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Research Article

Implementation of the Simulation to Evaluate The Student Care Process

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Abstract: The purpose of this project is to implement the simulation to evaluate the student attention process. For this, a statistical study with 90% reliability and a margin of error of 10% was used. The results that the project yielded was that productivity has 83.21%. Proposals for improvements were made in order to increase the performance of the process, with the activities carried out it reached 92.5%, with this productivity increased 9.29%.

Keywords: Simulation, attention process, productivity.

INTRODUCTION

The simulation arises from the evolution of the Monte Carlo Method, thanks to the construction of the first general purpose computers such as ENIAC; in the same way, due to the application of statistical and mathematical models through computer tools (Herrera, 2013). Specialized software is used to develop simulation models. Discrete event-based simulation software (Discrete-Event) and agent-based simulation software (Agent-Based) are distinguished. The former are focused on the processes and the latter on the entities (Pugh, 2006).

Simulation is the process of designing a model of a real system and experimenting with it, to understand the behavior of the system or evaluate new strategies for the operation of the system (Shanon, 1976). The simulation allows to experiment with a system model to better understand the processes, in order to improve the activity in the companies [Harrington & Tumay, 1999]. Simulation is a numerical technique for conducting experiments on a digital computer, which comprises certain types of mathematical and logical relationships necessary to describe the behavior and structure of real-world systems. It has the advantage that the system can be put into operation under certain conditions of the factors that affect it, through the representation of fictitious scenarios, which show the performance of the system without having to do it at a real level because it is not possible or is very expensive (García, García & Cárdenas, 2006). According to Kelton, Sadowski & Sadowski (2008) mention that simulation "is a wide collection of methods and applications, which allow to imitate the behavior of a real system. Simulation can be an extremely general term, which applies in many fields, industries and other applications. "The simulation is developed with the theory of statistical sampling and analysis of complex probabilistic physical systems. The common aspect of both is the use of random numbers and samples to approximate solutions (Ferreiro, Azcárate and Mallor, 2011). Vargas (2015) points out that simulation refers to the set of methods and applications that seek to mimic the behavior of real systems, usually on a computer with appropriate software.

For this reason it was decided to study the process of attention to students in a private school, since there have been complaints that the service is not good. For this, the simulation was used to evaluate this attention process.

BODY OF MANUSCRIPT
History of Specialized Softwares

Quick Response Code

ProModel Corporation (s / f) mentions that ProModel® is a simulator that allows you to simulate any type of manufacturing, logistics, material handling systems, etc. You can simulate transport bands, traveling cranes, assembly, cutting, workshops, logistics, etc. With the software you can simulate: Just in Time, Theory of Constraints, Push Systems, Pull, Logistics, etc. Virtually any system can be modeled.

On the other hand Pastor (2014) points out the following simulation software:

- Arena: valid for manufacturing, service or financial processes, mainly. It stands out for its intuitive environment, for its versatility and for its great graphic capacity.
- Witness: is the software that is developed and used throughout this work. Like Arena, its use is recommended for manufacturing, service or financial processes, mainly. It has an educational version, so it allows the training of personnel to operate with it.
- ExtendSim: it is one of the best simulation tools that exist in the current market; provides a graphical environment that allows visualizing the behavior of a dynamic system. It allows the use of a tool that facilitates its use. It is also valid for financial processes.

Application áreas

In the industrial sector, simulation softwares are used either when you want to implement a new stage or a new process in the current system, or when you decide to conduct a study to improve the performance of a plant. Softwares such as Arena, Simio and Promodel have already been used in this type of functions, such as implementing another production line

in the bakery industry (Mejía, 2008) or optimizing an existing production line (Bassan, 2015).

In the mechanical metal sector All the softwares mentioned in the previous section have references to studies in this sector, but some of them are more specialized in certain operations mentioned above. Visual Components specializes in robots, managing to accurately simulate maintenance times and periods. With Flexsim and Promodel, studies have been carried out on the flow of people and simulation of movements in the production line, allowing to optimize their times (De Macedo, 2015).

