IMPROVEMENT OF ASSET MANAGEMENT BY E-INVENTORY ASSET MANAGEMENT SYSTEM

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Abstract

Searching and recording assets in a laboratory is a critical task. This would occur because data storage would interfere with the search process causing the searching to be slower, without record of stock issuance, loss of badger and involuntary cutting off the supply of assets. Consequently, the E-Inventory Asset Management System was built to manage data storage, updating and facilitating the search for assets. This study was carried out at the workshop at the Department of Electrical Engineering, Politeknik Sultan Azlan Shah in 2011. E-Inventory Asset Management System was built by combining electronic hardware, computer equipment and also Visual Basic 6.0 software. This system can also be applied with the Bar Code Reader. Research on the effectiveness of E-Inventory Asset Management System was implemented and the data analyzed by comparing the time consumption between application of manual system and E-Inventory Asset Management System. The results shown that E-inventory Asset Management System facilitated and accelerated the management searching time on disposable item assets at the Installation and Wiring Workshop, Electrical Engineering Department, Polytechnic Sultan Azlan Shah. In addition, the safety factor on the recording of the loan, and the need to make the order before running out of stock can also be controlled by using E-Inventory Asset Management System. From this study, it can be concluded that the computerization of asset management systems could facilitate searching in terms of asset management, data storage, security and the re-ordering of the stock.

Keywords *Asset Manangement System, E-inventory, polytechnic*

INTRODUCTION

Asset inventories provide assets for an organization and usually the number of assets is constantly increasing from time to time. Therefore, a systematic system is needed to facilitate the storage, preparation and accessibility to the asset. Today, there are still stores that adopt the manual system for preparing and storing assets. This scenario gave the idea to the researcher to create a systematic inventory management system. Asset inventory management system that are used nowadays have proven its effectiveness and have been used widely. However, there are several criteria that need improvement, such as the time incured in searching and accessing inventory of assets. Therefore, e-inventory management system with the inventory process created by interaction with digitally delivered content, services and support is built to enhance the effectiveness of the existing inventory system. The system is divided into three parts, 1-the database for asset registration, 2-registration for location of assets and 3-search for the location of asset information.

Just like any manufacturer, education sectors (especially engineering department) also have to deal with their management processes. Failure to do so is not just a matter of profitability, it can also be one that reflect the success of teaching and learning process in producing high quality graduates.

With all these areas governed by some of the most stringent regulations and compliance standards in the country, it is no wonder that the demands made by educational sector on their manufacturing IT are amongst the most stringent. The problems many educational sector struggle with in terms of their manufacturing IT stem from using a variety of different non-connected or loosely connected IT systems. Data issues including duplication, variation, and version control are inherent with such an approach, especially where different departments may, for example, be working with different versions of the same spreadsheet for critical areas such as specification or formulation documents. Moreover, using different systems for different areas within the business, for example stock control, production control, accounts, warehouse and dispatch can also lead to a lack of visibility across the organization. By definition, these requirements are best met by a fully integrated the inventory management solution with a central database.

Each item in store, e.g., spare part, stationery item, should be entered on a dedicated stock card. These cards:

- Can be either hand-written or be stored in a computer; the important factor is accuracy;
- Show a running balance of the quantity of the specific item;
- Can be maintained by the store keeper who is responsible for entering the quantity issued and the requesting department on the card;
- Should be checked each month by someone in authority to ensure accuracy and also to enable monitoring of the general usage in each department.

Noting the monthly usage is useful when considering the annual budget and requirements for the year ahead. An end-of-year stocktaking exercise is required for correct auditing procedures.

Although Information Systems as a discipline has been evolving for over 30 years now (Avgerou, C., 2000), but in Malaysia, it was only formerly introduced in the middle 1990's.

The new technological tool sparked great interest in Malaysia thus, encouraging the use of computerized management among Malaysian organizations. The interesting and beneficial services provided by most service providers and the changes of Malaysians' management styles promoted and enhanced the need and importance of computerized management in thier daily lives.

Silver et al. (1995) provided two views on Information System (IS) and IS-centered view that included software, hardware, data, people, and procedures. A second managerial view included people, business processes and Information Systems. There are various types of information systems, for example: transaction processing systems, office systems, decision support systems, knowledge management systems, database management systems, and office information systems. Critical to most information systems are information technologies, which are typically designed to enable humans to perform tasks for which the human brain is not well suited, such as: handling large amounts of information, performing complex calculations, and controlling many simultaneous processes.

Lauden (1998) said that the 'classic' view of Information systems found in the textbooks of the 1980s was of a pyramid of systems that reflected the hierarchy of the organization, usually Transaction processing systems at the bottom of the pyramid, followed by Management information systems, Decision support systems and ending with Executive information systems at the top (as shown in Figure 1). Although the pyramid model remains useful, since it was first formulated, a number of new technologies have been developed and new categories of information systems have emerged, some of which no longer fit easily into the original pyramid model.

Some examples of such systems are data warehouses, enterprise resource planning, enterprise systems, expert systems, geographic information system and global information system.

