Algoritma : Jurnal Matematika, Ilmu pengetahuan Alam, Kebumian dan Angkasa
Volume. 3 Nomor. 5 September 2025
e-ISSN: 3046-5427; p-ISSN: 3032-6230; Hal 125-138
DOI: https://doi.org/10.62383/algoritma.v3i5.712
Tersedia: https://journal.arimsi.or.id/index.php/Algoritma

Correct Programming and Robust Queueing Theory in an Integrated Model for Quality-Of-Service Enhancement in Service Systems

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Abstract. *This article presents a review study that proposes a blended model combining actual programming techniques with queuing theory to improve the performance and service quality of service systems. The main objective is to design a system that is capable of serving customers as efficiently as possible, using solutions derived from queuing theory to regulate and optimize customer flow, while applying accurate programming methods to ensure that the system operates correctly and in accordance with established standards. The study discusses how these two approaches complement each other and demonstrates that integrating them provides a balance between operational efficiency and the quality of services delivered. To illustrate the effectiveness of this hybrid model, a case study is examined to highlight the practical impact and real-world implications of the proposed framework. Both mathematical formulations and experimental analyses were employed to evaluate the model's effectiveness. Findings indicate that this combined approach not only enhances system reliability but also provides measurable improvements in customer satisfaction and service outcomes. By offering a structured way to integrate queuing solutions with precise programming, this research contributes to the development of more sustainable and effective service management strategies. The model therefore has significant potential for broader application in industries that rely heavily on service delivery and customer flow optimization.*

Keywords: *Mathematical model; Programming; Queuing theory; Service quality; Service system.*

1. INTRODUCTION

Service systems have become increasingly important in our lives, from health care to banking and transportation. Such systems necessitate dynamic demand management to guarantee the delivery of the quality of service, alleviation of waiting time, and enhancement of user experience. Service systems are dynamic and multifaceted, with challenges around the management of demand flows and the provision of resources efficiently.

2. CORRECT PROGRAMMING

It is a fundamental technique that is used to verify that software operates correctly without errors, using mathematical methods and theories to demonstrate that the software meets its specified requirements. Good programming style is one of the many building blocks for system robustness/reliability, which is particularly key in designing complex demand management applications.

However, queue theory has been an efficient methodology for systems whose flow of orders is dealt with. This Theory proposes mathematical models that offer insight into and can predict the effects of demand and service rates on waiting times and system performance. The Theory has developed tactics to enhance the capability to handle orders, thus equilibrating demand and supply and decreasing the waiting times.

Naskah Masuk: 25 Agustus, 2025; Revisi: 08 September, 2025; Diterima: 23 September, 2025; Terbit: 26 September, 2025

The correct programming of the two, queue theory and programming, can lend itself as an inherent model for promoting the demand management of service systems. By combining the science of programming and queue models, greater system efficiency and quality service can be achieved. This mixture also offers a base for developing effective analytics of upper-service systems to meet their demand efficiently.

This research seeks to investigate how queuing systems theory can be combined with programming correctly to obtain an integrated model for demand management that is more efficient than other models. The paper will discuss the underlying principles of correct programming and queue theory, and how the latter can be exploited to help improve resource management in service systems. Through this research, we endeavor to gain a new understanding of how to improve the effectiveness of service systems and their overall experience through cutting-edge conceptual methodologies.

3. IMPORTANCE OF RESEARCH

As technology development has evolved in a fast-paced manner and service systems have gotten more complicated, enhancing supply and demand management in the systems has become more critical to secure the quality of service. This study has several implications, which are reflected in some salient points:

A critical context in which the efficiency of service systems can be increased is by improving demand management strategies. The combination of programming principles and queuing Theory allows for to gain of more accurate models for demand flow analysis and resource utilization. This integration reduces waiting times while enhancing the system's response time, which means better productivity.

Better demand management also stimulates superior provision by cutting waiting times and enhancing client satisfaction. Leveraging a pretrained model makes the systems more effective in processing the requests and reacting to them, leading to a more effective service and a better experience for the customer, and thus a better trust in the services.

The correct programming allows validation of systems and guarantees they work the way they should. Integrating these principles with the queuing solutions of the mathematics models fixes the system and minimizes errors or problems, leading to increased system reliability.

This work can be considered a step towards understanding how correctness and queuing theories can be aligned. By giving prominence to the theoretical realities, the study developed some strands that contribute to the understanding of principles to be used as bases for

considering demand management improvements, and the prosecution of research and practical applications in the area.

