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DISCRETE EVENT SIMULATION OF APPOINTMENTS HANDLING AT A CHILDREN'S HOSPITAL CALL CENTER: LESSONS LEARNED FROM V&V PROCESS

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ABSTRACT

Validation and Verification (V&V) is one of the most important aspects of the simulation modeling process. During the three stages of V&V (conceptual validation, verification, and operational validation), it is possible to identify inconsistencies in the model's development and, therefore, increase the trust that the model is an adequate representation of reality. The aim of this paper is to demonstrate practical problems and benefits while applying V&V techniques, even if takes a lot of project time, as an indispensable step in guiding the modeler to solving any missed issue. Shortcomings and benefits of V&V techniques application were demonstrated through a case study at a Children's hospital Call Center.

1 INTRODUCTION

Despite telecommunication field growth in the last decades, the Call Center segment has always faced a lack of knowledge in applying specific tools to identify and improve services as well as infrastructure. Companies and service providers commonly use intuitive ways to size the capacity and the infrastructure of Call Centers.

The Contact Center market in Brazil was responsible for about 14 billion USD in 2016, working with two business models: in-house operations, which have been showing a decreasing rate, 1.85% in 2016 compared to 2015, and using third part providers, in which case it is possible to see a growth of 7.8% in 2016 compared to 2015 (CIP 2017).

The most tools commonly used to dimension Contact Centers by professionals are based on data gathered from analytical methods, which do not consider system aspects such as: agent skills, advanced call routing, business rules, seasonality, statistic distribution, random and dynamic systems, combined type of calls (inbound, outbound and blended), manageable waiting time, call transfer, conferences and, most importantly, human behavior. With this in mind, it is highly recommended to adopt a tool that represents the real system, providing flexibility to create scenarios, and considering certain hypotheses to obtain expected outcomes (Chwif and Medina 2015). Considering these aspects, discrete event simulation is one suitable tool.

The "verification and validation" (V&V) process is a key part of the simulation methodology because it helps the simulation study to be successful. This process is divided into three main stages: Conceptual

Validation, Computation Model Verification, and Operational Validation. These phases must accompany the entire project life cycle, being, therefore, a continuous process (Balci 1997).

Model development process must be iterative, systematic, and repetitive until the computational model can meet the established requirements and is subject to operational validation (Sargent 2014). According to Chwif and Medina (2015), a conceptual model can be created being expressed, for example, in Activity Cycle Diagrams, which is a modeling tool that represents interactions between objects of a system. The validation process of the conceptual model is carried out confronting the conceptual model with the real-world system. In sequence, the conceptual model is implemented in some simulation language or simulation software. After implementation, the model behavior must be verified to check if it is in agreement with the conceptual model (verification of the model). After verification, the computational model is considered to be operational and it can be used for experimentation. Once experiments have been performed and preliminary results obtained, it is possible to conduct the so-called "operational validation process", which allows us for comparing the real-world data with model results.

Conceptual validation, which is related to the conceptual model, means assessing whether the considerations made, the level of detail, and the scope of the model will adequately represent the system to be simulated. Computational verification is related to the computational model or model implemented in some simulation software, which can be understood as the removal of bugs from the model or elements that are causing the malfunction. Operational validation is related to the outputs of the model, and this process is used to verify if the computational model reliably represents the system to be simulated, as well as if the data of exits are coherent with the expected ones (Shannon 1998).

Despite these procedures, it is still possible that a verified and non-problematic model is not considered valid because it does not adequately represent the real world. Actually, it is impossible to validate a model 100% i.e., to ensure that it is 100% valid: we can either increase the confidence in the model or basically we believe that it represents the system satisfactorily. It is also not possible to guarantee that a model is totally bug-free (Banks and Chwif 2011).

This paper demonstrates how the V&V process is effective to help the model designers in identifying issues and improvement points, besides guiding them to offer appropriated solutions.

2 LITERATURE REVIEW

The next subsections will briefly review the main theoretical topics related to this paper: queueing theory, discrete event simulation and operational validation techniques applied to call center operation.

2.1 Queuing Theory

Agner Kraup Erlang, a Danish Telecommunication Engineer, Member of the Danish Mathematics Association, had the opportunity to know other mathematicians, especially partners of the Copenhagen Phone Company, where he started working in 1908, first as a scientific collaborator and later as head of the laboratory. At that time, the company was facing trouble in dimensioning telephony traffic. Thus, Erlang applied probability theory, proving that random phone calls were driven by the Poisson Distribution Law and as a result, he had his first work, "The Theory of Probabilities and Telephone Conversations", published in 1909, starting the well-known Queuing Theory field (Cooper 1997).

