Read and if necessary add information	N.V.A.	E.D.	00:06:30	00:02:15	00:06:30	00:02:15	-	-		1	
11	Send the request to city councilman	N.V.A.	E.D.	00:03:00	00:01:15	00:01:30	-	00:01:30	00:01:15	60m	1	
12	Waiting for aproval	N.V.A.	C.C.O.	10:52:30	04:08:45	-	-	10:52:30	04:08:45		1	
13	City councilman agrees on the request	N.V.A.	C.C.O.	00:03:00	-	00:03:00	-	-	-		1	
14	Documents waiting to be transported	N.V.A.	C.C.O.	10:22:30	02:36:15	-	-	10:22:30	02:36:15		1	
15	Send the request to the accounting department	N.V.A.	C.C.O.	00:04:30	00:01:15	00:02:00	-	00:02:30	00:01:15	50m	1	
16	Waiting for employees' availability	N.V.A.	A.D.	21:52:30	08:45:00	-	-	21:52:30	08:45:00		1	
17	Register the transaction in the accounting system	S.A.	A.D.	00:05:30	00:01:15	00:05:30	00:01:15	-	-		1	
18	Send the request to the treasury	N.V.A.	A.D.	00:04:30	00:01:15	00:02:00	-	00:02:30	00:01:15	15m	1	
19	Waiting for employees' availability	N.V.A.	T.	13:40:00	06:28:45	-	-	13:40:00	06:28:45		1	
20	Register the transaction in the treasury diary	S.A.	T.	00:06:00	00:02:00	00:06:00	00:02:00	-	-		1	
21	Issue the bank order	V.A.	T.	00:05:00	00:01:30	00:05:00	00:01:30	-	-		1	
22	Store the proof of bank transfer	S.A.	T.	00:04:00	00:01:15	00:04:00	00:01:15	-	-		1	
TOTAL				74:32:00	29:39:30	01:10:30	00:16:45	73:21:30	29:24:00	230m		

Table 4-6 - Process 3: Process Activity Mapping of the current situation

T.A.-type of activity; V.A.-value adding activities; N.V.A.-non-value adding activities; S.A.-support activities; Dep.- department; G.S.-general services; E.D.-education department; C.C.O.-city councilman office; A.D.-accounting department; T.- treasury; Dur.-duration; I.Q.- interquartile interval; D.T.-distance travelled; N.P.I.-number of people involved.

If at least one of the previous conditions is not met, a letter is sent informing of the decision and the process is over. If all the requirements are fulfilled the request follows to the office of the head of the education department (activity #8).

After a waiting period that can last some hours (activity #9), the request is analysed by the head of the department and, if necessary, more information is added (activity #10). The request is sent to the city councilman office (activity #11) where it will wait to be analysed and approved - activity #12 and #13 - (as in the previous process, the city councilman approves all the requests because the ones which do not meet the requirements end in the education department, in activity #7 of Table 4-6).

Later on, the documents are taken to the accounting department (activity #14 and #15) where there is a new delay (activity #16). Afterwards, the accounting transaction is registered in the accounting system (activity #17); the document is stamped to confirm that it was analysed by the accounting department and it is taken to the treasury department (activity #18).

Before the document is analysed at the treasury department, a delay of more than one day and five hours is common (activity #19). Next, the employee registers the transaction in the treasury system (activity #20), issues the bank order to transfer the money to the customer's bank account (activity #21) and finally prints the bank transfer proof which is filed (activity #22) together with the form filled in activity #1 which was taken to all the departments during the process.

4.7.2. Initial efficiency and effectiveness

The total time of the process is 9 days, 2 hours and 32 minutes (interquartile interval of 3 days, 5 hours 39 minutes and 30 seconds). The value adding activities represent 1 hour, 10 minutes and 30 seconds of the total time (interquartile interval of 16 minutes and 45 seconds), the remaining 9 days, 1 hour 21 minutes and 30 seconds (interquartile interval of 3 days, 5 hours and 24 minutes) are considered wasteful activities.

As shown in Figure 4-11, 73% of the 22 activities performed were not value adding, while just 13% were value adding.

The movement between departments adds up to 230 metres.

Effectiveness is affected by the delays and the movements of documents between departments which slow the process. Considering the weight of the time of value added activities in the total time required by the full process it corresponds to only 1.6%.

