

# MAINTENANCE MANAGEMENT PROGRAMME FOR SMALL SCALE INDUSTRIES

*Dr. Aniekan Offiong*

## **Abstract**

The basic essentials of a planned maintenance system for industries are presented and the benefits expected from such a system highlighted. A description of a planned programme of maintenance management suitable for small-scale industries in Nigeria is given with emphasis on asset, work, record and spares inventory control procedures. The paper also presents the development of computer software for the control and support of the proposed maintenance management programme.

## **Introduction**

The main reason for setting up any industry is to make profit. Profit making though directly the concern of the production function depends decisively on the efficiency of the maintenance function (Offiong, 1993). The maintenance function is not subservient to the production function. All the manufacturing activities that take place within the industry can only be effective if there is a two-way co-operation between the maintenance and the production function. Maintenance is absolutely essential if plant, machinery and equipment are to remain in acceptance condition and ready for use when they are required. The decision is never whether maintenance should take place, but the form it should take to make it economically effective (Koboa-Aduma, 1991). Thus, maintenance like any other economic activity is subjected to planning.

A lot of definitions have been given to what maintenance is all about. Ofodile (1991) defines maintenance as being concerned with the day-to-day problems of keeping the physical plant in good operating condition according to standards set by management. Mont (1982) sees maintenance as any activity designed to keep equipment or other assets in working condition. While Norman (1972) defines maintenance as any activity undertaken in order to keep or restore every facility to an acceptable standard and may be planned or unplanned. One thing common among all the definitions is that they all imply that maintenance in broad sense can be taken as the combination of all technical and associated administrative action intended to retain an item in, or restore it to, a state in which it can perform its required function. A study of existing maintenance systems is very important before proceeding to develop any new maintenance management programme. A lot of research attention has been given in literature to the development of systems for the maintenance of equipment. Systems have been developed to cover preventive maintenance (Handlaraski, 1980); Corrective Maintenance (Federgruen and So, 1990); replacement (Nakagawa and Kowada, 1983); condition monitoring (Nwachukwu, 1994); and maintenance inventory (Mitchell, 1962; and Smith et al, 1980). Also the development of computerized

maintenance package has been the subject of much research since when the microcomputer became popular. For details see Offiong (1993).

## **Classification Of Maintenance**

Following Onwoiazo (1989) and Koboa-Aduama (1991) the practice of maintenance can be broadly classified into two major categories, namely, unplanned and planned maintenance. Unplanned maintenance is- the type of maintenance service that is generally used to tackle failure that has not been foreseen and to which no

advance thought has been given. Planned maintenance is not a specific form of maintenance, but rather the application of maintenance tackled in scientific manner (Onwuazo, 1989). It is maintenance work organized and carried out with fore-thought, control and records. Usually a study and analysis of the records will show the trend of the maintenance activities.

### **The Basic Essentials Of A Planned Maintenance Programme**

According to Offiong (1993) the fundamental basis of any planned maintenance system is deciding in advance:

1. The individual items of plant and equipment to be maintained.
2. The forms, method and details of how each item is to be maintained.
3. The tools, replacements, spares, trademen and time that will be required to carry out this maintenance.
4. The frequency at which these maintenance operation must be carried out.
5. The method of administering the system.
6. The method of analyzing the results.

In order to express these basic essentials of planned maintenance in a manner that will form the structure of a practical system, it is suggested there must be a schedule of all the plant and equipment to be maintained; a complete schedule of all the individual tasks that must be carried out on each item of plant, a programme of events indicating when each task must be carried out; a method of ensuring that the work listed in the programme is carried out and a method of recording the results and assessing the effectiveness of the programme.

### **The Benefits Of A Planned Maintenance Programme**

The introduction of planned maintenance scheme in an industry will involve time, money and considerable amount of hardwork. It has been shown from many sources that the benefits obtained from planned maintenance are far in excess of the cost if the planned maintenance is well designed. The benefits expected by this means of maintenance according to Offiong (1993) and Kobo-a-Aduama (1991) are:

1. That forced stoppages are reduced, any stoppages which occur, do so at planned intervals.
2. Production plans may thus be readily met, with allowance already made for plant stoppage.
3. Maintenance labour may be used more economically, the planned stoppage being so regulated that a steadier work load is applied to the maintenance labour force.
4. Ensuring the collection, record and subsequent interpretation of maintenance data whose benefit on analysis can be evident in the form of improved budgetary and spare stock control.
5. As a result of the above, production and maintenance overtime payment may be reduced.

