Improving operational efficiency in service delivery processes based on Lean Service approach

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Abstract

The application of process streamlining concepts and techniques comprised by the Lean Production (LP) paradigm was originally adopted by manufacturing firms driven by the need to systematize the efforts to improve operational efficiency in their plants. More recently, the potential application of this approach in other businesses and environments has attracted the interest of academics and practitioners. This paper explores the prospect of searching operational efficiency in service operations based on concepts and best practices embraced by LP. The application of the seven wastes taxonomy that underlies the process improvement rationale of the LP approach in the context of service processes and its further extension is explored in this study. The consideration of this taxonomy revealed that aspects and constraints that are specific to service businesses require adaptations in the way it is transplanted. An issue is dealing with the trade-off between the efficiency measures (e.g. resource utilization, transactions per day, service speed) and the perceived service quality. Based on field study observations, the paper suggests that leaner service delivery processes can be implemented by applying concepts, tools, and techniques prescribed by the LP paradigm and, by deploying rationalization mechanisms that are distinctive of service transactions.

Keywords: Lean Production, lean service, service delivery process, wastes.

1. Introduction

The purpose of this paper is to discuss the potential of systematized application of the Lean Production (LP) concepts and techniques in the improvement of service processes.

The diffusion of LP approach beyond the environs of repetitive production of standard products initially advanced towards the administrative areas in manufacturing firms. As ascertained by Womack and Jones (1996), besides the manufacturing value stream, other critical value streams such as the order fulfillment (from order to delivery) and new product development (from concept to launch) processes should be streamlined in manufacturing firms so as to reinforce their overall competitiveness.

Maleyeff (2006) has pointed up the potential of the evolutive diffusion of LP asserting that any organization, whether it is classified as a manufacturing, service, non-profit, or government entity, includes internal service systems that provide services to internal/external customers, and that the LP approach can be applied in the management of such systems to ensure that information important to customers is provided by means of fast and effective processes. It is important to note that the application of LP approach and propositions has already advanced to project process-based industries originating derivative approaches such as lean aerospace industry, lean construction and lean shipbuilding. Nowadays, it is being considered even by organizations that deal with information-intensive products such as software developers (Middleton, 2001; Poppendieck and Poppendieck, 2003) and software maintenance firms (Kindler, Krishnakanthan and Tinaikar, 2007) as well as by information-technology-based service providers like telecommunication firms (Robertson and Jones, 1999) and call centers (Marr and Parry, 2004). In this context, this paper discusses the emerging interest of

deploying the LP approach for enhancing operational efficiency in service delivery processes.

Bowen and Youngdahl (1998) recall that, as in the 1970s service firms borrowed some features of the production line approach (an epitome of the industrial mass production paradigm) to cope with their shortcomings in quality and productivity, in the 1990s, some promising evidences of service firms mirroring the logic and practices of lean manufacturing arose when limitations imposed by some premises of the former approach – like "narrow division of labor" and "limited discretionary action of personnel" – begun to hinder business performance and prospects.

In recent years, an increasing number of authors have investigated the feasibility and appropriateness of extending the application of LP approach to service firms. Just to mention a few, Allway and Corbett (2002), Swank (2003), Åhlström (2004) and Apte and Goh (2004) considered the application of LP principles aiming productivity and quality improvement in service processes. Allway and Corbett (2002) have also proposed a process model to deploy the LP approach by applying a set of Lean tools to deliver superior customer service. The idea of incorporating the operational efficiency rationale of LP in the design of lean service processes has also been developed by Cuatrecasas (2002, 2004).

Although the ideal of institutionalizing the elimination of non-value adding activities and delays sounds to be mandatory nowadays for businesses in which competition and customer expectations become increasingly stiffer, regardless on the market sector, the drive towards leaner processes in service firms should contemplate some specific aspects. This issue is discussed in the next section.