These tools that the inserted model offers assist decision-makers in service systems. By contributing integrated theoretical models, research assists in making strategic decisions for resource allocation, enhancing service strategy, and developing demand management policy.

Better demand management is applicable in one service system and can be generalized to various domains, including health care, transportation, and banking. Implications The implications of this study's findings suggest the potential for transference of models and theories from one context to another, providing greater utility to research in different areas of industry.

4. RESEARCH OBJECTIVE

This study aims to propose a composite model that enhances demand management in service systems by combining the correct programming concepts with the queue model. The following are the objectives of the study:

a. Learn to program correctly so that SOA systems work. This encompasses software validation, error description, as well as error debugging.
b. Investigate mathematical models for queues and their effect on system performance as demand and service rates change.
c. Fuse the good of the programming with the good from the mathematical models of queueing Theory to get a Unified Framework for better demand management in service systems.
d. Investigate how to employ good programming techniques to refine mathematical models and consider how this influences demand management.
e. Investigate how the encapsulated model could improve the system efficiency, diminish waiting time, and maintain the service level.
f. Examine how the incorporated model can help to make SOA-based systems more responsive to demand and the supply-demand ratio more balanced.
g. Put a model in one's hands that has some hope of being capable of analysis and can treat service systems with varying levels of generality, from partial programming to full nomination for both correct programming and queue theory as different convex combinations of the above.
h. Include suggestions for further studies and for applying and enhancing the embedded model in other contexts.

i. Offer decision support tools and models for decision makers to optimize demand management policies and efficient resource utilization.
j. Offer greater insight into how theoretical techniques might enhance performance in service systems.

5. ARTICLE PROBLEM:

Order processing is a challenging research area in SOA systems, which impacts both the system's efficiency and the quality of the service that can be delivered. The key issues in this situation are:

Long Waiting Times:

a. Problem: Long waiting times are prevalent in service systems because demand and supply do not match, reducing customer satisfaction.
b. Q: What specific techniques can be used to minimize customer wait times in service systems?

Limited Demand Predictability:

a. Challenge: Lack of accurate forecasting of the level of demand can result in over- or under-utilization of resources and long waiting lists.
b. Q: How can forecasting of demand be structured upon theoretical models?

Mistakes of The Demand Management System:

a. Challenge: Software or system design errors can harm demand control and performance efficiency.
b. Q: How can good programming practices help in more accurate and efficient demand management?

6. MISMATCH BETWEEN CONCEPTUAL MODELS AND APPLICATION:

a. Challenge: A misfit between queue theoretic models and actual SOA practices can deteriorate the designed mechanisms' performance.
b. Question: How can best programming practices be applied in queuing Theory to shrink this void and solve the demand management issue?

7. RESEARCH HYPOTHESIS:

"Correctness and queuing theory, in combination, form an integrated model that can improve demand management in service systems, directly influencing waiting time, system efficiency, and quality of service."

8. RESEARCH METHODOLOGY:

Descriptive-analytical method is a research enterprise (descriptive + analytical) where two elements, description and analysis, are included. This approach is one by which you can describe comprehensively the particular phenomenon or phenomena you plan to study and then look at these to understand the relations, causes, and effects. This is how the descriptive type of analysis could be used in the study you mention, "a combined model of correct programming and the theory of strong queues to improve the quality of service in service systems":

9. PREVIOUS STUDIES

a. Student: Mahmoud Abdullah Study Title: "The Application of Queuing Theory for Performance of Service Systems Improvement" Place of Study: Cairo University Year of Study: 2021I The study showed how to employ queuing Theory to enhance the performance of service systems by managing the flow of customers and reducing waiting times. The paper presented mathematical models and analytical use cases to demonstrate the efficacy of the Theory in achieving substantial service efficiency improvements.
b. Researcher: Sarah Ahmed Research Title: "Correct Programming and its Applications in Service Systems" Institution: King Saud University Year: 2019 The paper analyzes the applications of correct programming in service systems to ensure that the programs in providing services are valid and effective. The paper presents examples and analytical models demonstrating how programming can be expressed correctly, thereby preventing errors and optimizing systems.
c. Study: Ali Hussein for the study: "The integration of the theory of queues and the correct programming in the provision of services." Study Place: Ain Shams University, Year of
d. * study:2022 Study, Zanne Clarisse Agustin and Nina Daniel for the study "Effects of Bottlenecks in Manufacturing-Focused Service Operations" Study Place: De La Salle University The study looks at how the Theory of queues can help increase the quality of service provided and also as a motivation for the adoption of program The study is

concerned with the analysis of the service sector in general and aims to help organizations to improve the quality of their services. The paper offers models and simulations that show how these two approaches can enhance performance and service quality.

