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Research paper



Inventory Control System Using Waterfall Development Model

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Abstract

Information system innovation progress is turning out to be speedier and simpler to use. In many cases, there are an organization that still utilize the customary route in preparing their information. Customary routes will require people to move from one place to another to achieve their goals. In the case of Finance Department, UiTM Kampus Kuala Terengganu, the manual process involving the staffs to fulfill and submit the form and officer will approval and validation. The storekeeper will verify the availability of the item in the store. Using manual processes consumes a lot of time, high risk of human error and involves a lot of papers as well as files. Therefore, Bendahari Inventory Control System (BICS) was proposed to help the Finance Department to be more systematic in handling the inventory control. The implementation of the Waterfall Model in this research was turned to be useful and appropriate to help building up the system.

Keywords: *inventory control; monitoring; waterfall model.*

1. Introduction

Inventory Control System is a key instrument for businesses when tracking their inventory. Typically, an Inventory System is used by a firm that either sells or manufactures a product for purposes of accounting for all the tangible goods that allows the sales of a finished product or parts for making a product. The problem statement for the current flow, which is using the system manually is costly. Secondly, utilizing the manual system is time consuming. Third, staffs will face difficulties in searching for information from the inventory. Failure to manage inventory will adversely affect organizational operations. Operation will be disturbed due to lack of material resources, employee motivation declines as the quality of work produced does not reach a good level, and provides long term impact on service quality.

The objectives of this project are: (i) to identify current processes as well as the problems in managing the inventory at the Finance Department, Universiti Teknologi MARA (Kuala Terengganu), (ii) to design an online system for the Finance Department. To realize this project, the Waterfall model has been chosen as the system development model. This is because the waterfall model between models is easy and easy to use in development [7]. In addition, this model is ideal because it is easy to manage due to the rigidity of the model - each phase has specific deliverables and a review process [1].

The significant of this system will help the Finance Department's staff to record and manage the inventory data. Inventory management systems track goods through the entire supply chain or the portion of it an operations in. That covers everything from procurement, purchasing, storing, and all the movements of stock and parts between. By having this system, the work becomes more effective and efficient. Moreover, this system also diminishes the time of consuming and the cost when recording the information as the utilization of papers and documents can be minimized. In addition, it will help the staffs to view the flow of the inventory.

2. Literature Study

2.1. Management Information System (MIS)

The management information system (MIS) refers to the act of coordinating PC system, software and hardware used to meet an organization's key objectives. The purpose of management information system is to provide the information in the form of pre-specified report and display to support business decision making. The degree about automated the purpose for the software tools and their execution is constantly in light of specific requirement situated [2].

2.2. Inventory Information System

A database used for storing and administering all types of data required for efficient and accurate warehouse inventory management. Study [3] stated this may include modules or fields for keeping track of all items and locations, requisitions, back orders, required levels of inventory on hand, reorder points, lead times, inventory error tracking, and more. This type of system may interface with an ERP and other applications [10].

2.3. Waterfall Model

The waterfall model utilized at the organization goes through the stage requirements engineering, design & implementation, testing, release, and maintenance. Between all stages, the records need to pass a quality check, this methodology is referred to as a phase door model [8]. One important angle mentioned in [4] that is worth specifying is this model is outlined, such that when the former stage is finished; developers cannot proceed to the following

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period of improvement. Progress streams in a descending manner, like the way hurrying water, from tallness, streams downwards; subsequently the name "waterfall" was given onto this programming model [5]. Figure 1 shows the waterfall model.

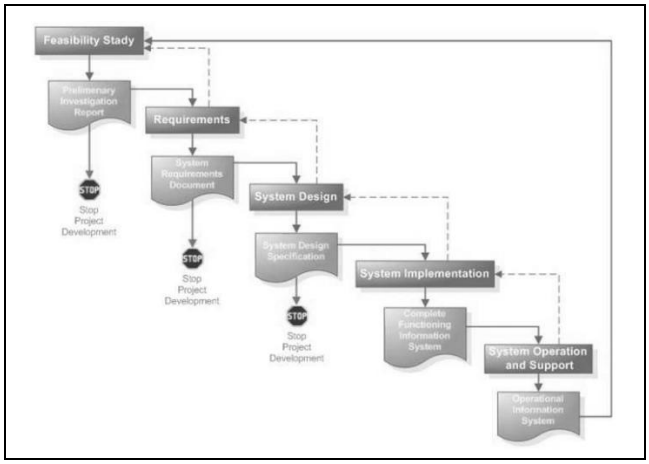


Fig.1: Waterfall Model [5]

