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DEVELOPMENT OF COMPUTER INTERFACE PROGRAM FOR THE MAINTENANCE PLANNING AND SCHEDULING OF DANGOTE FLOUR MILLS, ILORIN, NIGERIA

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ABSTRACT: *This work developed an interface for the planning and scheduling of plant maintenance operations at Dangote Flour Mills, Ilorin Nigeria. The focus of this computer based maintenance planning is to ensure continuous operations of equipment, plant and machineries and reduce operation stoppages or downtimes. It provides interactive modules whereby industrial activities can be assigned to employees by the company's management while employees can have an immediate view of job schedule, simplifies the process of requesting for work to be performed and manage the issuance of work permits, control parts and inventory, keep good record of equipments and appropriate safety management through proper documentation of accidents that may occur in plant operations among others. The paper form of planning and scheduling industrial work activities is tedious, past maintenance and scheduling records are always difficult to retrieve and in many instances when the stock level becomes zero all industrial production seizes and its attendant consequences.*
KEYWORDS: *plant maintenance, operation stoppages, interactive modules, work permits, stock level*

INTRODUCTION

Plant maintenance involves all activities carried out on a machine in order to prevent or minimize operation stoppages or downtimes in industries that may be due to equipment and facilities failure [1]. Maintenance Planning is the process of determining future maintenance decisions and actions necessary to accomplish operational goals and targets in the most efficient and effective manner. It minimizes costs and reduces risk and missing opportunities. It can also increase the competitive edge of the organization [2].

Maintenance Scheduling is the process of putting the task determined by the maintenance plan into a time frame. It takes into consideration, the intended goals, interrelations between the different planned task, the availability of resources overtime and any other internal and external limitations and constraints [2]. This can also uncover some areas of planning deficiency, which needs to be captured.

Unplanned and unscheduled work generally makes up the majority of breakdown work orders.

Maintenance planning and scheduling is often viewed as the centre of industrial maintenance management, since other processes such as preventive maintenance, root cause analysis (RCA), inventories record management, and other processes are dependent on the planning and scheduling process to work [3]. Industrial Maintenance planning and scheduling is often broken down into several sub-processes such as prioritization of work, scheduling of maintenance work, coordination of maintenance schedule and production schedule, planning of operation jobs and maintenance jobs, recording of work order history, and follow up by key performance indicators. Some of the reasons for planning and scheduling maintenance operations are that it:

(i) Enhances work efficiency since operations can be easily delegated among employees.
(ii) Assure the optimum availability of installed equipment for production or service.
(iii) Ensures operational readiness of all equipment required for emergency use at all times such as standby units, fire fighting, rescue units etc.
(iv) Enhances maximum possible return on investment.
(v) Ensures the safety of personnel.

PLANT MAINTENANCE OPERATIONS AT DANGOTE FLOUR MILLS

Operation downtime is the period of time during which a machine is not in a condition to perform its intended function. It is different from breakdown maintenance, since it only represents the duration of lost production, whereas breakdown (emergency or reactive) maintenance represents the total man-hours spent on corrective actions on failed equipment [4].

Dangote Flour Mills produces flour from wheat as raw material. The company has four mills A, B, C, and D, manufactured and installed by Buhler, Switzerland. The company's production process and maintenance operation carried out on the Mills are as given in Table 1 below.

The above maintenance operation is scheduled to staff through paper work, with an assumption that every staff is aware of what is expected of him. Also, the deduction of used inventories from

existing ones after the completion of a task is done through paper work, including taking records of accidents, witnesses of accidents and work permits issued. Notwithstanding, the paper form of scheduling becomes ineffective when employees become unaware of the scheduled task, misplacement of papers among others.

Table 1: Extract of maintenance plan schedule on Mill A in June, 2008 [5]

