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Implementation of Erlang C Formula in Inbound Call Center PT Telekomunikasi Selular

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Abstract

The use of services has become part of daily activities for humans. However, many users of services have been unable to fully utilize the services, resulting in complaints and requiring assistance. Call center as a service for providing information, technical support, and receiving complaints from service users are a solution to this problem. The large number of incoming calls from service users becomes a problem for service providers, so it is necessary to calculate the performance of the call center to implement the right number of agents. This research applies the Erlang C formula which is implemented in the inbound call center of PT Telekomunikasi Selular. Using data from November and December 2023 by reviewing several aspects, such as delay probability, service level, number of agents, and average delay time shows that the number of agents applied is sufficient, as seen from the service level that has met the desired target, so an increase in the number of agents is unnecessary.

Keywords: Call center, erlang c formula, service level.

1. Introduction

The use of services has become part of daily human activities. One of the most frequently used services is telecommunications services. In its use, not a few service users are dissatisfied with the services provided or need additional assistance and information so that they will contact the contact center of each service provider. There are many service user requests that enter the contact center per day.

Contact centers that use communication channel in the form of a telephone or commonly called a call center require quite a lot of agents because this channel is devoted to serving the needs of service users by interacting directly and can only serve one service user at a time per agent. The imbalance between the number of agents and the number of incoming calls causes the possibility of queuing on calls.

Previous research related to call center problems and the use of the Erlang formula is described as follows.

Chromy et al. (2011) discusses the use of the Erlang C formula to perform calculations on important parameters that affect the operation of the service system in call centers, Smith & Dmochowski (2013) discusses a study of blocking analysis on communication networks using the Erlang B model, Hou et al. (2022) discusses predicting service levels in call centers using data-based methods, and Kadioglu & Alatas (2023) about improving call center efficiency, namely prediction of work materials based on data and workforce optimization.

Based on the previous description, research will be conducted on the inbound call center of a company engaged in telecommunication services, namely PT Telekomunikasi Selular or often referred to as PT Telkomsel. The research title is “Implementation of Erlang C Formula in the inbound call center of PT Telekomunikasi Selular”.

2. Erlang C Formula

The Erlang C formula (Erlang Delay Formula), also known as the M/M/N model, was first discovered by A.K Erlang in 1917. This formula is generally used to analyze queues in communication network traffic, such as in call center systems or telephone networks and is used on the assumption that incoming calls will be transferred to the queue as well as all servers are full until there are empty servers.

Other assumptions underlying the use of the Erlang C formula include:

- The arrival pattern is random,
- Servers operate with full availability or all incoming calls can be served by any empty server,
- In statistical equilibrium conditions, and
- The queue distribution applied is First in First Out (FIFO).

The two main variables used are the number of agents (N) and traffic intensity (A). Traffic in telecommunications is defined as the movement of information from one place to another through a telecommunications network. The purpose of the calculation is to determine network performance and service quality of telecommunications networks (Soelistijoroni, Karismawati, & Yuliana, 2011). Traffic intensity is the average number of calls that occur simultaneously during a certain time interval. Traffic intensity is obtained with the following equation.

$$\mathrm{A} = \frac{\lambda}{\mu} \text{ or } A = \lambda \times h \quad (1)$$

where:

A : Traffic intensity
λ : Average number of incoming calls in a unit of observation time
μ : Holding time
h : Average service time per unit time

The performance of the queuing system at the call center can be done using the following equations (Iversen, 2015).

A. System Utility Level (ρ)

$$\rho = \frac{\mathrm{A}}{\mathrm{N}} \quad (1)$$

B. Probability of Delay/Erlang C Formula ($E_{2,N}(A)$)

$$E_{2,N}(A) = \frac{\frac{A^N \quad N}{N!\,(N-A)}}{\left(\sum_{x=0}^{N-1}\frac{A^x}{x!}\right)+\frac{A^N \quad N}{N!\,(N-A)}} \quad (1)$$

C. Service Level (S_N)

$$S_N = 1 - \left[E_{2,N}(A) \times e^{(A-N)\times\frac{AWT}{h}}\right] \quad (1)$$

where AWT (Acceptable Waiting Time) is the targeted time limit for answering calls. The service level value targeted by PT Telekomunikasi Selular is 95% and the AWT value set by PT Telekomunikasi Selular is 15 seconds.

D. Average Delay Time (w_N)

$$w_N = \frac{h}{N-A} \quad (1)$$

3. Results and Discussion

3.1. Call Center Service System

The service system at PT Telekomunikasi Selular is shown in Figure 1.

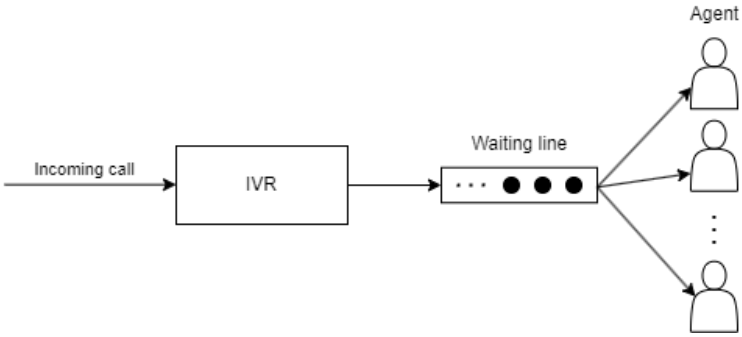

Figure 1: Schematic of PT Telekomunikasi Selular call center service system

3.2. Call Center Service System Analysis

The data obtained is used to determine the traffic intensity values. Table 1 and Table 2 show the calculation results for traffic intensity values in November and December 2023 at 6:00 am to 11:59 pm.

