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Priority-Based Scheduling Algorithm for Help Desk Support System

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Abstract*:* This research aims to develop a Help Desk Support System using a Priority-Based Scheduling Algorithm to automate the technical support process by creating a ticket automation, request queuing that handles technical problems and inquiries. A knowledge-based system was designed to provide information for common help desk issues. It presents an innovative method of serving ticket requests using the Priority-Based Scheduling Algorithm to ensure fair and balance processing. An object-oriented systems development model was used in the software development which follows several phases. These are the data gathering requirements, problem analysis, systems design, and implementation. To determine the quality and performance of the system, it was evaluated by the Domain and IT Expert based on ISO 25010 Criteria for software development. The results revealed that both the Domain and IT Experts rated Functional Suitability, Performance Efficiency, Usability, Reliability, Security, Maintainability, and Portability as excellent while Compatibility was rated very good. The overall result of the evaluation is excellent which implies that the system meets the standard criteria in the system's development and the implementation of the system is recommended.

Keywords: *Priority, Scheduling, ISO 25010, Help desk, OOSD, Turnaround Time, FCFS.*

1. Introduction

Support for end users of information technology (IT) has become one of the top priorities for enterprises. It has become difficult for firms to provide effective and efficient help desk services due to the constant adaptation and upgrading of new technology. Organizations are actively looking for innovative approaches to provide better help desk services that can meet the rising needs and expectations of their customers in the current trend [1].

A help desk is a tool designed to provide customers and other end users information and assistance on the goods and services offered by a business or institution. A help desk's primary function is to solve issues or provide advice about things including computers, electrical devices, food, clothing, and software. Typically, businesses provide their clients help desk assistance through a variety of channels, including toll-free phones, websites, instant messaging, or email. Additionally, there are internal help desks that are there to support staff members. [2].

Help Desk Support, which organizes and automates procedures for IT problems and incidents to enable IT Personnel and the Department to operate more quickly and effectively, serves as a single point of contact or location between end users and the technical support staff. Using specialized software, a help desk system monitors and records inquiries, grievances, and concerns determined by the MIS department and offers technical assistance for end users [3].

Nowadays, practically all institutions or agencies of the government as well as other private businesses have their own MIS divisions. Concerns and solutions for IT-related problems are handled by the technical support team [4]. The Aklan State University (ASU), which offers a variety of tertiary-level programs, is one of the government's institutions. The institution has five campuses, and each one includes a unit or department with MIS tools to help staff members properly carry out their jobs and obligations. The MIS/IT Support staff provides support for application deployment and its use, tracks ICT problems, and recommends enhancements. They assist users in the resolution of ICT issues to ensure that workstations and other peripherals are operational and that downtimes, if necessary, are kept to a minimum.

Based on the information gathered from the interviews with MIS/IT Support Personnel conducted as part of this study, it can be concluded that employees frequently report problems with their printers (paper jams, inability to print, cartridge replacement), computers that are running slowly or hang up, their inability to turn on their computers, and application or system errors (forgotten passwords, runtime errors, invalid username/password). In the present structure, these issues are often reported at the same time on the same day through phone calls, emails, and walk-ins.

In order to minimize downtime at work, these concerns need to be prioritized, given a sense of urgency, or demand an instant reaction. Communication must also be streamlined, urgent needs must be met quickly, and MIS/IT support capabilities must be fully used [5].

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The researcher is driven to create a helpdesk support system that monitors workers' service requests, addresses problems, keeps track of employees' assets, and manages the list of reports the institution needs in order to enhance the technical assistance provided to employees. The technology may increase the functionality of managing the help desk system by facilitating communication between workers and the office. It will enhance the level of help and support offered to workers and enable MIS technical support staff to free up valuable time and resources used to address employees' complaints and requests, reducing the overall time needed to solve an issue.