Machine no.	Description	Maintenance Plan
3M060(-64)	Air lock (AL S/T)	Check shaft alignment, Check gearbox oil
3M055	Screw Conveyor(SC)	Grease Bearing, Lubricate drive shaft bearing, etc
3M066	Choke feeder	DE/NDE BEARINGS (Clear the tube screw)
3M234	MF Vitamin A	Open and clean screw housing
3M235	MF Ascorbic Acid	Open and clean screw housing
3M236	MF Oxem/Alphamalt	Open and clean screw housing
3M237	MF Vit A Danvita	Open and clean screw housing
3M040(-43)	IMPACTOR	Grease Motor bearing, check the indent plate
3M050(-51)	DETERCHER	Grease motor bearing, check the indent plate
3M032 C4	Roller Machine (RM)	Plush strip on the exhaust panel at the grinding passages, Check Scrafer Knife/Brush, Check belt wear, belt tension for main drive, tooth transmission, belt and drive belt for feed rolls
3M072	Purifier MQRF	All Maintenance by the Millers that is cleaning of the frames and the machine, no lubrication is needed
3M067	Tube Screw Conveyor	Grease Bearing, Grease Gear Oil, Open and Clean the tube
2M013	Bucket Elevator (BE)	Check bucket mounting, bolts and bucket, Check safety devices, Check gear box oil level, Check belt, Check head pulley rubber, Grease bearing, Check shaft seal at elevator head and bolt

The Plant Maintenance Planning and Scheduling Interface Program was then designed able to solve these problems through the provision of a simple and readily accessible interface where:

I. *Management can easily schedule task for employees, having a first-hand view of what is expected of them.*
II. *A proper record of existing and used inventories can be kept including work permit issued, accident and witness report among others.*
III. *Employees can easily secure approval from management for task to be performed, therefore transforming the company's maintenance schedule with the program.*

MAINTENANCE SOFTWARE CREATION PROCESS

Maintenance software creation follows the process of the general software development life cycle [6], depicted in Figure 1 and the program development flow chart in Figure 2 below.

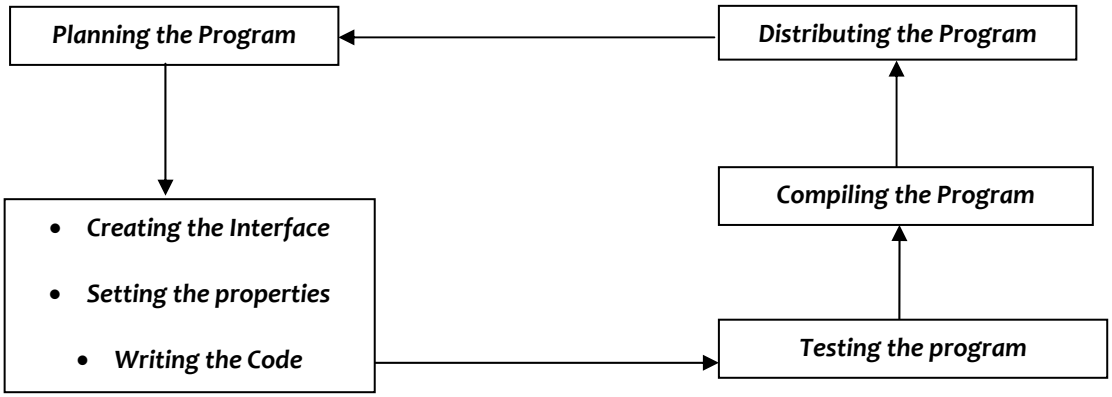

Figure 1: Software Development Life Cycle (Source:[6])

The plant maintenance planning and scheduling interface Program was designed with the compiler, Microsoft Visual Studio 2008, version 9.0.21022.8 RTM © 2007, Microsoft Corporation. The program is sectioned into nine modules. These include the Maintenance Planner module, Work Request module, Parts and Inventory Records module, Forms and Work Permit module, Equipment Record module, Safety Management module, Employees' Record module, Client's Records and a Personal Organizer module. Each of these modules provides specific functions and features that when combined together, becomes an outstanding maintenance management system. Each of the modules uses an SQL service based database. Separate table was developed in each database for each module and the data entered in the table is assigned to the database through specific linking dataset. Thereafter, program code is written behind each object (forms, buttons, textboxes etc) in the program, to give a better control on how data is processed, test for conditions and control the order in which the program carries out instruction. Most of the reports and other documents can be exported to one or more supported Microsoft formats. Depending on the document, these include Word, Excel, PDF, HTML, RTF, and others.

