Simulation for Analysis and Proposal to Improve the Application Process for Computer Services

Cilene Loisa Assmann1, João Carlos Furtado2, Liane Mahlmann Kipper2, Rejane Frozza2, Bruna Bueno Mariani3

[1] BIPSS Scholarship Program - Institutional Grants for Postgraduate Programs, University of Santa Cruz do Sul - UNISC, RS, Brazil, Notice 01/2012
[2] Master in Systems and Industrial Processes, University of Santa Cruz do Sul - UNISC, RS, Brazil
[3] Scholarship PROBIC – FAPERGS, Civil Engineering, University of Santa Cruz do Sul – UNISC, RS, Brazil

Email: cilenea@unisc.br , jcarlosf@unisc.br, liane@unisc.br, frozza@unisc.br, brunamariani@mx2.unisc.br

Abstract

Currently it is clear that the constant improvement in assistance services reflects the expansion of the quality of customer-supplier relationship. This improvement is directly related to the sustainability of an organization, seeking customer satisfaction. This article presents the use of simulation software (Arena) to analyze a process of requesting services in the informatics area of a university. The objective was to identify existing problems such as delays and resource overloads, and propose possible improvements in order to guarantee better assistance to users and to create satisfaction for this service. In this sense, we collected data of the process and different scenarios were defined for verification of their results compared with the current scenario. The results identified several points to be improved. We highlight one of the results that refers to the distribution of tasks. It was noticed that the team that makes the first contact with users is overloaded, receiving 10 times more jobs than the rest. A solution to this overload would be that the actual service requester selects the perceived problem with the equipment, which would be linked to a team. Thus, with this automatic forwarding, the initial analysis could be withdrawn from the flow. In addition to this, it was found that the tasks of service evaluation are burdening the process and causing queues. To handle this case it is possible to develop a procedure for finalizing the task automatically. Other solutions were found to improve the current process and are detailed in this article.

Keywords: process simulation; computer services; process automation.

1 Introduction

The process simulation, as its name indicates, is a technique that allows emulating the operation of a real system. This is relevant when it is possible to identify bottlenecks, ie, areas which cause queues and overloads of the process resources.

One way to better understand customer expectations is to identify the criteria that are used to evaluate services. These evaluation criteria should reflect the factors that determine customer satisfaction, or in other words, the quality of the project and service provision (Gianesi & Correa, 1994).

Facing the possibility of using simulation and the customer's knowledge of evaluation criteria about the service provided, we developed a simulation of a process for requesting computer services in the Arena software for analysis of their results, and verification of possible improvements. The process to be analyzed, which is the focus of this case study, covers the service activities of the area of informatics of an institution of superior teaching.

The developed simulation is described in detail in this article. Initially, we present the related concepts, then the process of applying for services, data collection, simulation of the current process and its different scenarios, and finally the results obtained from their applications.

2 Theoretical References

The subjects discussed in this section present the theoretical references which conceptualizes the management services that are important for companies and how a simulation can be used to analyze and improve a service process.

2.1 Services Process Management

The authors Rieg, Scramim and Zau (2009) point out that the growing importance of service operations in the economies of developed and developing countries has characterized the need to develop conceptual and empirical studies on quality evaluation of these operations.

In service management, the idealization of services, providing identification of the demand for specific and targeted information to each segment is fundamental and necessary. It is essential to take notice of all participating users, what their needs are, promote interaction between the supplier and the user of the information, show emphasis when receiving and analyzing requests for service, detail the needs of each user, specify what is necessary and most appropriate to that user. In search, always, for improvements in the company performance and a greater alignment of their goals with customer goals. However, for this to happen, constant evaluations and analysis of the services and of the users are necessary.

For Torres Junior (2009), good service processes not only create satisfied customers, but also reduce costs, increase the aggregate value and strengthen financial performance. Thus, it becomes important to identify, map and improve processes with a focus on customer needs. If we add to this process the use of simulation for analysis and monitoring of improvements in a service process one can generate dynamic scenarios and achieve better results quickly, focusing on cost reduction or expansion of added value for the customer.

2.2 Process Simulation

The principal motivation of the simulation is to improve processes and service delivery. However, any change process requires a clear justification. The simulation provides a means to get this, allowing all people involved to understand and analyze their processes in a computer simulation which means that it is cheaper and safer way of starting a change before doing it physically (Robinson, Radnor, Burgess & Worthington, 2012).