Purpose of the study

Implement the simulation to evaluate the process of attention to students.

Specific objectives

- Know the process of attention of the students of the university.
- Understand the composition of the process of attention to students.
- Simulate the attention process using specialized software.
- Analyze the productivity of the student attention process.
- Evaluate the results obtained from the attention analysis to propose improvements to it.

METHODOLOGY

The methodology used by Forero & Giraldo (2016) was used, which propose the following steps:

Definition of the System / Process to Be Modeled

At this stage the process of attention in boxes was observed. Each activity was monitored to find the average time it takes for each activity. The formula proposed by Salas (s / f) was used to know how many time samples should be made.

$$n = \frac{Z^2 * p[1-p]}{E^2}$$

Where:

n = is the number of times taken to develop.
z = is the confidence interval to use. For this project, 90% reliability was used.
p = is the probability of success. 0.5 success was used for this project.
E = is the percentage of the allowed error. 10% was used for this project.

$$n = \frac{(1.645)^2 * 0.5[1-0.5]}{(0.10)^2} = \frac{0.6765}{0.01} = 67.65 = 68$$

For the present project, using 90% reliability, a 10% error, a probability of success of 0.5 68 times were taken for each activity.

Construction of the Simulation Model

At this stage, the observed model was built with the average times. ProModel® software was used in its student version. ProModel® is a highly flexible discrete event simulation software, which allows

interaction with other computational tools such as Excel, and its integration with Excel makes it highly flexible and friendly (Hasan & Al-Hussein. 2010). Figure 1 represents an example of the construction of the model in the specialized ProModel® software.

ProModel® uses simulation based on discrete events,

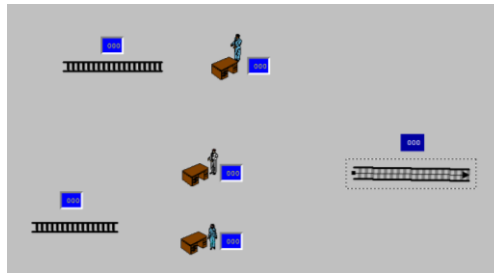which is the most commonly used on waiting lines.

Figure-1. Process example

Definition of the Decision Model

In this stage the variables for the simulation of the process under study were defined. The process is monitored, the entrance time is 8 a.m. at 4:30 p.m. Likewise, it is known that they have 60 minutes to eat, they have 15 dead minutes on average, because the machines take time to turn on the first, it was discovered that one of the causes is that they do not have a maintenance plan. On the other hand it was discovered that on average the workers lose 15 minutes, this wasted time is because they look for the files,

which are messy. With the monitored, there is an effective time of 7 hours, which will serve to simulate the process.

User-model interface. In this phase, the complete model was built in the specialized software, in order to be able to simulate the process completely, without any variable being discarded. Figure 2 represents an example of the process already built in specialized software.
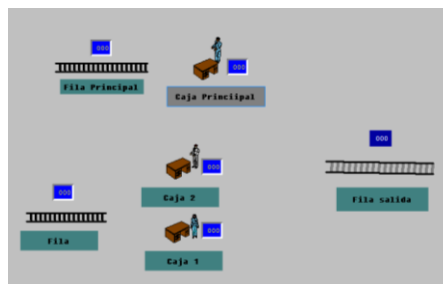

Figure-2. Example of the finished process

Experimentation with the Model

At this stage the model was simulated in the specialized ProModel® software. Figure 3 represents an

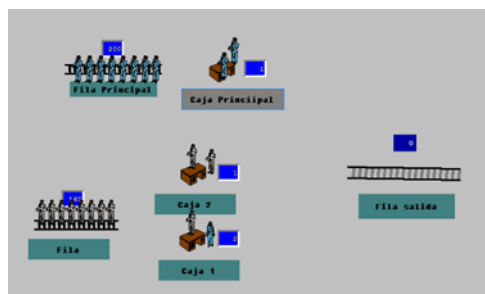example of the simulated process in specialized software.