According to Banks et al (2010), queuing theory is used to elaborate and solve math models, which represents analytically the queuing formation process, generated, basically, by the arrival process and the service process. The arrival process is represented by the customer average arrival rate in the system, whereas the service process is represented by the average services rate. Additionally, Chwif and Medina (2015) states that a queue problem can be solved following four steps: (1) identify and relate the variables involved in the problem, (2) identify the probabilistic distributions of entities arrival and service processes, (3) apply either the queuing theory or probabilistic simulation techniques (4) analyze Key Performance Indicators (KPIs), modifying the configurations in order to achieve the expected system behavior.

2.2 Discrete Event Simulation

Robinson (2004) states that a computational simulation model represents different interactions between parts of a certain system. It is an abstraction from reality, in which someone wants to get closer to real system behavior since the model is always simpler than the real one. Additionally, according to Shannon (1998), a simulation is an elaboration process of a real or hypothetical system, which reproduces real-world processes or systems over time. Its purpose is to conduct experiments to understand behaviors or evaluate operations, either manually or via a personal computer.

According to Chwif and Medina (2015), once the objective is defined and the resources are established, it is possible to understand how the system or process to be studied works in order to create the conceptual model, the first of three steps of this method. This is followed by the implementation and analysis of the model outcomes, as indicated in Figure 1.

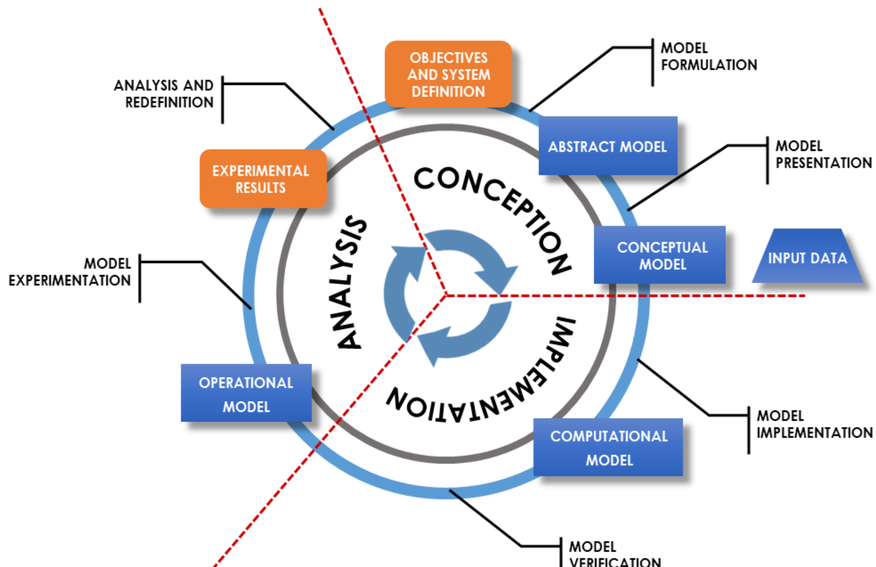

Figure 1: Simulation Methodology (Chwif and Medina 2015).

2.3 Queuing Theory and Simulation Model Comparison

Both Koole (2004) and Mandelbaum (2001) criticize the use of Erlang B formula to calculate resources needs since it can result in excess of capacity or sub-capacity caused by abandon. Wolff (2003) concludes that the average waiting time during peak traffic periods is overestimated when calculated using Erlang C, compared to an equivalent simulation model developed in ARENA® software. According to Franzese et al. (2009), the advantages of simulation models can be seen in Table 1.

2.4 Call Center Simulation

Simulation can be fitted with several Call Center requirements. It is commonly used in answering systems, where there are steps from the call arrival to call handling itself, such as Interactive Voice Response (IVR), Automated Call Distribution (ACD), Queue, Agent Groups and the Agents themselves. Another application is for those systems with a high complexity level, with different types of calls, different agent skills, abandoned calls, blended services (incoming and outgoing calls, answered for the same agents group). It is also applied for systems with high variability levels, including random and dynamic environments, available agents, abandoned calls, service time of each call and the answered call time. Lastly, the simulation contributes to designing and dimensioning the system, which has human and investment resource constraints (Vermeulen 2017).

Table 1: Erlang C and simulation comparison.