In the opinion of Mareth, Alves and Borba (2009), the Computer Simulation is an analytical and strategic tool that aligns with the modeling of processes, allowing the visualization with its activity flows and its bottlenecks, without the cost and risk of acting in reality. Also, it enables you to change the inputs and resources and, therefore, analyze the impacts of these changes. You can analyze, for example, problems such as queues and delays.

Similarly, Cox, Smith and Dimitratos (2006) state that with the use of simulation, a great variety of tasks can be performed and, as a virtual model, it becomes dynamic and easy to maintain. The simulation plays a significant role and can be used to design a new process, for solving problems of an already existing one; it can be used to test the efficacy of a new control and for the construction of a case study to see how much improvement adds value to a particular process. Although these tasks can be performed without a model, having a true to reality photo of a process readily available, radically changes the approach and countless possibilities can be used.

Han, Kang and Song (2009) describe how they use simulation in their processes. The authors explain that, once the target business process is selected for innovation or improvement, its performance, even in its current state, also called as-is process, is revised from the data analysis. Then the to-be process, characterized by how the process should be, is designed using simulation software. In this phase, parameters such as processing time and several other performance metrics are tested and compared with actual performance to evaluate the newly designed process. Thus, it is possible to assess whether the proposal is valid and whether the current process should be modified.

Finally, Cox, Smith and Dimitratos (2006), complement that the task of building the model can be an educational experience, that is, it still has the advantage of being a way to know the process. This knowledge increases the positive risk to lead directly to the best solution of the problem, resulting in less rework.

2.3 The Arena Software

In many projects there is no need to invest in equipment for the results to appear. Sometimes just changing the logic of production allows to have various benefits (Chwif & Medina, 2007).

The Arena Simulation Software (2011) performs the simulation of processes allowing to do analysis without interfering with the system. All and any modification in processes performed by the tool will only be modeled computationally and not with the real system. This is possible because all the defining characteristics of the real system are attributed to the software.

Furthermore, this software provides an integrated graphical environment for simulation which contains all the features for process modeling, design and animation, statistical analysis and results analysis. One of the differentials of the Arena is the templates and components that allow the user to describe the behavior of the process under analysis without programming, in an interactive and visual way.

The software also performs, through the information entered, coming from the real-time process, calculation of input data and delay of the tasks causing queues, among others. The obtained results are represented from reports and indicators of performance, to facilitate the analysis.

3 Case Study

This section presents the informatics sector and its teams. In addition to this, we describe how the service request process, objective of the simulation, works.

3.1 The Department of Informatics

The informatics sector, the focus of this case study, is an administrative area of an institution of superior teaching. It is the sector responsible for serving the employees of other administrative sectors, and also for providing the students of this institution with the resources of internet and access to the systems to consult their academic information.

The Informatics is divided into teams: Support, Networking, Development - Maintenance and Development - Projects, First Assistance, EDM - Electronic Document Management, support for the printers of the institution, Database administrators (or DBAs) and support for third-party systems. These teams are responsible for ensuring that the assistance process of the services in the informatics sector occurs in practice. In the next subsection is an overview of the functioning of this process, which was automated by BPMS tool.

3.1.1 The Process of Applying for Computer Services

The process of applying for services, that is, assistance of the informatics sector was fully automated in 2008 with BPMS technology. The software used to automate the process was the BPMS Orquestra (Orquestra BPM System, 2011), third-party tool that provides a visual environment for designing the workflow and build the electronic form with the fields that the applicant must fill out with the information of the request.

In the market there are various types of systems that support business processes. The systems of BPMS (Business Process Management Suite) are among these types. With BPMS tools, you can build and automate the processes modeled in BPMN (Business Process Modeling Notation), which allows you to represent the processes in a standardized manner.

Through the BPMS it is possible to perform processes quickly and with a strict control. The rules set out in the modeling are automated and the system forwards the processing of tasks automatically in accordance with these rules.

Figure 1 shows the service request process which was defined and modeled in BPMN into a process documentation tool. To initiate a service request, the user accesses the BPMS tool where the process is published. Following, the user fills out the form stating what problem was noticed on the computer, in any system, the mouse, keyboard, among others.