2. Becoming lean as a goal in service businesses

One can argue though that in service business, the trade-offs between the perceived service quality and resource utilization efficiency or service speed constitute a critical concern which may constrain the potential to apply the LP approach. When assessing the relevance and appropriateness of implementing best-practices promoted by LP, some fundamentals dimensions of service systems should be contemplated as follow.

- **Competitive strategy followed by the firm:** Service businesses may be established to build and exploit competitive advantage in terms of cost leadership or differentiation which requires different drivers and organizational capabilities. While the adoption of LP concepts and practices may enable service firms to build more cost efficient processes, the same elements may be irrelevant or even antagonistic to support differentiation-oriented businesses.

- **Location of the service production and delivery processes:** The activities comprised by service processes may take place in front-office or back-office environs. The applicability of LP approach depends on the degree of interaction with customers involved.

- **Service volume:** In their proposition to classify service systems into professional service, service shop, or mass service, Silvestro et al. (1992) considered the volume of customers processed. The higher the volume and therefore the repetitiveness of activities involved, the greater are the impact and benefits that the LP approach may render.

- **Nature of the service tasks:** Service systems are intrinsically subject to greater variability of customers needs than manufacturing systems. The tasks performed by service providers may be more or less susceptible to rationalization and routinization. The nature of the latter type of tasks, restrains the opportunities for the application of LP approach.

- **Quality perspective considered in the service process**: According to Garvin (1984), alternative definitions of quality have evolved from five basic approaches as follow: (a) the transcendent approach: quality as synonymous of innate excellence; (b) the product-based approach: differences in the quantity of some ingredient or attribute possessed by the product are considered to reflect differences in quality; (c) the user-based approach: quality is the extent to which a product or service meets or exceeds customers' expectations as suggests the widely used "fitness for use" definition of quality (Juran, 1974); (d) the manufacturing-based approach: quality is defined as conformance to specifications (Crosby, 1979); (e) the value-based approach: equates quality with performance at an acceptable price, or alternatively conformance at an acceptable cost. The promotion of the LP approach in streamlining service delivery process may be relevant when service quality is defined as "fitness for use". On the other hand, for those services businesses that rely on the transcendent or product-based perspective for quality, searching enhanced efficiency by means of leaner service delivery processes may not be a managerial issue or priority.

- **Participation of the customer in the process:** This implies that service tasks and interaction should be simplified, and thus time should be saved, not only for the service provider but also from the customer's standpoint (Womack and Jones, 2005).

This latter characteristic that keenly distinguishes service systems from manufacturing systems is emphasized in this work. Service firms should not only strive to streamline their own processes but also be aware of the wasteful activities and non-value adding time that customers are subject to when accessing service providers and having the service done. Moreover, the amount of customer's resources required (e.g. computer, phone, and telecommunication for distant access; transportation, fuel, and parking for direct contact) in accessing the service provider which may be free for the latter but not for the customer should be minimized. As a matter of fact, service firms seem keenly concerned with cutting their own operation costs which may enable them offer more competitive prices; however they tend to neglect or underestimate the cost of the effort undertaken by the customers in the service consumption processes.