2. Objectives and Conceptual Framework

OBJECTIVES:

a. create a ticket automation and queuing for requests, problems and inquiries;

b. create a scheduling scheme of help desk tickets based on priority;

c. design a knowledge-based system for common help desk issues;

e. generate and manage report; and

f. evaluate the system using the International Standardization Organization (ISO) 25010 criteria for software development.

CONCEPTUAL FRAMEWORK:

The conceptual framework of the study is illustrated in Figure 1 showing the input, process and output.

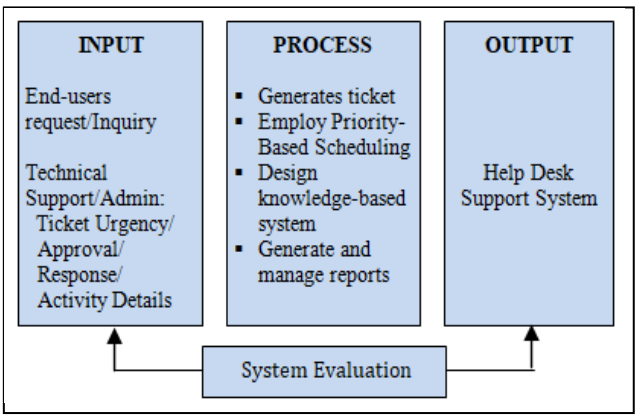


Fig. 1. The Conceptual Framework of the Study

The end users will provide the input data, which includes personnel information and requests and queries. These records include the date of the request, a description of the issue or request, the name of the product, and the office assignment. They also include information on complaints, enquiries, and service requests.

Another category of users is Technical help Personnel, which includes IT Staff and Administrators and functions as the IT Support Officer and has complete authority over how to utilize the system while offering technical help to end-users. The input data includes the ticket's urgency (low, medium, and high), approval of the ticket, and activity information, which correspond to the steps done to handle the end users' issues or questions

The procedure includes creating automated tickets and a queue for requests originating from various requests. The assignment of ticket status and request schedule are managed using a priority-based scheduling approach. All the processing techniques and steps for addressing the problems were intended to be stored in a knowledge-based system. The creation and administration of reports for documentation needs is the last step. The output of the system is a help desk support which is to be evaluated using the ISO 25010 criteria for feed backing mechanism.

3. Review of Related Literature

A help desk, according to Moussas [6], is a multifaceted resource used to assist in minimizing downtime for IT services and operations and maximizing their availability. Because of its particular attention to end-user functionality, it is in charge of promptly resolving end-users' urgent requests, incidents, and technical problems.

Paul et al., [7], a service-level agreement (SLA) outlines the amount of service you should anticipate from a vendor, the metrics used to assess service, and any penalties that may be imposed if the agreed-upon service levels are not fulfilled. Any deal with a technology provider must include it.

One of the crucial help desk operations is IT incident management, which is resolving IT service outages and restoring services within established Service Level Agreements (SLAs) [8].

The service desk creates a ticket once it recognizes the situation as an incident. The incident report, the user's name and contact information, the date and time of the occurrence, and other details should all be included in the ticket. Categorization, ordering, and the actions the service desk takes may all be included in the logging process. The process of categorization entails giving the occurrence at least one subcategory and a category [9].

The most typical prioritizing strategy used in ITSM, according to J. Mathenge [10], combines recognizing impact and urgency. Influence is described in ITILv3 as a measurement of how an event, issue, or change has an influence on business operations. Typically, the influence would be described in terms of a range or degree rather than in absolute terms.

Some incident management software automatically determine the urgency of a situation based on factors like

the impact, the (Service Level Agreement) SLA and (Operational Level Agreement) OLA involved, among others. The basic matrix, which will automatically determine incident priority out of the simple value of Impact x Urgency [11], is recommended by the majority of consultants.

When it comes time for the Help Desk Support to construct an Event Priority, the criteria that must be taken into account and the context of the company or institution determine each Priority's description [12].

The management of IT infrastructure, such as computers, monitors, keyboards, and even software installers, is a component of IT asset management. IT asset management comprises a thorough study of all the assets of the company or institution in addition to monitoring and setting all IT equipment inside a single information system [13].