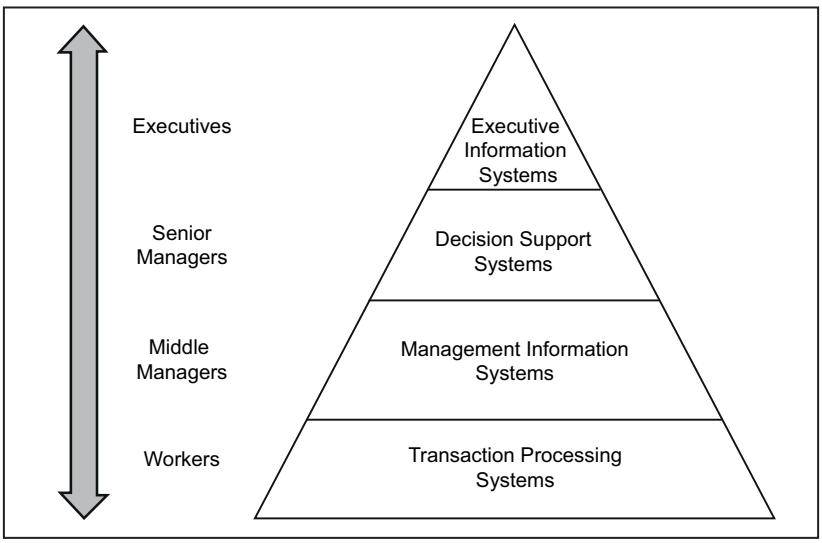


Figure 1 Information System and Management

This project is about the computerized management which is applied the Information System.

Problem Statement

The usage of the storage in management activities has spread widely across all organizations. Walking through any organization in Malaysia today, one will commonly find companies having storage rooms. Many are well-managed and some of them are badly-managed. In efficient systems, items in the storage room could be easily found.

Studies carried out at the installation and wiring workshop, Electrical Department, Polytechnic Sultan Azlan Shah's asset storage room showed that this store room has a total of 800 unit of asset including the capital asset, inventory and disposal material. It was reported that the numbers of assets are increasing every semester. The store room is also used for preparing materials for electrical wiring practical teaching and learning sessions for students' semester 1, 2 and 5. Normally there are 11 classes where each class consists of approximately 50 students.

At the initial stage, the process of storing, searching and accessing the assets does not cause any problems. However, when the number of assets kept increasing, the storage, searching and accessing became very difficult. Using the manual system, all assets are organized by using register card. However, these assets are not stored neatly and not well organized which led to the difficulties in searching for assets. The quest takes a long time and increases the use of paper. Manual methods used at present is time consuming where the user should find the name & location of the assets indicated on paper put up outside the cabinet and the user must than navigate to the location concerned. To save time and facilitate the search, the project was built.

To ensure the effectiveness of the system, the Visual Basic 6.0 software is used as an interface between users and systems. This paper describes the e-inventory management system which consists of two parts, the design of construction equipment (hardware) and software.

OBJECTIVES

The objectives of this study include

1. to computerize the inventory system by developing an E-inventory management system
2. to measure the time consumption in locating items.

Significance of the Study

Although the storage room not well-organized, there is a lack of computerized management system in managing it. If there is software to use, but the price is high, so the management might not want to buy it.

This study will focus on the producing the E-Inventory by creating the source code using Visual Basic 6 and integrating it with the hardware. After finishing this project, it can

be introduced to the other supervisors of workshop and laboratory in Polytechnic of Sultan Azlan Shah, especially to use this system to facilitate asset management in their laboratory. By this review, saving time and asset performance in the laboratory will become more rapid, orderly and easily in managing them.

Findings from this study may be useful to various factions, especially in managing items in storage rooms and management assets. Supervisors of the assets will easy to manage, to record and to allocate them, while the user is easily to find the assets. Through this project, the software can be shared with other organization especially for other department within Polytechnic Sultan Azlan Shah (PSAS) itself and maybe University of Putra Malaysia (UPM) with the less cost if buy from the other developer. By using the system, hopefully the management of assets will be well-managed and can lead to the quality production because the tense in finding and manage the assets was release.

LITERATURE REVIEW

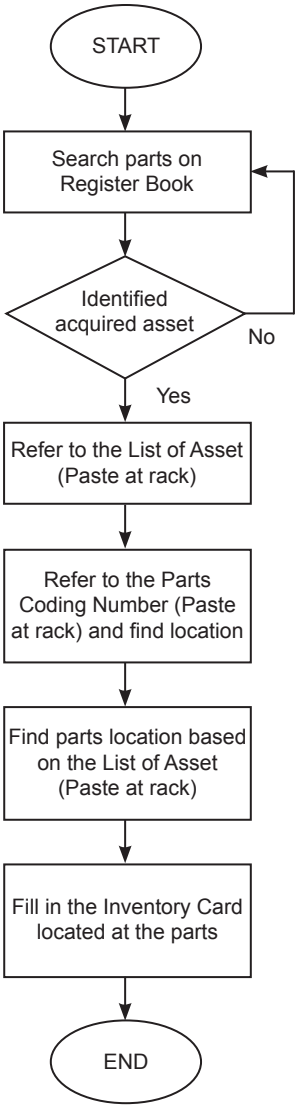
This section is divided into 9 main parts which are: 1) current system at IWW, 2) inventory & inventory system, 3) stock level determination, 4) its benefits system, 5) inventory control management, 6) e-management / e-inventory, 7) benefits of electronic asset search system and 8) traceability.

Current System at IWW PSAS

The system that was already in use at Installation and Wiring Workshop (IWW) of PSAS to search for an asset is manually which the users need to find out themselves where the assets were located.

