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THE APPLICATION OF QUEUEING MODEL/WAITING LINES IN IMPROVING SERVICE DELIVERING IN NIGERIA'S HIGHER INSTITUTIONS

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Abstract

This paper is an empirical study of the application of queuing model in improving service delivery in Federal Polytechnic Nasarawa, aimed at identifying the queuing structure, queuing discipline, and the basic components of queuing system on improving service delivery in the institution. Questionnaires were designed and administered in order to retrieve the required information. The results obtained were analyzed using tables and percentages. It is found that, lack of full online registration can result to long queues. It is recommended among other things that, the institution should provide full online registration, increasing servers (desk officers) and other facilities that will facilitate effective registration processes.

Keywords: Queueing Model, Waiting Lines, Service delivery, Quality, Nigeria

INTRODUCTION

Nigeria's higher institutions are faced with a growing number of applicants who want to undertake studies in different professional fields or disciplines. The successful applicants always find it hard to pass through the registration process because of its cumbersome nature. Most of the institutions still maintain the old ways of registering students. They often spend many days on the queues before completing the registration which has strong effects on the students' psychology, health conditions and other risks associated with staying long on the queue.

Queuing system or waiting lines has a wide spectrum application in most things that are taking place in the society particularly where the situation requires provision of services at a frequent interval. At the initial time, the model concentrated on commercial activities. A. K. Erlang the originator of this theoretical framework studied the fluctuating demands on telephone facilities and associated service delays. The application of the theory has now gone beyond commercial activities. It embraces other field of human endeavours.

Srivastava, Shenoy and Sharma (2008) enumerate the following as the examples of real queuing system. One significant class of queuing system that we always come across in our daily lives is commercial service system where customers receive service from commercial firms. This involves person-to-person service at a fixed location, such as banks, large retail sales outlets, barber shop, tertiary institutions, etc. Another instance of waiting lines is in the transportation services, where the vehicles are at a customer's service, such as truck applied most to business industrial systems. This includes material handling units (the servers) more loads (the customers).

The theory is applicable to social service systems. For instance, a judicial system is a queue network, where the courts are service facilities, the judges are the servers and the cases waiting to be tried are the customers.

From the assertions made above, it is a clear indication that the model can be applied to most aspects of our lives.

Scope of the Study

There are many higher institutions of learning in Nigeria. These institutions admit thousands of students yearly; each student is required to pass through registration processes.

The queuing model used varies from one institution to the other with distinct characteristics. This research focus only on the queuing model used in Federal Polytechnic, Nasarawa.

Literature Review

According to Onyeizugbe (2011:p.50), queuing theory attempts to determine the number of servers that strike an optional balance between the time customers want for services and cost of providing service.

Lucy (1989:p.210) sees queuing theory as the construction of mathematical model of different kinds of queuing systems so that prediction may be made about how the system will be upon it. Queuing system or waiting line can best be described as a line comprising of arriving customers or items that are form in front of servers or service facilities in order to have the expected services.

Basic Components of Queuing System or Waiting Lines

Ozigbo (2000:p.161) argues that the basic components of queuing system are arrival, servers and waiting lines.

Enwurum (2003) looks at it from a broader perspective, as he delineates the queuing theory into four:

i. An input source or calling population that generate customer.
ii. A service system that consists of one or more service facilities.
iii. A queue that indicates the number of customers waiting for service.
iv. A queue discipline or service discipline is the decision rule for service.

Arrivals

Every queuing problem involves the arrival of items such as customers, equipment, etc.

Servers

The service mechanism may involve one or more service facilities.

Waiting Lines

Waiting line: the essential thing about waiting line analysis is, of course, the waiting line itself. The extent to which queues exist naturally depends primarily on the nature of the arrival and service processes.