An asset's life cycle has numerous phases, including requisition, procurement, deployment, maintenance, and retirement. The moment an asset is acquired and delivered, the life cycle truly begins. Similar to this, life cycle management carries on when an item is no longer useful and includes retirement and disposal tasks. When historical asset data must be kept for a certain amount of time to satisfy legal and financial obligations, management of the life cycle may continue for an additional unspecified amount of time [14].

An efficient IT asset management program requires assistance from four key components, including an IT asset management source, information on the inventory and utilization of hardware and software, and integration with IT and business systems. The best way to evaluate an IT asset is via hands-on experience with a fully working trial or assessment setup. This offers a chance to fully investigate mixing with already-existing systems and settings and test software in-depth using actual data [15].

In the research by Bridge and Dearden [16], the key to improving the amount of client issues the Help Desk Officer can resolve without involving other employees is to provide expertise to the Help Desk Officers. If the consumer is given more information, the employees, whether a Help Desk Officer or Experts, may all be concerned less. The Help Desk Officer may get some of this information in "traditional" means like training and manuals.

Each process has a priority assigned to it, and the scheduler places the processes in the ready queue in priority order. According to Rajput and Gupta [17], higher-priority operations may halt lower-priority ones. When a process with a higher priority enters the system, a variant of this order permits the current process to be preempted. Response and waiting times are influenced by the process's priority. Lower waiting and response times are associated with higher priority procedures.

ISO 25010 Criteria

The degree to which a system fulfills the stated and implicit demands of its many stakeholders, and hence produces value, is defined as its quality. The demands of those stakeholders (functionality, performance, security, and maintainability, for example) are exactly what are reflected in the quality model, which categorizes product quality into characteristics and sub-characteristics.

4. Methodology

The structure and environment used in an organization to plan, create, and manage the process of building information systems are referred to as the system development methodology.

According to Stair and Reynolds [18], Object-Oriented Systems Development (OOSD) is a technique that blends the object-oriented modeling and programming approach with the logic of the systems development life cycle. Similar to the SDLC, OOSD follows a thorough systems development life cycle. The steps of the life cycle are often repeated until they are finished. The three stages of the OOSD software development process are analysis, design, and implementation. You may think of system development as a process. A description of the work to be done, a definition of the input necessary for the process, and a description of the product to be generated may all be broken down into smaller, interdependent stages called sub processes. The process of developing software may also be seen as a series of adjustments made to encourage the production of high-quality software [19].

Figure 2 shows the phases in Object-Oriented Systems Development Life Cycle which has three sequences of transformations.

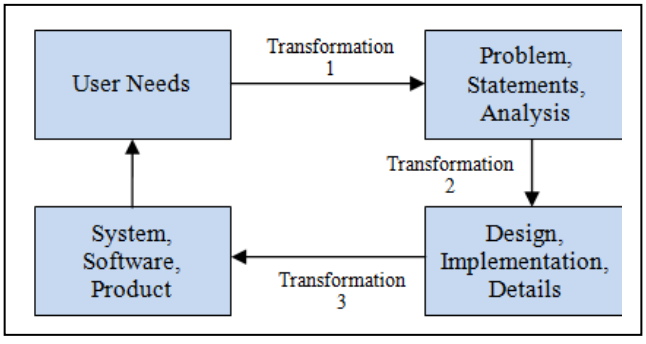


Fig. 2. Object-Oriented Systems Development Life Cycle [20]

Analysis. This stage calls for the system's beneficial behavior to be independent of deployment specifics.

This step of the research involves identifying the characteristics, establishing the objectives, and defining the

scope that must be adhered to while creating the system. Through monthly help desk and IT inventory reports, activities include conceiving and recognizing existing help desk concerns as well as identifying system input.

Transformation 1. It converts user needs into system obligations and requirements. The system may get understanding of the user's needs in this way.