### **Planned Maintenance Management Programme for Small Scale Industries**

No matter how sophisticated, simple, large or small the system is, some basic components are common to all, though depending upon the individual circumstances the form they take or the manner in which they are used may differ in each case. Thus for small scale industries in Nigeria the suggestion of Kobo-a-Aduma (1991) and Offiong (1993) on how to introduce a planned maintenance management programme can be reduced to the recommendations presented in the subsequent sections under the headings:

1. Asset control in a planned maintenance programme; Work
2. control in a planned maintenance programme; Record control in
3. a planned maintenance programme; and Spares inventory
4. control in a planned maintenance programme.

The recommendations given in this work though designed to meet the needs of most small scale industries in Nigeria are only to serve as building blocks for the actual system to be designed to meet the real life situation.

Even though it might seem to most engineers that there is nothing essentially complicated in the introduction of a planned maintenance system in a company, advice from those who have been involved with introducing planned maintenance will ensure that the benefits of planned maintenance are obtained as quickly as possible. Also experience is of considerable help in ensuring that the degree of complexity and comprehensiveness chosen matches the requirement of the company. The best people to consult for this kind of work are Industrial Engineering Management Consultants, preferably those who have advised on the planning of maintenance work in a wide variety of industries.

### **Asset Control In A Planned Maintenance Programme**

The first step in formulating the maintenance programme of a small scale industry is to draw up a comprehensive list of all items requiring maintenance from the record of all equipment owned by the company. This list should include production plant and machinery, buildings and structure, auxiliary equipment, transport and all the fixed physical assets of the company. In as much as the exact nature of the physical register will depend on the type and size of the organization concerned, Offiong (1993) has suggested that there are certain basic items of information in respect of each item which should be included. These are identification, location, description of facility, type, priority rating and essential spares.

### **Work Control In A Planned Maintenance Programme**

For each item of plant or major operating component, it is necessary that we establish how it is to be maintained. This is often done by preparing a maintenance schedule, which is a comprehensive lists of all the necessary maintenance tasks (inspection, lubrication, adjustment, component replacement, overhauls, etc) and intervals at which they should be carried out. The maintenance schedule consists of individual sheet, card or a set of sheets/cards for each item in the asset register. In as much as the maintenance schedule will depend on the maintenance task/item concerned. Offiong (1993) has suggested that there are certain basic items of information in respect of each maintenance task which should be included in any maintenance schedule. These are: -

1. Name and item number of the equipment involved.
2. Time, trademen, tools, spares and safety measures required for the execution of the maintenance task.
3. Frequency, and procedures of the maintenance task.

After the establishment of a maintenance schedule the next stage in drawing up any maintenance work control procedure will be the establishment of maintenance calendar which allocates each specific maintenance task to a specific time or period of the year. It is usually a wise decision to include only few tasks in the calendar initially, and then as experience is gained the number of tasks covered by the calendar can gradually be increased.

### **Record Control in A Planned Maintenance Programme**

A record of all the maintenance work done on each item of plant is known as plant history. Apart from the basic details of name, identification number, location, etc, the precise range of information to be recorded in plant history record will depend upon the type of facility involved. Offiong (1993) suggested that in most cases it is enough to record, such details as:-

1. Inspections, servicing, repairs and adjustments made with dates/duration of tasks.
2. Breakdown and failures, their causes, their results, and corrective action carried out with dates and duration.

There are a number of ways in which plant history can be presented, but whatever method is used the presentation should be simple to enable the pattern of events be seen clearly. Where possible it should have facilities for "before and after" comparisons. For continuity the plant history sheet should have sufficient space to record information for several years.

### **Spares Inventory Control In A Planned Maintenance Programme**

For any industry to successfully carry out its maintenance function, it must give serious consideration to the operation of an up-to-date and well organized maintenance store which is stocked with all necessary spares/materials. Adequate control and security procedures should be employed and proper records kept so as to enhance good control over stock. Normally, maintenance items are classified into three classes - Class A, Class B and Class C, Class A items are assembled parts of machines which are often called spare equipment and are usually costly. Class B are insurance items which do not have established turnover, but are readily available to avoid costly production shut down; while Class C items are standard store items such as electrodes, valves, bolts and nut with an approximately known requirement. Class A and Class B items are generally considered as slow-moving spares while Class C items are considered as fast-moving spares. Fast-moving spares are usually amenable to control by conventional inventory control methods (see Harper, 1982; Oguejiofor, 1990; and Offiong, 1993). Because of the difficulties encountered in the estimation of requirement and run-out cost, slow-moving spares are usually not amenable to control by conventional inventory control methods. It has been shown from many sources that for a slow-moving spare the decision on stock-holding policy will be either to hold bought, one or two. Seldom will the stock-holding policy of a slow moving spare be three or more. With this assumption following an approach similar to Mitchell (1962) slow-moving spares can be classified as either adequate warning spares or stand-by spares and control procedures recommended as follows:

1. For an adequate warning spares the holding should be bought but order should be made as soon as the warning is noticed.
2. For a stand-by spares the holding should generally be one but could be made two if there has been a history of run-out with the policy of one.

