INTERNATIONAL JOURNAL OF RESEARCH IN COMPUTER APPLICATION AND MANAGEMENT

CONTENTS

CALL FOR MANUSCRIPTS

We invite unpublished novel, original, empirical and high quality research work pertaining to recent developments & practices in the area of Computer, Business, Finance, Marketing, Human Resource Management, General Management, Banking, Insurance, Corporate Governance and emerging paradigms in allied subjects. The above mentioned tracks are only indicative, and not exhaustive.

Anybody can submit the soft copy of his/her manuscript **anytime** in M.S. Word format after preparing the same as per our submission guidelines duly available on our website under the heading guidelines for submission, at the email addresses, **info@ijrcm.org.in** or **infoijrcm@gmail.com**.

GUIDELINES FOR SUBMISSION OF MANUSCRIPT

1. **COVERING LETTER FOR SUBMISSION:**

Dated: _____

The Editor

IJRCM

Subject: **Submission of Manuscript in the Area of _____ (Computer/Finance/Marketing/HRM/General Management/other, please specify)**.

Dear Sir/Madam,

Please find my submission of manuscript titled '_____' for possible publication in your journal.

I hereby affirm that the contents of this manuscript are original. Furthermore It has neither been published elsewhere in any language fully or partly, nor is it under review for publication anywhere.

I affirm that all author (s) have seen and agreed to the submitted version of the manuscript and their inclusion of name(s) as co-author(s).

Also, if our/my manuscript is accepted, I/We agree to comply with the formalities as given on the website of journal & you are free to publish our contribution to any of your journals.

Name of Corresponding Author:

Designation:

Affiliation:

Mailing address:

Mobile & Landline Number (s):

E-mail Address (s):

2. **INTRODUCTION:** Manuscript must be in English prepared on a standard A4 size paper setting. It must be prepared on a single space and single column with 1" margin set for top, bottom, left and right. It should be typed in 12 point Calibri Font with page numbers at the bottom and centre of the every page.

3. **MANUSCRIPT TITLE:** The title of the paper should be in a 12 point Calibri Font. It should be bold typed, centered and fully capitalised.

4. **AUTHOR NAME(S) & AFFILIATIONS:** The author (s) full name, designation, affiliation (s), address, mobile/landline numbers, and email/alternate email address should be in 12-point Calibri Font. It must be centered underneath the title.

5. **ABSTRACT:** Abstract should be in fully italicized text, not exceeding 250 words. The abstract must be informative and explain background, aims, methods, results and conclusion.

6. **KEYWORDS:** Abstract must be followed by list of keywords, subject to the maximum of five. These should be arranged in alphabetic order separated by commas and full stops at the end.

7. **HEADINGS:** All the headings should be in a 10 point Calibri Font. These must be bold-faced, aligned left and fully capitalised. Leave a blank line before each heading.
8. **SUB-HEADINGS:** All the sub-headings should be in a 8 point Calibri Font. These must be bold-faced, aligned left and fully capitalised.
9. **MAIN TEXT:** The main text should be in a 8 point Calibri Font, single spaced and justified.
10. **FIGURES &TABLES:** These should be simple, centered, separately numbered & self explained, and titles must be above the tables/figures. Sources of data should be mentioned below the table/figure. It should be ensured that the tables/figures are referred to from the main text.
11. **EQUATIONS:** These should be consecutively numbered in parentheses, horizontally centered with equation number placed at the right.
12. **REFERENCES:** The list of all references should be alphabetically arranged. It must be single spaced, and at the end of the manuscript. The author (s) should mention only the actually utilised references in the preparation of manuscript and they are supposed to follow **Harvard Style of Referencing**. The author (s) are supposed to follow the references as per following:

- All works cited in the text (including sources for tables and figures) should be listed alphabetically.
- Use (**ed.**) for one editor, and (**ed.s)** for multiple editors.
- When listing two or more works by one author, use --- (20xx), such as after Kohl (1997), use --- (2001), etc, in chronologically ascending order.
- Indicate (opening and closing) page numbers for articles in journals and for chapters in books.
- The title of books and journals should be in italics. Double quotation marks are used for titles of journal articles, book chapters, dissertations, reports, working papers, unpublished material, etc.
- For titles in a language other than English, provide an English translation in parentheses.
- Use endnotes rather than footnotes.
- The location of endnotes within the text should be indicated by superscript numbers.

PLEASE USE THE FOLLOWING FOR STYLE AND PUNCTUATION IN REFERENCES:

Books

- Bowersox, Donald J., Closs, David J., (1996), "Logistical Management." Tata McGraw, Hill, New Delhi.
- Hunker, H.L. and A.J. Wright (1963), "Factors of Industrial Location in Ohio," Ohio State University.

