Business Processes in Technology and Information Services

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Abstract

In this work, we defined and simulated the processes in an information technology services company with the purpose of enhancing attention and functions defined for each of them. We analyzed several works related to the business management process and simulation. For model development, we designed a methodology based on business process management. For modeling and simulating the procedures and activities, we used a software tool establishing times and number of possible instances to be performed. The software allowed adapting these times and processes to a desired level of performance. Resulting processes contribute to adequately and time efficiently perform business activities to provide a higher quality service.

Keywords: Business processes management, simulation, methodology, information technologies.

Gestión de procesos de negocios en servicios de tecnología e información

Resumen

En este trabajo definimos y simulamos procesos en una compañía que presta servicios de tecnología de la información con el propósito de mejorar la atención y las funciones definidas en cada proceso. Analizamos diversos trabajos con respecto a la gestión de procesos de negocios y simulación. Para nuestro modelo de desarrollo, diseñamos una metodología basada en la gestión de procesos de negocios. Los procesos y las actividades fueron modelados y simulados con la ayuda de una herramienta de *software* para estables los tiempos y el número de posibles estancias ejecutadas. Dichos tiempos y procesos pueden ser adaptados al nivel de rendimiento deseado. El resultado de dichos procesos contribuyó a la realización de actividades de negocio de tal manera que las mismas sean más eficientes con respecto al uso del tiempo y por lo tanto otorguen un servicio de alta calidad.

Palabras clave: BPM, simulación, metodología, tecnologías de la Información.

Gestão de processos de negócios em serviços de tecnologia e informação

Resumo

Neste trabalho definimos e simulamos processos em uma companhia que fornece serviços de tecnologia da informação com o propósito de melhorar a atenção e as funções definidas em cada processo. Analisamos diversos trabalhos com respeito à gestão de processos de negócios e simulação. Para nosso modelo de desenvolvimento, desenhamos uma metodologia baseada na gestão de processos de negócios. Os processos e as atividades foram modelados e simulados com a ajuda de uma ferramenta de *software* para estabelecer os tempos e o número de possíveis estâncias executadas. Estes tempos e processos podem ser adaptados ao nível de rendimento desejado. O resultado de ditos processos contribuiu à realização de atividades de negócio de tal forma que as mesmas sejam mais eficientes com respeito ao uso do tempo e portanto outorguem um serviço de alta qualidade.

Palavras-chave: BPM, simulação, metodologia, tecnologias da informação.

Introduction

Nowadays, businesses organizations are involved in a continuous competition regarding products and services, which has led to an increased concern on the inner workings as well as finding ways for improving, which help increase profitability in business. Process management allows a better control of the activities and tasks performed. The main goal of the company is to provide clients with a better service in a short response time, low prices, and good customer support.

Business process modeling role is to analyze each level of the organization and monitor every department and the processes performed, with the objective of identifying weaknesses and strengths and proposing, trying and implementing solutions in the organization. Such solutions must go hand in hand with the implementation of good practices for ensuring the best quality management. For this reason, all levels of the organization, from management to the areas closest to clients, must be involved in this process.

It is no surprise to see that most companies rely on and need information technologies (ITS) to perform their functions, which main objectives are to provide services and products of the highest quality. However, small and medium size companies rarely make use of established standards or good practices in their processes, making this aspect vulnerable to errors since these processes lack organization and communication among the composing departments is not adequate. The inadequacy in processes results in little or no advantage in comparison to similar companies in the market these companies are competing. In addition, such non-optimized processes derive in problems when providing IT services because they cannot complete their projects due to misuse or lack of infrastructure, communication, security, communication with suppliers, customer complaints, and others that affect credibility and trust and may lead to loss of customers.

It is essential to have both an adequate management and structure of the it processes and services because that contributes to meet the needs of the organization, and the ones of users or companies that request a service or product. This allows improving the efficiency in the organization's operations and the company's value.

The company object of study provides it services, sales of products as well as accessories for its. This organization shows a lack of interdepartmental communication and of execution of activities and omission of them and processes to be followed by departments. The staff performs activities unrelated to a department, which doubles the number of functions performed by the department affecting the time allocated for their execution or of the services provided to customers.