Characteristics	Erlang C	Simulation
Arrivals	Poisson	Distribution defined by modeler
Traffic queued or refused	Queued	Complex
Call flow and routing	Simple Routing: Queue to Agents	Complex Routing: Overflow, Skill Based Routing, Transfer, Conference
Call overflow	No	Yes
Abandonment	The call wait untill be answered	Based on the call's wainting time
Retrials	No	Distribution defined by modeler
Call handling time	Exponential	Statistics distributions
Prioritization between different types of call	No (all calls are equal)	Yes
Agent ability (performance by type of call)	No (all agents are equal)	Yes
Interaction between events	No	Yes
Queue priority	FIFO	User-defined
Call types	Only inbound calls	Inbound, outbound and blended call types

Additionally, Vermeulen (2017) states some arguments for using simulation at Call Centers: (1) Assertiveness is recommended in the implementation of an IVR or new rules for the ACD. It is crucial to simulate before applying the changes in the real operation, in order to measure the impacts. A simple change in the service call flow can affect customers directly in a negative way and waste the company's financial resources, (2) In a service where there are differences in the volume of calls in a given interval for types of calls. This is most evidenced when a new campaign is put into practice or outgoing calls are added in a service that normally operates only with incoming calls, (3) Abandoned calls separated per call type, which affects the operation level of services as a whole, (4) Various service times per call type. These differences can be caused due to the disparity between the agents' skills.

Several case studies were reviewed in the literature in order to demonstrate how the uses of a Call Center Simulation and their benefits are developed in practice. One of these cases was applied to compare call routing technologies of a Call Center with 25 sites. The simulation helped in the decision to invest USD 17 million in technology innovation with annual operation costs of USD 8 million. The former model was based on telecom operator provider pre-defined routing rules set by the company. A new routing process, based on GeoTel ICR technology, was applied to allow the system to receive updated states in real time to decide for which site the call should be transferred. According to Miller and Bapat (1999), results from simulation demonstrated a saving of USD 25 million in the investments and a reduction of USD 8.4 million in operational costs.

Another case deals with the important segment of medical urgency services, which should be well coordinated. Buuren et al. (2015), indicates the importance between the solicitation's arrival time and the ambulance dispatch time for urgent services. Call Center incoming calls must be short, have minimum waiting times and the agents must proceed with the triage efficiently and effectively in order to send the ambulances quickly. For this study, data were collected and the authors created a probability distribution table between the inbound flow and the call urgency, prioritizing the most important ones.

2.5 Operational Validation Techniques

According to Sargent (2014), operational validation seeks to determine whether the output behavior of the simulation model has the precision needed for the purpose for which the model was created. More objectively, Pidd (2000) describes that the purpose of validation is to verify if the model has the same real-world behavior under the same conditions.

According to Chwif and Medina (2015), there are some techniques used for the Operational Validation of the model: Turing test or black-box validation, Paired-T statistical test, model duplication, comparison with previous models, sensitivity analysis and "Face to face" validation.

Validation techniques can be classified into three levels. The first one is called qualitative validation, the simplest of all, which seeks to know if the model behaves in a qualitative way like the real-world system. It doesn't depend on real system indicators in quantitative terms. The second is the informal quantitative validation, which compares the results of the simulation with the actual data. However, these data were taken at a certain time, small samples or obtained through interviews with agents, supervisors or managers of the department studied. The last level, the formal quantitative validation, addresses statistical techniques to validate all performance indicators available. It is important to note that validation levels can be used simultaneously (Chwif and Medina 2015).

To Sargent (2014), the tests performed in operational validation allows finding incoherencies arising from some deficiency in what was developed in the construction stages of the conceptual and/or computational model. Operational validation can be considered the stage with more complex and time-consuming analyses. Thus, the choice of a technique that provides objective results is more indicated. Therefore, for the present study, Paired-T test and sensitivity analysis were used. Thereby, it is possible to focus efforts on the most critical model aspects.

3 CALL CENTER SIMULATION APPLIED TO A CHILDREN'S HOSPITAL

In this section, we will describe the application of the simulation methodology, with a special focus on V&V techniques, in a children's hospital call center.

3.1 Objective

The hospital considered in this work was facing a high level of abandoned calls and low service level, incurring in missed exams and consultations, resulting in decreasing income for the institution and service quality for its patients and other stakeholders. Figure 2 shows the two main KPI's: Abandon Percentage, which measures the percentage rate of abandoned calls when compared to total arriving calls and Service Level Rate which measures the percentage of inbound calls that waits less than 10 seconds in queue.