2.4. Functional Testing

Functional testing is primarily being used to verify that a piece of software is providing the same output as required by the end-user or business. Typically, functional testing involves evaluating and comparing each software function with the business requirements. The software is tested by providing it with some related input so that the output can be evaluated to see how it conforms, relates or varies compared to its base requirements. Moreover, functional testing also verifies the software for usability, such as by ensuring that the navigational functions are working as required [9].

3. Methodology

Methodology is a set of standards from which specific techniques or procedure that might be utilized to decipher or take care of various issues inside the extent of a specific control. This section will examine in regards with the methodology of a model that is utilized to build up the project. For this project, the Waterfall model is utilized as a part of the advancement of this system. All the stages that have been additionally included in this model are examined more. The examinations made are identified with the procedures building up the BICS. This model is suitable because the project improvement approach that is part of this section is examined concerning the period of the model. The discourse was on how the BICS are produced by stages in the Waterfall Model. Moreover, this part additionally examines more on the strides and procedures of building up the BICS system.

The waterfall model utilized at the organization goes through the stage requirements engineering, design & implementation, testing, release, and maintenance. Between all stages, the records need to pass a quality check, this methodology is referred to as a phase door model [8]. The first phase is a requirement and analysis where the developer will make an interview with the Bendahari's staff that handles the inventory and collects the important details as well as asking the requirements and expectations of this system. The second phase is system design. The System Design phase takes the System Specification and outlines the architecture of the system. This will be done by characterizing a progression of segments with what the developers do and how they connect with different segments.

These parts can be a different system, interfaces, and modules of code, screens, databases and others. Besides, equipment and programming required for each module are recognized and outlined accordingly. Once the design of the system has been approved, the technical implementation will start. The design of the interface was done sufficiently, and the coding part will be implemented correctly and will abide the guidelines and standards to create this BICS. The developers will choose the most suitable programming language that fulfills the requirement of the system. At this point, the code experiences the lot of audits and will be streamlined for best execution before it is finished to be registered with storehouse. The next stage after the Implementation phase is the System Testing. Once completion of the full implementation phase, testing needs to happen before the item can be distributed to clients. The product testing group will utilize the configuration archives, personas and user case situations delivered by the developer with a specific end goal to make their experiments. There will be two tests in this phase, first will be the inside test and the second is the outside test. Upon completion of the System Testing phase, the fifth phase in the Waterfall model is Documentation. In documentation, all the records of the inventory are recorded.

3.1. Design

There are a few stages of outline required in the development procedure of BICS. This stage is available on the diagram basis as it will be clarified later. To get the exact function requirement, the finance officer at the treasurer's office has been interviewed. As a result, some diagrams depicting the user's requirements and system functions have been described. The lists of the diagram are Software Design and Implementation, Context Diagram, Data Flow Diagram level 0 (DFD), Entity Relationship Diagram (ERD). Figure 2 shows the context diagram of the BICS. As it is the Context Diagram, it shows the general overview of the system. The staffs' main task is approving the application and managing the inventory. On the other hand, the administrator is responsible in managing the details of the staffs. The staffs will record the transactions of in stock and out stock of the items that are located inside the store under their own unit.