Processes are considered an initial part of the operation of a company until it becomes a fundamental part of the organizational structure. Different techniques have emerged to include the use of processes in companies, so these become a part of the strategies, objectives, and policies of an organization (Zaratiegui, 1999); BPM (Business Process Management) is one of the principal technological solutions clients are applying in their companies so that the growth they experience in relation to management prolongs over the years, the use of BPM allows business management to become a strategy that makes changes timely, quickly, and reliably without losing quality in the services provided and staying focused on the strategic objectives proposed in the organizations (Díaz Piraquive, 2008). Having a model of business processes and quality, which organizations can apply to their processes to automate, control, and monitor them allows better management of the IT service (Hernández Villegas, 2013). The combination of adequate process management, the use of its and a business model help organizations to be competitive in the direction they headed (Díaz Piraquive, 2008).

For the management of IT services, there are several frameworks built with a set of best practices (Díaz Piraquive, 2008; Hernandez Villegas, 2013) and standards such as ITIL (Information Technology Infrastructure Library), COBIT (Control Objectives for Information and Related Technology), CMMI (Capability Maturity Model Integration), PMBOK (Project Management Body of Knowledge), which help the business to improve performance, transparency, and control over IT activities (Governance Institute, 2008).

Literature Review

The implementation of it services management in organizations helps to solve common problems which may prevent organizations from obtaining desirable results. The purpose of IT services is to provide organizations with the necessary skills enabling them to become efficient service providers for customers. Strategies and continuous improvement will be all the services' base. In order to implement service management, it is necessary to improve process management to allow the organization to achieve its goals. Below, we provide some examples of recent works in the field of IT with business process management at its core.

Health. Medicine can benefit from the application of process management because it proposes modeling technology with the purpose of providing telemedicine based health services (e.g. home care). This case used Aris technology, particularly for the implementation it used the Aris Toolset tool in conjunction with the event-driven process chain (EPC) technique (Parra et al., 2005). Framiñán et al. (2004) used processes redesign and reengineering in different health services based on current modeling process (as their models) to run a simulation and obtain models, which worked according to the objectives (to be models). Gómez Pérez et al. (2012) define a methodology that identifies areas for improvement in neurorehabilitation processes in patients with acquired brain damage (ABI) and provides tactics for their supervision and automation.

Software. Bonillo (2006) suggests different methods and tools paired with bpm, which allow the identification of the main processes, their analysis and modeling through the use of patterns and their representation with an architecture definition language (ADL) to then simulate, implement, evaluate, supervise and improve them. A combination of cloud storage and BPM allows running different processes in the cloud storage environment, which result in mobile applications, sensitive data, and a high level of performance that require the use of process engines (Karabogosian, Bazán & Martínez Garro, 2014)Ushuaia (Tierra del Fuego, Argentina. Sanchez et al. (2007) suggest the use of model driven architecture (MDA) in those business processes that are an essential part of computation independent model (CMI). They also recommend using BPM and Service Oriented Architecture (SOA) for defining processes and linking them to the most suitable software. The collaboration in the development of software projects aims for higher quality and fulfilling the requirements,

needs, cost, and delivery time. These lead to the development or implementation of modeling techniques in order to introduce, evaluate, and redesign software development processes by proposing the application of the stages which allow the conceptualization, capture, evaluation, redesign, and execution of software processes (García Mireles, 2001).

Commerce. The commercialization of products based on their traceability can also benefit from the application of process management. Santamaría (2011) provides a solution for the analysis of procedures, which helps to see a product in a specific period or moment, done through the design and analysis of a series of processes in BPMN. Pita (2015) suggests the use of software for process automation, aiming for management and control of the activities in the company.

Industry. In this sector, companies are always striving for the best way to provide services and high quality products, and this is why some companies have implemented bpm. Jaramillo Garza and Jaramillo Garza (2015) analyzed a methodology focused on business process reengineering models which are to be evaluated both quantitatively and qualitatively, proving to improve the efficiency of current processes and the competitiveness of the company. In the metallurgical sector, Sperandio Milan et al. (2012) applied a methodology based on the process management of ABPMP. This methodology consists of six stages that represent the management related activities performed in the organization related to the manufacturing of a product tailored to the needs of a customer. Also, Sperandio Milan et al. (2012) claimed for methodologies, which allow the standardization and improvement in manufacturing processes in small and medium enterprises. Martínez and Soler (2011) implemented a similar methodology in a medium sized basic metallurgy enterprise, which helped the company develop tools for the implementation of best practices. This methodology consists of five stages which aim at identifying all the departments interacting in a specific activity and the areas for opportunity and improving the manufacturing processes. The methodology makes use of tools provided by method engineering, quality engineering, and business processes. Process automation for documentation in a quality management system ISO 9001 with business management process allows for a more detailed documentation of the processes and building in the Business Process Management Suite (López Supelano, 2015).