Table 1: Traffic intensity (A_{hours}) call center service in November 2023

Hours	λ	h	A_{hours}
6:00 – 6:59	293	280	22.789
7:00 – 7:59	437	286	34.717
8:00 – 8:59	561	289	45.036
9:00 – 9:59	635	294	51.858
10:00 – 10:59	666	294	54.390
11:00 – 11:59	632	296	51.964
12:00 – 12:59	609	293	49.566
13:00 – 13:59	601	298	49.749
14:00 – 14:59	588	300	49.000
15:00 – 15:59	560	305	47.444
16:00 – 16:59	548	300	45.667
17:00 – 17:59	543	299	45.099
18:00 – 18:59	559	299	46.428
19:00 – 19:59	607	303	51.089
20:00 – 20:59	583	306	49.555
21:00 – 21:59	476	310	40.989
22:00 – 22:59	327	307	27.886
23:00 – 23:59	213	303	17.928

Table 2: Traffic intensity (A_{hours}) call center service in December 2023

Hours	λ	h	A_{hours}
6:00 – 6:59	284	281	22.246
7:00 – 7:59	423	288	33.920
8:00 – 8:59	570	287	45.442
9:00 – 9:59	642	298	53.226
10:00 – 10:59	666	298	55.213
11:00 – 11:59	669	297	55.275
12:00 – 12:59	625	297	51.563
13:00 – 13:59	621	300	51.833
14:00 – 14:59	603	303	50.753
15:00 – 15:59	566	304	47.796
16:00 – 16:59	563	301	47.157
17:00 – 17:59	569	300	47.500
18:00 – 18:59	559	299	46.428
19:00 – 19:59	609	299	50.581
20:00 – 20:59	584	307	49.888
21:00 – 21:59	479	313	41.646
22:00 – 22:59	342	319	30.305
23:00 – 23:59	223	308	19.079

3.3. Service system performance analysis

The results of traffic intensity and the number of agents are then used to analyze the performance of the service system by finding the probability of delay with Erlang C Formula, service level value, average delay time, and service utility level at the inbound call center of PT Telekomunikasi Selular. The calculation results are shown in Table 3 and Table 4.

Table 3: Analysis results of call center service in November 2023

Hours	$E_{2,N}(A_{hours})$	S_N	w_N	ρ
6:00 – 6:59	0.237%	99.895%	18	59.971%
7:00 – 7:59	0.400%	99.838%	17	66.764%
8:00 – 8:59	0.091%	99.972%	13	66.229%
9:00 – 9:59	0.353%	99.880%	14	71.039%
10:00 – 10:59	0.511%	99.821%	14	72.520%
11:00 – 11:59	0.370%	99.872%	14	71.184%
12:00 – 12:59	0.031%	99.992%	11	65.218%
13:00 – 13:59	0.034%	99.991%	11	65.460%
14:00 – 14:59	0.133%	99.958%	13	68.056%
15:00 – 15:59	0.058%	99.983%	12	65.895%
16:00 – 16:59	0.083%	99.974%	13	66.184%
17:00 – 17:59	0.225%	99.921%	14	68.332%
18:00 – 18:59	1.336%	99.418%	18	73.695%
19:00 – 19:59	2.145%	99.024%	19	76.252%
20:00 – 20:59	1.178%	99.499%	18	73.963%
21:00 – 21:59	1.158%	99.466%	19	71.910%
22:00 – 22:59	0.036%	99.987%	15	58.095%
23:00 – 23:59	0.003%	99.998%	15	47.178%
Average	**0.466%**	**99.805%**	**15**	**67.108%**

Table 4: Analysis results of call center service in December 2023

Hours	$E_{2,N}(A_{hours})$	S_N	w_N	ρ
6:00 – 6:59	0.002%	100%	12	49.435%
7:00 – 7:59	0.006%	99.998%	11	57.492%
8:00 – 8:59	0.029%	99.992%	11	64.002%
9:00 – 9:59	0.208%	99.934%	13	70.034%
10:00 – 10:59	0.506%	99.822%	14	72.648%
11:00 – 11:59	0.519%	99.818%	14	72.730%
12:00 – 12:59	0.015%	99.996%	10	64.453%
13:00 – 13:59	0.045%	99.988%	11	66.453%
14:00 – 14:59	0.210%	99.930%	14	69.524%
15:00 – 15:59	0.070%	99.979%	13	66.383%
16:00 – 16:59	0.119%	99.962%	13	67.367%
17:00 – 17:59	0.143%	99.954%	13	67.857%
18:00 – 18:59	0.432%	99.838%	15	70.346%
19:00 – 19:59	0.424%	99.848%	15	71.241%
20:00 – 20:59	0.660%	99.741%	16	72.301%
21:00 – 21:59	0.720%	99.687%	18	70.587%
22:00 – 22:59	0.069%	99.973%	16	60.610%
23:00 – 23:59	0.346%	99.999%	15	47.697%
Average	**0.232%**	**99.914%**	**14**	**65.620%**

Based on the results of the calculation of call center service performance in November and December 2023, it shows that the service level value every hour has exceeded the desired target of 95% so there is no need to increase the number of agents.

4. Conclusion

Based on the results of the service system analysis, the conclusions are obtained as following:

1. The service system currently implemented by PT Telekomunikasi Selular has excellent performance with the service level value every hour during November and December 2023 has exceeded the predetermined target of 95%, with an overall average service level value for two months of 99.860%. Followed by a low probability of rejection, a short delay time, and an average utility rate for two months of 66.364% explains that the performance of the service system at PT Telekomunikasi Selular is good.
2. The number of agents currently used by PT Telekomunikasi Selular is able to keep the call rejection rate as low as possible and achieve a service level value exceeding the desired target so there is no need to change the number of agents.

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