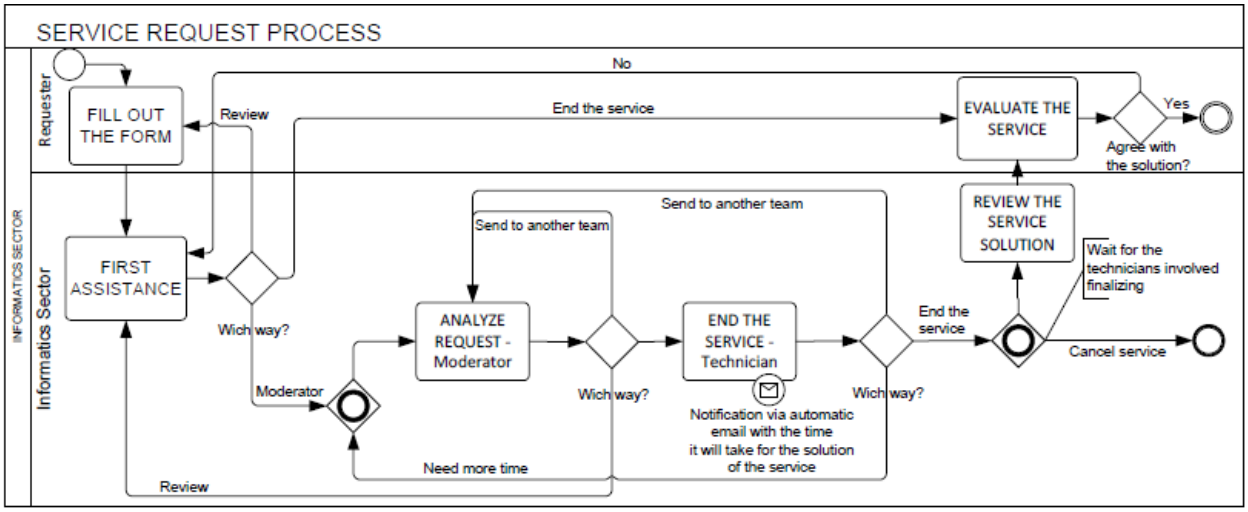

Figure 1: Modelling in BPMN of the Service Request Process. Source: System Management Processes, 2011.

The completed form is sent automatically to the task "First Assistance" of the process. The first assistance is a group that was created to answer directly to users demanding the service process. Currently this team consists of key people within the sector, they are experts and must be well trained to have knowledge of all services, understand the impact they have for the business and therefore have the facility to identify which is the adequate forwarding.

In possession of the task, the first assistance group can forward the request to any team. If there is need for more information about the reported problem it is possible to refer back to the requestor and ask for more details. The first assistance output arrow with the description "Review" represents the return path.

If it is possible to solve the problem immediately, without the involvement of the technical team's specialists, the first assistance can terminate the call directly and send it to the applicant for evaluation. When the request is forwarded to a team, the job goes first to the respective moderator who is in charge of the team.

The moderator, with the task shown in Figure 1 "Analyze Request - Moderator", checks the complexity and the tasks that are with each technician of the group. Based on this information, the moderator has more subsidies to make the decision and send the job to the technician who is more available to serve.

Once the technician is given the task "End the Service - Technician", the requestor of the process is notified via automatic email sent by the BPMS. In the text of the email, it is stated that the service is underway with the technician and informs the estimates of the maximum time it will take for the solution.

When the problem is solved, the technician ends the service and documents the solution found. Once the task of the technician is finished, the applicant receives the task "Evaluate the Service" to agree, evaluate and terminate the service.

The applicant must verify whether the solution found by the technician solves his problem. If so, he must agree with the process. If agreed, the evaluation options are shown. These can be positive (as "Excellent" and "Good"), negative (such as "Could Be Better", "Bad") and exempt (as "No Answer" and "I prefer not to express an opinion.")

If the applicant evaluates in a negative way, he must inform a justification, in this case, an email is sent to the moderators involved in the assistance and also to the coordinator of the informatics sector. The evaluation of the applicant is very important for those responsible for Information Technology (IT), especially when negative. These undergo a review and appropriate actions are taken for constant process improvement.

After evaluation of the applicant, the service is terminated and the process completed and is available only in the BPMS tool for consultation.

The process information, not previously recorded, is available for inspection in the reports of the BPMS tool. All process times are recorded, such as the duration of each task, whether it was completed after the allotted time, and the number of times that a service was sent to a particular technician, among others.

These and other data were extracted from the database system BPMS and were used as input in the modeling process in the Arena software to perform the simulation. The description of each step performed is detailed in this study.

4 Methodology

The simulation was carried out in stages: data collection, modeling of flow in the environment and the simulation itself. The description of each of these steps involved is presented in the following subsections.