In manual system, it starts with finding assets by referring to the Asset Register Book. After identifying the assets to be acquired, the user need to look on the list of assets that are pasted on the front of the storage racks (this is called Asset Search). Next the user must find the code lists of each level in the storage rack. Based on the code list specified, any place or equipment storage closet-sized label indications about 10cm X 10cm. At the rack, there are more labeled that are pasted to the asset. Finally, the tools found on a manual search system flow. If there any receipt or transfer of a new item, it must be recorded on the Register card with the box placed on the equipment storage closet. From the explanation given, its shows that the system used are proven effectiveness. However, there are several criteria that need improvement, in terms of search time, inventory and the use of paper documents.

The Figure 2 shows a flow chart of the stock search system equipment began by referring the Register of Assets and finds a list of equipment and the search is based on the label code of the location savings. This flow chart is based on *Pekeliling Perbendaharaan Bilangan 5 Tahun 2007: Bahagian C-Penggunaan, Penyimpanan dan Pemeriksaan*.



Stock search system flow (Manual)

Figure 2 The flowchart of manual system at Installation and Wiring Workshop

Inventory

According to Business Dictionary.com (2010), inventory is itemized catalog or list of tangible goods or property, or the intangible attributes or qualities. Value of materials and goods held by a firm (1) to support production (raw materials, sub-assemblies, work in process), (2) for support activities (repair, maintenance, consumables), or (3) for sale or customer service (merchandise, finished goods, spare parts). It is often the largest item in

the current assets category, and must be accurately counted and valued at the end of each accounting period to determine a firm's profit or loss. Firms whose inventory items have a large unit cost generally keep a day to day record of changes in inventory (called perpetual inventory method) to ensure accurate and on-going control. Firms with inventory items of small unit cost generally update their inventory records at the end of an accounting period or when financial statements are prepared (called periodic inventory method). The value of an inventory depends on the valuation method used, such as first-in, first-out (FIFO) method or last-in, first-out (LIFO) method. Inventory should be valued on the basis of either its cost price or its current market price whichever is lower of the two to prevent overstating of assets and earning due to sharp increase in the inventory's value in inflationary periods. The optimum level of inventory for a firm is determined by inventory analysis. It also called as stock in trade, or just stock.

Inventory System

From Inventory System (2010) website, it stated that an inventory system is basically a process whereby a business keeps track of the goods and material it has available. In its simplest sense it can be done manually by a count at the end of each day. In this way it is possible to keep a record of the goods coming in to the business and goods being sold. However this is only really appropriate for small businesses that do not have a lot of stock. For larger business it is more likely that a computerized system will be required.

Stock Level Determination

Baker and Timothy (1998) in their research stated that the inventory models currently available do not recognize a demand of the product. In their study, they evaluated an inventory system in which the demand rate of the items is a function of the inventory level (quantity on hand). By doing the project, they can control the items before the items are "out of stock".

Murat and Mustafa (2011), stated that businesses' execution of it's stock policies at the lowest cost depends on the forecasting amount of stock based on demand at least error, and minimum stock level determination and the appropriate time and amount of orders given to it. Thus, time and cost savings will be achieved by ensuring balance of continuity and speed in production of goods and services in the production process. By the rapid changes in consumer preferences, the variety of products, technologies and competitors are rapidly changing and increasing in rate. By increases in product variety, stock control and management is becoming even more difficult and complex. In recent years, effective and efficient resource use and management began to be kept in the foreground in public institutions as well as private sector.

According to Ingrid (2003), the heads of department will indicate the minimum stock levels required for each item based on the quantities required for maintaining a service. This figure is entered on the stock card. It needs to be taken into consideration whether an item

is a local or overseas purchase. Orders need to be placed well in advance of the minimum stock level being reached. At least two months working supply for local purchases and 6 months for overseas purchases is recommended. Forward planning is important as holiday times will affect the processing of orders from the suppliers. If the Unit has students in (surgical skills) training, allowance should be made for extra use of certain items, e.g., sutures and visco-elastic.

Benefits of computerization

From Database Company (2010), an information system is there to empower its users. A database simply provides data, but an information system is all about providing the best information the user needs to do their task more effectively. It also takes into account that different users doing their own specific tasks may need to see their information presented in differing ways. The benefits of an information system follow when the user can quickly access, understand and respond correctly to that information.

Inventory Control Management

Handojo (2010) said that inventory control management refers to the systems and strategies use to ensure that they have adequate supplies of raw materials for production and finished goods for shipment to customers, while also minimizing their inventory carrying costs. Storing excess inventory is costly, because the space and financial resources invested in the goods can often be put to better use elsewhere. At the same time, however, inadequate inventory stores can result in costly production shutdowns or delays in filling customer orders. Inventory control systems help companies to find the delicate balance between too little and too much inventory.

According to Handojo (2010) again, in today's business environment, even many smaller businesses have come to rely on computerized inventory management systems. Certainly, there are plenty of small retail outlets, manufacturers, and other businesses that still rely on manual means of inventory tracking. Indeed, for some businesses—such as convenience stores, shoe stores, or nurseries—the purchase of an electronic inventory tracking system might constitute a wasteful use of financial resources. But for firms operating in industries that feature high volume turnover of raw materials and/or finished products, computerized tracking systems have emerged as a key component of business strategies aimed at increasing productivity and maintaining competitiveness. Moreover, the recent development of powerful computer programs capable of addressing a wide variety of record-keeping needs—including inventory management—in one integrated system have also contributed to the growing popularity of electronic inventory control options.

Given such developments, it is little wonder that business experts commonly cite inventory management as a vital element that can spell the difference between success and failure in today's keenly competitive business world. Writing in Production and Inventory Management Journal, Godwin Udo described telecommunications technology as a critical

organizational asset that can help a company realize important competitive gains in the area of inventory management. According to Udo, companies that make good use of this technology are far better equipped to succeed than those who rely on outdated or unwieldy methods of inventory control.