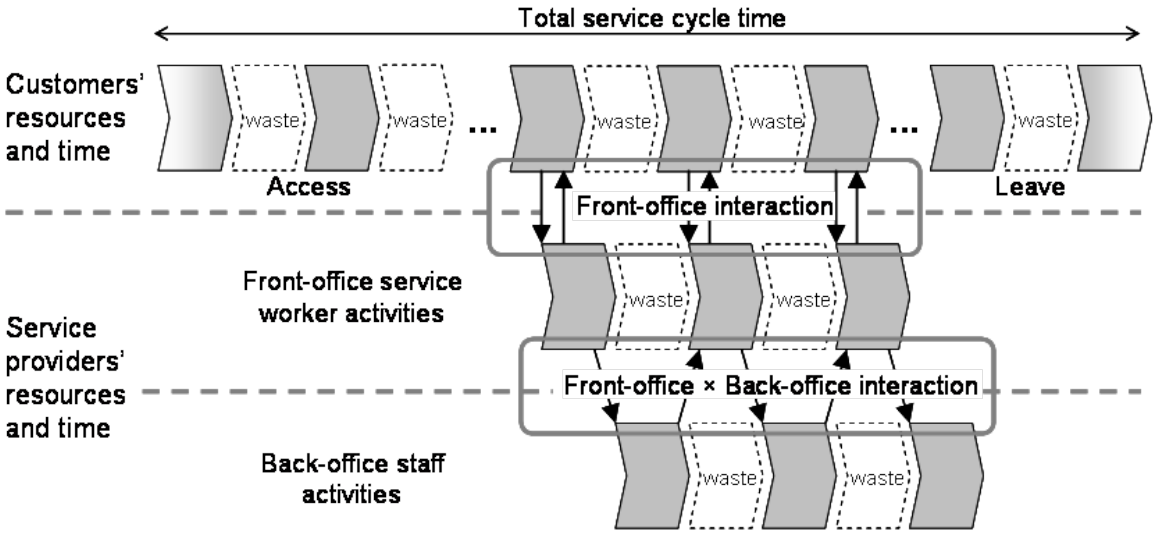

Figure 1 – Participation of service provider and customer in a service process

As Womack and Jones (2005) observed, service processes frequently cause countless loops of miscommunication, travel, waiting, and defects that result in reworking. To make the things worse, in the attempt to save time and money, some firms cause wastes of time to customers by off-loading work to them. Service firms should not only strive to streamline their service processes but also make them easier for customers to access, buy and use. This entails contemplating opportunities to reduce the total service cycle time as well as the amount of the customers' resources required to access the service provider and have the service done as indicated in Figure 1.

3. Analyzing and reducing wastes in service processes

The process rationalization rationale of LP approach is based on the systematized method of identifying non-value adding activities and delays in process flows. For such analysis, their classification into the seven forms of wastes in the context of manufacturing as proposed by Ohno (1988) became a widely accepted perspective.

Åhlström (2004) and Apte and Goh (2004) point out the relentless "elimination of waste" as a fundamental principle for transferring the LP approach to service organizations. Although they acknowledge that waiting, inventory and lack of conformance quality are evidences of wastes, they just consider them generally as non-value adding without presenting a framework that might facilitate the definition of major types of wastes in services.

More recently, Cuatrecasas (2002) proposed a more discriminating classification of non-value adding activities in service processes as follow: (1) excess production, (2) inappropriate process, (3) stocks of all kinds, (4) delays, (5) unnecessary carriage, (6)

unnecessary movement, and (7) quality defects. However, seemly, a more widely diffused taxonomy has not emerged yet.

Thus, in this paper, it is assumed that the application of the Ohno's original criteria to define waste types can be extended to the context of services with the purpose of facilitating the identification of process improvement opportunities in service process settings.

When a manufacturing process is analyzed, the materials are focused as the main objects of the transformation. The client is not considered in this analysis because he or she has no contact with the production process. On other hand, in service production process, the client is part of the production process and, sometimes, he or she takes part as co-producer. Therefore, in the analysis of service processes it is necessary to separate the *case* (the problem of the client that must be solved) and the *client* (a person with intelligence, wishes and perceptions). The case can be an information requirement, a telephone line installation request, the repair of a client's product, etc. In the handling of a case, it may be transported by physical or electronic ways.

To analyze wastes in service processes, this paper adopts the premise that wastes affect both the service provider and the clients, and thus they should be considered from these two perspectives not limiting to the firm's viewpoint. Table 1 describes separately the major types of waste from these two perspectives and this represents a major differential proposed by this paper.