### **Software Development**

A computer software for the control and support of the maintenance management programme proposed above for small scale industries is presented in the appendix. The development of the maintenance management software follows an approach similar to Offiong (1993). The maintenance management programme which is written in Basic is divided into four main modules namely -asset control, work control, record control and spares inventory control. This software is called Kan Maintenance Management Programme for small scale

industry

The asset control module is put together to draw up a comprehensive list of all the items requiring maintenance and to state for each of these items the identification number; location; description of the facility; type; priority rating and essential spares.

The work control module is put together to draw up a comprehensive list of all the necessary maintenance tasks and to state for these tasks the interval at which they should be carried out. Also this module states for each of the maintenance task tradesmen, tools, hours, spares procedures, and safety measures required.

The record control module is put forward to record, such details as inspection, servicing, repairs and adjustments made with dates/duration of tasks. It also records breakdown and failures, their causes, their results, and corrective action carried out with dates and duration.

The spares inventory module is put together to create record for any inventory item, add to an items stock, subtract from an items stock, display all items below minimum stock level, and display all items above maximum stock level. The module also displays inventory data for an item which will include its description, quantity in stock, minimum stock level, maximum stock level, and price per unit.

## **Conclusion**

There is no doubt that maintenance play a central role in any industry. Comprehensive planning and organization of the maintenance function is necessary, as maintenance practice has developed with sophistication of manufacturing and service plants and equipment to management level. This paper has given a detail description of a planned maintenance management programme suitable for any small-scale industrial organization. The paper has also presented a computer software for the control and support of the proposed planned maintenance management programme. This software is capable of being tailored to suit the individual requirement of most small scale industries in Nigeria.

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## APPENDIX

### KAN MAINTENANCE MANAGEMENT PROGRAMME FOR SMALL SCALE INDUSTRIES

10CLS

20 A\$=" ":B\$=" ":D\$=" ":E\$=" ":A=0 :B=0 :C=0 :D=0 :E=0 :P\$=" "

30 p\$ = » \*\*\* MAINTENANCE MANAGEMENT PROGRAM\*\*\*<sup>11</sup>

40 FOR I = 1 TO LEN (P\$) : COLOR 23

50 LOCATE 5,23:PRINT RIGHT \$ (P\$,I) : SOUND 150,,5

60 SOUND 500,,5

70NEXTLCOLOR7

80AS-CHR\$(178):B\$=CHR\$(218):C\$=CHR\$(191):D\$(192)

90E\$=CHR\$(217):F\$=CHR\$(196):G\$=CHR\$(197)

100 PRINT TAB(20)B\$+STRING\$(31,F\$)+CS

110FORJ=1TO7

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120 PRINT TAB(20):G$:TAB(52):G$
130 FOR K = 1 TO 100:NEXT K:NEXT J
140 PRINT TAB(20):D$STRING$(31,F$)+E$
150 LOCATE 9,25 :PRINT"ANIEKAN OFFIONG MAINTENANCE"
160 LOCATE 10,25:PRINT"PROGRAM DESIGNED IN 1998"
170 LOCATE 11,25:PRINT"AT THE DEPT. OF MECHANICAL "
180 LOCATE 12,25:PRINT"ENGINEERING, UNIVERSITY OF"
190 LOCATE 13,25 :PRINT"UYO, NIGERIA"
200 LOCATE 22,25:COLOR 23
210 PRINT "PRESS SPACE BAR TO CONTINUE"
220 COLOUR 7:1$ = INPUTS(1)
230 IF 1$ <> CHR$(32) THEN BEEP:GOTO 200
240 CLS: DISPLAY OF THE OPENING MENU
250 H$ CHR$(219)+CHR$(219):L$ - CHR$(219):L1$ = CHR$(178)
260 LOCATE 3,28: COLOR 23
270 PRINT H$+"O PENING MEN U"+H$:COLOR 7
280 LOCATE 5,15 :PRINT STRING$(51,L1$)
290 FOR T= 1 TO 7
300 PRINT TAB(5) L1$ TAB(65) :L1$
310 FOR K = 1 TO 100 :NEST K : NEXT T
320 PRINT TAB(15):STRING$(51,L1$)
330 LOCATE 7,20 : PRINT " 1. ASSET CONTROL "
340 LOCATE 9,20 : PRINT ' 2. WORK CONTROL"
350 LOCATE 11,20: PRINT ' 3. RECORD CONTROL "
360 LOCATE 13,20: PRINT ' 4. SPARES INVENTORY CONTROL"
361 LOCATE 15,20: PRINT ' 5. QUIT THE
PROGRAM " 370 LOCATE 20,15: INPUT
"SELECT YOUR CHOICE [1 -4]: ",SYC 380 IF SYC > 4 OR SYC < 1 THEN
BEEP :GOTO 370 390 ON SYC GOTO 400, 1010, 2010, 2660