Queue Discipline

Queue discipline: A queue discipline is a priority rule or set of rules for determining the order of service to customers in a waiting line. The rule selected can have a dramatic effect on the systems overall performance. The number of customers in the line, the average waiting time, the range of variability in waiting time and the efficiency of the service facility are some factors that could affect the choice of priority rules. Probably, the most common priority rule is first to

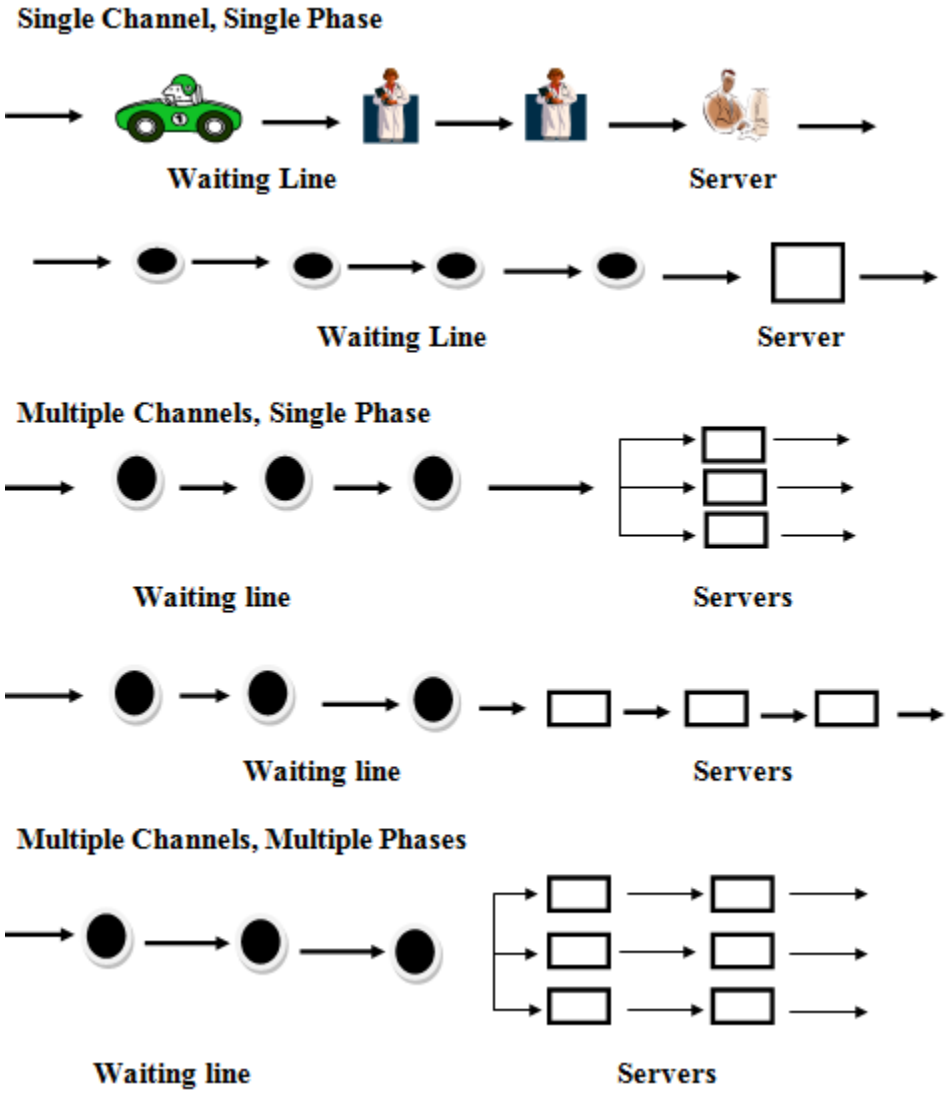
come, first to serve. This rule states that the customers in line are served on the basis of their chronological arrival (Onyeizugbe, 2011).

The discipline could be last in, first out (LIFO). This kind of discipline often occurs in hospitals. For instance, the last person that comes in with a serious medical problem may be attended to before others with less medical problem. Other priority rules include: higher profit customer first, largest order first, reservation first, etc.