4.1 Data Survey

Because the process is already fully automated in BPMS tool, where the intervals between the arrivals of requests for assistance, the duration of each task, in short, all times are recorded, it was possible to extract accurate data for the definition of variables input required to implement the model in Arena.

To ensure the extraction of these data as consistent as possible routines were developed in language SQL (Structure Query Language). As a development environment for these routines we used the software Microsoft SQL Server 2005 (Microsoft SQL Server, 2011).

The records of assistance in the period of one year were filtered: From August 2010 to August 2011, a total of more than 6,800 assistances were given.

In order for the times of the services to remain consistent with reality, the hours after work of the sector, holidays, weekends and even the time reserved for lunch were deducted from the time of the tasks.

Data were exported from the database into spreadsheets and then imported into the Arena via the Input Analyzer or "Input Data Analyzer". This is a module of Arena responsible for, based on arrival time and duration of the tasks, determining the statistical distribution that best fits these data.

To exemplify the use of this module, Figure 2 shows the distribution generated by the Input Analyzer from the time duration of each task performed for evaluating the service during the period of one year.

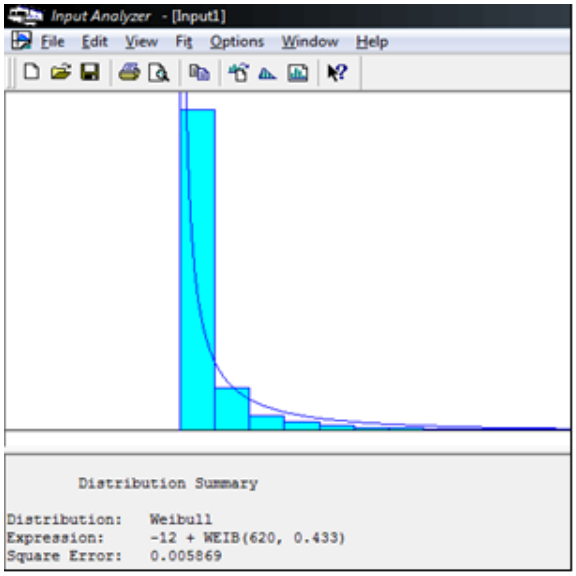

Figure 2: Distribution of work in evaluating the service. Source: Arena Simulation Software, 2011.

The distribution generated by the software was the Weibull. In order for this statistic to happen, to simulate the process, the resulting expression that lies just below the graph in "Expression: -12 + Weib (620, 0433)" is inserted in the configuration of the evaluation task.

The percentage of forwarding each object of decision (or Decide) of the flow has also been precisely defined for configuration of this component in the modeling process in the arena software. Thus, it was possible to calculate, for example, the percentage of forwarding from the first assistance team to the task of revision, which is the responsibility of the applicant, in the last year.

Based on these percentages or conditions it was possible to define which route the entities or in the case of this study, the assistance must take. Thus, reflecting the proportion of the forwarding of each team in the area of IT of the services to be met and, during the simulation, the routing of tasks follows this proportion.

By having the data of the process, it was possible to perform the modeling in the environment of the Arena software. The result, which is the modeled process with all tasks and decisions configured, ready to start the simulation, is presented below.

4.2 Process Modeling and Alternative Scenarios

The process modeling in the environment tool was relatively simple, since the process had been previously identified and modeled in BPMN. From this, we only had to create the same components within the tool to represent this flow, because for all components of BPM notation similar objects existed among the options provided by Arena.

Besides the process that is occurring in practice, that is, the current reality, two alternative scenarios were modeled for verification of the results. The first consisted of only reversing two tasks that already exist in the process: the “Review the Service Solution”, conducted by the team of the first assistance and the “Evaluate the Service”, performed by the applicant of the process.

The choice of the inversion of these two tasks was the suggestion of the members of informatics sector due to the fact that the task "Review the Service Solution" was created with the intention of being a temporary task, since it exists in order to initially follow the solutions of the assistance reported by the technicians.

The second simulated scenario, which would be to remove the task of "Review the Service Solution" in order to verify whether the service is met faster, has also been modeled and simulated.

After completing the modeling of the process of the current reality and of the alternative scenarios, it was possible to perform the simulation. The configuration of the simulation in Arena will be described below.

4.3 Simulation Performed

To perform the simulation process it is necessary to define the number of replications or repetitions to be done to reach the desired confidence interval.

The process was run initially with 10 replications, which are defined as a repetition of the simulation model, with the same configuration, the same duration and with the same input parameters. Despite having the same parameters, each repetition produces different results.