The classification of wastes for the service provider was basically derived by adapting Ohno's definitions to the context of service businesses. A slight extension is proposed by including poor design (i.e. design of services that do not meet the customers' needs) and overcapacity (i.e. under-utilization of resources and infra-

structure implemented to make the service available at a certain demand that can not be scaled down) as the causes of two additional forms of waste in Table 1. The consideration of poor design and overcapacity was suggested, respectively, by Womack and Jones (1996) and Miyake, Francischini and Giannini (2007). Furthermore, Table 1 considers that when analyzing the client's wastes, it is relevant to acknowledge that a service process can incur in wastes of client's time or wastes of client's resources, thus broadening the understanding of what are non-value adding activities.

Table 1 – Types of waste for service providers and clients

Type of waste	For service providers	For clients
Service defect	Resources and time spent to receive non-quality service	Total or partial blocked use of the product or service
		Repair cost
		Waste of time to get defect repaired
Unnecessary process	Resources and time spent in an activity that does not add value to the client or shareholder	Client's resources and time spent in unnecessary co-production
		Waiting time spent in unnecessary process by the service provider
Work in Process	Resources to store and control queues of clients and cases	Waiting time spent until total or partial delivery of service
Stock of finished cases	Resources to store and control the stock of finished cases	Charge billed by the service provider to maintain finished cases stocked
Unnecessary movement	Resources and time spent in movements of service provider that do not add value to client or shareholder	Waiting time during the service provider's movements that do not add value to client
		Client's resources and time spent in movements for unnecessary co-production
Unnecessary transportation	Resources and time spent in transportation of material/document that does not add value to client or shareholder	Waiting time during transportation of material/document that does not add value to client
		Client's resources and time spent to access physically or virtually the service provider
Waiting time	Time underutilized while waiting for the end of previous process or start of next process	Waiting time caused to client in queues and whenever the service provider has to halt the process to await the availability of a required information or other resource
Overcapacity	Underutilization of resources waiting use by client or service provider	Cost of service provider's overcapacity included in the billing for the use of service
Poor design	Inefficient work caused by poor service process design	Cost of service provider's inefficiency included in the billing for the use of service

As advocated by the Lean Thinking, once identified, wastes should be eliminated or reduced by means of process improvement concepts, techniques and devices prescribed by the LP approach. These elements are here referred to generically as "tools".

Notwithstanding these tools were primarily conceived and applied in the context of manufacturing systems, lean service firms have revealed the potential of their

effective application in service processes. Table 2 exhibits the potential applications of major lean tools in service processes.

Table 2 – Lean Production tools adaptable to service processes

Tools	Description
Pre-processing	Tasks performed by operator or equipment in advance to reduce process time in constrained resources
Quick setup	Activities that enable the rapid setup of the type of service provided
Multi-tasking	Developing operators capable to work in different types of service production processes
Service cell	Lay out pattern that facilitates mutual support and exchange of information among a small team of operators assigned to handle a given type of cases
***Poka Yoke* for operator**	Fool-proofing device which prevents operators making an error during service production process
***Poka Yoke* for client**	Fool-proofing device which prevents clients making an error during service co-production process
Autonomation (*jidohka*)	Building-in the function of autonomous control in equipments or information systems
Production smoothing (*heijunka*)	Planning to reduce peaks and idleness caused by service demand variation
Standardization	Definition of standard work procedures
Kanban	A means of information to control the operation of resources according to the pull system
Andon	Visual control devices to make problems evident and activate countermeasures promptly
Self-control	Quality assurance responsibility assigned to operators of service production processes

During the realization of the field studies which are discussed in the next section, the analysis of process improvement efforts in service businesses also revealed that the very nature of service systems has allowed some productivity improvement tools, not yet familiar in the context of manufacturing, to be applied in the implementation of lean service processes. Table 3 exhibits some of such tools that were originally introduced in service businesses.