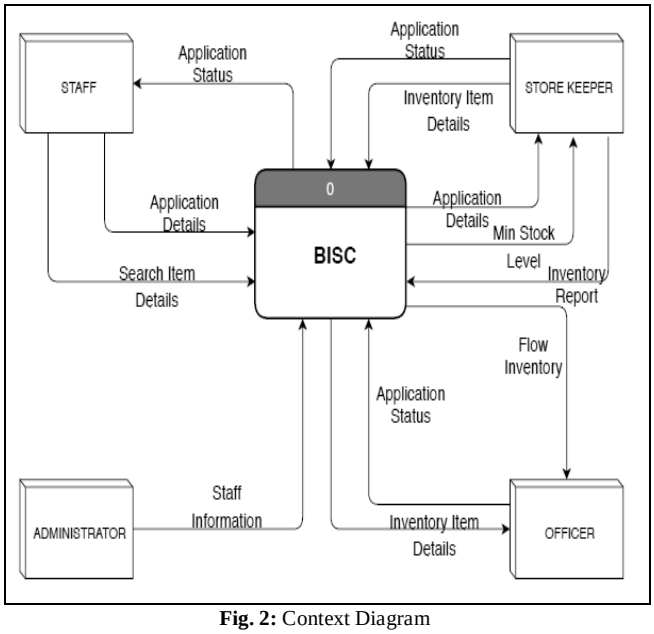


Fig. 2: Context Diagram

Figure 3 shows a data flow diagram level 0 which shows the process flow that is involved in the system. The staffs enter the system to fill the application form after verifying the availability of the item request in the inventory list. The storekeeper will update and manage the inventory details. Besides that, storekeeper also approves the application once the value of the item is occupied and the storekeeper will generate the report monthly and or yearly of the inventory. The administrator will manage and update the staffs' details. All the transactions are stored in the database.

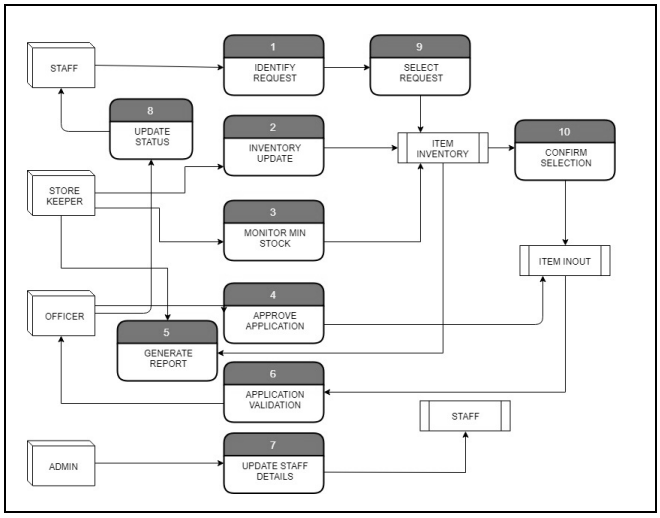


Fig. 3: Data Flow Diagram (DFD) Level 0

Figure 4 shows the Entity Relationship Model (ERD). The ERD of this system shows how the tables in the database relate with each other. In addition, it describes the attributes of every table that will clarify the elements and the relationships among them. The primary key and foreign key are also identified so that it can linked between tables.

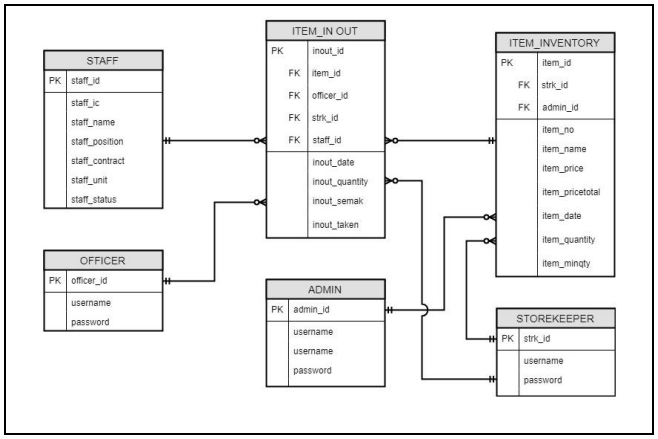


Fig. 4: Entity Relationship Model (ERD)

3.2. System Function & Implementation

Functions provide system information regarding user sessions. A superuser as a System Administrator has unrestricted access to all system information, whereas users can view only information regarding their own, current sessions. There are also the Staffs, Storekeeper and Officer who are the main users for this BICS and the Administrator holds the main role in managing the user details. Staff are system users who will apply for goods. The storekeeper is responsible for keeping the goods in store and pull out the items as directed. Officers are the person who is responsible for approving the application of the goods and monitoring the movements of outgoing inventory.

Staffs can fill in the application form and request the inventory from the financial department store. The staffs will be able to view their application statuses or approval through the system once they submit the application form. Figure 5 shows the application form that will be submitted by the staff.