400 CLS:REM ASSETS
410 CLS : "LOCATE 5,15:COLOR 23: PRINT"*** ASSETS REGISTER**"
:COLOR 7
420 LOCATE 7,10: PRINT STRINGS (41,L$)
430 FOR L = 1TO7
440 PRINT TAB(10);L$; TAB(50);L$
450 NEXT L
460 PRINT TAB(10); STRINGS (41,L$)
470 LOCATE 9,15: PRINT" ASSET PROVIDES "
480 LOCATE 10,15: PRINT" FACILITIES TO RECORDS, ALL DETAILS"
490 LOCATE 11.15: PRINT" OF EACH ASSET"
500 LOCATE 12,15: PRINT" LOCATION, TYPE AND"
510 LOCATE 13,15: PRINT" ESSENTIAL SPARES"
520 LOCATE 22,25: PRINT" PRESS SPACE BAR TO CONTINUE"
530 DCP$ = INPUT$(1) : IF IKP$ <> CHR$(32) THEN BEEP:GOTO 3060
540 CLS: LOCATE 1,15: PRINT "1. ASSET CREATION"
550 LOCATE 3,15: PRINT "2. ASSET VIEW"
560 LOCATE 5,15: PRINT "3. EXIT TO OPENING MENU"
570 LOCATE 7,15: INPUT "ENTER SELECTION [Q - 9]: ", ENSE
580 IF ENSE > 3 OR ENSE < 1 THEN BEEP: LOCATE 8,15:
PRINT "INVALID SELECTION": T = 1 TO 5000: NEXT:
LOCATE 10,15: PRINT CHSR& (6); GOTO 570 590 ON ENSE GOTO
600, 770, 270 600 CLS: REM ASET CREATION 610 OPEN "asrg.bas" FOR

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OUTPTU AS #1 620 LOCATE 5,30: PRINT ASSET CREATION" 630
LOCATE 6,15: INPUT "ENTER TOTAL NUMBER OF ASSETS" 640
PRINT #1,C: FOR TA - 1 TO C
650 LOCATE 7,30: INPUT 'ENTER CODE1, CE$ = PRINT #1, CE$ 660 LOCATE
8,1:INPUT "ENTER NAME OF EQUIPMENT ",NM$ :PRINT #1,IM$
670 LOCATE 8,40:INPUT "ENTER ITEM NUMBER", NM$:PRINT #1,IM$
680 LOCATE 9,1:INPUT "ENTER PRIORITY RATING ",PT$ :PRINT #1,IN$
690 LOCATE 9,27: INPUT "ENTER TYPE OF EQUIPMENT",RD$ :PRINT
#1,IN$
700 LOCATE 9,54: INPUT "ENTER LOCATION OF EQUIPMENT",PM$
:PRINT#1,PM$
710 LOCATE 10,1: INPUT "ENTER ESSENTIAL SPARES" :,INS :PRINT
#1,WAS$
720 PRINT
730 CLS
740 NEXT TA
750 CLOSE #1
760 GOTO 3410