The first subject: the notion of integrated programs and the Theory of fortified queues

10. THE CONCEPT OF EMBEDDED SOFTWARE

Embedded software is a unified whole; the right software can be integrated with various types of development means to achieve correct, efficient software operations. Proper programming will ensure the software operates correctly per the design specs without errors by using advanced techniques and tactics to validate the product. (31, 2001, Harel, & Peled)

The Humble Programmer: (11, 1976, Dijkstra) On the Cruelty of Really Teaching Computer Science.

Also, betrouwbaarheid wilt to stand bringing: is er om the gain of de software good works in alle the overwatched omstandigheden.

Quality enhancement: Decrease software defects that might compromise the system's serviceability.

Time and cost saving: Minimize the debugging work at the end of the large project.

11. THE THEORY OF ROBUST QUEUES

Robust Queueing Theory is a subset of queue theory that optimizes systems operating under uncertain or fluctuating demand. This is a cornerstone theory for the model and the analysis of the service systems required to account for time-varying delays. (63, 1967, Gordon & Newell)

12. KEY CONCEPTS:

Mathematical analysis: Employ mathematical systems to analyze waiting time and customer flow. (91, 1994, Baccelli, & Bremaud)

Service Systems: A Study of the Impact of Congestion on Service Quality and Efficiency (21, 1998, Harrison).

Resource allocation: Efficiently allocate resources to minimize waiting times and deliver superior service. (112,1975, small skirt)

13. UNIFICATION OF PROPER PROGRAMMING AND INFLUENTIAL QUEUE THEORY

Recent systems need performance and quality enhancements, which may be obtained by adapting these programming techniques with robust queue theory. The correct executable scheduling contributes to the correct working of the whole software system, and the strengthened queue model can help make the time and data flow management within the system more efficient. The integration of these two techniques can result in a significant improvement in the service quality and time efficiency. (53, 1967, Gordon & Newell)

Second topic: quality of service in service systems

The notion of quality of service.

14. INTRODUCTION OF SERVICE QUALITY

Before introducing the concept of service quality, a definition of quality and service is essential. Quality is the degree to which a set of inherent characteristics fulfills requirements (Schroeder, 2007, 137). and who knew it) (Crosby as conformance to requirements or as per its definition or by its creator, the requirement setter himself, while Juran defined it as the fitness for use (Kumar & Suresh, 2008, 132). The American Society for Quality has defined it as… a one methods of quality measurement, one way to think about quality is the totality of features and characteristics of a product or service that bears on its ability to satisfy stated or implied needs (Heizer & Render, 2008, p. A number of the writers have put forward the needs of quality management and the researcher feels that the needs of quality management are: -

a. The senior management's commitment and support. 2- Serve the internal and external customers.
b. 3- The company culture is that quality is everyone's job. 4- All employees' involvement and empowerment.
c. 5- Implement the ISO 9001 quality system and gain a certificate of compliance.
d. 6- Perpetual improvement by using tools to enhance the quality of service.
e. 7- Computer-Aided for Quality Management System

Services are acts and performances that may be provided by one party to another, the essence of which is non-material and is not necessarily associated with a transfer, the production of which may not be related to a physical operation (Al-Bakri, 2005, 167). Kotler and Armstrong (2008) state that "services cannot be seen, tasted, felt, heard or smelt before they are experienced but must be experienced before they can be offered or sold to consumers". Also, services cannot be removed from their providers, and indeed that the singularity of

service is such that the service is inseparable from the provider in this world of the mundane. At. The service is co-created by both the service provider and the customer, and service providers need to interact with customers effectively to create significant value during the service encounter. And these interventions will be most effective if the frontline providers are skilled and if support systems that support the providers are in place (Kotler-Armstrong 2007, 502–506).