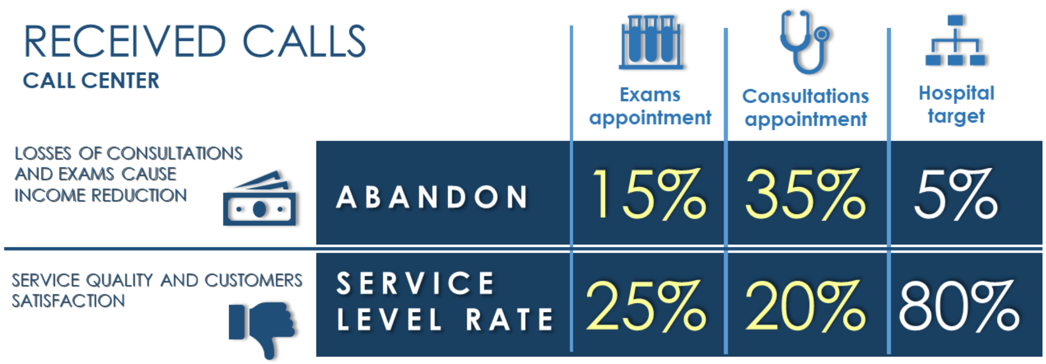

Figure 2: Abandoned calls and service level rates.

Although the Automated Call Distribution (ACD) system, already installed in the hospital, has been updated for its latest version, the management team was unable to use any method to identify the root causes of the problem in order to improve those KPIs. Therefore, discrete event simulation has been chosen to guide them in their decision making.

The aim of the project was to evaluate, via discrete event simulation, the appointment processes of two service channels, exams and consultations, for a children's hospital in Brazil, in order to identify improvement points in Information and Communication Technology (ICT) infrastructure, enhancing answering services and consequently reducing the number of abandoned calls per day with higher service levels, showing the advantages and viability of this tool.

3.2 Conceptual Model and Data Analysis

Regarding the call handling process, the study considered global times, from the moment that the call is answered by the two systems, exams and consultations, passing through queues, until agents hang up, depicted in Figure 3. The same skill could be considered for the agents since the study did not identify any considerable answering time variation between them. Withdrawal times, such as coffee breaks, were considered as agents' inefficiency in the simulation model. For the exam appointment, the hospital has three agents, working from 08:00 AM to 09:00 PM and for consultation appointments, there are two agents, working from 08:00 AM to 06:00 PM.

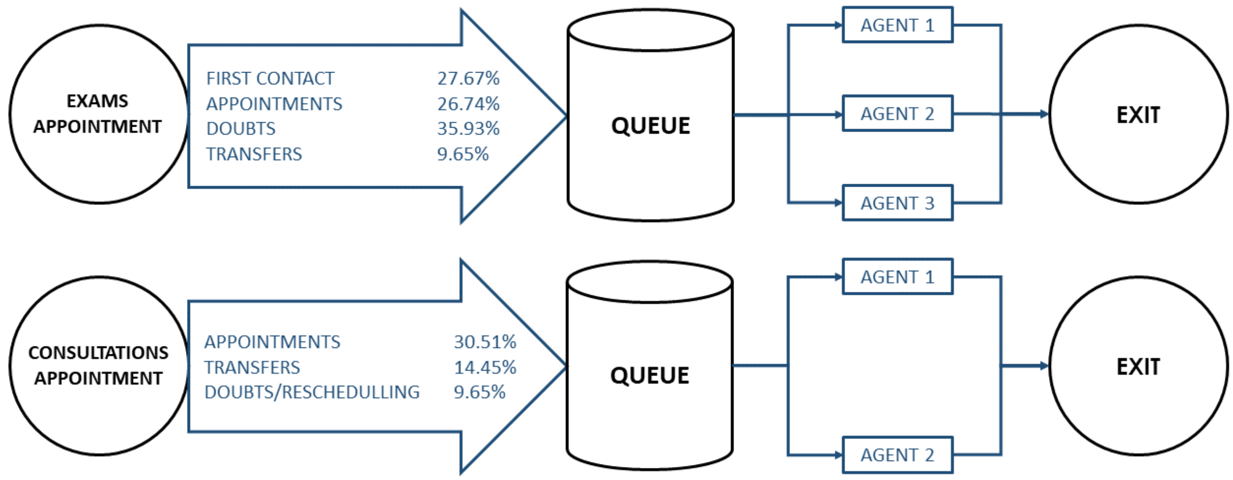

Figure 3: Model's overall process.