E-Inventory / E-Document Management

Bhupendra et al. (2007) in his research stated thata e-document is an electronic document management system. A state of the art feature that is of immense help in documenting and tracking materials is an electronic document management system. This can resolve paper handling challenges by allowing any electronic file like jpg, Word, Excel, pdf, etc. to be attached to any sales order, item master, customer, vendor, purchase order, or accounting transaction file within an ERP system. The main two advantages of this capability are instant access to supporting data, and permanently secure electronic storage. A document can be viewed merely by clicking on it, eliminating the possibility of lost or misplaced paper records. Digital files are safely kept in one central location in a SQL server database. Some of examples are; certificates of analysis attached to raw materials, formula or engineering information attached to the batch formula, delivery confirmation signatures attached to shipping orders, scanned delivery tickets attached to purchase orders etc.

According Handojo (2010), E-inventory means services which are delivered, enabled or mediated by ICT for the purposes of conducting inventories, and the technology and services which help create, manage and deliver those activities. For the majority of manufacturers, computerization can substantially enhance their competitive edge and stock control is one area in particular that lends itself to the rapid processing power of a computer system. A computerized stock control system can help the manufacturers by manipulating assembly data and providing requirements planning facilities, component costing, kit marshalling, and labour input costing. Software providing these facilities is not easily available and many organizations have written their own inventory packages. The alternative is to use an established package.

Control of inventory is critical for an organization, so that the existing inventory to meet demand and at the same time not so much that it takes a lot of storage costs (Czyszczewski, 2010). It is very important especially in an organization engaged in education services. Inventory control system in a company under investigation at the moment still be done based on estimates, habit and intuition, but many types of electronic equipment that is handled by the company has its own complexity factors that are difficult to treat by human memory (Culpepper, 2006). To improve the capability of doing inventory control that aims to increase efficiency and service to students in an organization's inventory system, an application was made by combining the software (database) and hardware (display) for accessing asset. The application is designed to help organization obtain information about the inventory more easily and quickly, and determine when and the amount of goods must be ordered by using by setting reference limit. So the minimum inventory level that is consistent with organization needs to be maintained.

Based on the results of the study doing by Yulianti (2008), respondents considered that the storing system and electronic information retrieval and information search success by users in Yogyakarta State University Library is quite good. System applied to help the user to obtain library materials that as needed (relevant). The information obtained is considered qualified, can provide benefits and can assist in solving problems faced.

Benefits of Electronic Asset Search System

Thelma (2010), in his article said that the electronic asset search system will save time and add efficiency on asset management. Much time can be saved compared with the previous manual system. Asset searches of electronic systems can also store data safely.

According Czyszczewski (2010), the systems, methods, and media of the disclosed embodiments provide an improved methodology for managing and tracking asset devices. The electronic asset tag provides a relatively permanent and efficient method for managing individual asset devices. When these assets are properly managed electronically, in addition to cost savings, it actually helps organizations achieve greater efficiency in management and most importantly the security and confidentiality of an asset is more secure. This project is similarly with Warehouse Management System, which is controlling the movement of materials and the storage of the materials (Management Hub, 2010). The primary purpose is to control the movement and storage of the materials. A good warehouse management system would have a flexible location system, get user defined parameters to direct warehouse tasks and uses live documents for execution of the tasks. Some form of integration with other devices is possible so that the warehouse management system gets live data from other devices connected to it. Automated data collection in the warehouse management system would reduce the cost in the labor and increases the accuracy of the data. It increases the effectiveness of the service provided to the customer by reducing the cycle time. Inventory reduction and increased storage capacity are less likely. The level of safety stock can be reduced while increasing the efficiency of the system. Customer services like first-in-first-out, cross docking, order tracking and automated material handling are some of the area that finds an increase in the efficiency.

Traceability

Horio (2009) in his research stated that, traceability is the procedure which discover for a specific product, where did they come / placed. Also traceability can be the process which discover for a specific material which are the products which and where did they go. The production process may include one or more technological phases, which may be inside one or more stock management unit, which means that our traceability can be like a graph in which inputs and outputs are represented like nodes, and the discharging links are represented like links between nodes. Traceability is very necessary in the industry to identify for a batch of finished products, the source of raw materials, where did they come, they placed and they go.

From the literature review it can be concluded that previous researches show that there is necessary to manage the inventory by computerized. It does bring more beneficial compared managed by manually. It's obligation for manager in keeping right all the items (inventory) in right amount, in the right place at the right time and cost. So the E-Inventory Asset Management System is needed to achieve management improvement.

METHODOLOGY

The general aim of this study was to produce the E-Inventory. Therefore, research methodology is focus on how to develop the E-Inventory. This chapter will describe in detail the research methodology used in this study.

Location and Sample of the Study

The present study was conducted at Installation and wiring workshop at Electrical Department, PSAS. This workshop was selected because firstly, of its accessibility and convenience to the researcher. Secondly, this workshop is an already established manually manages, and used mostly by other lecturers, so this area seemed highly appropriate.

Instrumentation and Measurement

To achieve the objectives of this study, the research instrumentation and measurement for this study are as below:-

Project Requirement

The requirement to build this system is hardware and software. To achieve the objectives of this study, instrumentation and measurement were divide as below:

RQ 1: Why E-Inventory needed to develop?
To get the findings on this research question, observation, and personal experiences were recorded as a data to strengthen this study.