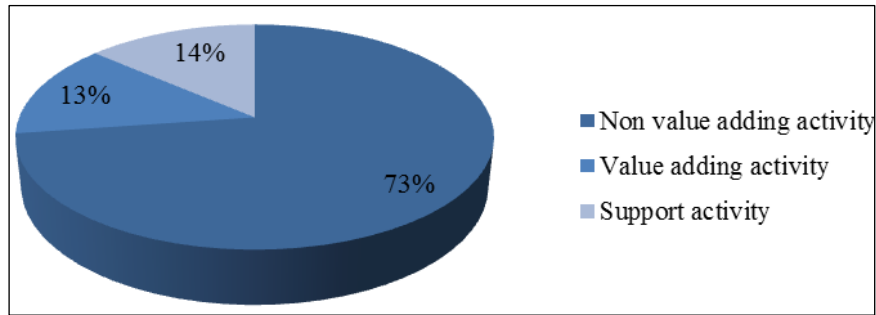


Figure 4-11 - Process 3: Proportion of each time of activity in the current situation

In terms of the different departments involved in the process, and the internal customers, it is not efficient neither effective since there are duplications, inventories and delays between activities which affect the performance of the subsequent departments.

The lack of efficiency and effectiveness that is seen for the final customers and internal customers also affects the whole society as tax payers – the process could be performed with less money if it did not involve wasteful activities; these customers have the same expectations regarding quality (namely accuracy and timeliness) since they may need to use the services in the future, however this expectation was not met due to the disruptions which affect the process.

4.7.3 Waste identification

In this process, and similarly to what had happened in the previous ones, the excess of disruptions in the flow originated by the waiting periods between activities are noticeable.

Duplication is a consequence of the process being executed twice, on the computer system and in physical documents.

The reviews by the department’s head and the city councilman are once again a waste since they do not add value to the process, they inspect the work previously done by employees who are trained to correctly perform their tasks. Despite the approval by the city council being mandatory it was considered as a non-value adding activity.

Movement is also a visible waste: the process is physically transported between departments creating unnecessary movement and increasing delays.

The human resources, the time and the electronic resources are not being used to their full potential as the process includes a revisiting and reanalysis of decisions taken

previously in process 2 (such as the analysis of the transport which the student must use) and this can be seen mostly as a duplication and a resource inefficiency.

4.7.4 Improvement opportunities and redesigned mapping

After identify the wasteful activities, a new process with suggestions for improvement is provided.

In order to improve the service, the process should be rearranged starting with the reception of the refund request in the general services. The request is on hold an entire day to be registered on the computer and sent to the education department which is excessive. Moreover, the duplication of formats (physical and electronic) is a waste of resources. Registering the request directly on the computer would avoid waiting time, the non-value adding activities of confirmation and copy, improving the flow of activities.

The employee who analyses the request starts by doing the same analysis that he did before when performing process 2 (studied above), that is, verifying the correction of the decisions taken and approved by the head of department and by the city councilman. Employees should receive the necessary training to eliminate this review and start using the existent electronic system which allows the creation of databases. It would be much more efficient and accurate to develop a database with all the students that are to be refunded every month (the database would contain the name, address, origin and destination, type of transportation, month in which the entitlement to the refund starts and amount of the refund). With this improvement the employee would only confirm the name of the student in the database, the month and route of the receipt and the percentage of the ticket that should be paid.

The reviews by the chief of the education department would be eliminated in this proposal since in the current solution it is only confirming the work done by the staff of his department without adding any value.

As all the activities would be performed on the computer, movement would be reduced. Bearing in mind the wastes identified and the suggestions presented above, a new process activity mapping (Table 4-7) shows a possible scenario for the process after improvements.

The time used to fill in the map is based on the useful times measured during the observation of the current process.

The improved process comprises seven activities. Starting in the general services, the employee would register on the computer the data of the customer and scan the payment receipt (activity #1). As it is not the first time that this customer goes to the municipal services, he is already registered in the electronic system, therefore the information necessary for identification would just be the name and the identity card number.

Then, the request would be analysed in order to confirm the address, the route and transport used, as well as, the amount of the refund and the month of the receipt (activity #2). The analysis would not be as detailed as it is in the current state; as stated above, a database would be created to display the necessary information for a quick verification of the data, not for a new analysis of the benefit entitlement. This activity could be eliminated using a new electronic system which would automatically confirm the data for each student; however this solution would require higher investment which is not possible in the current situation of economic constraints.