The usage and administration of IT assets are covered in this research by actions such collecting historical ASU published rules, issued memoranda, and department directives, as well as key information via interviews with workers and Technical Support Personnel.

Design. The environment is taken into account when this phase analysis model is improved. Find and declare any extra objects and classes needed to enable the implementation of the requirements at this phase.

The department's needs, such as who will use the system and how they will use it, are being identified in this phase. workers and IT Technical Support Personnel were identified as the users of the system, and it was determined how workers make requests and face various difficulties with the present system and how IT Technical Support Personnel resolves these issues. To access the system, both users must register or enroll.

Transformation 2. The issue statement is at the start, and the design is at the end. It is capable of becoming a functioning system. It encompasses the majority of the software development activities in this transition. This implies that it also contains details of the software's creation, testing, and design. contains both the software and the exam preparation materials.

The work sheet that employees now utilize for all IT-related problems serves as the anchor for the system's screen layout throughout this phase. The help desk support process and transaction flow are examined and built to suit user demands, including how to allocate help desk tickets and assign priority using a priority matrix and developing sets of rules and criteria. Offsite and onsite user resolution are taken into consideration when handling help desk problems.

Implementation Phase. A programming language or database management system is used to put the design into practice.

Each system feature is written and developed separately during this phase, and its functioning is tested based on the users' intended roles in utilizing the system. The design and construction of several modules, including the asset inventory, knowledge-based solutions, and report production, are based on the users' present process flow. Its user interface, database, and integration of the many module operations are all implemented.

Transformation 3. It improves the deployment of the system using the thorough design. The requirements of the user will be met. It consists of the people, tools, and processes. It symbolizes integrating the software product into its operational setting.

This stage involves reviewing the design and determining if the functionality that has been implemented for the help desk support system, IT inventory, knowledge-based solutions, and report production satisfies user needs. Upon the creation of the programs, each module is additionally checked to look for faults. The system was assessed using the ISO 25010 Software Development Criteria by Domain and IT Experts.

Priority-Based Algorithm

In the utilization of the priority-based algorithm, the process starts with creating a ticket that checks first if the system’s date falls on a holiday or weekend. If it does, then ticket creation is terminated. Otherwise, the ticket is created and follows the approval, and then it is assigned a priority level, namely: critical as the highest and very low as the lowest priority wherein each priority level has an equivalent resolution time to serve the ticket request. Once the priority level is determined, the date and time approved are checked if it is equivalent to the current date and time of the system.

If the approval time is no longer within the office hour, it is then verified if the time is before or after. Thus, if it is checked before the office hour, then the date and time approved must be equivalent to the current date and beginning time of office hours (8:00) in the morning. The resolution time is derived from: Resolution time = *Date and Time Approved + Resolve Minutes (Priority Level).* Thus, the date and time of approval and resolved date and time are processed and updated in the system. Approval time also means response time wherein, resolution time is the same terminology as the burst time.

Then, if the approval time is within the office hour, the system checks if the following day falls on a weekend. If yes, a time extension is applied and approval time is updated using: Next Day = *Current Date + 2days (Saturday & Sunday) and beginning office hour (8:00)* in the morning. Else, the system checks if the following day is a Holiday, following the approval time is equivalent to the previous computation of the Next Day. The approval and resolved date and time are updated.

If the approval time is within office hours, the system verifies if the resolution date and time are less than the end of office hours (5:00) in the afternoon, then automatically the approval and resolution time is updated in the system. Otherwise, the process on the time difference of resolution time from the end of office hours is calculated and added to

the computation of the Next day to get the updated resolution time. The same process follows if it falls on a weekend or holiday.

To execute the queuing process:

Turn Around Time (TAT) = *Resolve Date/Time –*

Current Date/Time

This is to reduce the value of turnaround time while the clock is running. Therefore the queuing process is based on the turnaround time. Wherein, the waiting time is displayed in the system to show the amount of time spent while in the queue using:

Waiting Time = *Current Date/Time + Resolve Date/Time*

System Architecture

The system architecture presents the physical view of the systems and shows the interrelationship among different entities when implemented. Figure 3 illustrates the system architecture.