RQ 2: How to develop the E-Inventory?
This research question is a major scope in this study. Therefore the instrument and requirement used are :-

Software requirement
Visual Basic 6.0 is a software used as interface between user and the system.

Hardware requirement
Hardware requirements for this product are computer and electronic devices such as ULN2803, transmitter and receiver and LED as a location display.

Developing an E-inventory system by using Visual Basic 6.0 as a platform which connected to the hardware via parallel port to search for assets in the Installation Wiring Workshop, Polytechnic Sultan Azlan Shah.

RQ 3: What are the implications of using E-Inventory?
For this research question, observation and testing will be conducted to measure it. It will give a data to answer this research question.

Measurement
Measurement in this study is to measure the time consuming before and after using this E-Inventory.

RESULTS

An E-Inventory is a database used for managing assets. The data is offloaded from the operational systems for reporting. The data may pass through an operational data store for additional operations before it is used in the reporting.

An E-Inventory functions in three layers: staging, integration, and access. Staging is used to store raw data for use by developers (analysis and support). The integration layer is used to integrate data and to have a level of abstraction from users. The access layer is for getting data out for users' specialization in searching the assets. This definition of the E-Inventory focuses on data storage. The main source of the data is cleaned, transformed, catalogued and made available for use by lecturers for data mining and searching assets.

Importance of E-Inventory

Through experience and observation, E-Inventory should be established because:

1. Increasing number of assets
   Increase in assets and inventory at the labroratory lead to slower search process. This delay will cause an interruption in the daily work of teaching and learning process.

2. Safety
   When there is no system of control for goods in the laboratory, losses cannot be traced, and this will need supervisors to find the items.

3. Access
   Without a perfect system, the search for the goods is difficult and slow. By using E-inventory, with just a card swap, data can be accessed easily.

4. Paperless
   By using this system, the use of paper can be minimized and the use of paper records can be stored easily and systematically.

Development of E-Inventory

The objectives of improvement on the manual systems that are using registration cards to the electronic system is to reduce the search time and facilitate the storage system assets. LED display on the Visual Basic that is wirelessly fixed to the rack which indicates the location of the asset items.

This project used parallel output port on a personal computer connected to a circuit that is controlled by integrated circuit IC ULN2803. Visual Basic is used as the interface between systems and users looking for an asset such as capital asset, inventory and disposal material. This system also can be used as a database for storing asset data and its quantity.

Parallel port found on a personal computer is a convenient feature that can be used to control external devices such as home appliances, lamps and components such as light emitting diode (LED). The method for connecting personal computers with LED components used in this innovation is linking '25 pin D Female connector shape' wirelessly with LEDs on the shelves of asset storage that will be used as a sensor display. Output pin 25 pin interface is used, and can be divided into two parts, the output pins, numbered 2 through 9 are used as data lines while 18 and 25 pin is used as a grounding signal. Data bits transmitted to the pin data lines can be set to a low logic "0" (OFF) and a high logic "1" or "5 volt" (ON) in which the sensor LED display can be controlled wirelessly through Visual Basic.

Table 1 Pin Number with its Function

No	Pin	Function
1	2	D0
2	3	D1
3	4	D2
4	5	D3
5	6	D4
6	7	D5
7	8	D6
8	9	D7

Writing Visual Basic code is based on the function of the set. Values that will be sent by the program is in binary form that will control the output of one bit. The relationship between bits, the output pins for the parallel port and the bit is shown below: -

Table 2 Relationship between Bit and Output Pin Parallel Port

Pin	2	3	4	5	6	7	8	9
Bit	D0	D1	D2	D3	D4	D5	D6	D7
Value	1	2	4	8	16	32	64	128

The examples given below shows how the program sets the value to select the pin that will operate to send a signal:

1. If the pin on the parallel output signals are selected to remove pin 2, the output value of the program should be set to 1.
2. If the pin on the parallel output signals are selected to remove pin 3, the output value of the program should be set at 2.
3. If the pin on the parallel output signals are selected to remove pins 2 and 3, the output value of the program should be set at 1 + 2 = 3.
4. If the pin on the parallel output signals are selected to remove pins 2, 3 and 4, the output value of the program should be set at 7.

However, the logic or voltage delivered to the external circuit will be different from the ideal value required when the circuit is connected to the load or external circuit. Thus, an integrated circuit is used as an intermediate buffer or line drives to be used. A ULN2803 is an Integrated Circuit (IC) chip with a High Voltage/High Current Darlington Transistor Array. It allows interfacing TTL signals with higher voltage/current loads. The chip takes low level signals (TLL, CMOS, PMOS, NMOS - which operate at low voltages and low currents) and acts as a relay of sorts itself, switching on or off a higher level signal on the opposite side.

A TTL signal operates from 0-5V, with everything between 0.0 and 0.8V considered "low" or off, and 2.2 to 5.0V being considered "high" or on. The maximum power available on a TTL signal depends on the type, but generally does not exceed 25mW (~5mA @ 5V). Computers and other electronic devices frequently generate TTL signals. On the output side the ULN2803 is generally rated at 50V/500mA, so it can operate small loads directly. Alternatively, it is frequently used to power the coil of one or more relays, which in turn allow even higher voltages/currents to be controlled by the low level signal. In electrical terms, the ULN2803 uses the low level (TTL) signal to switch on/turn off the higher voltage/current signal on the output side.

