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Surgery Scheduling Using Simulation with Arena

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***Abstract*—**The institutions seek to improve their performance and quality of service, so that their patients are satisfied. This research project aims, conduct a time study program in the area of gynecological surgery, to determine the current level of capacity and optimize the programming time in order to adequately respond to demand. The system is analyzed by waiting lines and uses the simulation using ARENA to evaluate proposals for improvement and optimization programming time each of the surgeries.

***Keywords*—**Time study, waiting lines, reducing time, simulation.

I. Introduction

IN Mexico one of the features that have the Mexican worker is obtaining Social Security, which is provided by the Mexican Social Security Institute (IMSS), which is a government institution for health-care workers and relatives of the same. Today, there are more than 1,500 family medicine units, 228 hospitals in second and third level, plus 25 highly specialized medical units throughout the country, which serve more than 60 million people [4]. One of the difficulties of this institution to provide its services is to meet many people in a single day, in different circumstances and for different reasons. In a clinic will cater to many people per day, which causes chaos exists in many different areas of the clinics, due to overcrowding that has in each medical unit.

Because both the patient's time, primarily, as the worker's medical units is substantial, it is important to formulate proposals for the solution of this problem, which is presented every day, and that time is crucial and most valuable, and much more if you invest in an activity that is done, and even more so if it is time for each patient died waiting for a consultation or waiting for a particular procedure. Therefore, our objective is to conduct a simulation study to obtain data on where the problem is more concentrated and can bring solutions to this problem does not cause further chaos within the institution and so the people time and there is no too many in a medical unit.

II. Corporate Information

A. Organizational Goals

The Mexican Social Security Institute has a legal mandate derived from Article 123 of the Constitution of the UMS. Its mission is to be the basic instrument of social security, established as a national public service for all workers and their families [5]. That is, the increase in population coverage is pursued as a constitutional mandate, in a social sense.

As a risk management institution: Manages the various classes of insurance which provides for the LSS, requiring proper management of contributions and financial resources to provide benefits in kind and cash, and in his capacity as independent fiscal agency conduct an effective collection achieving transparency and control information generated.

As a service provider in: Promotes the health of the working population insured and their families, pensioners and students holistically, through the provision of preventive and curative medical services, childcare and economic and social benefits provided in the LSS [1].

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III. Simulation

It is natural that we try to know the result of the implementation of an improved design before investing all resources in it. The improved design of any process ends with the approval of the implementation based on the alleged impacts on some of the indicators that help measure the success of it. In this sense it is very important for people who make the decisions have estimates that are more accurate.

Simulation is a long task that leads to model the real situation and the proposal with the goal of which is to identify more clearly the impact of any changes you want to do in the process. Simulation applied to health centers is helpful to implement improved design without any conflict. Not just about knowing how to behave the new process but also how the current process reacts in case of strange situations.

A. Simulation of the Model with ARENA

Simulation is the process of designing a model of a real system and conducting experience with the same order is to grasp the behavior of the system or of evaluating various strategies (within the limits imposed by a criterion or a set of them) to understand how the system works [9].

1. The Computer Simulation

It refers to a series of methods to study a wide variety of models of real world systems by numerical evaluation, using appropriate software, designed to mimic the operations or system characteristics, often with respect to time. From a practical standpoint, the simulation is the process of designing and creating a computer model from a real or proposed system, in order to conduct numerical experiments to better understand the behavior of the system as a set of conditions given [6].

2. Development of Simulation

When the capabilities and sophistication of languages and simulation packages began to increase dramatically over the

40s, the concept of how and when to use simulation changed. At first, in the late 50s and the 60s, the simulation was an expensive and specialized tool that was generally used only by large corporations requiring large capital investments. The use of simulation as it is known today began on the 70's and early 80's. Computers began to be faster and cheaper and the value of the simulation began to be discovered by other industries, though most companies were still quite large [7].