N.	Activity	T.A.	Dep.	Total time		Useful time		Wasted time		D.T.	N.P.I.	Comments
				Dur.	I.Q.	Dur.	I.Q.	Dur.	I.Q.			
1	Register the request and the data in the electronic system and scan the	V.A.	G.S.	00:08:30	00:02:30	00:08:30	00:02:30	-	-		1	
2	Analyse if the applications should be refunded	V.A.	E.D.	00:15:00	00:04:30	00:15:00	00:04:30	-	-		1	If not granted, send a letter. The process is over.
3	City councilman agrees on the request	N.V.A.	C.C.O.	00:03:00	-	00:03:00	-	-	-		1	
4	Register the transaction in the accounting system	S.A.	A.D.	00:05:30	00:01:15	00:05:30	00:01:15	-	-		1	
5	Get the amount of refund from the accounting system	S.A.	T.	00:06:00	00:02:00	00:06:00	00:02:00	-	-		1	Obtain the amount of refund automatically - linking the accounting and treasury systems.
6	Issue the bank order	V.A.	T.	00:05:00	00:01:30	00:05:00	00:01:30	-	-		1	
7	Store the proof of bank	S.A.	T.	00:03:00	00:01:15	00:03:00	00:01:15	-	-		1	
TOTAL				00:46:00	00:13:00	00:46:00	00:13:00	-	-	0m		

Table 4-7 - Process 3: Process Activity Mapping of the improvement proposal

T.A.-type of activity; V.A.-value adding activities; N.V.A.-non-value adding activities; S.A.-support activities; Dep.- department; G.S.-general service s; E.D.-education department; C.C.O.-city councilman office; A.D.-accounting department; T.-treasury; Dur.-duration; I.Q.- interquartile interval; D.T.-distance travelled; N.P.I.-number of people involved.

The request would be approved by the city councilman, a non-value adding activity necessary according to the law (activity #3). For an even leaner solution, and without regarding the legal constraints, this activity could be eliminated.

Next, in the accounting department, the financial transaction would be registered in the accounting system (activity #4).

Afterwards, in the treasury, the employee would get the data from the accounting system (activity #5), would issue the bank order to transfer the money for the student's bank account (activity #6), and would store the electronic banking proof of the transference in the electronic system alongside the request (activity #7).

The reshaped process would have a lead time of 46 minutes (with a variation of 13 minutes) and all of the time would be useful. Although this improvement solution was not implemented, it is reasonable to assume some waiting time between some of the activities, namely before activities #3 and #4. Nonetheless, it is not possible to estimate this waiting time. However, if they existed, they would be considered wasteful activities. As so the improvement assessment is performed based on the total useful time. Comparing with the useful time of the current situation, the improvement would represent a saving of 34%.

Non-value adding activities would be removed, and only the approval by the city councilman would be maintained, as it must be performed according to the law; as a result, the process would have 43% of value adding activities (Figure 4-12), while in the current state it has only 13% (Figure 4-11).

The distance travelled would be null, since all movement would be eliminated when using exclusively the electronic system.

Creating a database with the students would benefit the process, leading to quicker and more accurate decisions. In general, it would contribute to a more efficient and effective process.

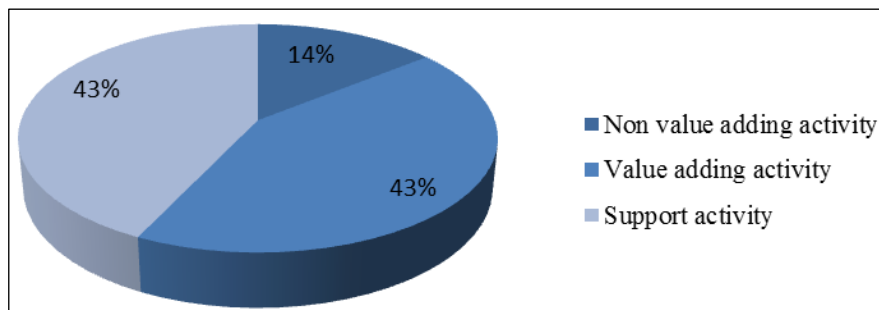


Figure 4-12- Process 3: Proportion of each type of activity in the improved process

Just like in processes 1 and 2, more improvements would be possible with a change in the Portuguese law, namely the elimination of the approval by the city councilman. Customers requesting their money at home, using an online system instead of going to the municipal service could be another possible change but it would involve an investment in new software.