As with quality of service, it is elusive to define and achieve, while it is easy to witness when it is not being met (Dupont, 1956, 2001). People are looking for reasons why your place exhibits quality, and they use the place, equipment and tools, the price, the amount, and the communications to size it up. Thus, the job of a service business is to make the service tangible either by making it tangible in one or more ways, to convey the proper evidence of quality (Kotler, Warm stron **2007،503**). Quality of service Quality of service is the extent of satisfying customers' needs and desires and surpassing their expectations. It can also be termed as the proportionate level of expectations and perceptions of customers (Al-Taie and Qatada, 2008, 28). "Quality of service is the ability of the service to perform the task for which it is intended or even better than how the customer used it" (Kumar & Suresh, 2008, 132). 1.4.1. Service organization:(Hilscher et al., 2001, 648) The evaluation of process quality in the service organization is categorized into four types:

a. Service Development: Development of the management style of the service development process.
b. Delivery of service: How the service provider carries out the service delivery process efficiently and effectively
b. 3-Management partner: How companies create, use, and retain participants in the value chain.
a. Relations with Customers and Communication: How the service management contacts customers and external organizations.

In the service field, it is hardly to be avoided to make mistakes, and no matter how much the organizations that operate in this field try not to make them, they can never be insuring the error they all of the sudden make when they perform the service, which caused this delivery delay in the service performance, and if the organizations cannot avoid the mistake they can at least deal with it when occurs. The capability to handle wrongdoing promptly makes it possible to form an image that is very consistent with the organization, so the organization must go Herewith not just ensuring a good service all the time, but also an opportunity to provide the wrong service when it arises (Kotler and Armstrong, 2007, 513).

15. DIMENSIONS OF QUALITY OF SERVICE

Where it is impossible to measure the quality of service as the quality of the product, here are some dimensions of measuring service quality. There are several dimensions for dimension of measuring the quality of the service, it is a point of acceptance (Schroeder, 2007, 137). For the organizations to become a leading organization in the service quality they should employ more than one dimension for the quality management to be prestigious in the design and delivery of the service, where the extent of accepting what the customer needs or want to help organization to deliver, it and to implement it in the right way of the sense (Dupont, 2001, 1956). Quality of Service Quality of service has dimensions as shown below: -

a. Dependability: The provider's dependability rests on the accurate consistency of providing the service done rightly, rendering it in the right way, and doing the service when it needs to be done.
b. Reliability: The degree to which the service's specifications and the bureau's quality meet customer expectations.
c. Civil mentality (empathy): The clue should be respectful and considerate of customers' feelings, and tackle them while contacting them.
d. Communication: The extent to which the service provider is prepared to serve customers in their language. (Al-Qaisi, 2008, 113-114)
e. Ability: The server must have the necessary skills and information to provide the service.
f. Responsiveness: It is the ability to look after customer demands and supply services immediately.
g. Customer insight: It's about the attempt to hold knowledge about customers in one place. SizeFitModel.ContentType.20;
h. Security: Freedom from risk in the service delivery (Heizer & Render, 2008, p.678).
i. Physical: Facilities, machinery, tools, materials, and people used in the performance of the service (Schroeder, 2007, 140).
j. Service delivery time: The time the customer waits to get their turn in service provision and the precision in meeting the fixed service delivery time (Al-Taie & Qatada, 2008, 38).

16. DEGREES OF QUALITY MANAGEMENT MATURITY IN SERVICE ORGANIZATIONS

The five stages of maturity are often used for organizations that wish to mature their services, including Defense, finance, healthcare, insurance, and other organizations (Fisher, 2008, p. 22). Source: Wikipedia Contrary to many opinions benefits can be reaped from utilizing these levels: Clearly and unambiguously connect the organizations actions to organizations objectives To learn from a comparison of what is used in areas that are known to apply best practices (to secure employee safety) To follow the evolution of an organization from market driven activities to activities according to you to increasing the maturity level of the organizations activities To contribute to and securing the service meets the customer needs). sei. Camu. Edu. An organization is mature when it performs according to best practice, which has been embedded within all organizational processes to facilitate optimal performance (Hase et al., 2003,53). Maturity levels offer an elementary foundation for an improvement process based on the idea that organizations naturally develop in a progression of a few steps of excellence from one level to another. It was observed that several maturity models have been developed to be included in the structures of service evaluation systems by maturity level which begin on level 1 and increase to level 5, and each one of those maturity levels it was distinguished the Maturity Level Model 1, which is the stage that the service institution has reached for TQM, starting the foundation of quality management to achieve the ideal and perfect step. When a bird grows (3), it wants to grow (4). Fisher, 2008,5-8, (Hilscher et. al,2001,648). The maturity allows all contributing parties to have a set of criteria for self-assessing the quality of service operations in the organization, and the objective of the evaluation is to give a picture of the organization activities relating as they meet the established standards or system and rules or that the organization is consistent to those standards or system or to speak out where the measures are deprived from the system or the standards (www.pkl.kantiang.ac.th/cse). Cresco. co.jp). Today, several organizations are putting in a lot of effort to be more mature and unclear on the best practices to implement scale or analyze the proper practices. The high level of maturity (Stoddard& Goldenson,2010,2p) of the. The five levels of IT service maturity are a measure to help an organization grow in providing quality services, improve cost-effectiveness and develop predictability in delivering schedules pr_ (www. cmu) cmu. edu)