Education. Academic institutions are attentive to advances in management models focused on quality such as BPM, SIX, SIGMA, and LEAN in classrooms and their processes. It is possible to implement BPM in machinery and equipment with the use of 7FE and software tools suited for real life processes according to the needs of people (Lizano Mora, 2014).

Simulation. A retirement home used simulation and business process modeling are used for forecasting the necessity and availability of space as well as the effects caused by the duration of the processes, whose available capabilities are surpassed by requested services (Pecek & Kovacic, 2011). Understanding why some systems and processes are not working properly makes possible implementing improvements in business processes related to the use of a management system for a database (Zarei, 2001). It also supports the modeling and improvement of care in the emergency department in a hospital. In order to reduce the response time, a hospital analyzed and entered the records, while running simulations (Shim & Kumar, 2010). Sarvepalli and Goding (2017) detailed a learning experience with BPM that included simulations and graphic elements of processes present in a game.

BPM methodologies. Lowenthal's method consists of 4 phases that includes 13 principles (Martínez Cruz, 2012). The phases represent the stages of the life cycle followed in this method: preparing, planning, designing, and evaluating change; the principles are the activities or tasks to be performed in each stage. The Execution Premium relates the formulation and planning of the strategy with the operational execution, which consists of six stages (Sistos Mendoza, 2015): Development of the strategy, its translation, alignment of the organization, planning the operations, monitoring and learning, and testing and adapting the strategy. Smith (Fundibeq, 2015) relied on the review of the strategic process to improve the performance of the processes. The phases are vision and mission, strategic assessment, strategy maps, balanced scorecard, execution. Jeston and Nelis (Carrión, 2016) proposed four critical aspects for a process improvement project: people, process, technology and project management. These aspects are composed of 10 phases: organization strategy, process architecture, process launch pad, understand, innovation, develop, people, implement, realize value, sustainable performance. This method has three main components: project management, change management, and leadership.

Methodology

The methodology considered for this study was Execution Premium (Sistos Mendoza, 2015) oriented towards the administrative departments. The aim is to choose the most suitable strategy for the company from an array of options, how to implement it and the people involved in its implementation. Lowenthal's method (Martínez Cruz, 2012) serves as a guide for making improvements in the processes starting on a chosen strategy. With these two features, we designed a methodology usable for small and medium enterprises in the it departments with the goal of improving administration, operation and increasing the quality of products and services. This adaptation consisted of five steps: analyze, plan, design, assess and apply.

- Step 1. Analyze. A full analysis is performed in order to clearly define the mission, vision and values and to also set the possible strategies for business management. Staff is made aware of the selected strategy and prepared for change. This step comprises nine activities.
- Step 2. Plan. The administration plans the strategy, sets the goals and, considers resources, organizes work teams, makes budgets and assigns goals, contemplates risks and makes decisions. In addition, it schedules training courses for employees, feedback sessions about the implemented strategy and activities aimed to improve the quality of the service. It esteems nine activities.
- Step 3. Design. The administration identifies and analyzes the current processes, selects those that need improvement, and makes the necessary changes based on the selected strategy, as well as creating new procedures, which it will compare to the current ones. The administration also sets the process' objectives, selects the staff to be involved in them, decides the tool for design and process modeling, as well as the device to be used by employees for further improvement. There are eleven activities in this step.
- Step 4. Assess. The administration tests the selected strategy and processes, assess the results and determines the required changes until these fulfill the company's needs. It proposes four activities.

- Step 5. Apply. The administration implements the selected strategy and new processes, permanently checks the results and documents all the problems to be solved, which in turn it will use for decision making. There are four activities in this final step.