Figure-3. Example of the simulated process

RESULTS OF THE OBSERVATION

The process is shown in Figure 2, and then the simulation stage is followed, for which the specialized ProModel® software was used, the formula proposed

by Díaz (1995) was used, who proposes a formula to know the number of runs to simulate a process, in this case, the value chain map in its current state.

The formula used was the following:

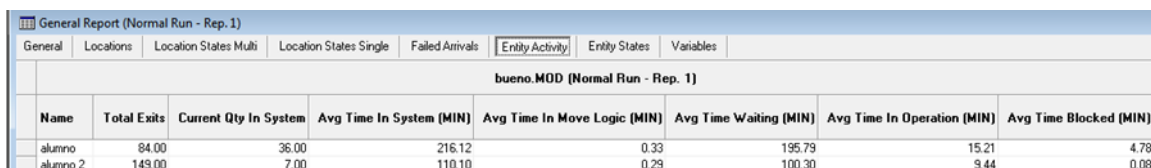$$T = \frac{t_{\frac{\alpha}{2}}^2 \, p_h (1 - Ph)}{A^2}$$

Where:

T = is the number of replications,

Ph = is the default level of inaccuracy A

1 - = is the level of trust

For this investigation, a 99% confidence interval was calculated, using a right tail of probability of 0.05 and an imprecision level of 0.05. The theoretical probability of the interval according to the author is in a range (0.045 - 0.055). The formula will be as follows:

$$T = \frac{t_{\frac{\alpha}{2}}^2 \, p_h (1 - Ph)}{A^2} = \frac{(2.57)^2 * 0.05 * (1 - 0.05)}{(0.05)^2} = \frac{0.3136}{0.0025} = 125.44 \approx 126$$

The result shows that in order to be 99% reliable and 0.05 inaccurate, the chain map was simulated 126 times in its current state. Continuing with the analysis, the process times using 90% and a maximum permissible error of 10% show the following results (see figure 4):

General	Locations	Location States Multi	Location States Single	Failed Arrivals	Entity Activity	Entity States	Variables		

Name	Total Exits	Current Qty In System	Avg Time In System (MIN)	Avg Time In Move Logic (MIN)	Avg Time Waiting (MIN)	Avg Time In Operation (MIN)	Avg Time Blocked (MIN)
alumno	84.00	36.00	216.12	0.33	195.79	15.21	4.78
alumno 2	149.00	7.00	110.10	0.29	100.30	9.44	0.08

Figure-4. Process results

ANALYSIS OF RESULTS

Once the process was simulated, the results of the care process were analyzed. Table 1 represents the results of the process.

Table-1. Example of process results

Variable	Total
Students Served	233
Students waiting for service	43
Total	280
Productivity	83.21%

It can be seen that the results obtained from the observations in the specialized software have 83.21% productivity; This analysis resulted from observations of approximately seven hours, given the minutes lost due to lack of maintenance and wasted time searching for the files. The software showed a total of 233 students served correctly and a total of 43 students staying in line waiting for service.

Likewise, the software shows the percentage of work in each work area (figure 5). It can be seen that an equal result is not shown in the processes, which means that some activities work more than others.
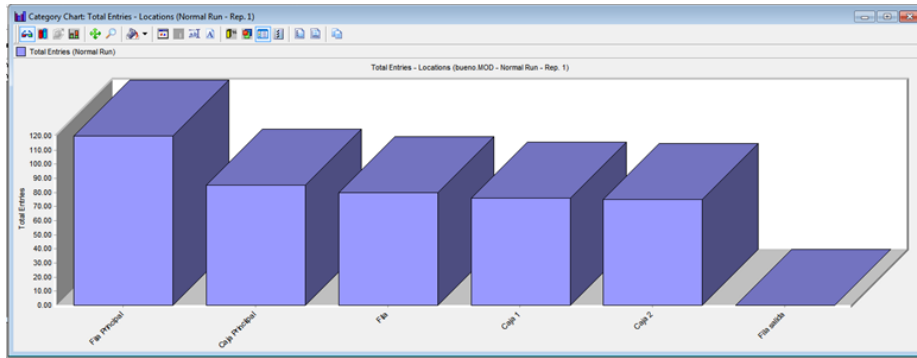
Figure-5. Results of the activities