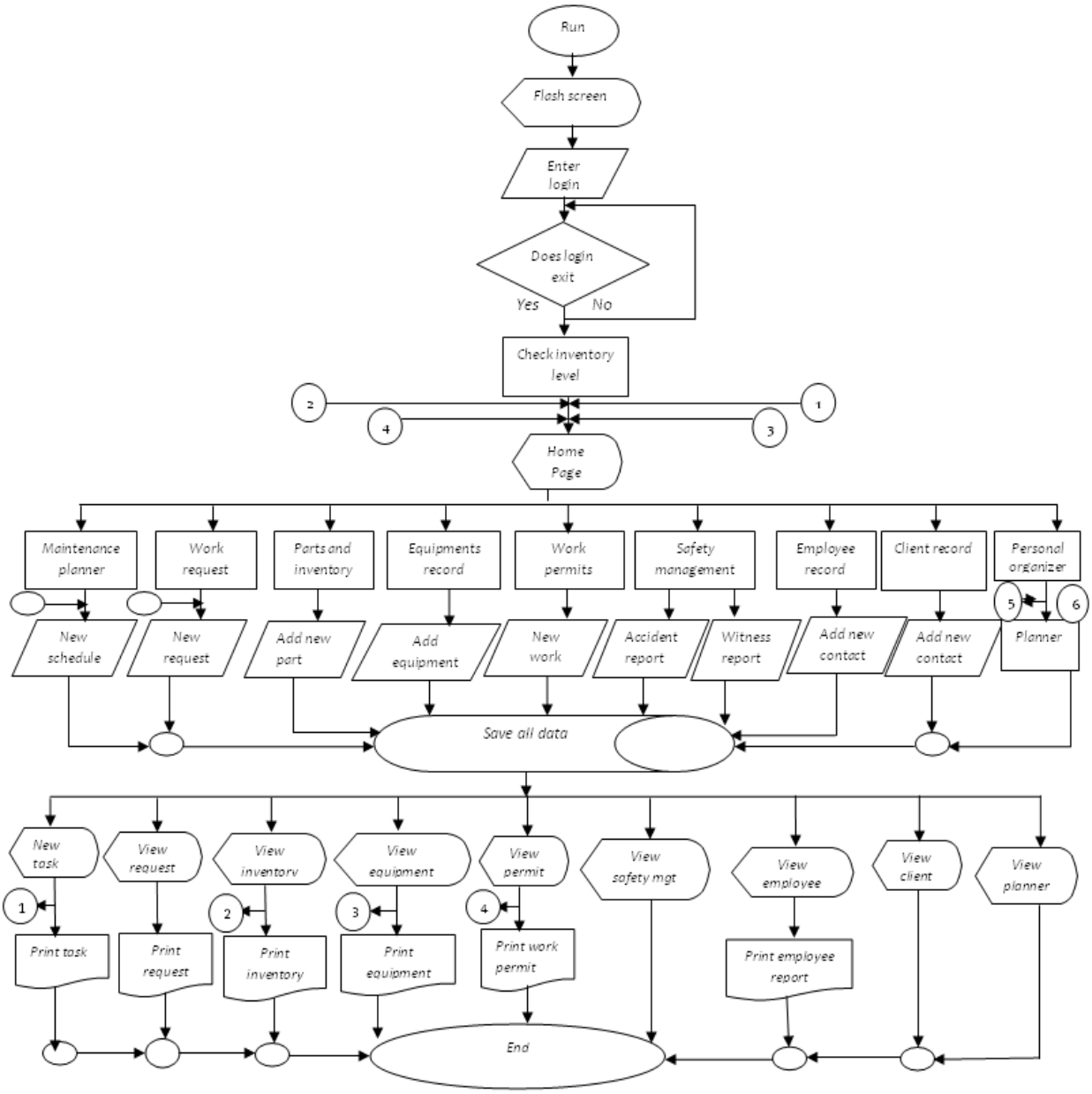

Figure 2: Program Flow Chart

The software program was tested at Dangote Flour Mills, Asa Dam Road, Ilorin, between the 17th and 22nd of May, 2010, after an approval by the company's management. The relevance of the program in Mill maintenance was established after the testing process.

The functions and areas of application of some of the modules are as discussed below.