For 10 replications, with the defined period of 10 days and 1 day of "Warm-up", the following average of finalized and evaluated assistances was found: 18,2. The unit used for further analysis of the times and bottlenecks in the process was in hours.

In this case, a day "Warm-up" was necessary because it defines a warm up period of the system and must not be considered. At the beginning of the simulation the process is "empty" and service requests start arriving. In Case Studies using Arena (2011) it can be verified that from the point of view of performance analysis, it is interesting that this period, since the beginning of the process until the moment the request arrives at the technician's service task, is disposed of the statistics, because it distorts the results.

In the process, the period of one day "Warm-up" was chosen, which means that from the 10 days of simulation, the results for the first day are discarded and only the next 9 days are considered.

With 10 replications, the accuracy of the results is h = 3.85, that is, they can vary up (3.85) or down (-3.85). To increase the accuracy by 30%, reaching a h * = 2.70 it is necessary to increase the number of repetitions. The following formula is used to reach the new number of replications:

n* = (n (h/ h*)2) = (10 (3,85 / 2,70)2) = 20,408

Where: n * = new number of replications
n = actual number of replications
h = current accuracy
h * = desired accuracy

The result of n * = 20.408 may be rounded to 20. This is the new number of replications and it has been used in the simulation.

The process was run again and officially, with 20 replications, during 10 days and 1 day of "Warm-up". The results are shown below.

5 Results Analysis and Improvement Proposal

This section presents the results obtained using the simulation software Arena and the improvement proposal that sets the points to be modified in the process.

5.1 Results of the Simulation

Arena Software provides various reports with the results obtained from simulations. The graph in Figure 3 was extracted from one of these reports and summarizes the number of times that the services went through each team in the 10 days of simulation.

The histogram shown in Figure 3 shows that the first assistance team received tasks a number of times considerably larger compared with the other teams. Compared to the support team, which ranks second on the chart, the first assistance team received 10 times more tasks, in other words, from the first to the second the number fell from 586 to 58 tasks received.

Figure 3: Overload in the first assistance team. Source: Arena Simulation Software, 2011.

This contact with the first assistance would be receiving tasks during the execution of the process. Whether performing the initial analysis of the request, or by reviewing the solution informed by the technician.

An interesting point, noted during the simulation was that an existing functionality in the flow which is sending for the approval of the manager when the service involves cost had never been used. The purpose of this referral was the approval if it was necessary to change a part and this would involve a purchase that presents costs not covered by the service.

Another feature that exists in the flow is the possibility of returning the service to the requestor when some information of the request is unclear, raising doubts. In this case, the moderator of each team and the first assistance could send a review task to the requester. However, with the simulations performed, based on the real data, it was noted that this option was never used by the first assistance and only a percentage of 1% by the moderator of each team.

The task called "External Pending" is used when the area of IT outsources any assistance or when the service is covered by warranty. Thus, the process is halted in this task until the return of the third-party company. However, it was realized that this task, even if it does not depend on the technicians of the sector, does not cause queues and is also used, but sporadically. Therefore, this is not a bottleneck in the process.

The percentage of services that do not reach the technicians of the specialists' teams, that is, that are solved and finalized by the first assistance is 8%. These problems are simpler and therefore faster. In addition to this, the first assistance also sends the tasks to the moderators, which corresponds to 90% of the cases. The remaining 2% refer to canceled requests.

The simulation of alternative scenarios also showed good results. From this it was possible to conclude that by removing the review task the process time does not diminish; in other words, the aim was to reduce the time until the flow reached the end, as "Serviced". However the change in the process made no difference in this time.

The conclusion is that the withdrawal of the review made no difference because the task of evaluation of the assistance that occurs soon after the first assistance, is taking too long to be concluded. In Figure 4, the highest average of tasks queues perceived in the simulation are presented. The longest queue was the task "Evaluate the service" which reached an average of 88 calls on hold. Therefore, this delay is the bottleneck. This is where the process is stopped and increasing the queue, which reach more than 100 calls waiting in some moments of the simulation.