The ULN2803 comes in an 18-pin IC configuration and includes eight (8) transistors. Pins 1-8 receive the low level signals, pin 9 is grounded (for the low level signal reference). Pin 10 is the common on the high side and would generally be connected to the positive of the voltage apply to the relay coil. Pins 11-18 are the outputs. For examples, Pin 1 drives Pin 18 and Pin 2 drives Pin 17, etc.

The objective to innovate the E-Inventory Management System with wireless operation system is obtained where from output pins 11 to 18, power is sent to the relay coil which control the transmitter circuit to transmit 315Mhz frequency to the receiver which controlled a relay that act as switch to the Light Emitting Diode display circuit. Wireless operations permits services, such as short or long range communications, that are might possible or impractical to implement with the use of wires. The term is commonly used in the telecommunications industry to refer to telecommunications systems (e.g. radio transmitters and receivers, remote controls, computer networks, network terminals, etc.) which use some form of energy (e.g. radio frequency (RF), infrared light, laser light, visible light, acoustic energy, etc.) to transfer information without the use of wires. Information is transferred in this manner over both short and long distances.

Process Using E-Inventory

The process to use this E-Inventory starts with a scan bar code or by manually typing Identity Card numbers. The user will successfully log in and if it could not log in, this process should be repeated again. After user successfully logs in, user can select either to access Capital Assets –A, Inventory Assets – B or Disposables Assets-C. If user selects A and B, the process will start with the selected item in the database or by scanning the item using bar code scanner. The database will show either the item is available or borrowed by other users. For Disposable Item – C, at this time, LED at the rack will illuminate, as an indicator where the items are located. The quantity of the items C can also be checked whether it needs to be re-ordered or enough for the lab. The diagram of the flowchart is shown in Figure 2.

E-Inventory

Illustrations below are the interface of the system. Type of instruction is to use instruction buttons, and mouse. Each page is linked to one another. Each screen is as simple as KISS (Keep It Straight and Simple), where each screen is consistent with each screen connected to the buttons that are placed on each page.

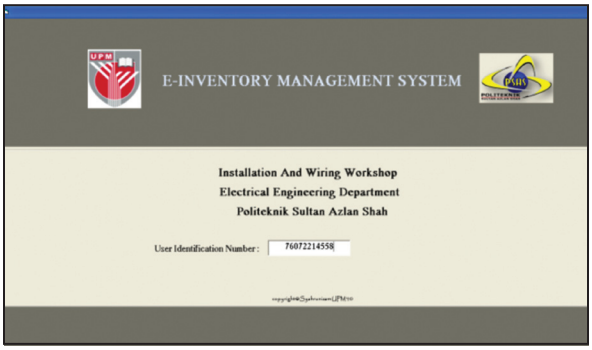


Figure 3 Main Menu

Figure 3 is the interface for the main menu of this system. It has an area to log in by key in the Identity Card number in the User Identification Number. Before users use this system, all the user must be registered. The registration is using Identity Card number. Identity Card number is selected as log in ID because it is unique and different from others, so probability of user clashing can be avoided.

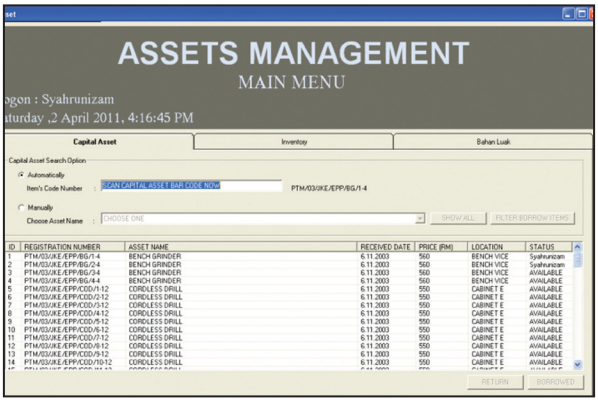


Figure 4 List of Capital Asset

After user has logged in, the system will show the interface as in figure 4. In this phase, user can select asset automatically by using bar code reader or manually based on selected item. If users do a selection manually, in this interface, users can select either to manage capital asset, inventory or disposable items. In every selection, it will show the list of the items.

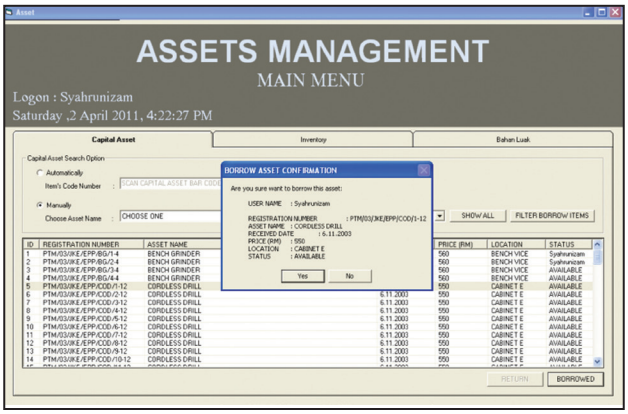


Figure 5 Confirmation in borrowing items

After users select the items, this pop-up will appear to do a confirmation. In this phase, if the items were borrowed by other user, the name of user will appear in the status, while if the item is not borrowed by other user, word “available” will appear at the status area. This will be appear if users click on “show all”. Figure 5 shows the pop-up confirmation in borrowing capital assets items.