MAINTENANCE PLANNER MODULE

Maintenance planner module is used to create planned maintenance type tasks [7]. The Plant Engineer will be able to schedule and assign maintenance operations to be performed on different machines with this module. Also the personnel to carry out the maintenance operations and can likewise be given appropriate safety instructions for successful operation performance through this module. Similarly, parts and labour required to carry out the task can be assigned through the parts and labour

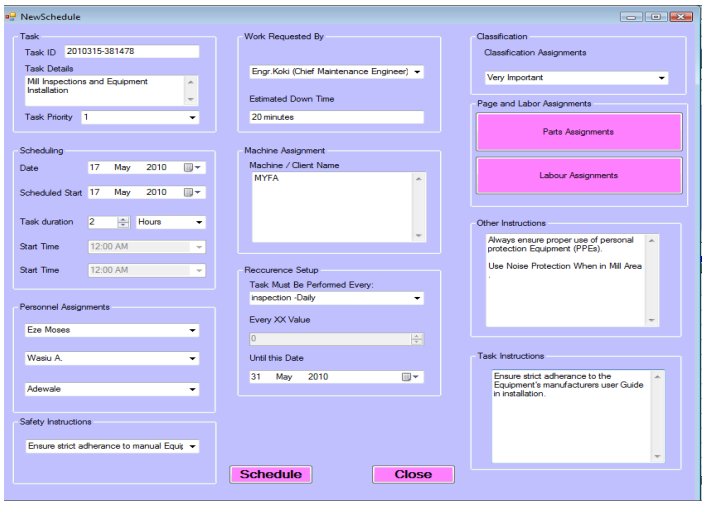

Figure 3: Maintenance Planner Module

assignment button. Other features of this module shown in Figure 3 include; recurrent setup, classification assignments and task instructions [8].

WORK REQUEST/PERMIT MODULE

Work request module provides important detail about work activities that staff wishes to embark upon. The work request often includes elements that help the management to know exactly what the staff member wishes to order, including what work to embark upon, equipment required, scheduling and completion information among others. Through the work order, the management is able to respond to the work requirements of the staff member while making an appropriate use of the existing inventories [8].

The permit module shown in Figure 4 contains such information as permit identification, date issued, building where work is to the performed, permit expiration date and a column for management approval among others. The permits are also documented electronically as they are being issued. Appropriate record is listed in the look-up view of the data grid table, and the detailed view can also be seen by clicking the Detailed-View tab button. More so, the issued permit summary is documented on the home page in order to present an instant knowledge of activities being performed. The permit can be printed after due completion through the permit report wizard. Furthermore, there is a generalized safety instruction included in the permit to be printed alongside with the permit. The instructions are understood by the receiver of the permit and any observe violation of the instruction will lead to the withdrawal of the permit with an immediate stoppage of operation or as the management specifies.

Figure 4: Work Request Module

PARTS AND INVENTORY RECORDS MODULE

The parts and inventory records module in Figure 5 is designed for inventory control purposes. Here, part information such as parts description, part number, manufacturer name etc are recorded. It is also possible to setup stock levels for the inventory items as well as storage locations. After the completion of a task, the part used will be deducted from the initial quantity in stock to give the stock balance and this will ensure accurate record of inventories.