A storekeeper can verify the availability of an item requested by a staff and when the storekeeper verifies the total amount of each item, they may approve the application that has been submitted by the staff as shown in Figure 6. The storekeeper will also be able to insert and update the item details as shown in Figure 7 and generate yearly and monthly report for the inventory.

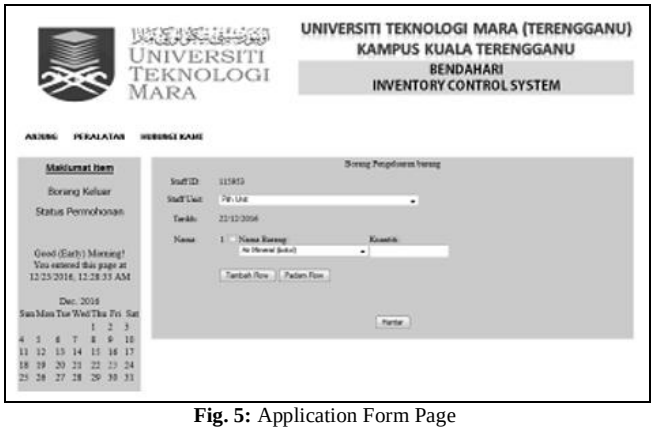


Fig. 5: Application Form Page

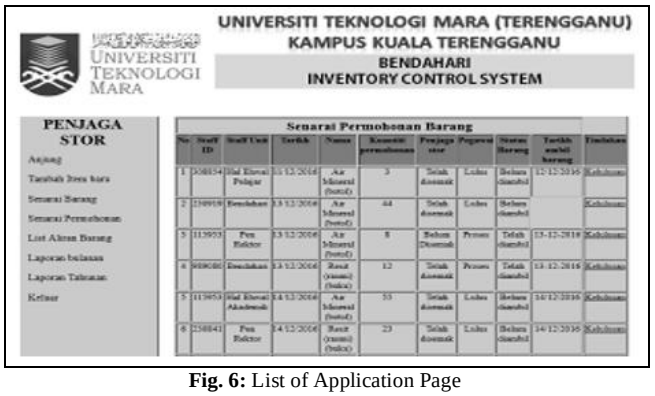


Fig. 6: List of Application Page

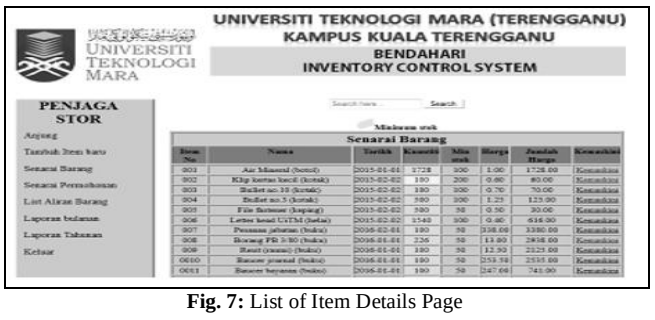


Fig. 7: List of Item Details Page

The officer will be able to access the system for viewing the application that needs the validation from the officer and verifies the flow of the inventory as shown in figure 8. The "Lulus" (Approved) status from the officer will link to the status item request of the staff.

The admin will be able to add new staff and edit staffs' details through the system. The staffs are also able to view all their details.

3.3. System Testing and Evaluation

The evaluation and testing process will be done after the system has been fully developed. Three types of testing include the testing of the functionality of the system, expert testing as well as user testing. The functionality of the system had been tested. Experts are those who have knowledge in the system development either from educational background or industry; they are composed of senior university lecturer, financial officers, and expert systems development. Whereas users of the system are staffs of the Finance Department and the staffs of UiTM Kuala Terengganu.

The purpose of evaluation is to ensure that the system meets the user's requirement, they can know how to use the system and they like it. In this phase, all the system functionalities and usability will be tested and any errors in those system functions will be detected and rectified. The user manual will be provided to navigate users when using the BICS.

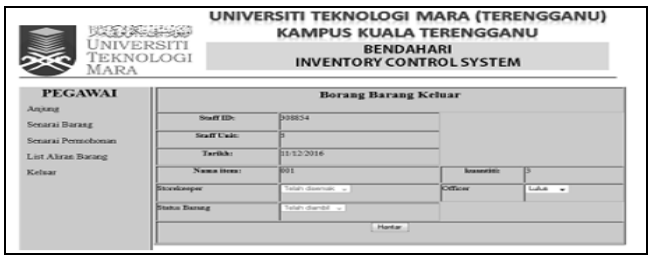


Fig. 8: View Application Page

The development of BICS is tested by the developer and the users during the testing phase. Table 1 shows the testing results for staffs of UiTM Kuala Terengganu including the list of requirements of BICS.