Table 3 – Process rationalization tools primarily applied in service businesses

Tools	Description
Training the client	Training performed by the service provider to facilitate co-production or correct use of the service by the client
Information Technology for back-office automation	Information equipments and software to automate in back-office tasks
Information Technology for front-office automation	Information equipments and software to automate in front-office tasks
Self service machine (co-production)	Equipment that allow a service task to be undertaken by the client

The classification criteria and definitions presented by this paper for the main types of wastes and performance improvement tools in the context of service businesses are just tentative, in the sense that they still need to be reviewed based on broader theoretical

discussions and empirical investigations. However, they already provide an adequate frame of reference for the purpose of an exploratory study and thus were adopted to structure the discussion and analysis of the cases observed in the field studies presented in the next section.

4. The experience of service firms in streamlining service processes

Nowadays, in many emerging countries, the services businesses developed rapidly and already represent the most important sector of the economy. As of 2005, in Brazil, the service sector contributed with 52.3% of the Gross Domestic Product (GDP) employing some 49% and 71% of the male and female work force. In spite of these weighty social and economic roles, service organizations in Brazil are still lagging behind in the management of quality and productivity in service delivery process. In this context, searching opportunities to extend the application of the Lean approach in service environments arise as a promising direction. Based on this motivation, field study observations were conducted in a sample of service firms established in Brazil in order to investigate how they have rationalized operational tasks and resource allocation, and streamlined process flows in search of leaner services. The sample observed was constrained to include service systems that can be characterized as "service shops" or "mass service systems", based on the assumption that in "professional services", a lean service approach is inherently less suitable and effective.

The sample of firms investigated comprises three cases classified as service shops established in the businesses of computer components distribution (COD), electric energy distribution (ENE), and budget hotel (HOT), and two cases of call centers, one in a retail bank (CAL) and the other in a telephone service operator (AUX)

which may be classified as mass services. The characteristics of these five firms are listed in Table 4.

Since a service firm can provide a variety of services by means of different access modes, the scope of the services focused in this study was restricted. In the three cases of service shops, the subject service involves the presence of clients while in the two cases of call centers the contact is virtual. The distributor of computer components can also be accessed by phone. As for the case of budget hotel, in the considered scope, the physical contact is essential.

Table 4 – Characterization of the sample

Description	COD	ENE	HOT	CAL	AUX
Main service	Distributor of components to computer assemblers	Support of electric energy installation order	Low fare lodging	Call center	Call center
Scope	Personal contact, by phone or by Internet	Reception of orders and documents for installation or re-connection of electric energy Appeals against fines and penalties	Reception desk, restaurant, room service and cleaning service	Provider of bank account information and conventional distant services offered by retail banks	Provider of subscribers' telephone number or address information
Facilitating service	Direct store delivery Credit analysis	Credit analysis	Maintenance	Audible Response Unit (ARU)	Audible Response Unit (ARU)
Target public	Computer assembly and maintenance companies	Users of electric energy: consumers, new home, and corporate clients.	Business travelers	Individuals and corporate clients	Telephone users in areas covered by the telephone service operator
Type of service	Service shop	Service shop	Service shop	Mass service	Mass service

It is worth mentioning that the scope of the subject services was deliberately defined in a way to include typical front-office activities. As a matter of fact, as observed by Johnston (2005), the LP approach has been applied in the context of service management, with a few exceptions, to the back-office parts of service organizations or heavily commoditized service processes, thus the application of Lean principles and tools to support efficiency in front-office without compromising service quality or the customers' experience represents a major challenge.

Table 5 – Typical wastes for the service provider identified in the sample of service systems