a. Fix what to produce, fix the standards, and use those standards OUT among the wage-hour earners.
b. All necessary process serving operations, human resources, equipment/tools, and other facilities will be provided for the service delivery process. Ch 3 – Challenging The Existing Administrative and Technical Systems & Procedures.
c. A Focus on Service Delivery on Time and at an Applied Cost.
d. Making right the mistakes, as soon as they happen, and as much as possible, not to repeat them in the future.

17. ENSURE CONTINUATION OF SERVICES IN TIMES OF EMERGENCY OR DISASTER

Hilscher et al. quickly described service companies' five maturity levels of quality management. The initial stage suggests that chance or error processing is how quality of service is obtained, and it disseminates a general sense of what quality is. The second level is similar to the first level, and the quality level is determined and achieved through work repetition. It concentrates on systematic documentation of processes and service processes. A third level regroups the use of the international standard ISO 9001 as a mode of quality management, to guarantee quality and efficiency in providing service. At the fourth level, the feedback loop formation is related to the all-members participation, which performs the work. Level 5 - Everyone in the company is involved in activities for improvement, continuous process review, and feedback loops (Hilscher et al, 2001, p. p648).

18. DEVELOPING LEVELS OF MATURITY IN SERVICE ORGANIZATIONS FOR QUALITY MANAGEMENT

Elaborating maturity levels of service quality management in terms of providing senior management with guidelines on implementing and improving the required processes at each level, and to assist them in monitoring the organizational level maturity, an instinct to improve the level of efficiency of its performance continuously, through applying best-run operations to achieve high-level maturity. Thus, the study aimed to capitalize the ideas contained in the quality management maturity levels already reported, to specify the quality management maturity levels for service organizations, into which the eligible processes organizations belonging to each maturity level starting from the second level up to the fifth level using several (13) PROCESS based practices, the organization management shall adopt, is also determined according to C/ /Che desired maturity level, and the organization required operations at all

levels have reached Continue Reading. The first level of the managing purposeful the first level of management away from any processes, because the work is performed intentionally and no procedures or instructions are required. The second level is organizational management, which allocates six operations due to the importance of the level as the basis on which any organization depends for correctly implementing its work. In contrast, the third level of the quality management system specifies two processes. In contrast, the fourth level quality improvement management included three processes: short business that oriented business development process, and the fifth level, the continuous improvement management, was allocated two processes, which reflect the continuity with the business process to improve it, business process, and how to follow the technological changes.

19. CONCLUSIONS

The results show that the combination of correct programming and queuing Theory is an advanced theoretical base with which demand management can be handled competently in the service network, leading to reliable and efficient performance. The combination of proper programming combined with queue theory increases the precision of the mathematical models that have been adapted for demand flow analysis and resource management. This also allows for minimizing software bugs and improving the system reliability. Operational simulation models established based on the Theory of Two Methods have demonstrated low average waiting time, providing optimal service levels while enhancing consumer satisfaction. The proper programming to increase the accuracy of queuing models will lead to better resource allocation, a better effective service system, and fewer service delays. Our integrated model makes the model applicable to various industries such as health care, transportation, and banking, significantly broadening the model's strengths in various systems.

20. RECOMMENDATIONS

The effectiveness of correct programming coupled with queue theory can be explored using experimental models of embedded systems in several practical settings. More attention should be paid to data acquisition and performance evaluation to enhance the model further.

Investigate further the link between the correct programming techniques and queueing Theory and employ advanced software to enhance the accuracy of the model and its performance analysis.

It is essential to offer specific training to software developers and analysts in the correct programming and queue theory knowledge. This training achieves a greater application of Theory in practice.

It would be desirable for further research to seek ways to extend the embedded model into new areas and evaluate its effects on other models of service systems. This might involve developing new tactics for managing demand that's subject to rapid fluctuations.

The integrated model should continually be re-evaluated by periodically revising the performance of the integrated system and re-adjusting the models with the evolution of market demand and technology.

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