Methods and Tools

Following the steps provided by the selected methodology (analyze, plan, design, assess, apply) and Bizagi as modeling and simulation tool, we propose the following model and process map (Figure 1).

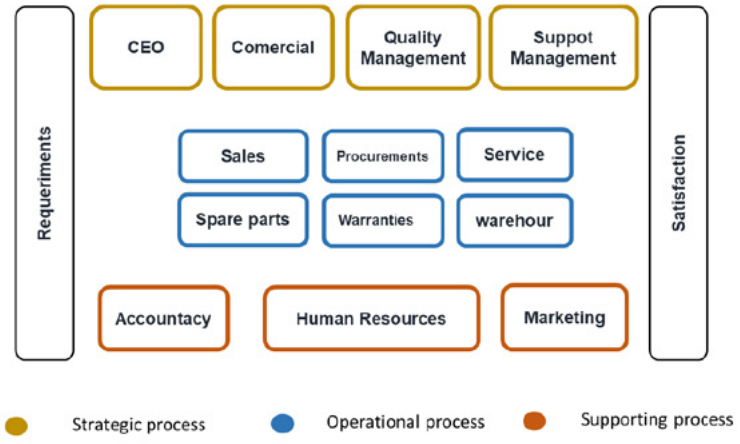

Figure 1. Classification of the suggested processes

Source: Own elaboration

These allowed identifying customer needs and strategic, key and supporting processes while keeping as a goal the customer satisfaction. The suggested processes are

Strategic processes. They aim at defining and controlling the goals of the organization, as well as policies and strategies.

- *ceo*. This process organizes the company's management plan in order to perform all activities and achieve goals. It also verifies and guarantees the fulfillment of all policies and authorizes all requests and revisions regarding the administration management.

- *Commercial management.* It is responsible for managing the procurement and sales of all products and services. It aims to find the best strategies when promoting the products offered by the company.
- *Quality management.* Its main role is to follow and control all processes in the company and to verify areas follow them correctly. Also, it is in charge of making all necessary adjustments in order to contribute to the goal of offering a better service.
- *Support management.* It arranges all services and sales of spare parts in order to make any repairs or get it done through an external repair service.

Operational Processes. These allow generating all products and services offered to customers.

- *Sales.* It has direct contact with customers, finds the best products and services by considering their needs, and provides sales advice and tracking of customers and potential sales. Its main roles are 1) counter sales; 2) verify the availability of a product; 3) authorization; 4) quotes; 5) placing an order, and 6) billing.
- *Procurement.* It finds and administers resources efficiently; provides materials to the company; requests quotes of products, and evaluates and selects suppliers based on the costs, availability, delivery time, quality of the product and service, so the company always has the necessary resources to keep the organization running. Its main responsibilities are 1) request purchase, 2) request quote and select the best supplier, 3) making the purchase.
- *Service.* It analyzes, diagnoses and repairs equipment provided by customers. Activities performed are: 1) Reception, 2) Review, 3) Diagnose, 4) Repair, 5) Return equipment, 6) Customer satisfaction survey.
- *Spare parts.* Its principal roles are purchasing and distributing spare parts as the means for repairing any equipment or hiring maintenance to prevent malfunctioning. Its main activities are 1) spare parts request, 2) Quotes, 3) Making the purchase, 4) Deliver materials.
- *Warranties.* It receives and handles all requests related to the warranty of products, equipment or services which have any defects on quality or problems arising from performed services. Its activities are 2) Receive warranty request, 2) verify purchase information, 3) perform tests, 4) request warranty, 5) supplier resolution, 6) communicates resolution to customer.

- *Warehouse*. It controls and stores products and equipment from the organization; receives and verifies all of those requested based on quantity, features, cost, and adequate conditions; records all resources received, and distributes all assigned spaces. It performs the following activities: 1) receive goods, 2) verify goods received are the ones billed, 3) verify goods are in good conditions, 4) register the goods in the system, 5) store the goods.

Supporting processes. These processes are the necessary activities for the proper functioning of the operational processes.