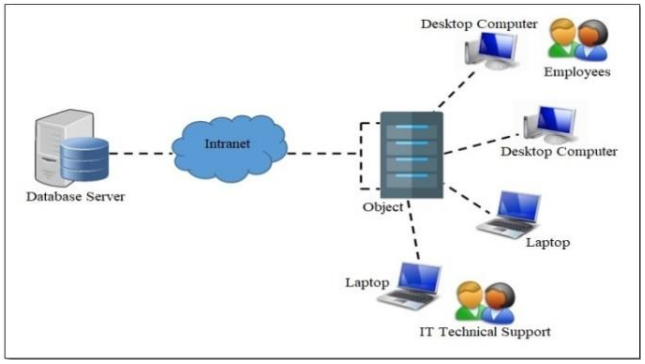


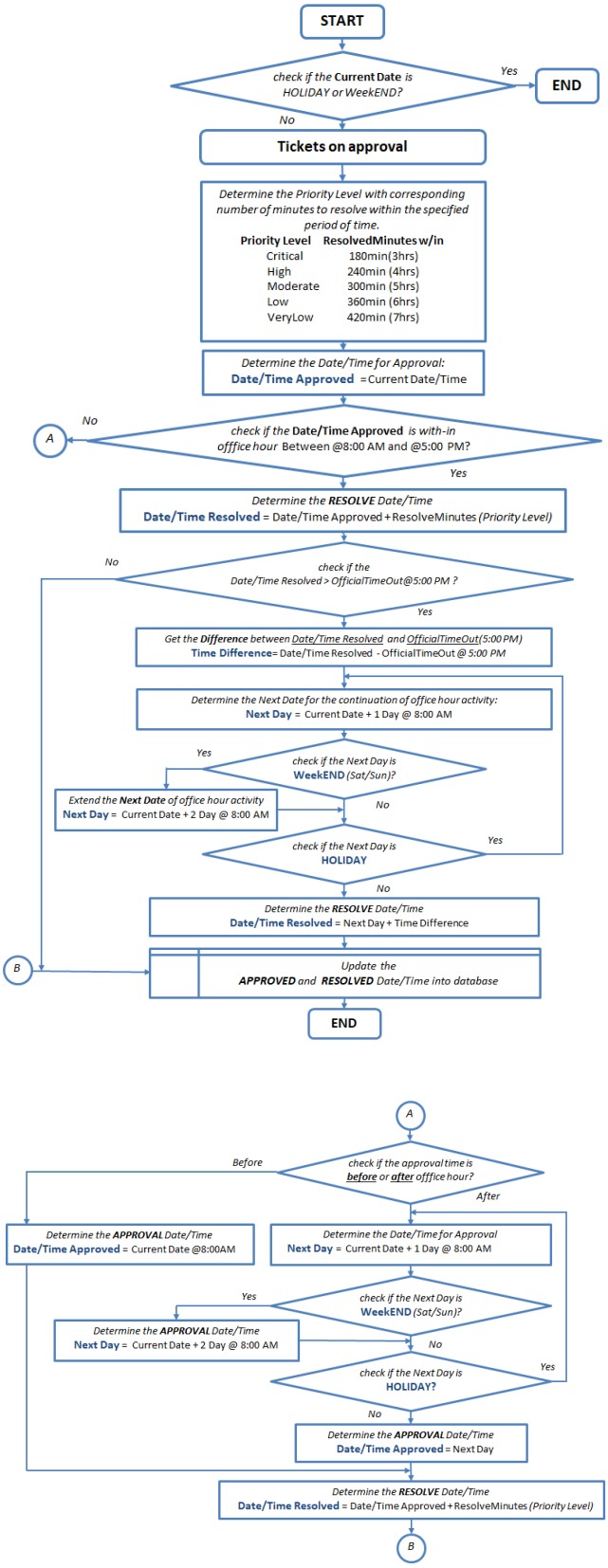
Fig. 3. System Architecture

The figure shows the system architecture wherein it is accessible through a dashboard and works in an intranet technology where all desktops and computers are connected. Employees and IT Technical Support Personnel as the users of the system can view the system as an object. The object is represented as a different component or integrated module that is composed of a help desk support system such as ticket generation for IT-related issues, IT asset inventory management, knowledge-based solutions as a self-help tool, and report management.