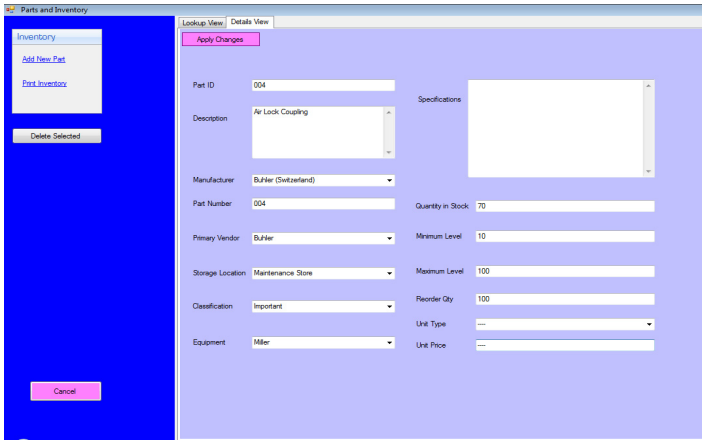

Figure 5: Parts and Inventory Record Module

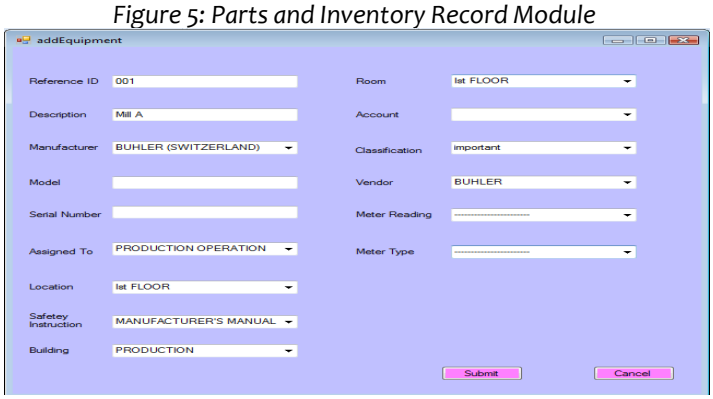

Figure 6: Equipment Record Module

EQUIPMENT RECORD MODULE

The Equipment Record Module in Figure 6 is where information on equipment and other assets are recorded. Information such as asset numbers, warranty information, leasing information, etc, can be maintained. With the Equipment Log feature, a complete record of equipment history is kept. This include the date it was installed and maintenance performed and the equipment history with the associated notes can be printed whenever required.

ADD PARTS AND LABOUR MODULE

Only the management of the company has access to the planner module shown in Figure 7. It is used to delegate work responsibilities to workers. Employees will therefore be able to view the schedule work on the data grid table

at the first view of the home page and thus know what they are expected to do. The whole scheduled work can be printed for record purposes through the maintenance planner report.

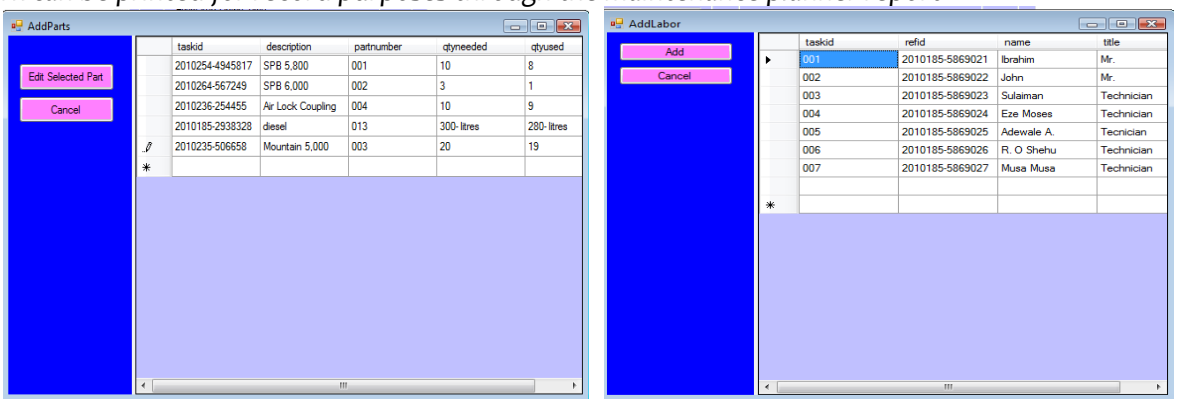

Figure 7: Add parts and add labour

SAFETY MANAGEMENT MODULE

This safety management module in Figure 8 fully track and analyze accidents in the work place. The report help to identify where recurring types of accidents occur, thereby assisting in the subsequent prevention of the problem. The module contains the accident report and the Witness Report. The accident report contains general information such as employee information (name, sex etc.), incident details (accident type, nature of damage etc.), medical details (treatment provided, risk evaluation etc.), accident causes, action-reviewed and investigations carried out. There is also the witness report wizard to track the actual circumstance of the incident and the whole record is stored in the database.

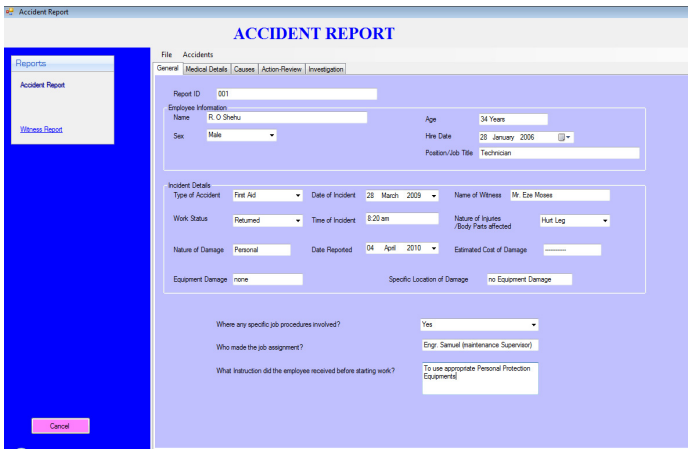

Figure 8: Safety Management Module

CLIENT'S RECORD MODULE

Accurate recording of clients and business partners' information is important as it facilitates all time business transactions that promote business operations. This module in Figure 9 contains information about clients' details such as; company name, bank account details, contact address, telephone number, fax, email and company's websites among others.