- *Accountancy*. It allows for the elaboration and presentation of information related to financial reports used as tools for adequate planning and decision-making. The activities performed are 1) tax calculation, 2) control of expenses, 3) account management.
- *Human resources*. It verifies, administers and leads personnel in the company, and recruits and selects staff, authorizes leaves of absence and training courses. Its main activities are 1) staff request, 2) recruitment and selection, 3) hiring, 4) scheduling leaves of absence and vacation, 5) training, 6) end of contracts.
- *Marketing*. It designs strategies to find and keep customers. Its main activities are 1) identify customer needs, 2) needs analysis, 3) customer advice, 4) design promotional strategies, 5) design advertising campaigns, 6) visit potential customers, 7) make sales.

Results

With the use of a BPMS, we modeled and simulated processes, validated fluxes and processes, and assigned time to activities. Simulated processes correspond to operational processes, which majorly influence the organization's services. Input data —ID— (table 1, table 3, table 5, table 7, table 9, table 11) specify the amount of time assigned to each activity or task in the process, which also provided the opportunity to perform them. We used several minimum and maximum arrival intervals for specific processes. The maximum value of instances was set at 100. Time may vary according to circumstances;

we took input time data from real life time intervals executed by the personnel involved in the service processes which allow obtaining execution times in the simulated ones (table 2, table 4, table 6, table 8, table 10, table 12).

Table 1. Input data for simulation in sales

Activity/Process		Input Data
Arrival Interval		5 min.
Maximum value of arrivals		100
Customer service time		5 min.
Customer advice		2 min.
Check availability of the product		7 min.
In stock?	Yes	80 %
	No	20 %
Price quote		1 hr.
Submit quote to sales		10 min.
Notify customer about price		20 min.
Authorization		2 hrs.
Place order		10 min.
Send request to procurement		15 min.
Billing		10 min.
Deliver invoice		1 min.
Receive product		1 min.

Source: Own.

Table 2. Times obtained after processing one hundred possible sales in days (d), hours (h) minutes (m)

Name	Type of event	CI	SI	MinT	MaxT	AvgT	TT
Sales	Process	100	100	2 h 26 m	4 h 9 m	2 h 51 m 45 s	11 d 22 h 15 m
None Start	Start event	100					
Customer service time	Task	100	100	5 m	5 m	5 m	8 h 20 m
Send request to procurement	Task	25	25	15 m	15 m	15 m	6 h 15 m
Notify customer about price	Task	25	25	20 m	20 m	20 m	8 h 20 m
None End	End event	25					
Customer advice	Task	100	100	2 m	2 m	2 m	3 h 20 m
Check availability of product	Task	100	100	7 m	7 m	7 m	11 h 40 m
In stock?	Gateway	100	100				

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Name	Type of event	CI	SI	MinT	MaxT	AvgT	TT
Deliver invoice to accountancy	Task	75	75	0	0	0	0
Notify customer about price	Task	75	75	0	0	0	0
Deliver invoice	Task	75	75	1 m	1 m	1 m	1 h 15 m
None End	End event	75					
Receive product	Task	75	75	1 m	1 m	1 m	1 h 15 m
None End	End event	75					
Place order	Task	25	25	10 m	10 m	10 m	4 h 10 m
Submit quote to sales	Task	25	25	10 m	10 m	10 m	4 h 10 m
Quote	Task	25	25	1 h	1 h	1 h	1 d 1 h
Authorization	Task	75	75	2 h	2 h	2 h	6 d 6 h
Authorization	Task	25	25	2 h	2 h	12 h	2 d 2 h
Billing	Task	75	75	10 m	10 m	10 m	1 h 30 m

Source: Own.

Completed Instances (CI), Started Instances (SI), Minimum time (MinT), Maximum Time (MaxT), Average Time (AvgT), Total Time (TT) are the representations of the values.

Table 3. Input Data for Simulation in Procurement

Activity/Process		Input Data
Arrival interval		5 min.
Maximum number of arrivals		100
Make purchase request		30 min.
Analysis of purchase request		1 day
Request quote		2 hrs.
Select supplier		5 hrs.
Create purchase order		1 hr.
Approval needed?	Yes	70%
	No	30%
Approve purchase order		2 hrs.
Request purchase order authorization		2 hrs.
Approved?	Yes	90 %
	No	10 %
Notify approval		1 hr.
Send purchase order to supplier		30 min.

Source: Own.