All employees and the IT Technical Support Personnel can access the system through their own dashboard through their user's account which has a different content of the system as to the privileges assigned to them. Employees submit IT-related issues and inquiries wherein the IT Technical Support Personnel can receive and view submitted tickets with the corresponding ticket number. Help desk activities together with the records of IT assets and the repository of knowledge-based solutions are stored in the database server.

Design Specification

System Flowchart utilizing the Priority Algorithm



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Waiting Time = *Current Date/Time +*

Resolve Date/Time

Project Evaluation

The system was evaluated by five (5) Domain Experts which are the Unit Heads and five (5) IT Experts using the ISO 25010 criteria for software development. It is a standard criteria composed of functional suitability, maintainability, performance efficiency, compatibility, reliability, usability, security, and portability.

Data Gathering Instrument

A standard ISO 20510 Questionnaire was adopted and prepared by the researcher and distributed to the Users, Domain Experts, and IT Experts for the system's evaluation.

To interpret the scores, the five-point Likert scale was used.

Range	Descriptive Rating
4.21 – 5.00	Excellent
3.41 – 4.20	Very Good
2.61 – 3.40	Good
1.81 – 2.60	Fair
1.0 – 1.80	Poor

Data Analysis Procedure and Statistical Treatment

The Mean and Standard Deviation were used as the statistical formula to determine the result of the Domain and IT Experts' evaluation. The result was tabulated using the Statistical Package for the Social Sciences (SPSS) Software.

5. Results

Evaluation of the Software Quality Standards Based on ISO 25010

The system was evaluated by five (5) IT Experts and five (5) Unit Heads based on the ISO 25010 software quality standards to test the system's conformance to the international standards in terms of its functional suitability, reliability, performance efficiency, usability, security, compatibility, maintainability, and portability.

Summary of Result based on ISO 25010 Criteria

The following result summarizes the IT Expertss, Domain Experts' and Group Mean evaluation of the system based on ISO 25010 criteria.

Table 1. Summary of Results base on ISO 25010-IT Expert

ISO 25010 Criteria	IT Expert	Interpretation
Functional Suitability	4.44	Excellent
Performance Efficiency	4.16	Very Good
Compatibility	4.00	Very Good
Usability	4.30	Excellent

Reliability	4.34	Excellent
Security	4.75	Excellent
Maintainability	4.70	Excellent
Portability	4.50	Excellent
IT Expert Mean	4.39	Excellent

Table 2. Summary of Results base on ISO 25010-Domain Expert

ISO 25010 Criteria	Domain Expert	Interpretation
Functional Suitability	4.66	Excellent
Performance Efficiency	4.62	Excellent
Compatibility	4.20	Very Good
Usability	4.31	Excellent
Reliability	4.31	Excellent
Security	4.60	Excellent
Maintainability	4.74	Excellent
Portability	4.44	Excellent
Domain Expert Mean	**4.48**	**Excellent**

Table 3. Summary of Results base on ISO 25010-IT and Domain Expert Group Mean

ISO 25010 Criteria	Group Mean	Interpretation
Functional Suitability	4.51	Excellent
Performance Efficiency	4.39	Excellent
Compatibility	4.10	Very Good
Usability	4.30	Excellent
Reliability	4.32	Excellent
Security	4.67	Excellent
Maintainability	4.72	Excellent
Portability	4.47	Excellent
Over-all Mean	**4.43**	**Excellent**