Table 1: Testing Results

No	Behavior of Description	Process	Developer	Tester
1	Enter username and password	START	✓	✓
2	Press Login button		✓	✓
3	Click "Tambah item baru"		✓	✓
4	Fill the form with product details		✓	✓
5	Press "Hantar" button	END	✓	✓

There are two (2) types of users that are involved during system evaluation, which is expert user and user. There are 3 experts referred as references in this evaluation. They have evaluated the BICS and gave their comments, suggestions, and judgment regarding the system. The experts commented that 'the hyperlink size is too small' and suggested to increase the font size for the user interface and they also commented that 'overall usability is ok'. Suggestions include a report for storekeeper view. Moreover, the experts also commented control by "date" for application list form and suggested the list should be in ascending order by date for the inventory control system and made a remark that the BICS is easy to use.

They also commented that the system is effective in terms of stock status view and they suggested to add a dashboard to alert the users on stock statuses especially for the storekeeper. Hence, they are satisfied with the user experience. For user evaluation, 30 questionnaires were distributed among the students of UiTM Kuala Terengganu. They have tested the system in perspectives of all four- staffs, storekeeper, officer and administrator All the respondents have been given the questionnaire form to evaluate the system's convenience and level of fulfillment towards the user interface of the system. The questionnaires consist of 2 parts which is demographic questions and the 6 constructs regarding the system.

User Interface Satisfaction is the second build in a survey that will demonstrate the investigation of user interface. Table 2 shows that the respondents are bound by the user interface satisfaction of BICS. Moreover, the highest mean value is 4.23 with the standard deviation 0.50 for item 6. While the lowest on the item no 3 with the mean 3.87 and standard deviation 0.57. For the median of all questions, are 4. Overall, the respondents are bound by the user interface and meet their satisfaction.

Table 2: Results of Interface Satisfaction

Item	Question	Med	Mode	Mean	Sd
A1	Overall reaction to the system	4	4	3.90	0.48
A2	Screen: Organization of information	4	4	3.90	0.40
A3	Screen: Sequence of the screens	4	4	3.87	0.57
A4	Terminology and system information: position of messages on screen	4	4	3.90	0.55
A5	Learning: Learning to operate the system	4	4	3.93	0.64
A6	System capabilities: System Reliability	4	4	4.23	0.50

The average and mode for the 6 items that represent the user interface satisfaction of the BICS is as shown in Figure 9. The highest average for the user interface satisfaction is item number 6 with the value at 4.23. While the lowest average, for the contract user interface satisfaction is item number 3 with the value at 3.87. Besides that, the mode for every item is at the value of 4.

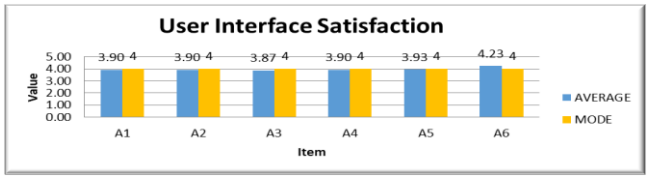


Fig. 9: User Interface Satisfaction

4. Conclusion and Future Work

There are numerous spots that could be taken into the future, so that the system will not fail the most noteworthy of this project and there would be more advancement in a classification system that could supplant the old one. It is hoped that this system will create more future undertaking upgrades with the goal that it will be advantageous to both financial department and staffs of UiTM Kuala Terengganu. Moreover, it is hoped that this project advancement would be an extraordinary work created in helping all strolls of staffs to help us and enhance the overseeing of the application and stock level and reports and staffs to make an application [6].

There are a few recommendations for development change to improve the usability and usefulness of the BCIS in the future. BCIS should be able to transfer the pictures of stock for staff view and "forget the password" option for the users to make sure that the administrator of notice for further actions. There also should be an intuitive chart in creating reports and the user interface should be more users amicable as can be performed in different stage such portable device.

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