The calls arrival profile was obtained from the software used by the institution to manage the Call Center (called CCS), with a six-month historical database of daily calls (from March to June 2017). Figure 4 shows an example for Mondays, considered the busiest day.

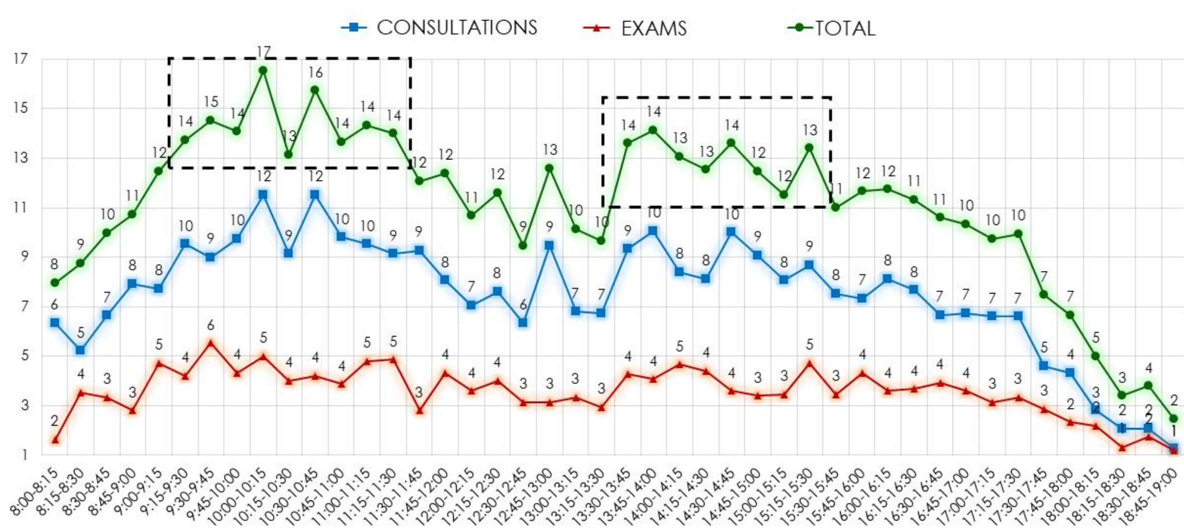

Figure 4: Call arrival rate for Mondays.

Analyzing the graphs for each day of the week, it was possible to conclude that the behavior is the same as described for Mondays from Figure 4. It is possible to notice a peak in the morning, from 09:30 AM to 12:00 AM and in the afternoon, from 13:30 PM to 16:30 PM, showing a dip in the lunch time, from 12:00 AM to 01:30 PM. A low call flow from 08:00 AM to 09:30 AM and 04:30 PM to 07:00 PM is also observed.

It was necessary to proceed with a chrono analysis to confirm the agent's answer time, the withdrawals, and, most importantly, it was possible to identify different types of services. For exam appointments, four types of services were identified:

- First contact, with 27.67% of the total call volume;
- Appointment, 26.74% of the total call volume;
- Doubts, 35.93% of the total call volume;
- Transfers, 9.65% of the total call volume.

In consultation appointment, three types were identified:

- Appointments, with 30.51% of the total call volume;
- Transfer, with 16.45% of the total call volume;
- Doubts and Rescheduling, with 53.04% of the total call volume.

A critical situation for the hospital's operation is abandoned calls. In the exam appointment case, 48% of abandoned calls occur with the telephone still ringing and the other 52% in the queue. For the consultation appointment, 40% of the abandoned calls occurs with the telephone still ringing and the other 60% in the queue. Analyzing those groups for both services it is possible to conclude that the customers (patients or family members) wait longer to be answered due to the critical service, tending to abandon after 60 seconds, 42% for exams and 55% for consultation. Another relevant situation found in this operation was the fact that the agents do several activities such as coffee or restroom pauses, meetings, feedbacks, small talk, personal matters, internal calls and external calls, during a working day. All withdrawals were considered as inefficiencies, adding up to 40% of the available work schedule for both services.

All data gathered were treated and processed through statistical fitting software, in which mathematical probability curves were found for service levels and abandon profiles. In order to implement the simulation model in a simple but effective way, it is necessary to assume some hypotheses. In this study, six main hypotheses were considered: (H1) there is no skill difference between agents; (H2) time of outgoing calls, external or internal, made by the agents were considered by total availability, except for one of them, who proceeded to make some external outgoing calls in order to confirm the scheduled exam; (H3) distribution time between calls was considered exponential due to unavailable data source; (H4) during chrono analysis phase, the verified average withdrawal time was 20 minutes per day for both services and was also included in agent's availability; (H7) in consultation appointments, a backup agent was considered whenever one of the two regular agents was unavailable. The simulation model created in SIMUL8 software for exam appointments is presented in Figure 5, and for consultation appointments, in Figure 6.