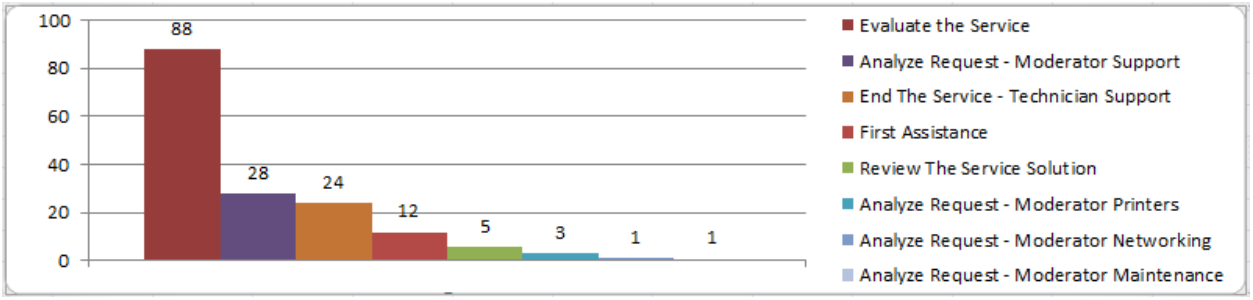

Figure 3: Average of services in queue per task. Source: Arena Simulation Software, 2011.

The tasks "Analyze Request - Moderator Support" and "End The Service - Technician Support" came in second and third row in quantity of cases. However, the support team is responsible for 51% service requests in the informatics area. Therefore, these queues proved to be justified due to the large amount of requests attended by this team. In developing this graph, only the averages which were higher than zero were considered.

With the simulation results, it was possible to identify several adjustment points in the process. Thus, an improvement plan could be developed. This will be presented in the next subsection of this study.

5.2 Proposal for Improvement

The team of first assistance was created in order to be the single point of contact with the user. When it receives the request, which refers to the perceived problem and described by the user, the first assistance classifies the call according to its type and forwards it to the appropriate team. As described in the simulation, the first assistance is overloaded, because the amount of tasks forwarded to this team is great. The proposal would be that the own service requester selects the perceived problem in his equipment, and this would be linked to a category that would also be linked to a team.

With this automatic forwarding, the initial analysis of the first assistance could be withdrawn from the flow, thereby decreasing the tasks of this team. But for this to happen, it is necessary to define a list of services or problems that may occur and their respective categories.

The task of evaluation by the manager, in case of unforeseen costs in the service, will be evaluated as it has not been used so far, this seems to be unnecessary. As it was noticed that the review task also is not being used by the moderator and first assistance, the doubts are eventually resolved, or even perceived, by the technician when performing the service and, as he does not have the option to review via the system, ends up using the phone or e-mail to the contact the requestor of the service. It was concluded that it is necessary to add this possibility of sending (via the system) for the technician's use.

The task of evaluation of the assistance is burdening the process and causing queues. Moreover, it cannot be replaced or withdrawn from the process because the evaluation of the assistance by the requesting client allows the continuous improvement of services. However, it is recommended to develop a routine program to automatically close the task of evaluating and finalizing the process as soon as the task expires and is not yet finalized, for example, determining a period of two days in case the return of the evaluation of the assistance by the requesting client does not occur.

6 Conclusion

In this study we present the results achieved with the use of process simulation software. Initially, a study was conducted on the process simulation and the Arena software was presented. The Arena Software provides a graphical environment that facilitates the modelling process, since it is possible to draw the entire flow only with the help of the mouse, dragging and dropping components on the screen. The simulation technique was adopted in order to analyze their results applied to a process of requesting IT services and propose, in a fast way and from solid data, possible improvements.

The step that took the longest time was the data collection due to the large number of records that were searched in the database and also due to the SQL routine that involved programming, which always takes more time by being more technical.

The results from the simulation revealed several points that can be improved in the process. With the simulation of alternative scenarios, it was possible to analyze how the procedures of the process would be even without altering them in real life, almost costless. The amendment proposed by one of the scenarios, which would rule out the task of reviewing the solution, brought the result that would have no effect on the completion time of the flow, which was a surprise, as one would expect better results when reducing the time running the process.

The reduction of the deadlines for assistance of the service, without sacrificing quality, is reflected in the company's strategy which is to improve its processes, constant adjustments are developed with the aim of achieving excellence in customer service of the institution.

Numerous actions can still be taken to make it possible to serve the customers as efficiently as possible. The technique used in this study allowed the modeling and simulation of the process seeking improvements for their adequate implementation. It proved to be an important tool to support decision making. It enabled the identification of problems without interference in the real process, which means less time for analysis and thus less cost.

The way in which a company organizes its key processes has a direct impact on customer service. Those involved in the process should work in an integrated manner and comprehensive at the same time, having the vision of the whole and how their activity affects the others. The administrators should worry constantly about the reevaluation of their methods and practices, reducing costs and time in order to ensure organizational sustainability.

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