Table 4. Results Obtained After Processing One Hundred Possible Purchases in Days (d), Hours (h) Minutes (m)

Name	Type	CI	SI	TMin	TMax	TP	TT
Procurement	Process	100	100	1 d 9 h	1 d 14 h	1 d 12 h 11 m 24 s	150 d 19 h
None Start	Start event	100					
Make purchase request	Task	100	100	30 m	30 m	30 m	2 d 2 h
Analysis of purchase request	Task	100	100	1 d	1 d	1 d	100 d
Request quotes	Task	100	100	2 h	2 h	2 h	8 d 8 h
Select supplier	Task	100	100	5 h	5 h	5 h	20 d 20 h
Make purchase order	Task	100	100	1 h	1 h	1 h	4 d 4 h
Request purchase order authorization	Task	68	68	2 h	2 h	2 h	5 d 16 h
None End	End event	14					
Receive quotes	Intermediate event	100	100				
Send purchase order to supplier	Task	86	86	30 m	30 m	30 m	1 d 19 h
Approval needed?	Gateway	100	100				
Approve order	Task	68	68	2 h	2 h	2 h	5 d 16 h
Notify approval	Task	54	54	1 h	1 h	1 h	2 d 6 h
None End	End event	86					
Approved?	Gateway	68	68				

Source: Own.

Table 5. Input Data for Simulation in Warehouse

Activity/Process		Input Data
Arrival Interval		1 day
Maximum number of arrivals		100
Delivery of goods to warehouse manager		30 min.
Receive goods		25 min.
Receive invoice and verify goods		1 hr.
Are goods complete?	Yes	98 %
	No	2 %
Verify goods are in good conditions		1 hr.
Are goods in good conditions?	Yes	90 %
	No	10 %

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Activity/Process	Input Data
Register the goods in the system	3 hr.
Label goods	30 min.
Store goods	40 min.
Send copy of invoice	5 min.
Receive invoice for archives	10 min.
Send invoice to accountancy	2 min.
Report any missing goods to supplier	30 min.

Source: Own.

Table 6. Results Obtained After Processing One Hundred Possible Events in Warehouse in Days (d), Hours (h), Minutes (m)

Name	Type	CI	SI	MinT	MaxT	AvgT	TT
Warehouse	Process	100	100	2 h 25 m	7 h 22 m	6 h 55 m 19 s	28 d 20 h 13 m
None Start	Start event	100					
Delivery of goods to warehouse manager	Task	100	100	30 m	30 m	30 m	2 d 2 h
Receive goods	Task	100	100	25 m	25 m	25 m	1 d 17 h 40 m
Goods are stored	Task	89	89	40 m	40 m	40 m	2 d 11 h 20 m
Verify goods are in good conditions	Task	99	99	1 h	1 h	1 h	4 d 3 h
Receive invoice and verify goods	Task	100	100	1 h	1 h	1 h	4 d 4 h
Label goods	Task	89	89	30 m	30 m	30 m	1d 20h 30 m
Receive invoice for archives	Task	89	89	10 m	10 m	10 m	14 h 50 m
Report any missing goods to supplier	Task	11	11	30 m	30 m	30 m	5 h 30 m
Record goods in the system	Task	89	89	3 h	3 h	3 h	11 d 3 m
Are goods complete?	Gateway	100	100				
Are goods in good condition?	Gateway	99	99				
Send invoice copy	Task	89	89	5 m	5 m	5 m	7 h 25 m
Receive invoice for archives	Task	89	89	0	0	0	0
Send invoice to accountancy	Task	89	89	2 m	2 m	2 m	2 h 58 m
None End	End event	89					
None End	End event	11					

Source: Own.

Table 7. Input data for simulation in Warranties

Activity/Process		Input data
Arrival Interval		50
Maximum number of arrivals		100
Request warranty		15 min.
Request receipt or invoice		5 min.
Verify date of purchase		1 min
Is it still under warranty?	Yes	70 %
	No	30 %
Is it a product or service?	Product	50 %
	Service	50 %
Perform tests		30 min.
Failure	Yes	30 %
	No	70 %
Receive product		10 min.
Send to supplier		2 day
Is it covered by warranty?	Yes	40 %
	No	60 %
Receive replacement product		2 day
Deliver product to customer		15 min.
Inform customer about void warranty and state reason		10 min.
Receive equipment		10 min.
Verify equipment		1 hr.
Is it covered by warranty?	Yes	90 %
	No	10 %
Repair equipment		2 hrs.
Report the event		20 min.