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770 CLS: REM ASSET VIEW
780 LOCATE 5,15 :PRINT "ASSET VIEW"
790 LOCATE 6,15 :INPUT "ENTER CODE OF ASSET REQUIRED ",AR$
800 OPEN "asrg.bas" FOR INPUT AS #1
810 INPUT #1,C
820FOR TA - 1 TO C
830 INPUT #1,CE$, NM$, PTS, PM$, INS, WAS, BR$
840 IF AR$ = CE$ THEN 890
850 NEXT TA
860 CLOSE #1
870 BEEP : LOCATE 9,20 :PRINT "ASSET NOT IN FILE"
880 LOCATE 9,20 :PRINT CHR$(6) :GOTO 3410
890 CLOSE #1
900 LOCATE 7,30: PRINT "ASSET CODE ", AR$
910 LOCATE 8,1: PRINT " NAME OF EQUIPMENT ",NM$
920 LOCATE 8,40: PRINT "ENTER ITEM NUMBER ", IMS
930 LOCATE 9,1: PRINT "ENTER PRIORITY RATING ",PT$
940 LOCATE 9,27: PRINT "ENTER TYPES OF EQUIPMENT ",TE$
950 LOCATE 9,54 PRINT "ENTER LOCATION OF EQUIPMENT",LE$
960 LOCATE 10,1: PRINT "ESSENTIAL SPARES",ES$
970 LOCATE 23,20: PRINT "PRESS SPACEBAR TO CONTINUE"
980A$ = INPUT$(1)
990 IF A$ <> CHR$(32) THEN BEEP: GOTO 970
1000 CLS: GOTO 3410
1010 CLS :REM *** WORK CONTROL MODULE ***
1020 CLS : DISPLAY OF WORK CONTROL MENU
1030 LOCATE 5,20: COLOR 23: PRINT "WORK CONTROL MODULE"
1040 COLOUR 7
1050 LOCATE 7,15: PRINT B$ + STRING$(31,F$) + C$
1060FOR I= 1 TO 7
1070 PRINT TAB(15): G$: TAB(52) G$
1080 FOR J = 1 TO 100 : NEXT J:: NEXT I
1090 PRINT TAB(15) :D$ + STRING$(31,F$) +E$
1100 LOCATE 8,15: PRINT " 1.CREATE PREVENTIVE MAINTENANCE

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SCHEDULE"
1110 LOCATE 9,15: PRINT " 2.VIEW WORK REQUEST"
1120 LOCATE 10,15:PRINT " 3.CREATE SCHEDULE OF JOBS"
1130 LOCATE 11,15:PRINT  4.VIEW WORK SCHEDULE "
1140 LOCATE 12,15:PRINT  5.EXIT TO OPEN MENU "
1150 LOCATE 22,15:INPUT "ENTER
SELECTION": SECTN
1160 IF SECTN > 5 OR SECTN < 1 THEN BEEP: GOTO 1150
1170 CLS
1180 ON SECTN GOTO 1200, 1420, 1690, 1830, 1960
1190 DIM

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```

FQS(TNUM),TRQ$(TNUM),TIMRQ(TNUM),LBQ$(TNUM),LC(TNUM),CD
S
(TKUM),SP$(TNUM),CSP(TNUM),PR$(TNUM),SF$(TNUM),ITN$(TNUM)
3
DAS$(TV),CO$(TV),NE$(TV),PE$(TV,N),LAS(TV,N),CE$(C),NM$(C),IM$(
C
),PT$(C),PM(C),IN$(C),WAS(C)E$(,ND),EP$CND)
1200 'PREVENTIVE MAINTENANCE SCHEDULE'
1210 OPEN "prvrnn,bas" FOR OUTPUT AS #1
1220 LOCATE 6,10: INPUT "ENTER TOTAL NUMBER OF PREVENTIVE
MAINTENANCE"
1230 PRINT #1,TNUM
1240FORI=1TOTNUM
1250 LOCATE 7,1: INPUT "ENTER CODE ", CD$:PRINT #1,CD$
1260 LOCATE 7,40: INPUT "ENTER NAME OF EQUIPEMENT
",NE$PRINT
#1,NE$
1270 LOCATE 8,1: INPUT "ENTER ITEM NUMBER MTN:PRINT #,ITN$
1280 LOCATE 8,40: INPUT "ENTER FREQUENCY ",FQ:PRINT #1,FQ
1290 LOCATE 9,1:INPUT "ENTER TIME REQUIRED " TIMRQ:PRINT
#1,FQ
1300 LOCATE 9,27:INPUT "ENTER COST OF SPARES ", CSP:PRINT
#1,CSP
1310 LOCATE 9,54: INPUT "ENTER LABOUR COST ",LC:PRINT #1,LC
1320 LOCATE 10,1: INPUT "ENTER LABOUR REQUIRED ",LBQ$:PRINT
#1,LBQ$
1330 LOCATE 12,1: INPUT "ENTER TOOLS REQUIRED ",TRQ$:PRINT
#1,TRQ$
1340 LOCATE 14,1: INPUT "ENTER SPARES REQUIRED :,SP$:PRINT
#1,SP$
1350 LOCATE 16,1: INPUT "ENTER SAFETY MEASURES ",SF$:PRINT
#1,SF$
1360 LOCATE 19,1: INPUT "ENTERPROCEDURES ", PRS:PRINT #,PR$
1370 PRINT :CLS
1380 TC=C*TIMRQ+CSP
1390 NEXT TI
1400 CLOSE#1
1410 GOTO 1010
1420 REM WORK REQUEST
1430 CLS: LOCATE 5,15: PRINT "WORK REQUEST "
1440 LOCATE 7,15: INPUT "ENTER WORK REQUIRED",WR$