Type of waste	COD	ENE	HOT	CAL	AUX
Quality defects	Purchase order and/or product delivery with defect	Defective installation of electric energy	Lodging, food or maintenance with defect	Bank account information with defect	Telephone or address information with defect
Unnecessary process	Input process of information that will not be used	TV set presenting information concerning the company during the client's waiting time		Introduction of unsolicited financial product or service by operators	Automatic call of the searched phone number
Work in Process	Inventory of products for sale	Building areas and furniture to accommodate queues of clients waiting for service	Building areas and furniture to accommodate queues of clients waiting for service	Queues of calls from clients waiting for service while telephone lines are busy	Queues of calls from clients waiting for service while telephone lines are busy
Stock of finished cases	Building areas and storage equipment to stock products already sold waiting for delivery	Building areas, furniture and hardware to store magnetic or physical documents waiting for delivery	Resources to store belongings of clients that have already checked out		
Unnecessary movements	Operator has to walk long distance to analyze financial information with a specialist	Operator has to walk long distance and then search to retrieve documents	Waiter has to walk long distance to get drinks	Supervisor has to walk long distance to assist a workstation in solving specific problems	
Unnecessary transportation	Transportation of the purchased materials from the storage area to the parking area	Transportation of documents between the service unit building and administrative service building	Transportation of pre-processed food items from a catering centre to the hotel		
Waiting time	Operator and hardware waiting for financial analysis to finish the service	Waiting of operator and hardware while the client fills-in the service order forms	Waiting of clerk and hardware while the client fills-in the check-in forms	Waiting of operator and hardware while the client searches or selects the information to be requested	
Overcapacity	Telephone lines, operators, hardware.	Operators, furniture, building, hardware.	Clerks, furniture, building.	Telephone lines, operators, hardware.	Telephone lines, operators, hardware.
Poor design	Difficulty to navigate between system screens		Unreasonable effort required to clean guestrooms	Different operators have to ask redundant questions to same clients	

In the field studies, typical wastes were identified in the service systems observed and then classified according to the taxonomy adopted in this paper. Table 5 exhibits the wastes identified from the service providers' perspective.

In the case of the budget hotel, it was noticed that in comparison to more comfortable hotels of superior class, its facilities and processes were relatively much more rationalized, and because of this no evidence of unnecessary process could be identified within the scope considered.

Table 6 – Typical wastes for the clients identified in the sample of service systems

Type of waste	COD	ENE	HOT	CAL	AUX
Service defects	Malfunction or degraded function of a purchased component	Malfunction or degraded supply of electric energy	Malfunction or degraded condition of the lodging, food or maintenance	Malfunction or degraded operation of bank account information provider	Malfunction or degraded function of subscriber information provider
	Client's resources spent to access the CAS	Client's resources spent to access the CAS	Client's resources spent to access the CAS	Client's resources spent to access the CAS	Client's resources spent to access the CAS
	Waiting time to have repaired wrong delivery or defective component	Waiting time to have repaired defective electric energy installation	Waiting time to have repaired defect in accommodation, food or maintenance	Waiting time to have repaired defective bank account information	Waiting time to have repaired defective information of a subscriber
Unnecessary process	Time to provide unnecessary fiscal information	Time to provide unnecessary personal information	Time to provide unnecessary information in the check-in	Re-input bank account data already informed to get access	Re-input phone number already informed
	Waiting time while unnecessary information of other clients is processed	Waiting time while unnecessary information of other clients is processed	Waiting time while unnecessary information of other clients is processed	Waiting time while unnecessary information of other clients is processed	
Work in Process	Waiting time to receive purchased components from the storage area	Waiting time to pay tariff	Waiting time during the cleaning of a free room or until room service arrives	Waiting time for a free operator	Waiting time for a free operator
Stock of finished cases	Penalties if the client is not available to receive the products when the delivery service arrives at the client's place	Electric energy installation order is cancelled due to absence of client	Reservation is cancelled due to non appearance of client		
Unnecessary movements	Waiting time for picking of products in a distant storage	Waiting time while operator walks to obtain fiscal information in a distant file	Waiting time while the waiter walks to get drinks in a distant refrigerator or bar	Waiting time while the supervisor walks to analyze a problem in a distant workstation	
	Client has to walk to a distant storage area to receive the components	Client has to walk to access next service station which is distant	Client has to walk to access the parking area which is distant		
Unnecessary transportation	Waiting time while purchased goods are transported from the provider's storage area to the client's location	Waiting time while documents are transported from one department building to another			
	Time and cost of transportation to go to the service provider building for physical contact	Time and cost of transportation to deliver documents at the service provider building			
Waiting time	Waiting time while the operator accesses the manager to analyze a credit problem	Waiting time while the operator consults with the manager on a document problem	Waiting time while the clerk accesses the maintenance service to solve a problem	Waiting time while the operator consults with the supervisor to get information	
Overcapacity	Overcapacity costs of operators and equipments included in the price	Overcapacity costs of operators, building area and equipments included in the tariff	Overcapacity costs of operators, building area and equipments included in the rate	Overcapacity costs of operators, telephone lines and hardware included in the tariff	Overcapacity costs of operators, telephone lines and hardware included in the tariff
Poor design	Difficulty to navigate between the pages of the website	Time to fill in complicate forms	Use of keys instead of magnetic cards require its return at reception	Successive answering of same questions	