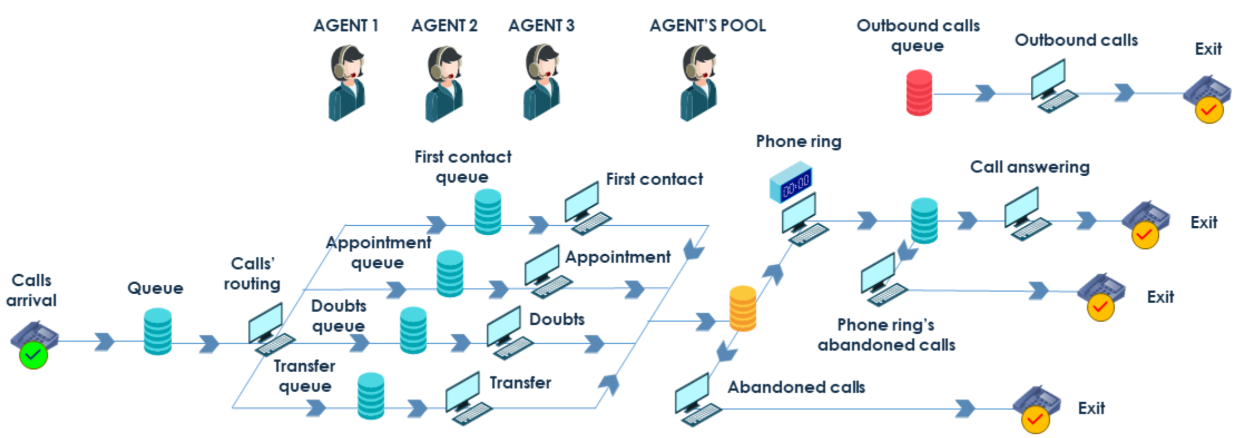

Figure 5: Exam appointment design (SIMUL8® software).

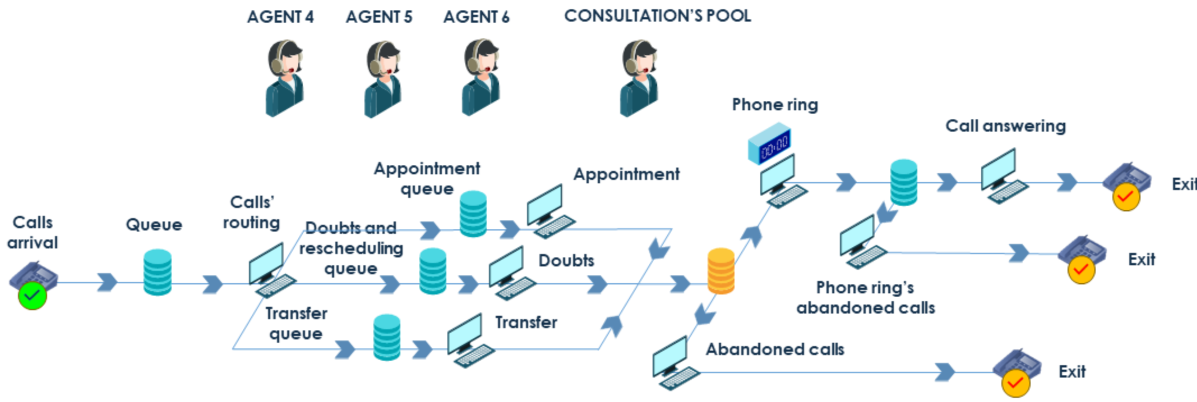

Figure 6: Consultation appointment design (SIMUL8® software).

3.3 V&V Applied to the Call Center Simulation

A meeting with the Hospital Call Center management team was set up in order to validate the conceptual model. The objective was to investigate if there were mistakes or missing information to be added. Once the steps of conceptual model creation and conceptual validation were overcome, it was possible to create the computational model, which in this project the SIMUL8® software was used. Mainly two verification techniques were applied while creating the computational model: "Modular Implementation / Modular Verification" and "Graphic Analysis". One of the most important steps for the simulation model design was undoubtedly the operational validation, not only due to difficulty levels, including variables to take into account but also because of the excessive time spent by the modeler.