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1450 OPEN "prvm.bas" FOR INPUT AS #1
1460 INPUT #1,TNUM
1470 FOR TI- 1 TO TNUM
1480 INPUT#1,
CDS^ESITNS^QJIMRQ^SP^C^BQS.TRQS.SPS^FS^RS
1490 IF WR$=CD$ THEN 1540
1500 NEXT TI
1510CLOSE#1

1520 BEEP : LOCATE 9,20: PRINT" WORK REQUIRED NOT IN FILE "
1530 LOCATE 9,20,:PRINT CHR$(6): GOTO 1010
1540 CLOSED!
1550 LOCATE 7,40: PRINT "NAME OF EQUIPMENT ":NES$
1560 LOCATE 8,1: PRINT "ITEM NUMBER ": ITO$
1570 LOCATE 8,40: PRINT " FREQUENCY ":FQ$
1580 LOCATE 9,1: PRINT "TIME REQUIRED " :TIMRQ
1590 LOCATE 9,27: PRINT "COST OF SPARES ":CSP
1600 LOCATE 9,54:PRINT "LABOUR COSTS ":LC
1610 LOCATE 10,1:PRINT "LABOUR REQUIRED ":LBQ$
1620 LOCATE 12,1:PRINT "TOOLS REQUIRED ":TRQ$
1630 LOCATE 13,1:PRINT "SPARES REQUIRED ":SP$
1640 LOCATE 15,1:PRINT "SAFETY MEASURES ":SF$
1650 LOCATE 18,1:PRINT "PROCEDURES ";PR$
1660 LOCATE 6,30:PRINT "MAINTENANCE COST ":TC
1670 LOCATE 23,20: PRINT "PRESS ANY KEY TO CONTINUE"
1680 CLS: GOTO 1010
1690 REM CREATE SCHEDULE OF JOBS
1700 OPEN "jbsch.bas" FOR OUTPUT AS #1
1710 CLS : LOCATE 4,10 : PRINT" SCHEDULE JOBS "
1720 DIM CO$(I), NA$(I), PE$(I), LASS$(I)
1730 LOCATE 5,10: INPUT "ENTER TOTAL WORK
SCHEDULE":TV"PRINT #1, TV
1740 FOR V=1 TO TV
1750 LOCATE 6,35:INPUT "ENTER DATE":DAS$:PRINT #1,DAS$
1760 LOCATE 7,20;INPUT "ENTER NUMBER OF JOBS SCHEDULED FOR
THE DAY":N
1770 PRINT #1,N:FOR 1=1 TO N
1780 LOCATE (S+3*(I-1)),1;INPUT "ENTER CODE":CO$:PRINT #1,CO$
1790 LOCATE (8+3*(I-1)),40:INPUT "ENTER NAME OF
EQUIPMENT":NA$:PRINT #1,NE$
1800 LOCATE (9-J-3*(M)), 1 .INPUT "ENTER PERSONS
INVOLVED":PE$:PRINT #1,PE$
1810 LOCATE (9+3*(I-1)),40:INPUT "ENTER LOCATION OF
JOB":LA$PRINT#1,LA$
1820 NEXT I
1830 CLS: REM WORK SCHEDULE
1840 NEXT V
1850 CLOSE #1
1860 LOCATE 7,20:PRINT "NUMBER OF JOBS SCHEDULED FOR THE
DAY":N
1870 FOR 1=1 TON
1880 LOCATE (S+3*(I-1)),1:PRINT "CODE":SPC(2) CO$(1)
1890 LOCATE (8+3*(I-1)),40:PRINT "NAME OF EQUIPMENT":SPC(2)

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NA\$(1)