Queuing Structure

The structure of waiting lines largely depends on the nature of the service facilities. The structures are displayed below (Ozigbo, 2000:163):

Figure 1. Structure of waiting line



Source: (Ozigbo, 2000)

Assumptions of the Queuing Theory

Ozigbo (2000) enumerates the following as the assumption of queuing theory:

i. Arrival are served on a first in, first out basis
ii. Every arrival waits to be served regardless of the length of line
iii. Arrivals are independent of preceding arrivals, but the average number of arrivals does not change over time.
iv. Service times also vary from one customer to the other and are independent of one another, but their average rate is known.
v. Service times occur according to the negative exponential probability distribution.
vi. The average rate is greater than the average arrival rate.

Queuing Equation

The equations below are typically used to solve problems on single channel, single phase queuing model.

X = mean number of arrivals per time period

N = mean number of people or items per time period

$\sum(n) = \frac{X}{N = X}$ average number of people in the system

$\sum(m) = \frac{X^2}{N(N=)}$ average number of people on the queue (that is, the number in the line plus the number being served)

$T = \frac{X}{N}$ traffic intensity i.e. the queue is too busy

$\sum(w) = \frac{X}{N(N=x)}$ the average time a person spends waiting in the queue

$PO = \frac{1 - X}{N}$ the probability of no person or unit in the system

$Pn = \left(\frac{X}{N-X}\right)$ Pn the probability of "n" units in the system

1-PO – the probability that a person arriving will have to wait.

Illustration

Supposing that, during students' registration in Federal Polytechnic Nasarawa, it is assumed that students, arrival rate can be approximated by a Poisson distribution with an average arrival rate of 40 students/hour. The service facilities can only serve 48 students per hour. If first in, first out service discipline and an arrival pattern that is poison are applied.

From the given problem, X = 40, N = 48

Average rate X = 40/hour, N = 48 average service rate

1. $\sum(n) = \frac{X}{N=X} = \frac{40}{48=40} = 40 = 5$ students/hour

   8

   i.e. the system has an average of registering five (5) students/hour.

2. $\sum(m) = \frac{X2}{N(N-X)} = \frac{(40)2}{48(48-40)} = \frac{1600}{384} = 4$

   i.e. on the average, four (4) students will be waiting on the queue for service

3. $\sum(w) = \frac{X}{N(N-X)} = \frac{40}{40(48-40)} = \frac{40}{384} =$ 6mins

   i.e. on the average, a student will wait on the queue for six (6) minutes

   (N) $T = \frac{X}{N} = \frac{40}{48} = 0.83$

   i.e. 0.83.3 is the probability that the queue will be too busy.

Application of Queuing Model

Queuing model can be applied in all areas of human lives. The table below summarises several instance of commonly recognized queuing situations.

Table 1. Queuing situations

S/N	Situation	Arrivals	Servers	Service Process
1.	School Registration	Students	Registration	Course assigned & forms signed
2.	Grocery Store	Customers	Check out counter	Bill computation and payment
3.	Bank	Customers	Teller	Deposit/withdrawal
4.	Doctor's office	Patients	Doctor and staff	Treatment
5.	Machine Maintenance	Machine breakdown	Repairs men	Repair machine
6.	Air Terminal	Air Planes	Runways	Landing and Taking off

Source: Ozigbo (2000)

RESEARCH METHODOLOGY

For the study purpose, a descriptive research design is used. A simple random sampling method was used to select 100 respondents (students and registration officers). Each respondent was served with a questionnaire. The essence of using the questionnaire as a research tool is to collect the required information easily from the respondents.

Statistical techniques such as frequency distribution tables are percentages were used to analyse data.

ANALYSIS

This aspect deals with the analysis and interpretation of data collected from the field using frequency distribution tables and percentages. The analysis involves the use of average figure collected from the field by the use of questionnaire as earlier stated for this analysis. Hundred (100) questionnaires were distributed out of which sixty (60) were returned. Therefore, the analysis would be used based on the sixty (60) questionnaires returned.