3. Applications of Simulation

As already seen, the advent of computer and simulation application has made possible the development of a large number of techniques and their application in many fields: Production systems: planning, inventory control, product lines, programming.

B. Program LINDO

Lindo is a handy software to build and solve linear and integer, Lindo has become a very popular program for solving linear optimization problems, Whole, and Quadratic, all this thanks to its speed and ease of use. Cute optimization is the most popular software for Instruction and Research. His simple style of expression of models and their friendly interface make it easy to learn and use. For large or small models, linear or integer, just use Lindo.

C. Simulation with ProModel

ProModel is a simulator with animation for personal computers. It enables you to simulate any type of manufacturing systems, logistics, material handling, etc. You can simulate conveyors, overhead cranes, assembly, cutting, workshops, logistics, etc. ProModel is a simulation package that requires no programming, although permitting.

D. Avantsim Software

It develops solutions for modeling and simulation for industrial process improvement, logistics and services. We intend to support business decision making, minimizing the risks associated with investments in production equipment and mobility infrastructures. Our ambition is to contribute to the modeling and simulation of computer operations is a practice as common in our house as it is in the more advanced countries and these activities available to all companies, so that the benefits are both for the multinational company to SMEs.

E. Linux Program

Linux is an Operating System. It is a freely distributable implementation of UNIX for personal computers (PCs), servers, and workstations [8].

As an operating system, Linux is very efficient and has an excellent design. Is multitasking, multiuser, multiplatform and multiprocessor on Intel platforms running in protected mode memory protection so that a program cannot bring down the rest of the system load only the parts of a program that is used, shared memory between programs increasing speed and decreasing memory usage, uses a system virtual memory pages, using all free memory for cache, can use linked libraries, is distributed with source code, uses up to 64 virtual consoles, has an advanced file system but can use other systems, and networks supports both TCP / IP and other protocols.

IV. Application in the Health Sector

In 2008 it published an article that presents a simulation model which describes the current procedure of Emergency Department Care and Hospital Health Care Center Immediate (CAMI) D.T, Health Authority Prime Lending level official in the city of Bogota. The process produced a synthesis of study and overall record of the activities under the current conditions of attention in the area of emergency and hospitalization, as well as proposals that would improve the conditions of patient care and help optimize the resources available to the institution in that area [3]. This contrast was obtained waiting times, people in line and staff utilization, with the proposed structure of the triage procedure presented by the Office of Public Management and Hospital Self Rafael Uribe and which method is to be implemented within the framework the remodeling and expansion project of CAMI. We also tested different scenarios to assess the feasibility in reducing waiting times and number of people in the queue, trying different alternative schedules and support resources available, which shows a substantial reduction in service time and patient waiting.

In 2010 was developed a discrete simulation model of Obstetrics-Gynecology department of public hospital emergency in the region. Arena was used Rockwell Automation software to analyze patient flow, identify bottlenecks and propose improvements to reduce waiting times for patients during their stay. The simulation model covered from patient arrival to the module output information to the recovery area. Assessment was used scenarios to determine the improvement proposals obtaining a 76% reduction in total waiting times [2].

Later, in 2011 we developed a model that analyzed the situation of the emergency area that serves adults, in a public hospital. Arena software was used to perform discrete simulations, in order to obtain suggestions for improvement to reduce the total time patient stays in this area before it is discharged or admitted to the hospital. We developed a simulation model which identified several types of patients seen in the topics of surgery, medicine and traumatology, in some cases requiring analysis in laboratories. To reduce the time spent by a patient in the system examined various possibilities, and was obtained as a better alternative modification in the working hours of doctors in the medical topic. This solution considers that four doctors attend from 7:00 am to 7:00 pm and two doctors from 7 pm to 7 am [3].