Figure 6 represents the results of clients served, where it is observed that for clients (student 2) they are the ones that serve the most.
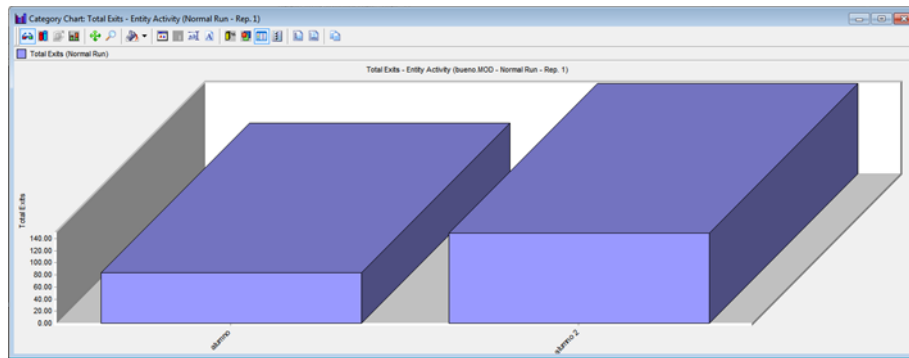

Figure-6. Results of students served

INTERVENTION PROPOSAL

Once the productivity of the student attention process is known, the following improvements are proposed:

• Have a maintenance plan, this will reduce the average of 12 minutes.

•

• Have an orderly, clean and classified place, this will reduce on average the 12 minutes it takes for workers to search the files.

• Develop an analysis of activities in each work area, in order to eliminate minutes in activities that do not add value in each process.

With the aforementioned proposals, the process was re-simulated and the results obtained were the following (see table 2):

Table-2. Process example

Variable	Total
Students Served	259
Students waiting for service	21
Total	280
Productivity	92.5%

It can be seen that the results obtained from the observations in the specialized software have 92.5% productivity; This analysis resulted from seven-hour observations with approximately 24 effective minutes and reduced minutes in activities. The software showed a total of 259 students served correctly and a total of 21 students staying in line waiting for service. Figure 6 represents a comparison of the original process against the improved process. There was a 9.29% increase in process productivity. This improvement in the process came with the aforementioned improvements (see figure 7).
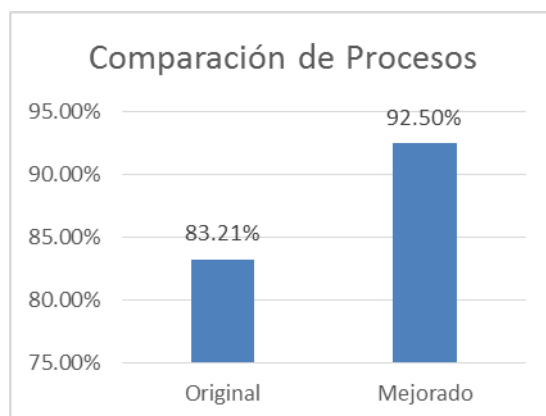
Figure-7. Results of productivity.

CONCLUSIONS

Simulation is a very powerful tool, since it helps to analyze the behavior of the variables that you want to evaluate. Also, when using specialized software, this is useful in the analysis of the study area. In this sense, ProModel® software is very useful to analyze, understand and evaluate a service process.

This project met the general objective, which was to implement the simulation to evaluate the process of student attention. Likewise, the specific objectives of the research were met. The attention process was simulated using specialized software. The productivity of the care process was analyzed. Finally, it was possible to evaluate the results obtained from the analysis of the productivity of the process of attention to students to propose improvements to it. The improvement alternatives were made, increasing the productivity of the care process.

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