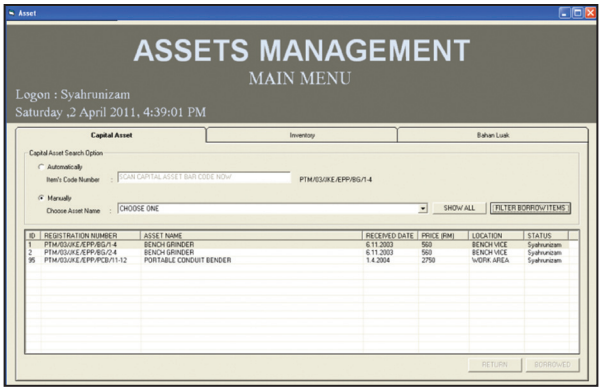


Figure 6 Filter borrower

Figure 6 shows the filter borrower of capital asset. If the user clicks on the "filter borrow items", the list will show all the items which is borrowed by other users. This application facilitates user in searching an item which is not available to be borrowed. It also shows who the borrowers are, so if the items are not returned in the time given, the manager can find the person.

Figure 7 Inventory asset

After user has logged in, the system will show the interface as in figure 7. In this phase, user can select asset automatically by using bar code reader or manually based on selected items. If users do a selection manually, in this interface, users can select either to manage capital asset, inventory or disposable items. In every selection, it will show the list of the items. Figure 7 shows the list of items in the inventory.

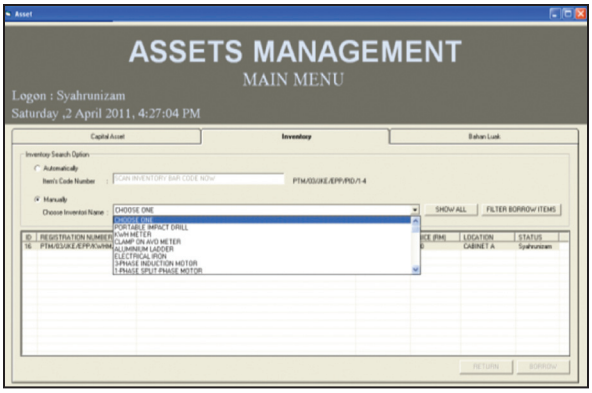


Figure 8 Filter based on type on inventory

After users has selected the items, if the items were borrowed by other users, the name of the user will appear in the status. Users also can choose the items by using scrolling down in "Choose Inventory Name" as in figure 8.

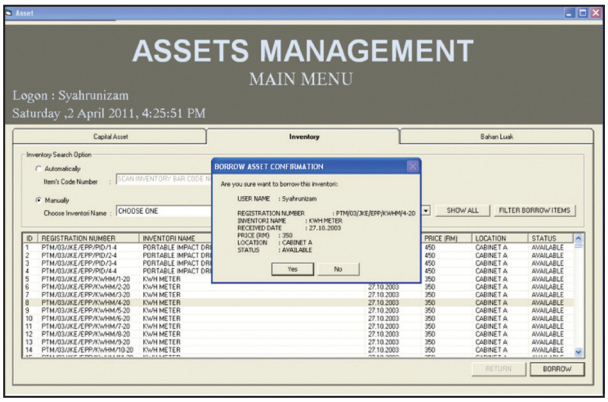


Figure 9 To borrow inventory assets

After users has selected the items, this pop-up will appear to do a confirmation. In this phase, if the items were borrowed by other users, the name of user will appear in the status, while if the item not borrowed by other users, the word "available" will appear at the status area. This interface will appear if users click on "show all". Figure 9 shows the list of items in the inventory.

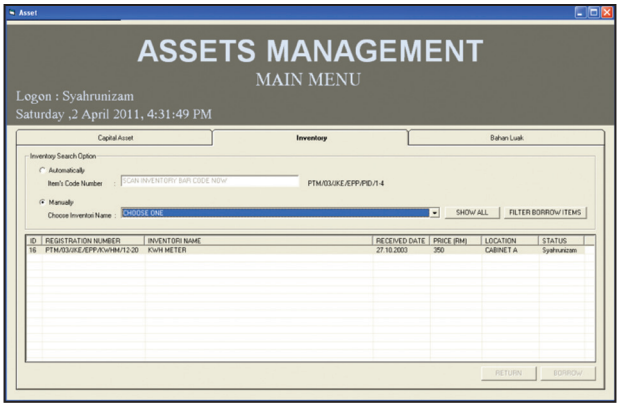


Figure 10 Filter borrower of inventory assets

Figure 10 shows the filter borrower of inventory asset. If the user clicks on the "filter borrow items", the list will show all the items which are borrowed by other users. This application facilitates user in searching an item which is not available to be borrowed. It also shows who the borrowers are, so if the items are not returned in the time given, the manager can find the person.

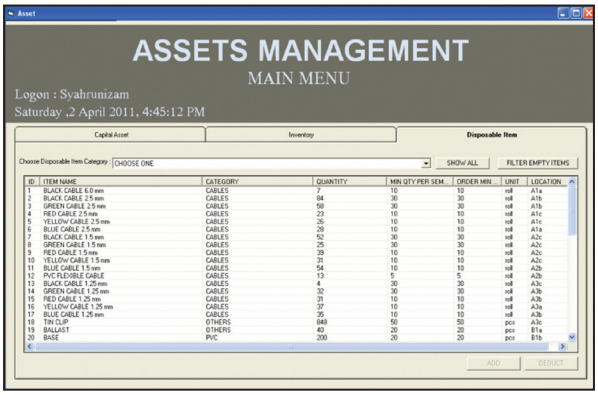


Figure 11 List of disposable item

After user log in, the system will show the interface as in figure 11. In this phase, user can select asset manually based on selected item. Figure 11 shows the list of the disposable items.

