



## INTERNATIONAL JOURNAL OF RESEARCH IN COMPUTER APPLICATION AND MANAGEMENT

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## OPTIMIZATION OF THE ENROLMENT SYSTEM OF UNIVERSITY/COLLEGE X USING SIMULATION MODEL

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### ABSTRACT

*This study presents the results of a simulation study on optimization of the enrolment system in University/College X. The desired measure of performance is the server's utilization and enrollee's time spent in the system measured in terms of service time plus waiting time. The study was conducted during peak hours to determine the system's capacity. The proponent used Stat: Fit for the input data for descriptive statistics and their fitted probability distribution. To transform the input into a more valuable insight, Promodel was used to determine the performance measure of the system. The researcher performed several iterations of the different alternatives in order to accomplish the stated objective of the study, which are shorter waiting time, and increased utilization of the system's resources. The bottlenecks in the system are in all operations. But the most constraints are in the advisement and encoding since they have a larger variability of inter-arrival time and service time. The study determines the number of server in each serving point.*

### KEYWORDS

Optimization, Server's Utilization, Simulation, Waiting Time.

### INTRODUCTION

One factor that affects or contributes to the efficiency of the system is Technology. These will often break or make the company's success. Many companies nowadays respond to the fast changing technology, otherwise they will be left behind or worst, they will not exist anymore. University/College X has successfully responded to these changes by providing several Instructional Technology Rooms and Seminar Rooms. Each selected room was equipped with video/data projectors, audio systems and a teaching station with appropriate computers and related peripherals. Also there were Industry Software Rooms, where several licensed software were available with the integration of industry needs.

All of these improvements resulted in enhanced learning strategies of the students and faculty, which provide excellence in education. Technology therefore, can be a powerful enabler in the learning process and a valuable tool in improving student learning and can help offset the challenges created by larger classes. But again there is a saying that "the sum of its part is greater than the whole." Likewise, the movement of the whole is based on the behavior of the parts. It is worthwhile to know the behavior of the parts to assess the whole system if it is effective and efficient. The larger part of the system, as enumerated a while ago, creates services through educational excellence resulting in customer satisfaction. This study therefore would look into one part of the service system of University/College X, which is the enrolment system. During this period, students undergo several procedures and processes to be officially enrolled for the coming semester. At some stage in the process, particularly during peak hours, they often experience long queues, which lead to fatigue and a feeling of dissatisfaction of the services provided to them.

In these times of sophisticated technology, too long and tedious enrolment procedures could be avoided. In fact there are now institutions in the country offering on-line enrolment, which can make life easier for the students and parents as well. From a new enrolment perspective, the on-line is good, particularly for the parents who accompany their children during enrolment period. They can see the benefits of finalizing their enrolment online with immediate confirmation of units/days/times, and are impressed that it doesn't take too long.

There are several factors to consider though, in the on line system, such as: financial requirements and technical difficulties as the use of computer-based technology may cause frustration. The less familiar you are with the technology the more intrusive and distracting it can be. There are numbers of strategies you can employ to overcome these, but it requires excessive time and effort both on the part of the users and the technical people.

At this time of economic difficulties, technology's role as a cost-efficient enabler is even more critical. We might as well use technology as a tool for decision making to select the best alternative of improving the enrolment system in this institution. It is the goal of this study therefore to investigate various approaches to speed up the enrolment processing time and use the four production elements (man, machine, material, methods) efficiently.

The study use ProModel Optimization Software. This technology software is simulation-based software for evaluating, planning, or designing manufacturing, warehousing, logistics and other operational strategic applications. The animation and graphical reports are powerful tools for visualizing, understanding and improving the system. Hence, this study will use the capabilities of simulation, as defined by Banks and Carson (2001). Simulation is the imitation of the operation of a real world process or system over time whether done by hand or on a computer. The same author refers to simulation as the process of designing a computerized model of a system and conducting experiments with this model for the purpose of understanding the behaviour of the system and evaluating the various strategies for its operation. Thus, there is a need to develop a simulation environment to allow verification of performance measures, without disturbing the real world system, as it allows predicting the outcomes of decisions before committing capital and resources. This paper aimed to conduct a study that will optimize the Enrolment System Phases of University/College X. Specifically, to identify the optimum number of server at each serving point in relation to the desired level of utilization and the cost of customers waiting. Through this study, Management can identify the effectiveness and efficiency of the system in satisfying the enrollee's need.