4.7.5 Discussion

Comparing the effectiveness and efficiency between the current and the proposed processes, there are evidences of possible improvements since the lead time can be reduced as well as the number of activities; the accuracy could improve given that the handoffs of information were eliminated.

In this process the duplication does not only involve the paper and electronic format but also activities done in the previous process. The resources are not used properly; there is an electronic system with great potential which is not well used thus increasing the waste and also the costs. Training staff could solve this issue since they would be able to use the resources available and be trusted with them, thus eliminating the duplication, the transportation of documents between departments and consequently the delays and disruptions in the flow. All the improvement would increase the value for all the customers identified in sub-chapter 4.3 – internal customers would have a faster flow of information; external customers would obtain the output quicker; and the society (tax payers) would see the cost reduced with a better designed process.

5. Conclusions

The central purpose of the present thesis was to analyse if the application of lean tools creates effectiveness and efficiency gains for a specific set of local government processes.

In order to achieve the goal three processes of the municipal services of Arruda dos Vinhos were selected based on criteria defined beforehand; the customers and the value they derive from the process were presented and the processes were mapped through one of the tools from the *Value Stream Mapping Toolkit*.

The efficiency and effectiveness of the current processes were assessed and proposals for improvement were suggested measuring, once again, the efficiency and effectiveness in order to establish a comparison and reach the goals of the research.

The present chapter discloses the final conclusions regarding the purpose and the research questions. The validation of the results and the limits of the study are also approached. Finally, some opportunities for future research are considered.

5.1 Research questions and goals analysis

In order to achieve the global purpose some partial goals and research questions were defined in Chapter 1. When reviewing those goals, it is considered that they were attained throughout this thesis:

- Partial goal 1 - the criteria which underpinned the choice of the processes was described in the methodology based on the relevance of the processes, the existence of waste and the use of information, given that the analysis is about services;
- Partial goal 2 - according to the criteria the processes to be analysed were identified; application for free school meals for students who apply for social benefits, application for “home-school-home” transport allowance and money refund from transport expenses were the processes that better match the criteria;
- Partial goal 3 - concerns the identification of the customers of the processes and their perception of value. These were identified in Chapter 4 before the analysis of the processes;
- Partial goal 4 - the most suitable lean tools which were applied in the analysis of the processes were selected based on criteria defined in Chapter 3;

- Partial goal 5 - the processes were mapped using a Process Activity Mapping, a Value Stream Mapping and a Spaghetti Diagram were applied in order to complement the analysis;
- Partial goal 6 - the analysis of the resources, efficiency and effectiveness in each of the processes were performed;
- Partial goal 7 – the wastes visible during the processes were identified;
- Partial goal 8 – considering the wastes identified, improvement proposals were developed; the efficiency and effectiveness were assessed and compared with the current situation.

The research questions which guided this thesis were designed considering the main purpose and the concept of lean thinking. This study tried to address the following questions:

RQ1: How executable is the use of Value Stream Mapping tools in order to analyse municipal services?

RQ2: How are efficiency and effectiveness affected by applying lean thinking tools to public services?

Regarding **RQ1**, all processes analysed validated the use of Value Stream Mapping tools in the municipal services. The Process Activity Mapping, the Value Stream Mapping tool selected, enabled the identification of wastes and the possibility for improvement opportunities. The Value Stream Map was used to provide the big picture of the processes and the Spaghetti Diagram was used to highlight movement of people and physical documents between departments.

With regards to **RQ2**, despite the proposals not having been implemented, there is clear evidence of possible gains in efficiency and effectiveness when applying lean thinking to public services. Considering the useful time, in the first process the improvement would be of about 29%; in the second process the improvement from the current process to the proposal would be of about 47% and in the third process the improvement would represent a reduction of 34% of that time.

The application of lean thinking in the present thesis was based on tools and techniques with main regard to customers, flow and waste reduction, i.e. value. Despite the importance of engagement, leadership and strategy in a lean approach, as described in

Chapter 2, these were not considered since the purpose was to analyse the impact of lean thinking tools. Moreover, the implementation of the redesigned processes was beyond the scope of the work.

In terms of effectiveness and efficiency measurements, the first one is more subjective since it considers the customers' perceptions - value - that might not be easily understood. Efficiency is simpler to measure as it concerns more tangible aspects such as time, distance or other resources used which are easily quantifiable.

A relationship between efficiency and effectiveness can be suggested as some efficiency gains also impact on effectiveness since some characteristics when measuring efficiency are common to effectiveness, namely what happens with the lead time, for example.