Source: Own.

Table 8. Results obtained after processing one hundred times the process of Warranties in days (d), hours (h), minutes (m)

Name	Type	CI	SI	MinT	MaxT	AvgT	TT
Warranty	Process	100	100	21 m	4 d 1 h 16 m	10 h 35 m 24 s	44 d 3 h
Deliver product to customer	Task	44	44	15 m	15 m	15 m	1 d 1 h
None Start	Start event	100					
Request warranty	Task	100	100	15 m	15 m	15 m	8 h 20 m
Is it a product or service?	Gateway	76	76				
Request ticket or invoice?	Task	100	100	5 m	5 m	5 m	8 h 20 m
Verify date of purchase	Task	100	100	1m	1m	1m	1h 40m
Inform customer about void warranty and state reasons	Task	11	11	10 m	10 m	10 m	1 h 50 m
Perform tests	Task	34	34	30 m	30 m	30 m	17 h
Failure?	Gateway	34	34				
Receive product	Task	13	13	10 m	10 m	10 m	2 h 10 m
Send to supplier	Task	13	13	2 d	2 d	2 d	26 d
Is it covered by warranty?	Gateway	13	13				
Receive replacement product	Task	5	5	2 d	2 d	2 d	10 d
None End	End event	79					
None End	End event	21					
Receive equipment	Task	42	42	10 m	10 m	10 m	7 h
Is it covered by warranty?	Gateway	100	100				
Verify equipment	Task	42	42	1 h	1 h	1 h	1 d 18 h
Is it covered by warranty?	Gateway	42	42				
Repair equipment	Task	39	39	2 h	2 h	2 h	3 d 6 h
Report the event	Task	3	3	20 m	20 m	20 m	1 h

Source: Own.

Table 9. Input data for simulation in spare parts

Activity/Process		Input Data
Arrival Interval		30
Maximum number of arrivals		100
Request service		10 min.
Repair or spare parts?	Repair	80%
	Spare parts	20%
Request authorization		2 hrs.

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Was it authorized?	Yes	65 %
	No	35 %
Authorize purchase		8 hrs.
Request purchase		2 days
Deliver product to customer		3 days
Customer satisfaction survey		10 min.
Express needs		5 min.
Request information about product and customer		2 min.
Request quote		1 day
Inform customer about cost and delivery time		30 min.
Deliver quote		5 min.

Source: Own.

Table 10. Results obtained from simulation in Spare parts

Name	Type	CI	SI	MinT	MaxT	AvgT	TT
Spare parts	Process	100	100	2 h 10 m	6 d 1 h 2 m	3 d 17 h 37 m 38 s	373 d 10 h 44 m
NoneStart	Start event	100					
Express needs	Task	22	22	5 m	5 m	5 m	1 h 50 m
Deliver quote	Task	22	22	5 m	5 m	5 m	1 h 50 m
Request service	Task	100	100	10 m	10 m	10 m	16 h 40 m
Repair or spare parts	Gateway	100	100				
Request information about product and customer	Task	22	22	2 m	2 m	2 m	44 m
Request quote	Task	22	22	1 d	1 d	1 d	22 d
Inform customer about cost and delivery time	Task	22	22	30 m	30 m	30 m	11 h
Authorize purchase	Task	64	64	8 h	8 h	8 h	21 d 8 h
Request purchase	Task	64	64	2 d	2 d	2 d	128 d
Deliver product to customer	Task	64	64	3 d	3 d	3 d	192 d
None End	End event	100					
Request authorization	Task	100	100	2 h	2 h	2 h	8 d 8 h
Was it authorized?	Gateway	100	100				
Customer satisfaction survey	Task	64	64	10 m	10 m	10 m	10 h 4 m

Source: Own.