Note: CAS - Customer Assistance Service

Also, it is worth mentioning that in the cases of call centers, since there is not physical contact between the operator and the client, the realization of the subject process involved a narrower variety of wastes that may incur.

Table 7 – Applications of Lean Production tools adapted to service processes

Type of waste	COD	ENE	HOT	CAL	AUX
Pre-processing	Software prioritizes the backlog calls	The reception desk operator verifies if the client's documents are correct	Food served in the restaurant area is pre-processed in a catering centre	ARU directs the client to a self-service	ARU directs the client to a self-service
	Software dials a selected phone number			ARU directs the client to a specialist in a specific banking information	ARU directs the client to a specialist in a specific telephone information
	When a client calls, the software identifies the client and displays specific files related to this client to facilitate negotiation			When a client calls, the software identifies the client and displays specific files related to this client to facilitate the information service	
Quick setup	Packages separated by client are arranged next to the expedition desk to facilitate shipment	Lot of similar cases is arranged to facilitate database input	Kits of cleaning products/gadgets and service carts are available in all floors to facilitate room-maid work		
Multi-tasking	The operator is able to analyze many technical alternatives to solve the client's problem	The operator is able to work in the reception desk, credit analysis desk or technical service desk	The clerk is able to work in the reception desk or in the restaurant	The operator is able to work in the bank account information service or in the credit card information service	
Service cell	Software allows instant access to all kinds of credit information or technical service related to the client	Documents reception desk, credit analysis desk and legal support desk are physically next to each other	Inter-communication between reception desk and restaurant desk	Software allows instant access to a variety of bank account information or services related to the client	Software allows instant access to all kinds of telephone information or service related to the client
Poka Yokes for operator	Software alerts the operator about time outs and necessary call backs to clients	Software verifies ZIP code and asks references to facilitate the recognition of the client's home or building	Software asks magnetic code of the guest's room key to access the check-out process	Software asks information of codes by the clients to open and display correct files to the operator	ARU inform the client the telephone number found by the operator
Poka Yokes for client		Software guides the client to the operator who knows his/her case	Magnetic bar of the key blocks access to a wrong room	ARU replies the code number input by the client	
Production smoothing	Software directs the next call to a free operator avoiding queues to busy operators	Input of the client's documentation data is done in a period of low demand	Cheaper rates on weekends when demand is lower for hotels in business centers	Software directs waiting calls to the next free operator	Software directs waiting calls to the next free operator
Autonomation	not identified	not identified	not identified	not identified	not identified
Standardization	Standard Operating Procedure for new clients' data input	Standard Operating Procedure for new clients' data input	Standard Operating Procedure for check-in, clean service and periodic maintenance	Standard Operating Procedure includes standard scripts to be spoken by operator	Standard Operating Procedure includes standard scripts to be spoken by operator
Kanban	Software displays and prioritizes queued waiting calls so that the operator can decide which one to pull	Software displays the waiting queue organized by kind of service or client	Replenishment of pre-processed food is pulled by *kanban*	Software displays the waiting queue organized by kind of information or service required	Software displays the waiting queue organized by kind of service

The same remark can be applied to the content of Table 6 where examples of wastes from the clients' perspective are listed. As physical contact does not exist, the variety of client's wastes is also narrower in the cases of call center. Inversely, in the case of the computer components distributor, the variety of potential wastes of client's time or resources is broader owing to the efforts the clients must undertake in accessing the service provider.