V. The Process

In the field of gynecology, the day he performs the surgery schedule is concurrent since at each step only one person attending per stage, and there are several timeouts [6]. To achieve better efficiency with patients we do a simulation to

see the process:

1) It begins with the arrival of the patients were grouped by clinical area (those who arrive late will have to return until next week), social workers come and start a tour of all the areas you have to spend the patients. At the end of the tour they take them to a salon where they are given a social work talks.
2) At the end of the talks, this arrives attending anesthesiologist per patient. Once the patient has a diagnosis is directed to the head of gynecology to schedule your surgery date (depending on your condition can also quote the patient to the next week).
3) By having your surgery date the patient is directed to file to get the stamp of validity and finally lead to the blood bank where they are given the donor hello and explain the procedure [10].

A. Patient Arrival

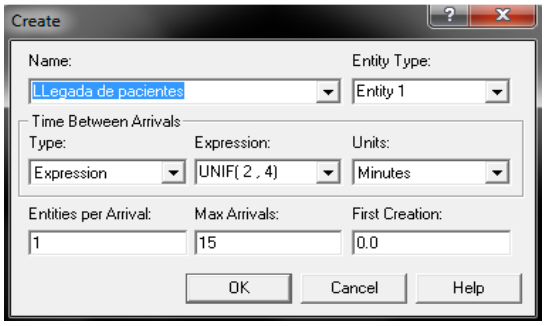

Fig. 1 Create Symbol

The arrival of each patient is in a uniform expression with at least 2 minutes and a maximum of 4 minutes. Patients arrive one at a time and with a maximum of 15 patients per day programming.

B. Check Room Time

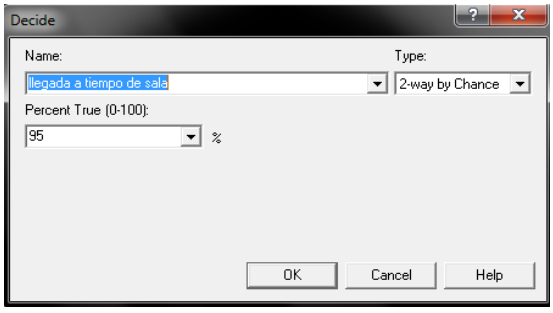

Fig. 2 Decides Symbol

Approximately 95% arrives in time to start the process of scheduling surgery.

C. Out People Unpunctual

If that patient is not on time, you have to come back another day programming to set a date for surgery.

D. Arrival

It is the first station, which is where you will collect the patients as they arrive at the IMSS.

E. Go to Meeting

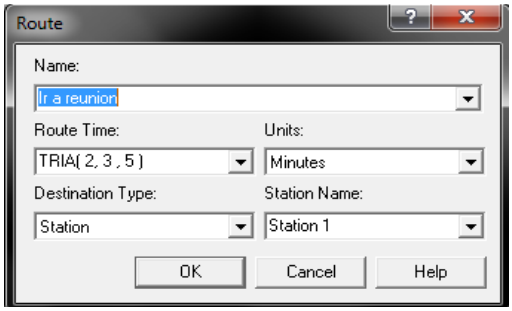

Fig. 3 Route and Station Symbol

Route from the entrance to the IMSS to get where patients should be placed to begin the process. The transfer process has an expression triangular with maximum 5min, a minimum of 2 min and a value of 3min which is the most prevalent.

F. Meeting Room

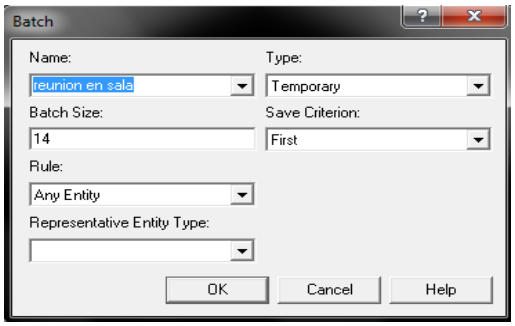

Fig. 4 Batch Symbol

In this figure, we can meet the 14 patient's only one, as the next process occurs for all patients together.