The IT experts' overall evaluation of the software quality characteristics of the system based on ISO 25010 criteria was excellent with an overall mean of 4.43 which is interpreted as excellent. The IT Experts' rating on functional suitability is 4.44 which is interpreted as excellent, performance efficiency is 4.16 which is interpreted as very good, compatibility is 4.00 which is interpreted as very good, usability is 4.30 which is interpreted as excellent, reliability is 4.34 which is interpreted as excellent, security is 4.75 which is interpreted; as excellent, maintainability is 4.70 which is interpreted as excellent, and portability is 4.50 which is interpreted as excellent. The IT Experts put emphasis on the system's security and maintainability which got the highest rating and suggested improving the system's performance efficiency and compatibility which got the lowest rating.

The Domain Experts' overall evaluation of the software quality characteristics of the system based on ISO 25010 criteria was also excellent with an overall mean of 4.60. The Domain Experts rating on functional suitability is 4.66, performance efficiency is 4.62, compatibility is 4.20, usability is 4.31, reliability is 4.31, security is 4.60, maintainability is 4.74, and portability is 4.44 all of which is interpreted as excellent. The Domain Experts summary of evaluation also agrees with that of the IT Experts that puts emphasis on the system's security and maintainability which got the highest rating and suggested improving the system's performance efficiency and compatibility which got the lowest rating.

The overall evaluation of the software quality characteristics of the system based on ISO 25010 criteria was excellent with an overall mean of 4.43. Security has the highest rating with a total grand mean of 4.67 which is interpreted as excellent. The result also agrees with literature that claims the importance of security in protecting the data while compatibility got the lowest rating with a total grand mean of 4.10 which is interpreted as very good. The result suggested that the system's compatibility needs to be improved since software and hardware requirements usually change and are updated over time. The system needs to adapt to these changing environments.

6. Summary

This study aimed to develop a Help Desk Support System using a Priority-Based Scheduling Algorithm that monitors and supervises technical issues in a timely manner. The system has the capability to assign priority levels on help desk tickets based on sets of rules and provide time monitoring on each transaction in the queuing process. The system also makes available the knowledge base solutions function that serves as the repository of some frequently asked questions of users which can assist the users in

dealing with hardware-related problems without the intervention of the IT staff. The procurement and inventory which holds the information of all the IT equipment owned and assigned to employees is also kept and managed by the system since it is one of the concerns of the growing number of properties in an institution.

The Object Oriented Systems Development model was used in the development of the system which is useful for systems iterative approach on each phase of software development. The Priority-Based Scheduling Algorithm was employed to manage the ticket request based on the turnaround time.

The system was evaluated by five (5) IT Experts and five (5) Domain Experts based on ISO 25010 criteria in terms of functional sustainability, performance efficiency, compatibility, usability, reliability, security, maintenance, and portability.

The summary of findings revealed that IT and Domain Experts' evaluation of the system's Functional Suitability, Performance Efficiency, Usability, Reliability, Security, Maintainability, and Portability is excellent.

The security has the highest rating which shows that the system has the capability to prevent unauthorized access and modification of the data. While the performance efficiency and compatibility have a very good rating from both the IT and Domain Experts, however, it has the lowest rating since compatibility issues are always prevalent in software updates.

7. Conclusion

Based on the findings of the study, the following conclusions were drawn:

Ticket automation can manage queuing requests for problems and inquiries based on the excellent result of the evaluation in terms of functional suitability and performance efficiency.

The system's scheduling scheme based on priority with every ticket request provides a fair and balance processing based on the excellent result of the evaluation in terms of reliability and performance efficiency.

The system's knowledge-based self-help tool can effectively extend the help desk's hours of availability, allowing employees to get answers to their questions when the help desk is not staffed based on the excellent result of the evaluation of the system's usability and reliability.

The system's automated report generation is efficient and can filter date selection with ease of control based on the excellent result of the evaluation of the system's performance efficiency and maintainability.

The system met the standard criteria for the system's development based on the excellent result of the overall evaluation of the system based on ISO 25010 Criteria.

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