Contributions to books

- Sharma T., Kwatra, G. (2008) Effectiveness of Social Advertising: A Study of Selected Campaigns, Corporate Social Responsibility, Edited by David Crowther & Nicholas Capaldi, Ashgate Research Companion to Corporate Social Responsibility, Chapter 15, pp 287-303.

Journal and other articles

- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

Conference papers

- Chandel K.S. (2009): "Ethics in Commerce Education." Paper presented at the Annual International Conference for the All India Management Association, New Delhi, India, 19–22 June.

Unpublished dissertations and theses

- Kumar S. (2006): "Customer Value: A Comparative Study of Rural and Urban Customers," Thesis, Kurukshetra University, Kurukshetra.

Online resources

- Always indicate the date that the source was accessed, as online resources are frequently updated or removed.

Website

- Kelkar V. (2009): Towards a New Natural Gas Policy, Economic and Political Weekly, Viewed on February 17, 2011 http://epw.in/epw/user/viewabstract.jsp

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

MA. TEODORA E. GUTIERREZ
ASST. PROFESSOR
INDUSTRIAL ENGINEERING DEPARTMENT
TECHNOLOGICAL INSTITUTE OF THE PHILIPPINES – MANILA
938 AURORA BLVD., CUBAO, QUEZON CITY, PHILIPPINES

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 enrolee'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.

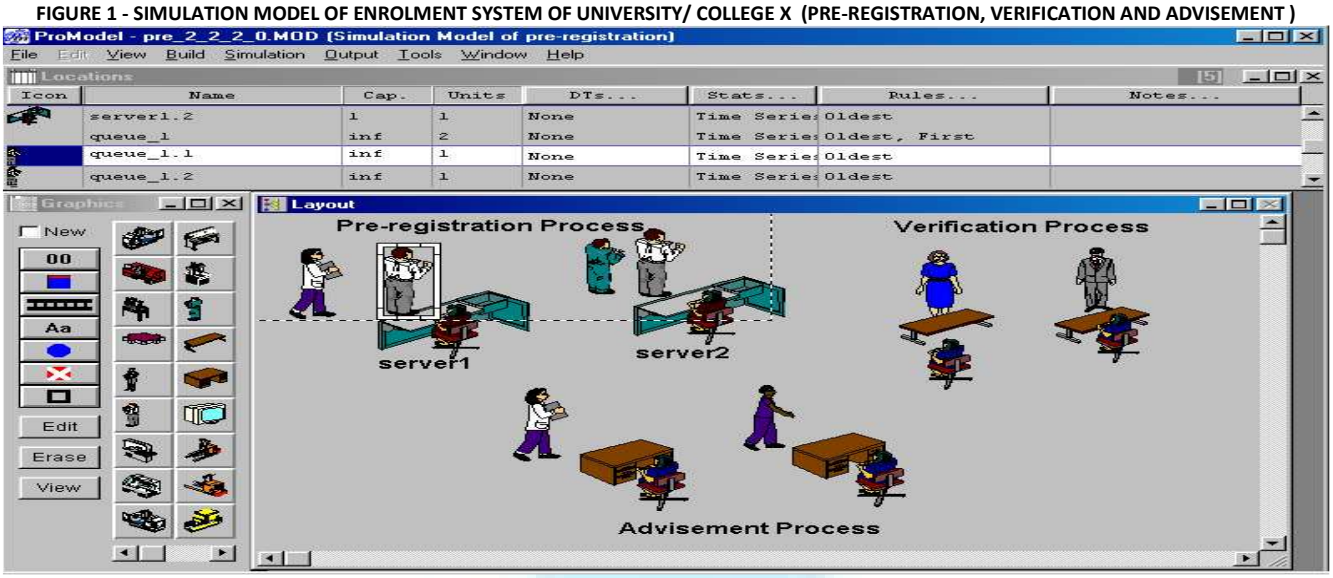
Length of data collection was statistically significant which is greater than or equal to 50 data points for each variable in the system. The proponent used work measurement technique in determining arrival time and service time of each server at each serving points. For the Inter-arrival times, the 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 enrolees 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
SERVER	Pre-registration		
Ave. Total Entries for each server	640.15	640.15	557.5
Ave.% Utilization of Each Machine/Server	99	99	90
ENROLEES	Pre-registration		
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 enrolee 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
SERVER	Verification		
Ave. Total Entries for each server	947	772	580.05
Ave.% Utilization of Each Machine/Server	99	81	61
ENROLEES	Verification		
Ave. Minutes in System	42.63	1.31	1.5
Overall Total Served*	1891	2323.4	1159