G. Route

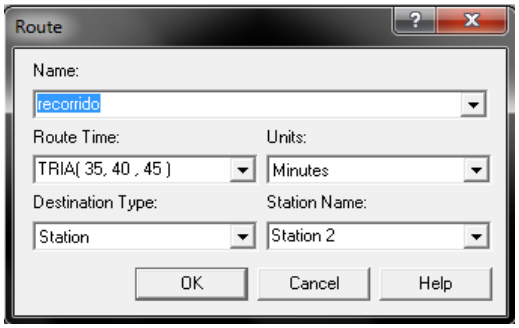

Fig. 5 Route and Station Symbol

The first process is to give all patients a journey through the seasons you have to spend each, to familiarize yourself with the routes you have to spend. The tour has a triangular expression with a maximum of 45min, 35min minimum and a value of 40min which is the most common. After the tour, take patients to a room done they are going to give some talks.

H. Talks Social Work

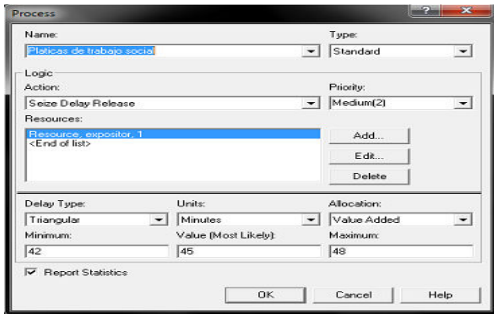

Fig. 6 Process Symbol

The talks bring an action to take to patients, give talks and released. The talks are conducted by social workers has a triangular expression with a maximum of 48min, a minimum of 42min and 45min value which is the most common.

I. Out of Room

This figure allows us to separate the group that had formed, since the process is performed following patient to patient.

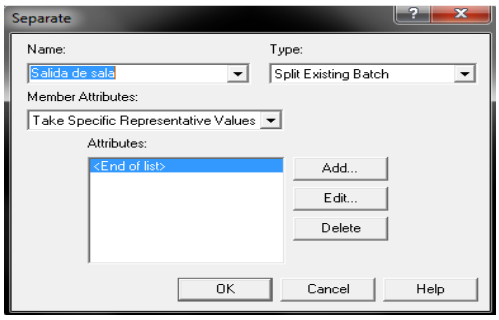

Fig. 7 Separate Symbol

J. With Anesthesiologist

At the end of the talks, the anesthesiologist comes the salon.

K. Check Anesthesiologist

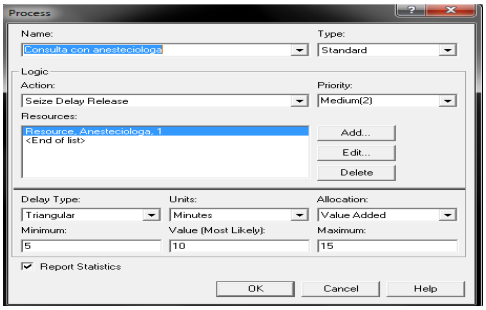

Fig. 8 Process Symbol

Anesthesiologist takes action to evaluate patients. The query is performed by a triangular expression 15min with maximum, minimum 5min and 10min value that is the most prevalent.

L. Chief of Gynecology

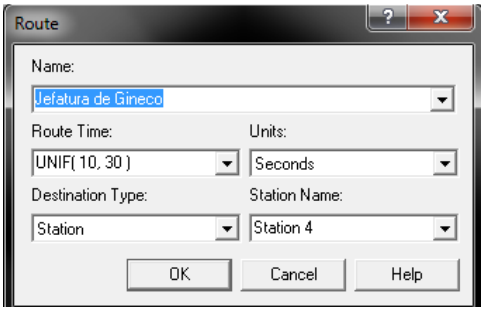

Fig. 9 Route and Station Symbol

The transfer of the hall to the headquarters of Gynecology presents a uniform expression with a maximum of 30min and 10min minimum.