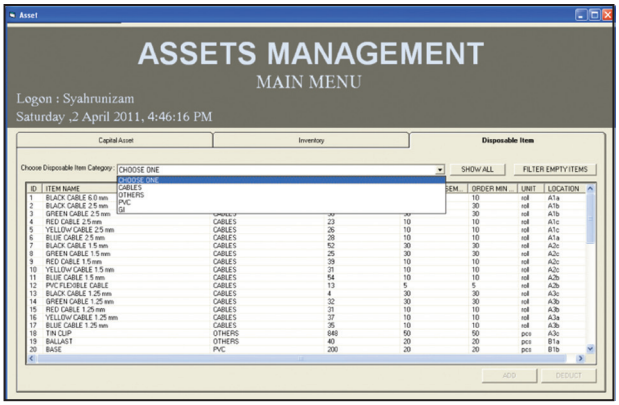


Figure 12 Choose of disposable item category

Figure 12 is the list of Disposable Items in the EPP. It shows the quantity of each item, location and minimum ordering. User can search the items by referring to location ID and search the assets manually, and also by using E-Inventory, LED will illuminate at the location at the rack. It will indicate where the items are located. In this interface, it shows all the item in the disposable item categories.

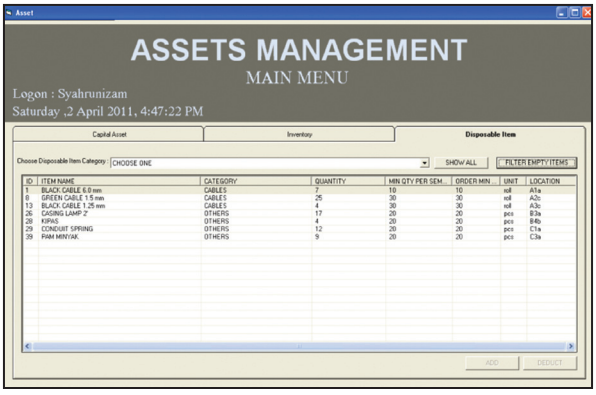


Figure 13 Filter empty item

In this project, the items that reach the minimum quantity level can be detected by clicking at "filter empty items" as in figure 13. These applications are really useful in asset management because it can tell the manager, which items are at the minimum level and need to be ordered.

Implications of Using E-Inventory

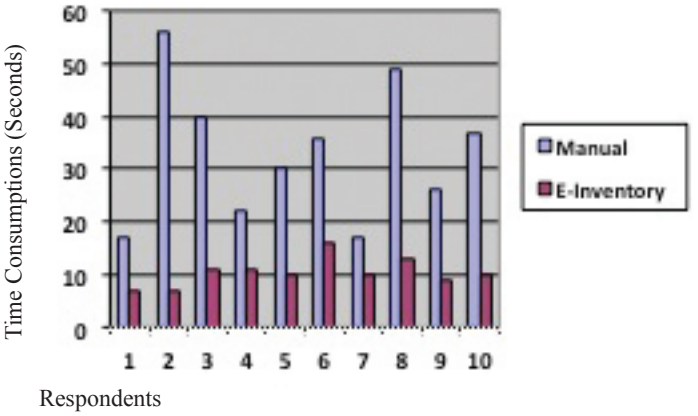


Figure 14 Time Consumption by using E-Inventory

Time consumption test on finding item with and without E-Inventory management system have been carried out. Figure 14 shows time consumption for finding items that are using both methods. A total of 10 respondents was involved in this test. The process begins with the detection of items in the system until the user finds the item in the storage racks. The results showed that all respondents were able to find items faster by using E-inventory system than using the manual method. The average search time is 33 seconds manually, while only 8.4 seconds was recorded for the search made using E-inventory system.

CONCLUSION AND RECOMMENDATION

As conclusion, the production of E-inventory brings many positive effects in asset management. It is really needed to be produced in the world today because our life is based on computer and information technology. In the developed world today, it is detrimental if the asset management is still done manually. With the use of this E-inventory, security, data recording and management of assets will become more structured and systematic as well as facilitate the management of it. Through this research, it can be concluded that to build an asset management system, software and hardware combination are essential. For this project, using Visual Basic 6.0 software, Barcode Maker 5, and Proteus 7 Professional. The hardware used computers, bar code reader, parallel port circuit (relay control circuit) receiver, transmitter and display circuit. The reason for developing an electronic inventory system is because computerization is the best medium for communication and searching information. The system will be developed for installation and wiring workshop at Politeknik Sultan Azlan Shah, which will be used to store and to record all information about assets. This system will manage all assets effectively. All users can get information easier and

more systematic and efficiently. User just needs to key in the code of assets to search for the material and they will find the assets' location. This system will be easy to use, understood and it is built with user-friendly interface. By using the manual system, it needs much time to search for the location and items. It is similar with Thelma's (2010) study, which was noted in his article that the electronic asset search system will save time and add efficiency to asset management. Much time can be saved compared with the previous manual system. Asset searches of electronic systems can also store data safely.

It can be concluded that the E-inventory system, have a positive impact. Its effectiveness is proven by looking at the significant savings of time before and after the use of e-inventory. From this research, it showed that the E-Inventory system is important and should be developed in any organization. For the next research, it can be recommended that:

1. Using serial port to replace the parallel port;
2. Change Bar code reader to Radio Frequency Identification (RFID);
3. Do it in a large room.

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