For this project, the Paired-T test was adopted to analyze the following KPIs: (1) Call arrivals, (2) Average queuing time, (3) Average answering time, (4) Service level agreement and (5) Abandoned calls. As shown in Table 2, the 95% confidence interval for the difference between real and simulated data includes the value zero for all KPIs studied, indicating the model validity. Initial Paired-T tests calculations showed some inconsistencies in the model's outputs:

- *Average Attendance Time*: this parameter varied greatly from one replication to another. The first assumption was that the calculation formula could be wrong; a careful analysis showed that the denominator considered was the total number of calls that entered the system, being attended or abandoned, but the true value should be the number of calls that were actually answered.
- *Call Queue Time*: the queue time did not match with real value. By analyzing the results of the queue provided by SIMUL8 software, it was detected that the equation of Queue Time took into consideration all the calls, even with 0 queuing time, changing the average value downwards. The model output was changed to consider the KPI of the system with only non-zero-time queuing entities.
- *Abandonments and Service Level Agreement*: both values were very divergent from reality, way below the real average. After analyzing the configurations of activities in the simulation model and assuring that they were correct, it was hypothesized that the problem may have occurred in the mapping process - something that had not been identified during the visits to the operation. When revaluing service infrastructure, it was noticed that the calls were sent to the attendant, but they were not answered directly, they were still waiting in the telephone ring until the attendant could capture the call. Thus, it was necessary to study the time in which the calls were in telephone ring. For this, it was necessary another visit, this time anonymously and in a room away from the operation, so it could not influence attendants' behavior. Monitoring was done via software and it was found that the ring timeout was, in fact, significant and frequent because there is routing of calls. A call not answered within 15 seconds was routed to the next available attendant and if it had

not another available attendant, it would stay on the telephone ring until the attendant picks it up or is finally abandoned. So, in the simulation model, another queue was created to represent the waiting time at the telephone ring.

- *Abandonment Queries*: After the implementation of the telephone ring, the dropouts for Queries continued to diverge. Once again there was a suspicion that there was some detail, specific to this kind of service, which had not been identified in the operation mapping. When investigating the area policy, it was noticed that the minimum number of attendants in operation should be two, and the Consultation service only had two attendants throughout the day, so when one attendant was out for her/his lunchtime, the area would have a deficit in the capacity. The hypothesis was created to consider the existence of a third attendant in the real operation. In order to prove this hypothesis, an interview was elaborated and it was verified that there was an attendant of readiness that replaced the attendants during lunch time and other schedules in which the area was empty. In this way, this reserve attendant was added to the model.

After correcting inconsistencies, new Paired-T calculations indicated more realistic results (Table 2).

Table 2: Confidence interval (95%) of "real data - simulation model".

KPI	Exams appointments	Consultations Appointments
Call arrivals	-17.22; 14,96	-35.98; 37.98
Average queuing time	-24.46; 2.67	-6.08; 10.52
Average answering time	-15.77; 11.28	-11.70; 9.44
Service level agreement	-0,01; 0,07	-0,02; 0,02
Abandoned calls	-12.69; 4.02	-23.57; 47.44

3.4 Simulation Analysis

We identified three points that could be improved in operations, exams and consultation appointments. By the time that the simulation study ended, these recommendations were only simulated (not implemented), because such modifications should be approved by Hospital's board of directors.

3.4.1 Scenario #1: Ring canceling

The first scenario was related to phone rings. Differently from most Call Center operations, in this hospital, inbound calls were allowed to ring until an available agent answered it. However, to worsen the situation, if the agent that was supposed to be ready to answer the call did not take any action within 15 seconds, the call would be transferred to the next available agent and so on until one of them finally answered the call. This situation contributed to increasing the call abandonment, which represented half of the total abandoned, and reduced the service level, consequently providing poor quality service to the customers.

The solution for this matter was to cancel the phone ring, allowing the incoming calls to be automatically answered by the agents. Considering the peak days, for the exam appointments there was an increased rate for the Service Level Agreement from 24% to 83%, reaching the goal of the institution, which means that 80% of the total calls will be answered in 10 seconds, and for the consultation appointments there was an increase from 17% to 65%.

3.4.2 Scenario #2: Work force schedule adjustment

Assuming that the first one was implemented, this second scenario was related to the agent's work schedule adjustment. With the Brazilian Consolidation of Labor Law in mind, it was necessary to modify the workforce schedule. In order to meet the demand need of the inbound calls, it was also necessary to add two more agents for exam appointments and one more for consultation appointments. The results for the exam appointments, also considering peaks days, was an increased rate for the Service Level Agreement from 83% to 86% and for the consultation appointments, from 65% to 74%.