M. Date of Surgery

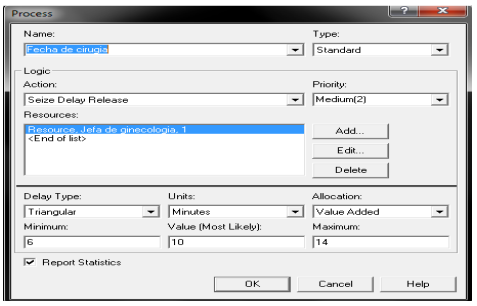

Fig. 10 Process Symbol

The head of gynecology takes an action to schedule the surgery date or delay depending on the results that gives the anesthesiologist. The query is performed by an expression triangular with a maximum of 14min, at least 6min and 10min value which is the most common.

N. Terms

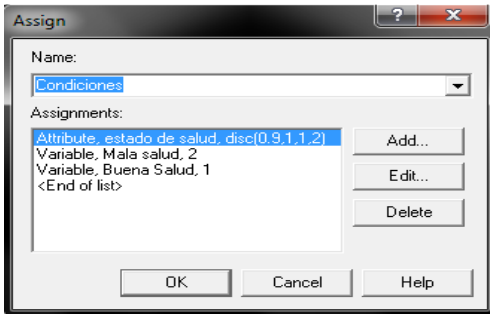

Fig. 11 Assign Symbol

The anesthesiologist gives the health status of the patient to the head of gynecology, through study 90% have good health and is suitable for you schedule a surgery date.

O.Patient Conditions

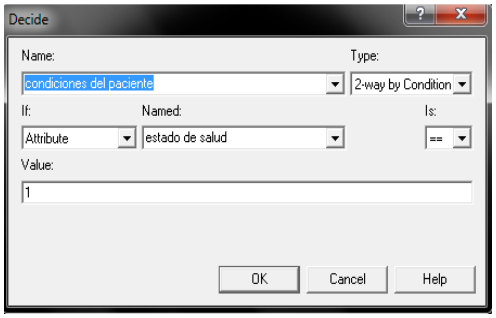

Fig. 12 Decides Symbol

Depending on the patient's condition, if you are in good health follows the process of programming, otherwise have to come another day to continue the programming process.

P. Walk-ins

Patients who did not have a good health should quit the process and return another day to continue the process of scheduling surgery.

Q.Seal

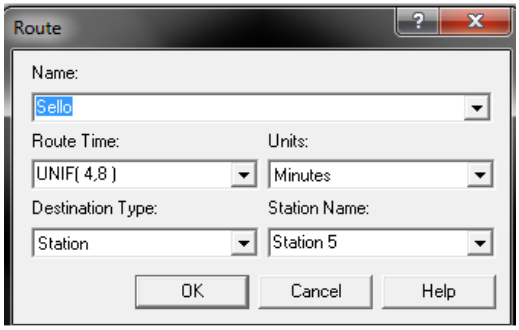

Fig. 13 Route and Station Symbol

The date will be scheduled surgery; patients should be directed to file a seal.

R. Clinical Archive

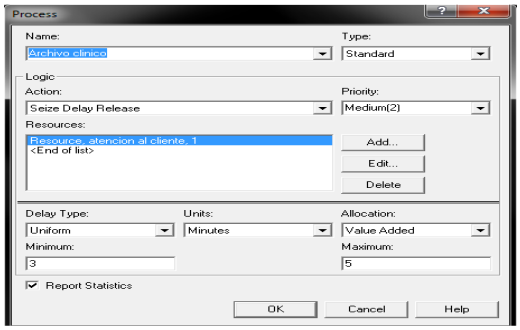

Fig. 14 Process Symbol

At clinical file the action takes the format they put the seal. The seal is affected by a uniform expression with maximum and minimum 5min 3min.