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1900 LOCATE (9+3*(I-1)),1:PRINT "PERSONS INVOLVED":SPC(2) PE$(1)
1910 LOCATE (9+3*(I-1)),40:PRINT "LOCATION OF JOB":SPC(2) LAS(1)
1920 NEXT I
1930 LOCATE 22,20: COLOR 23 :PRINT "PRESS SPACE BAR TO
CONTINUE"
1940 A$=INPUT$(1):IF A$ <>" " THEN BEEP : GOTO 1980
1950 CLS: GOTO 1010
1960 EXIT TO OPENING MENU
1970 CLS : LOCATE 10,15:INPUT "ARE YOU SURE? [Y/N]":YN$
1980 IF YN$ = "Y" OR YN$ <= "y" THEN 270
1990 IF YN$ = "N" OR YN$ \ "n" THEN 1010
2000 SCREEN 2:SCREEN 0: CLS
2010 REM RECORD CONTROL MODULE
2020 CLS: LOCATE 5,15: COLOUR 23: PRINT "*** RECORD CONTROL
***": COLOUR 7
2030 LOCATE 7,10: PRINT STRINGS (41,L$)
2040 FOR L - 1 TO 7
2050 PRINT TAB(IO); L$; TAB (50); LS
2060 NEXT L
2070 PRINT TAB (10); STRING $ (41,L$)
2080 LOCATE 9,15: PRINT "RECORD PROVIDES"
2090 LOCATE 10,15: PRINT "FACILITIES TO RECORD ALL DETAILS"
2100 LOCATE 11,15: PRINT "OF EACH ASSET"
2110 LOCATE 13,15: PRINT "HISTORY OF"
2120 LOCATE 22,15: PRINT "SPACE BAR TO CONTINUE"
2130 IKP$ = INPUT $(1): IF IKP$<> CHR$(32) THEN BEEP:
GOTO 2120
2140 CLS: LOCATE 1,15: PRINT "1. RECORD CREATION" 2150
LOCATE 3,15: PRINT "2. RECORD VIEW" 2160 LOCATE 5,15:
PRINT "3. EXIT TO OPENING MENU" 2170 LOCATE 7,15:
INPUT "ENTER SELECTION [1-3]: ",ENSE 2180 IF ENSE > 3 OR
ENSE < 1 THEN BEEP:
LOCATE 22,15: PRINT "INVALID SELECTION": T = 1 TO 5000: NEXT T:
LOCATE 22,15: PRINT CHSR$(6): GOTO 2170
2190 ON ENSE GOTO
2200,2390, 1960
2200 CLS: REM RECORD CREATION 2210 OPEN "asrg.bas" FOR
OUTPUT AS #1 2220 LOCATE 5,30: PRINT "RECORD CREATION"
2230 LOCATE 6,15: INPUT "ENTER TOTAL NUMBER OF ASSETS"
2240 PRINT #1,C : FOR TA = 1 TO C 2250 LOCATE 7,30: INPUT
"ENTER CODE", CE$: PRINT #1,CE$

2260 LOCATE 8,1 : INPUT "ENTER NAME OF EQUIPMENT", NMS:
PRINT
#1,NM$
2270 LOCATE 8,40: INPUT "ENTER ITEM NUMBER", NM$: PRINT
#1JM$
2280 LOCATE 9,1 : INPUT "ENTER SERVICING", PT$: PRINT #1,IN$
2290 LOCATE 9,27: INPUT "ENTER REPLACEMENT DATE";RD$:
PRINT
#1,RD$
```

```
2300 LOCATE 9,54: INPUT "ENTER PREVENTIVE
MAINTANANCE",PM$:
PRINT #1,PM$
2310 LOCATE 10,1: INPUT "ENTER INSPECTIONS", INSS: PRINT
#1,INSS$
2320 LOCATE 13,1: INPUT "ENTER WARNING", WA$: PRINT #1,WAS$
2330 LOCATE 15,1: INPUT "ENTER BREAKDOWN WITH DATES
CAUSES
AND DURATION": PRINT #1,BR$
2340 PRINT
2350 CLS
2360 NEXT TA
2370 CLOSE #1
23 80 GOTO 2000
2390 CLS: REM RECORD VIEW
2400 LOCATE 5,15: PIUNT "RECORD VIEW"
2410 LOCATE 6,15: INPUT "ENTER CODE OF ASSET REQUIRED",AR$
2420 OPEN "asrg.bas" FOR INPUT AS #1
2430 INPUT #1,C
2440 FORT A=1 TO C
2450 INPUT #1,CE$, NM$,PT$,IN$,WA$,BR$
2460 IF AR$ = CE$ THEN 2520
2470 NEXT TA
2490 CLOSE #1
2500 BEEP: LOCATE 9,20: PRINT "RECORD NOT IN FILE"
2510 LOCATE 9,20: PRINT CHR$(6): GOTO 2500
2520 CLOSE #1
2530 LOCATE 7,30: PRINT "ASSET CODE", AR$
2540 LOCATE 8,1 : PRINT "NAME OF EQUIPMENT", NMS
2550 LOCATE 8,40: PRINT "ITEM NUMBER", IMS
2560 LOCATE 9,1 : PRINT "SERVICING", SE$
2570 LOCATE 9,27: PRINT "REPLACEMENT DATE", RD$
2580 LOCATE 9,54: PRINT "PREVENTIVE MAINTENANCE", PMS
2590 LOCATE 10,1: PRINT "INSPECTIONS", IN$
2600 LOCATE 13,1: PRINT "WARNING", WAS -
2610 LOCATE 15,1: PRINT "BREAKDOWN WITH DATES CAUSES AND
DURATION", BR$
2620 LOCATE 23,20: PRINT "PRESS SPACEBAR TO CONTINUE"
2630 A$ = INPUT$(1)
2640 IF A$ <> CHR$(32) THEN BEEP GOTO 2620
2650 CLS: GOTO 2010
```