### METHODOLOGY

Data required in the study were the Inter-arrival time of the enrollees in each serving points and the service time. These were collected during the enrolment period at peak time so as to derive the actual capacity of the system. The sources of data were based on the actual observation, where the proponent conducted time study from each serving points and the historical data of a selected serving points such as encoding and assessment section and payment section. Actual Observation data and historical data were compared so as to validate the computerized model to the real system behaviour.

Length of data collection was statistically significant which is greater than or equal to 50 data points for each variable in the system. The proponent used work measurement technique in determining arrival time and service time of each server at each serving points. For the Inter-arrival times, the proponent uses stopwatch and checklist, the content of which were numbered, that is, 50 data points, Arrival time and Number of Students Arrived. The proponent entered in the serving point, ignoring the student in queue, (if it exists in the serving point), set the clock to zero and started timing the arrival of the first student(s). When the first customer arrived, proponent recorded the necessary information in the checklist such as Number of data points, Arrival time and Number of students arrived. The inter-arrival time or time between arrivals of the first student was assumed to be at time 0. When the next customer arrived, the proponent recorded arrival time or clock time and number of students arrived until the 50 data points had been taken. The time measurement of the service times of each server at each serving point is the difference the time service begins and departure of the students at the serving points. Service time is measured from the time service began up to departure of customer in the serving points.

The proponent validated the study in the sense that the collected data falls under their usual performance range. Also, the simulated output of the present system was closed to historical data averages.

**RESULTS**

This section presents all data that were gathered during the course of the study. The significance of all the data presented was to understand the systems behavior and its performance measures. All data were converted in minutes because the Stat: Fit software and the Simulation Optimization Software could be defaulted in minutes.

**FIGURE 1 - SIMULATION MODEL OF ENROLMENT SYSTEM OF UNIVERSITY/ COLLEGE X (PRE-REGISTRATION, VERIFICATION AND ADVISEMENT)**



The above figured is the simulation model for the enrolment system of University/College X. The simulation run length was 8 hours since this is the average working time of the system. The simulation model was run in 10 replications, which mean that the same initial conditions and assumption were considered but with a different random number stream. The simulation of the different process was done in sequential order. Starting from pre-registration process, three different alternatives were made as reflected in table 1. Scenario A has 2 servers each with its own waiting line and number of enrollees per arrival was 2. Scenario B is the same with scenario A except for the number of queue with only one waiting line for 2 server. Scenario C had 2 servers, 2 queue and 1 enrollee per arrival. The output reports are in table 1.

**TABLE 1 – SUMMARY OF SIMULATION OUTPUT IN PRE-REGISTRATION PROCESS**

Scenario	A	B	C
Number of Server	2	2	2
Number of Queue	2	1	2
Qty per arrival	2	2	1
<b>SERVER</b>	<b>Pre-registration</b>		
Ave. Total Entries for each server	640.15	640.15	557.5
Ave.% Utilization of Each Machine/Server	99	99	90
<b>ENROLEES</b>	<b>Pre-registration</b>		
Ave. Minutes in System	106	106	2.97
Overall Total Served*	1264	1264	1154

Scenario A and B had the same performance measure, although the condition was different only in the number of queues. Therefore number of waiting line did not affect the performance of the system. Scenario C had shorter time spent in the system as reflected in the average minutes in system which is 2.97 minutes but had lower server utilization. The main reason for shorter time in scenario C was because of the quantity of arrival. The proponent used 1 enrollee per arrival, which was the mode or most frequent occurrence in the number of students per arrival.

**TABLE 2 – SUMMARY OF SIMULATION OUTPUT IN VERIFICATION PROCESS**

Scenario	A	B	C
Number of Server	2	3	2
Number of Queue	1	2	1
Qty per arrival	2	2	1
<b>SERVER</b>	<b>Verification</b>		
Ave. Total Entries for each server	947	772	580.05
Ave.% Utilization of Each Machine/Server	99	81	61
<b>ENROLEES</b>	<b>Verification</b>		
Ave. Minutes in System	42.63	1.31	1.5
Overall Total Served*	1891	2323.4	1159