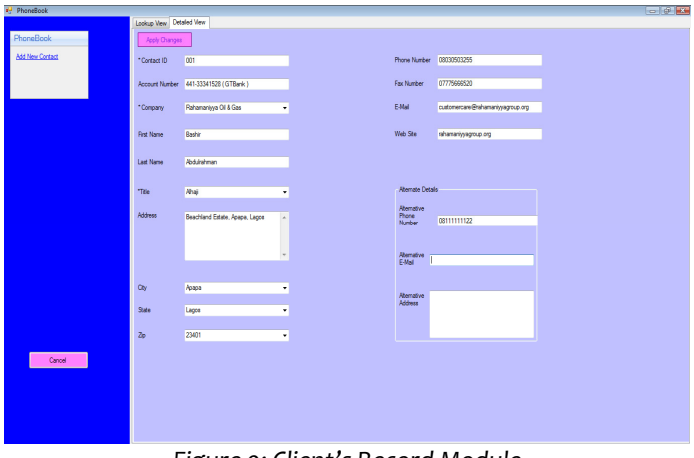

Figure 9: Client's Record Module

DISCUSSION OF RESULTS

A major setback to the appropriateness of paper form of maintenance planning and job scheduling is the absence of a means of reminding the management on the inventory stock level. This usually becomes a problem when the stock level becomes zero and as such, all industrial production seizes, an unpleasant scenario that every industry strives to prevent as they plan to operate on zero downtimes as much as possible. This program was written and tested with appreciable success as part of the effort aimed at reducing industrial operation stoppages and plant downtimes. It was designed to run on a local network but can be improved upon as a web based application.

CONCLUSIONS

Effectively planning for future actions help in achieving goals in the most efficient and effective manner. It minimizes costs and reduces risk and missing opportunities. It can also increase the competitive edge of an organization. This work utilized the knowledge of computer programming to develop a plant maintenance planning and scheduling interface to coordinate industrial work operations.

The program was developed with simple, friendly look-up screens and appropriate buttons as guide that aid the planning and scheduling of plant maintenance operations. More importantly, with a means of deducting used stocks from the inventory record so as to remind management of rate of stock usage. Thus, the risk of downtimes or operation stoppages resulting from shortage of consumables or parts is greatly reduced.

REFERENCES

[1.] *Ajao K.R and Ajimotokan H.A (2010), Computer Application for the Maintenance Management of Hydropower Plant. Technical Transactions of National Centre for Hydropower Research and Development, University of Ilorin, Nigeria, Vol.1, pp.126-137*

[2.] *Umar M. Al-Turk, (2009), Handbook of Maintenance Management and Engineering, Springer London, (accessed on 20/04/2010), Available online at http://SpringerLink-Book Chapter.htm*

[3.] *Maintenance planning and scheduling article, book and invent information, (accessed on 20/04/2010), Available online at http://Maintenance planning and scheduling article, book and event information.htm*

[4.] *Jooste J. L., (2007), Maintenance Performance in the South African industry, South African Journal of Industrial Engineering, Pragma Africa, South Africa, pp 1-9.*

[5.] *Dangote Flour Mills (2008), DFMPLC Ilorin Monthly/Quarterly/Bi-annually/Annually Maintenance Schedule*

[6.] *MERT BAL., (2004), Fundamentals of computing lecture notes (CMPE 106), chapter 1" writing your first program", Eastern Mediterranean University*

[7.] *Maintenance Coordinator, Simplicity Software Technologies Inc, (Accessed on 10/11/2009), Available online at http://www.cordinator/maintenance_coord.htm*

[8.] *Issa W.A, (2010), Development of Maintenance Planning and Scheduling Interface for Dangote Flour Mills, Ilorin. Unpublished B.Eng. Thesis, Department of Mechanical Engineering, University of Ilorin, Nigeria*

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