S. Blood Bank

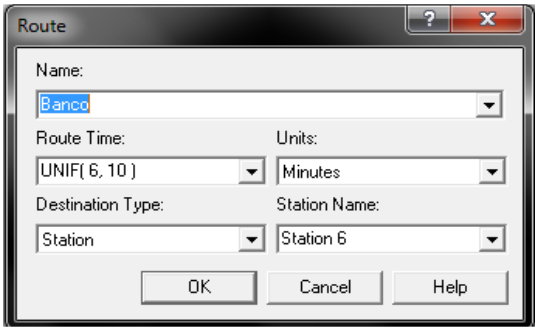

Fig. 15 Route and Station Symbol

By having the seal, you need to go to the blood side.

T. Donor Sheet

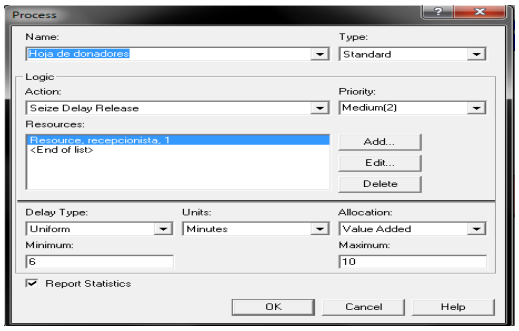

Fig. 16 Process Symbol

At the blood bank clerk gives the donor sheet to the patient and explains the process to be performed. The last step is performed by a uniform expression with maximum and minimum 10min 6min.

U.Output Patients

Final is the output of the patients and all the steps to programming.

V. Animation

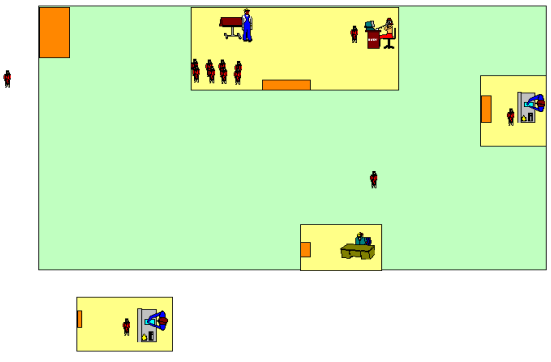

Fig. 17 Animation

This is a simulation of the surgery scheduling process, the first image in the top left shows the social worker in the talks, which is to his right but in the same room is the anesthesiologist, then go to the head of gynecology that is the one stuck right into his office, then go down towards the seal

file validity and finally leaves the clinic and is directed toward the blood bank.

VI. Conclusion

Upon time study and analysis of simulation surgery scheduling, we see that in the current method bottlenecks are formed in the course and when to end the conversation was too time-based and these references rely to make recommendations for improvement in the various stages of the process. Developing the simulation resulted in several proposals for reducing unnecessary time and motion, thereby reducing the processing time. The proposals were:

1) The stage presents waiting longer is the date the anesthesiologist, it is suggested to assign an anesthesiologist assistant to expedite the reception of patients for review.
2) Quote to small groups of people to talk and that this is done several times a day, so you can speed up the wait with the anesthesiologist.
3) Another improvement is to reduce the talk time.
4) A significant improvement proposal is to avoid extensive travel to the patient, which is to put the stamp of validity, since the patient has to go down that file to put the seal. It plans to eliminate this path by putting the stamp on the head of gynecology this speeds the process and less on running the patient journey.

In conclusion, we see how we can make different methods or applications to different areas that we use daily in our lives, such as the IMSS, and primarily on helping patients not waste much time in a process that can be more agile and dynamic. We obtained interesting results that take into account in order to implement the proposals that we put forward, especially because today besides saving money is very important, there is also a word very valuable for customers, patients, etc., and is the TIME.

On the other hand, are minimal records that exist in the network, in books, etc., which they rely to implement this type of system in a health center or hospital.

For this reason, it is important to follow so you can make a complete study of this system will probably convince national IMSS managers to innovate the way they do their transactions and simplify them so that patients do not lose too time and at the same time reduce the conglomeration of people in the health center.

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