Table 2: Sex distribution of the respondents in Federal Polytechnic Nasarawa

Sex	Frequency	Percentage (%)
Male	46	76.67%
Female	14	23.33%
Total	60	100%

Table 3: Age distribution of the respondents

Age	Frequency	Percentage (%)
Less than 18 years	0	0%
18 years and above	60	100%
Total	60	100%

Table 4: Students registration queue of the institution

Response	Frequency	Percentage (%)
Long	22	36.67%
Very long	20	33.33%
Moderate	12	20%
Very moderate	2	3.33%
Short	4	6.67%
Total	60	100%

From the above table, 36.67% of the respondents show that, the students registration queue of the institution as long, 33.33% of the respondents indicates students registration queue of the institution as very long; while 20% of the respondents rated the students registration queue of

the institution as moderate. Also, 6.67% of the respondents agreed that the students' registration queue of the institution is short and lastly, 3.33% of the respondents indicate that the students' registration queue of the institution is very short.

Table 5: The period people stay on the queue in the institution

Response	Frequency	Percentage (%)
Less than 30 minutes	8	43.33%
30 minutes and above	52	86.67%
Total	60	100%

The above table clearly shows that 13.33% of the respondents stayed on the queue for less than thirty (30) minutes while 86.67% stayed on the queue for more than thirty (30) minutes.

Table 6: The attitudes of registration officers

Response	Frequency	Percentage (%)
Very cordial	36	60%
Not cordial	24	40%
Total	60	100%

The above table clearly indicates that 60% of the respondents agreed that the attitudes of the registration officers are very cordial; in contrast, 40% of the respondents who are of the view that the attitudes of the registration officers are not cordial.

Table 7: How the institution uses ICT throughout the registration process

Response	Frequency	Percentage (%)
High	18	30%
Very high	2	33.33%
Low	18	30%
Very low	14	23.33%
Not at all	8	13.33%
Total	60	100%

From the above table, 30% of the respondents show that the use of Information Communication Technology (ICT) throughout the registration process in the institution is high; 3.33% of the respondents agreed that the use of Information Communication Technology (ICT) throughout the registration process in the institution is very high. While 30% of the respondents rated the use of Information Communication Technology (ICT) throughout the registration process in the institution as low. Also, 23.33% of the respondents are of the opinion that the use of Information Communication Technology (ICT) throughout the registration process in the institution is very

low and lastly, 13.33% of the respondents said that the institution does not use Information Communication Technology (ICT) throughout the registration process at all.

SUMMARY OF THE FINDINGS

Having presented, analyzed and interpreted the data obtained in the course of this research work, the following are identified as major findings of this research effort:

i. One of the major causes of long queues in Federal Polytechnic Nasarawa is lack of full online registration. The institution combines manual and computer.
ii. The institution did not assign enough staff to various service points with the required facilities.
iii. The period given is too short to accommodate the teeming population of the new arrivals.
iv. The students' registration queue of the institution is long because of the disorderly behaviour of some students and members of staff.

RECOMMENDATIONS

Based on the research findings, the following recommendations are made to improve service delivery in Nigerian higher institutions with a particular reference to Federal Polytechnic Nasarawa:

1. The students' registration should be online. This will enable them to register themselves wherever they are, which will reduce the cost of having to come down and eliminates the risks identified with making frequent journey.
2. The queuing system should be decentralized. The processes are too long, from admission office to screening committee, department and bank. Each department should be allowed to cater for its students.
3. The servers (desk officers) are not enough when compare with the inflows of students. Therefore, the institution should engage more hands to handle the registration tasks.
4. The new arrivals (students) should behave in an orderly manner. This will enhance the smooth process of registration.

LIMITATIONS

There are a few limitations in this study that provide opportunities to further research. Previous theories or academic work on queuing model/waiting lines and hypothesis testing are nearly nonexistent. This study relied on previous research on traditional methods of queuing lines/models.

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