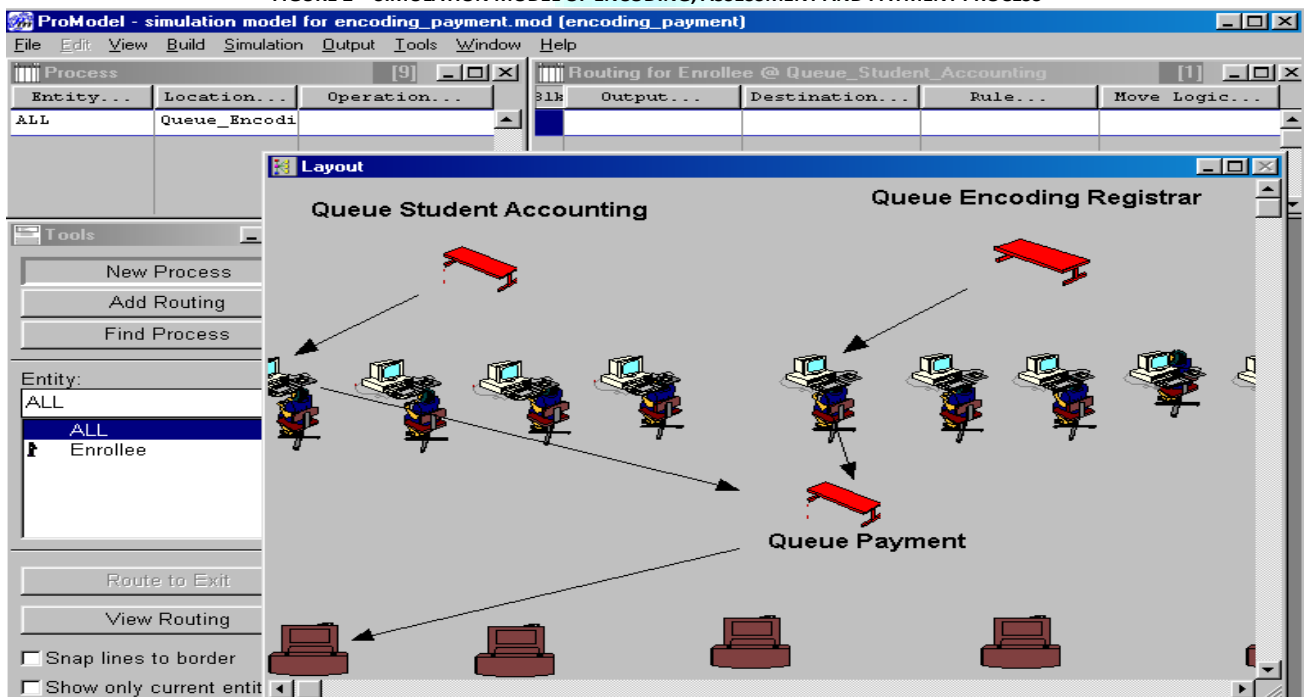
Scenario A and B followed the round – up mean quantity per arrival in the gathered input data which was 2 enrollees per arrival. In this case, 42.63 minutes will be the time spent in the system if you have 2 servers. On the other hand, if you have 3 servers this will have a significant decrease time in system where the enrollees will spent 1.31 minutes in the system. If the quantity per arrival is 1 enrollee, with 2 servers the time spent in the system per enrollee is 1.5 minutes.

TABLE 3 – SUMMARY OF SIMULATION OUTPUT IN ADVISEMENT PROCESS

Scenario	A	B	C	D
Number of Server	2	3	2	3
Number of Queue	2	3	1	1
Qty per arrival	2	2	1	1
<b>SERVER</b> Advise ment				
Ave. Total Entries for each server	384	386	380.15	290.7
Ave.% Utilization of Each Server	99	99	99	74.46
<b>ENROLEES</b> Advise ment				
Ave. Minutes in System	136.67	78.2	34.95	2.15
Overall Total Served*	738.8	1156	758	869.4

If the scenario in the enrolment system have two servers with each queue per server and two students arrived in the system every minute then enrollees spent 136.67 minutes in the system. The total number of enrollees served for a day is 738 enrollees. Additional of one server from scenario A significantly decreased the time spent in the system with 78.2 minutes, (scenario B), the result also have the same resource utilization that is 99%. However, if one enrollee per arrival was used in the simulation model which was the mode or most frequent occurrence in the gathered data, as reflected in scenario C, enrollee’s time in system is 33.67 minutes, at the same time maximizing the resources utilization, 99%. Scenario D has the smallest time spent in the system which is 2.15 minutes per enrollees.

FIGURE 2 - SIMULATION MODEL OF ENCODING, ASSESSMENT AND PAYMENT PROCESS



The above figured showed the simulation model for last phase of enrolment systems which is encoding, assessment and payment process. Below are the summary results of the simulation output.