The wastes mentioned during the informal interviews with the staff members involved in the process were confirmed during the detailed analysis of the processes.

Information is the basis of these processes; it is transformed during the value stream resulting in a final output. However, the existence of waste, namely transportation between departments and functional areas and delays, disturbs the flow and affects both efficiency and effectiveness.

The main purpose of this thesis was stated in sub-chapter 1.1 *“to analyse if the application of lean tools creates effectiveness and efficiency gains for a specific set of local government processes”*. Thus, throughout the research it is considered that the goal was accomplished and it is possible to affirm that the efficiency and effectiveness of the processes analysed would benefit from the use of a lean approach and of lean thinking tools as shown by the improvement proposals provided.

Redesigning the processes, removing delays, revisions, handoffs of information, duplications, resources and processing inefficiencies would primarily decrease the lead time and the processes would become more accurate, thus increasing their efficiency. Furthermore, effectiveness would also be improved through the satisfaction of the final customers who value timeliness and accuracy.

For internal customers, the suggestions of improvement would make the processes more effective and efficient as they value the accuracy of the information transmitted by the previous departments and the elimination of delays between departments that would be improved if the suggestions were implemented.

Citizens, who also represent a customer, since they pay taxes, are also interested in the process and value the proper use of their money. The process would be more efficient if

the suggestions developed according to lean thinking were implemented because the wastes would be eliminated and resources would be saved. The effectiveness for these costumers of the process would also increase since, as citizens, they might need to use the municipal services and they would value more accurate and faster processes.

5.2 Results validation

A theoretical background regarding the application of lean thinking to services, in particular to the public sector, was considered throughout this research.

Maleyff (2006) highlighted the importance, in the services sector, of delivering relevant and accurate information quickly; and, the author indicates this aspect as the basis for improvement.

The present research followed with this approach since information flows were in the centre of the improvement proposals.

The positive enhancements of applying lean thinking tools in the public sector are in line with the ones supported by authors such as Hines and Lethbridge (2008), Kenworthy (2013), Arlbjørn *et al.* (2011), Radnor and Johnston (2013), Hasenjager (2006), Krings *et al.* (2006), Barraza and Pujol (2010) who mention efficiency improvements, smaller leading times, cost reduction and quality as the main gains.

Activities which are mandatory according to the law were found in this research, corroborating the existence of unavoidable wastes as described by Teeuwen (2011) and Kacakulâh *et al.* (2011).

Despite the difficulty in identifying the customers and their perceptions of value, as stated by Radnor and Osborne (2013), in the present research they were identified which enabled the verification of the impact on effectiveness.

5.3 Research limitations

The validity of the results of this thesis is contingent to the scope of the research.

One of the concerns regarding the case study approach is the “*little basis for scientific generalization*” (Yin, 2009:15). In effect, analysing specific processes of a specific public service prevents the generalisation of the results. Thus, the findings of the present thesis are only applicable to the three processes analysed in the municipal services in Arruda dos Vinhos.

Despite the impossibility of generalisation, the results may contribute with more data for researchers who are interested in the potential of lean thinking tools to improve public services, especially the municipal services. Therefore, this thesis extends the range of examples and contributes to enlighten research in this area and to clarify the results of using lean thinking tools.

Moreover, this thesis may be useful for the city council where the processes were analysed.

It should be noted that this research is focused on analysing only a set of specific processes of one department in the municipal services; in the case of a more extensive scope, a different approach should have been used.

Also, it should be stressed that the application of the improvement proposals was not considered in this research.

5.4 Future research alternatives

The application of lean thinking tools in public services has been researched previously, however the literature is still scarce and more tests are needed in order to reach solid results.

The present thesis was developed intending to reduce the aforementioned gap. Therefore, a possible continuation of this research could aim for the analysis of a wider set of processes and departments and could attempt to apply the suggested improvements based on the lean thinking approach.

Performing identical researches in other city councils would enable a comparison and would create conditions, according to Yin (2009), to generalize the findings.

Moreover, it would be interesting to analyse processes in other public services in which management is performed by managers instead of politicians (as it happens in the municipal services which are the responsibility of the mayor) in order to clarify the influence of politics in the public services operation, particularly its effects on efficiency and effectiveness.

In a broader theoretical perspective, it could be relevant to re-design the correspondence between the tools from the *Value Stream Mapping Toolkit* and each of the wastes in the services sector.

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