Table 11. Input data for simulation in Service

Actvity/Process		Input data
Arrival Interval		50
Maximum number of arrivals		100
Request service		10 min.
Repair or spare parts?	Repair	90 %
	Spare parts	10 %
Receive equipment		10 min.
Check equipment		2 hrs.
Run diagnostic tests		30 min.
Does it need spare parts?	Yes	35 %
	No	65 %
Request quotes		30 min.
Deliver quote		15 min.
Request authorization		10 min.
Was it authorized?	Yes	80 %
	No	20 %
Change spare part?		1 hr.
Perform repair		2 hrs.
Deliver equipment to customer		10 min.
Customer satisfaction survey		10 min.
SPARE PARTS		30 min.

Source: Own.

Table 12. Results obtained after processing one hundred possible Services in days (d), hours (h) minutes (m)

Name	Type	CI	SI	MinT	MaxT	AvgT	TT
Service	Process	100	100	40 m	7 h 5 m	5 h 10 m 15 s	21 d 13 h 5 m
None Start	Start event	100					
Deliver quote	Task	37	37	15 m	15 m	15 m	9 h 15 m
Request service	Task	100	100	10 m	10 m	10 m	16 h 40 m
Repair or spare parts?	Gateway	100	100				
Deliver equipment to customer	Task	82	82	10 m	10 m	10 m	13 h 40 m
None End	End event	91					
Request authorization	Task	37	37	10 m	10 m	10 m	6 h 10 m
Was it authorized?	Gateway	37	37				

continúa

Name	Type	CI	SI	MinT	MaxT	AvgT	TT
Customer satisfaction survey	Task	82	82	10 m	10 m	10 m	13 h 40 m
Request quote	Task	37	37	30 m	30 m	30 m	18 h 30 m
Change spare parts	Task	28	28	1 h	1 h	1 h	1 d 4 h
Check equipment	Task	91	91	2 h	2 h	2 h	7 d 14 h
Does it need spare parts?	Gateway	91	91				
Receive equipment	Task	91	91	10 m	10 m	10 m	15 h 10 m
Perform repair	Task	82	82	2 h	2 h	2 h	6 d 20 h
Run diagnostic tests	Task	91	91	30 m	30 m	20 m	1 d 21 h 30 m
None End	End event	9					
Spare parts	Task	9	9	30 m	30 m	30 m	4 h 30 m

Source: Own.

Discussion

With the input data provided, a customer is served in 14 minutes if the product or service is available, and the customer does not need an invoice. Sales processes require an excessive amount of time when a quote is requested (1 hour) and authorization requires 2 hours. Minimum time (MinT) is 2 hours 26 minutes, maximum time (MaxT) is 4 hours 9 minutes and the total time required for running 100 instances is 11 days 22 hours 15 minutes after performing all the activities in the process.

In procurement, MinT is one day 9 hours, MaxT is one day 14 hours and total time required after running 100 instances and performing all activities is 150 days 19 hours. Analysis of purchase request needs one day, and supplier selection takes 5 hours. These are the activities that require the longest time in the process.

In Warehouse, MinT is 2 hours 25 minutes, MaxT is 7 hours 22 minutes, and the total time required after running 100 instances and performing all activities is 28 days 20 hours 13 minutes. These are the activities which require the longest time in the process: Register the goods in the system —3 hours—, verify they are in good conditions —1 hour—, and receive the invoice and verify goods again —1 hour—.

In Warranties, MinT is 21 minutes, MaxT is four days 1 hour 16 minutes and the total time after running 100 instances and performing all activities is 44 days 3 hours. These are the activities which take the longest in the process: Send to the supplier, receive replacement product and repair, each of these requiring 2 hours.

In Spare Parts, MinT is 2 hours 10 minutes, MaxT is six days 1 hour 2 minutes and the total time after running 100 instances is 373 days 10 hours 44 minutes. These are the activities which take the longest: Deliver product to the customer three days, request purchase two days and request quote one day.

In Service, MinT is 40 minutes, MaxT 7 hours 5 minutes and the total time after running 100 instances is 21 days 13 hours 5 minutes. These are the activities which take the longest: Check equipment 2 hours, and Perform repair 2 hours.

Conclusion

Establishing processes allows performing activities and tasks in less time. The adequate definition and scope of the procedures for the accomplishment of them permit a better specification of responsibilities and roles. This helps allot time for each process reducing downtime and response time when the organization provides services to customers. We also identified processes and activities which require excessive amounts of time or slow down performance. We must note that some processes or activities are under the control of the organization while others are not.

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