TABLE 4 – SUMMARY OF SIMULATION OUTPUT IN ENCODING/ASSESSMENT AND PAYMENT PROCESS

Scenario	A	B	C	D
Number of Server	Encoding:14 Payment: 6	Encoding:16 Payment: 5	Encoding:19 Payment :8	Encoding:21 Payment :9
Number of Queue	1	1	1	1
Qty per arrival	2	2	2	2
<b>SERVER</b> Encoding and Payment				
	Encoding	Payment	Encoding	Payment
Ave. Total Entries for each server	78	179	76.46	232.62
Ave.% Utilization of Each Server	91	77	89	96
	75	149.125	62	136.6
	76	61	73	59
<b>ENROLEES</b> Encoding and Payment				
Ave. Minutes in System	29.05	30.89	11.45	12.58
Overall Total Served*	1068	1158	1188	1225

Scenario C and D had a good performance measure with respect to time, however, they revealed slight differences in all the performance measures. To test whether, they have significant differences; statistical analysis was conducted to compare these two systems design. Using t- test as test statistic in a correlated sampling since they have the same input variables. Using a level of significance equal ( $\alpha$ ) to 0.05, the absolute value of  $T_0$  (1.079) is less than the value of  $T_{\alpha,9}$  ( 2.262) , we failed to reject the null hypothesis and claim that there is no significant difference between the two alternatives. Therefore, the mean difference of 1.217 minutes was due to random variability and chance occurrence. Hence, scenario c is the optimum scenario in the enrolment system of university/college X.

**DISCUSSION**

Quantity per arrival of enrollees greatly affects the performance measures of the system. Furthermore, it has no fitted distribution so analyst need not only collect data but must have a good insight in the system so as to decide what to use, the mean average quantity per arrival or the mode or most frequent occurrence of quantity per arrival. However, the number of queue or waiting line does not affect the performance measures of the system.



The constraints or bottleneck in the system are in all processes where queue occurs. Waiting line occurs when demand is greater than capacity; likewise in enrolment system queue occurs when service time is greater than arrival rate. Service time varies in all serving point. Allowances were provided in extending the service time, this includes allowances for personal needs, fatigue and unavoidable. There are some observed delays that occurred in the serving point. Example is in verification, failing to filled the necessary data in pre-registration form. Another is in encoding and assessment, the scheduled subject written in pre-registration form has a conflict with the other stated subject written pre-registration form and the inaccuracy of writing subject code. These delays are beyond the control of the management and it is only the enrollees that have a direct control.

Below table is the summary for the best scenario of the different serving points in the enrolment system of University/College X. The capacity of serving points has been determined by the simulation output report with the condition of peak period in an 8 hour work. These are the following: Pre-registration: 1154 enrollees, Verification Process: 2323 enrollees, Advisement Process: 758 enrollees, Encoding and Payment: 1188 enrollees.

Scenario	C	B	C	C	
Number of Server	2	3	2	Encoding:19 Payment :8	
Number of Queue	2	2	1	1	
Qty per arrival	1	2	1	2	
SERVER	Pre-registration	Verification	Advisement	Encoding	Payment
Ave.% Utilization of Each Machine	90	81	99	76	61
ENROLEES	Pre-registration	Verification	Advisement	Encoding and Payment	
Ave. Minutes in System	2.97	1.31	34.95	11.45	
Overall Total Served*	1154	2323.4	758	1188	

Computing for the total average time spent in the different serving points in enrolment process the summation is 50.8 minutes. This means that an enrollee will spend approximately an hour to enrol in University/College X. This does not include the filling of the information of enrollees in pre-registration and getting the desired schedule for the next semester.

**CONCLUSION**

The study would like to assert that, given those scenarios, their corresponding performance measures (as tabulated in result sections), should be reflected with the given assumptions and conditions of the study so that optimization of the system might result. However, if this were not reflected in the system, there may be interventions occurring that affects the efficiency of the organization. Factors that will likely intervene in the efficiency of the system are: Management Intervention, this happened when they failed to plan properly their system’s resources such as manpower, material, machine and method. On the other hand, the output of this simulation study can be used to avoid, if not eliminate the management intervention. Next is server intervention, when they failed to implement the Standard Operating Procedures of the system and go beyond their allowable relaxation period. Then, customer intervention, when they go beyond the proper procedure of enrolment system. Nevertheless, the study provided allowances to cover some unavoidable circumstances in the system like equipment breakdown, material irregularities, etc. For instance, allowance provided for the process of pre-registration, verification and advisement is 23% of the job time or of the total working time. Likewise, process of encoding and assessment and payment were provided for an allowance of 34% of the job time. Allowance factor was based on criteria of working condition set by the International Labour Organization. Thus, the simulated study was not merely conducted in an ideal condition but in a realistic one. Looking in the summary of findings of the best scenario of each serving points with respect to its performance measures, the current system is already optimized with respect to its service facility.

## **REQUEST FOR FEEDBACK**

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