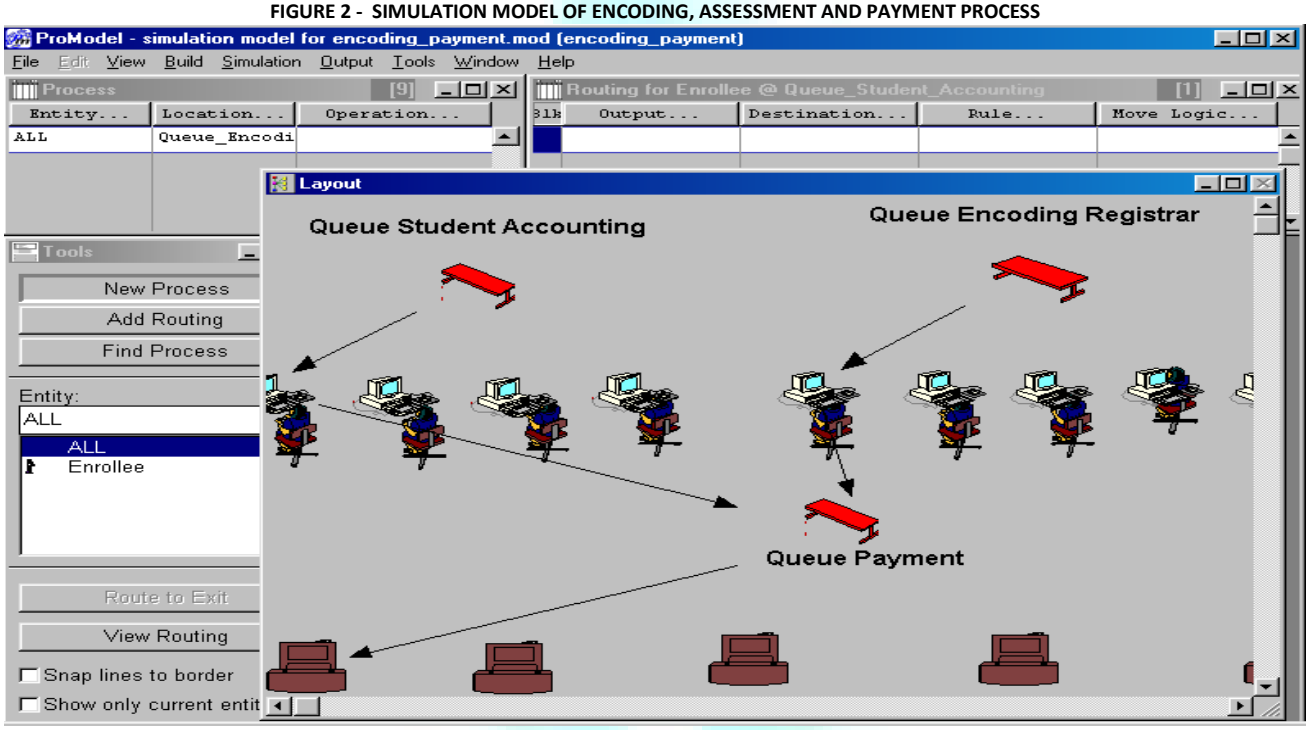
Scenario A and B followed the round – up mean quantity per arrival in the gathered input data which was 2 enrollees per arrival. In this case, 42.63 minutes will be the time spent in the system if you have 2 servers. On the other hand, if you have 3 servers this will have a significant decrease time in system where the enrolees 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 enrolee 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
SERVER	Advisement			
Ave. Total Entries for each server	384	386	380.15	290.7
Ave.% Utilization of Each Server	99	99	99	74.46
ENROLEES	Advisement			
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 enrolees spent 136.67 minutes in the system. The total number of enrolees served for a day is 738 enrolees. 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 enrolees.

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	
SERVER	Encoding and Payment							
	Encoding	Payment	Encoding	Payment	Encoding	Payment	Encoding	Payment
Ave. Total Entries for each server	78	179	76.46	232.62	75	149.125	62	136.6
Ave.% Utilization of Each Server	91	77	89	96	76	61	73	59
ENROLEES	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 (α) 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 enrolee will spend approximately an hour to enrol in University/College X. This does not include the filling of the information of enrolees 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

Esteemed & Most Respected Reader,

At the very outset, International Journal of Research in Commerce and Management (IJRCM) appreciates your efforts in showing interest in our present issue under your kind perusal.

I would like to take this opportunity to request to your good self to supply your critical comments & suggestions about the material published in this issue as well as on the journal as a whole, on our E-mails i.e. **info@ijrcm.org.in** or **infoijrcm@gmail.com** for further improvements in the interest of research.

If your good-self have any queries please feel free to contact us on our E-mail **infoijrcm@gmail.com**.

Hoping an appropriate consideration.

With sincere regards

Thanking you profoundly

Academically yours

Sd/-

Co-ordinator