Besides the identification of typical wastes, the field studies also contemplated the performance improvement tools applied by the service providers to eliminate such wastes. As indicated in the previous section, the tools identified can be divided into two basic categories: LP tools adaptable to lean service systems and process rationalization tools primarily adopted in service systems. The evidences of these rationalization tools observed are presented by Tables 7 and 8.

Table 8 – Applications of process rationalization tools introduced by service firms

Tools	COD	ENE	HOT	CAL	AUX
Training the client	Operator guides the client to use internet service for searching product prices	Operator informs the client to bring documentation during low demand periods	Clerk explains the correct use of room facilities	ARU asks the client to input the codes slowly	ARU asks the client to speak keywords to facilitate the search of requested information
Information technology to back-office automation	Software alerts the operator about backlog time outs	Software blocks installation service process if there is fiscal or legal restriction related to the client	Pager alerts maintenance crew on urgent repair service	Batch processing software to update clients' bank account information	Batch processing software to update telephone subscribers' information
Information technology to front-office automation	Software displays automatically to operator all kinds of information and allows access to previous orders	Software prioritizes service provider for special clients (old man or woman, pregnant woman) identified in the reception desk	Software alerts about internal or external restriction about specific client asking for lodging in the reception desk	Software displays automatically the bank account information to operator and allows access to banking services related to the client	Software recognizes keywords spoken by the client ARU returns the information requested by the client
Self service (co-production)	Client can use internet service to search product price or technical information and register to receive promotional offers		Automatic vending machines (AVM) to supply soft-drinks and snacks and automatic polishing machines for guests' shoes	ARU leads the client to input personal code numbers	Client speaks keywords to input data

It is important noting that Tables 7 and 8 just enumerate some practical examples that could be gathered in the field studies. They are presented as illustrations

of typical wastes found in service processes and to indicate that these wastes can be effectively reduced or eliminated by the application of the tools which were pointed out.

5. Conclusion

Evidences of practical applicability of concepts and techniques advocated by the Lean Production (LP) paradigm could be identified. Empirical observations suggested that while the application of many LP elements can be transplanted to the context of service businesses, rationalization of service process may require consideration of specific concerns such as the need to relieve the need to require customers' own resources and time for the completion of the service process.

This study has shown that for the analysis of processes and identification of wastes in service systems, the proposed scheme of including the contemplation of the clients' participation in the service is meaningful and instrumental to find not only opportunities to improve the service from the service provider's perspective but also to sustain customer satisfaction.

The field studies also revealed the adoption of a set of tools which were introduced by service firms as means for process rationalization. This hints at the possibility of process rationalization tools primarily implemented in the context of services businesses to be inversely adapted for new applications in manufacturing environments.

Finally, it was noticed that none of the five service firms investigated, had planned and implemented the process rationalization tools observed driven by an explicit reference model of Lean Service. As a matter of fact, managers in the service businesses are very concerned with process improvement targets but so far, are not

aware of any model like LP that could provide principles, analytical concepts, methodologies, and tools to carry out systematized efforts to turn service processes leaner. In manufacturing industries, an increasing number of LP adherents have benefited from the improvement approach advocated by this management paradigm. There are already some theoretical propositions and practical experiments promoting the derivation and systematization of a similar improvement approach better fitted to service organizations. The evidences presented in this work suggest that the emergence of such a reference model could be very instrumental to provide a more solid foundation to the performance improvement initiatives already in course in service businesses, and to promote their own boost.

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