3.4.3 Scenario #3: Service centralization

In this scenario, the plan was to unify the operations, exam and consultation appointments, considering the first and second scenarios already implemented. In this situation, all the five agents from exam and four from consultation would have the skills to answer all types of inbound call service. Considering the peaks period, the rate, Service Level Agreement, for the exam appointment remained at 86%, the abandonment decreased from 17 to 16 calls per day and, for the consultation appointment, the SLA increased from 74% to 91% and the abandonment had an important decrease from 57 to 14 calls a day.

As noted above, all proposed scenarios led to important operational improvement, pointing out that, for the SLA indicator, scenario #1 was more effective for both services. Regarding abandoned calls, scenario #1 was the best for consultation appointments and scenario #2 provided a gain for exam appointments.

4 LESSONS LEARNED FROM V&V PROCESS

Based on inconsistencies found during operational validation, we can highlight three main sources for Validation Shortcomings:

Human Factor: Knowing how to deal with people is of extreme importance to any business sector, and simulation is no different. In cases where the operation is carried out by people, some of the information is obtained directly from the executor; to know how to extract this information is fundamental because people's behavior changes when they know that they are under observation. In this study, initial visits were carried out directly in the department along with the attendants, so from the beginning, they already knew that it was an improvement study; it was possible to notice that they were afraid, but with the course of the visits, they got used to it and became cooperative. During the mapping process, it was noticed that one of the attendants left a client waiting on the telephone ring, purposely letting the call be forwarded to another attendant, but since this had not been noticed from other attendants, whose answered in the first telephone rings, it was considered that the routing index could be negligible, simply by observation, without any statistical analysis to support the decision. Interaction with the modelers was another factor that affected the behavior of the attendants: when available, they talked to evaluators about day-to-day matters, which was allowed by the area manager and by the modelers, resulting in total distraction from the work.

System mapping: The system mapping process is the cornerstone of the simulation; it is the step when system data collection occurs. A complete understanding of the system is essential for the correct modeling of the simulation; thus, it's important to be cautious when collecting the most diverse information involved in the system to be studied. These procedures will help the modeler to have the model as reliable as possible compared to the reality. In this study, the strategy established for data collection and process mapping did not consider some qualitative information such as the management of processes and people resources that could be involved in the process and there were not present in the same Call Center's environment during data collection; it had been mainly focused on the quantitative data. Another important factor was the lack of technical knowledge on the management side: since it was a newly created area, the manager did not have a deep knowledge about the infrastructure available, so when posed any technical matters, the answers weren't accurate, being necessary to ask to the hospital's infrastructure technician, who was not available to give readily information all the time.

Output Calculation: To perform the Operational Validation, it was necessary to compare the simulation model output data with real system data - so both data should be calculated in the same way. When data are extracted directly from the database of the real system, it must be known how it was calculated and evaluate if this data is also calculated in the same way by simulation software; otherwise, adjustments must be made to equalize the data, ensuring that the comparison made in the operational validation will be correct. In this study, to measure the queuing time of the connections, a standard queue parameter in simulation was used (mean time in queue); but the real system considers only non-zero waiting time entities, due to lack of evaluators knowledge, this was not initially considered.

5 CONCLUSION AND FUTURE WORK

The case study analyzed in this article was the first project of the first two authors regarding simulation. Therefore, some errors were committed during simulation model development, and that could be identified due to the application of the Operational Validation, allowing for the correction of errors, validation of the model, and proving the importance of this step for the simulation.

Analyzing the facts that occurred, the lesson for the next studies about the human factor is the following: it is necessary to have a more professional attitude on the part of the evaluators, which means, try to interfere as little as possible in the day by day of the operation, without distractions; and be able to evaluate each hypothesis raised in the mapping, which is, do not discard them without being based on a statistical analysis. About System Mapping, the lesson is to structure the information collection, both quantitative and qualitative data, not looking only at the flow of the process, but at what surrounds the system and can influence it; try to explore all data sources. Special attention to qualitative data is usually obtained through conversation, observation, or interviews, so care must be taken in the preparation of the questions, which should be clear and objective, avoiding the subjectivity of those who read them, with questions being made to people who actually know the subject, thus providing more consistent data and analysis. Finally, regarding output calculations, we stress that it is necessary to have a good knowledge on how the simulation software calculates these, as well as also knowing the database of the real system, so operational validation can be done between indicators that demonstrate the same thing.

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