```
2660 CLS: STORE CONTROL MODULE
2670 OPEN "R",#1,"INVEN.BAS",44
2680 FIELD #1,1 AS F$, 30 AS D$, 3 AS Q$, 2 AS R$, 2 AS T$, 6 AS P$
2690 PRINT: PRINT "FUNCTIONS11: PRINT
2700 PRINT 1, "INITIALIZATION PROGRAM"
2710 PRINT 2, "CREATION OF FILE PROGRAM"
2720 PRINT 3, "STATE INVENTORY FOR ONE PART"
2730 PRINT 4, "SUPPLY"
2740 PRINT 5, "CONSUMPTION"
2750 PRINT 6, "LIST ALL ITEMS BELOW MINIMUM LEVEL"
2760 PRINT 7, "LIST ALL ITEMS ABOVE MAXIMUM LEVEL"
```

```

2770 PRINT 8, "EXIT TO OPEN MENU
2780 PRINT :PRINT :INPUT "FUNCTION" FUNCTION
2790 IF (FUNCTION < I) OR (FUNCTION > 8) THEN PRINT "BAD
FUNCTION":GOTO 2700
2800 ON FUNCTION GOSUB 3340, 2820, 2980, 3200, 3250, 3410
2810 GOTO 2780
2820 REM BUILD NEW ENTRY
2830 GOSUB 3310
2840 IF ASC(F$) <> 255 THEN INPUT "OVERWRITE";A$: IF A$ <> "Y"
AND A$ <> HEN RETURN
2850 LSET FS = CHR$(0)
2860 INPUT "DESCRIPTION" :DESCS
2870 LSET D$ - DESCS
2880 INPUT "QUANTITY IN STOCK: Q%
2890 LSET Q$ = MKI$(Q%)
2900 INPUT "MIN LEVEL" :R%
2910 INPUT "MAX LEVEL": T%
2920 LSET T$ * MKI$(T%)
2930 LSET RS * MKI$(R%)
2940 INPUT "PRICE PER UNIT": P
2950 LSET P$-MK$(P)
2960 PUT #I,part%
2970 RETURN
2980 REM LIST ENTRY
2990 GOSUB 3310
3000 IF ASC(F$) = 255 THEN PRINT "NULL ENTRY": RETURN
3100 PRINT D$
3120 INPUT "QUANTITY TO SUBTRACT": S%
3130 Q% = CVI(Q$)
3140 IF (Q%-S%) < 0 THEN PRINT "ONLY":Q%:"IN STOCK": GOTO
3120
3150 Q% = Q%-S%
3160 IF Q% = < CVI(RS) THEN PRINT "QUANTITY NOW":Q%: "MIN
LEVEL" :CVI(R%)

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```

3170 LSET Q$ = MKI$(Q%)
3180 PUT #1,PART%
3190RETUN
3200 REM LIST ITEMS BELOW MIN LEVEL
3210 FOR I = 1TO 100
3220 IF CVI(Q$) < CVI(R$) THEN PRINT D$: "QUANTITY": CVI(Q$):
TAB(50):"MIN LEVEL": CVI(R$)
3230 NEXT I
3740 RETURN
3250 REM DISPLAY ITEM ABOVE MAX LEVEL
3260 FOR 1=1 TO 100
3270 GET #1,1
3280 IF CVI(Q#) > CVI(T#) THEN PRINT D$:"QUANTITY": CVI(Q#):
TAB(50):"VEL": CVI(TS)
3290 NEXT I
3300 RETURN
3310 INPUT "PART NUMBER": PART%
3320 IF (PART% < 1) OR (PART% > 100) THEN PPJNT "BAD PART
NUMBER": GOTO LSE GET#1, PART%: RETURN
3330 END
3340 REM INITIALIZATION FILE (106)
3350 INPUT "ARE YOU SURE":B$: IF B$ <> "Y" AND B$ <> "y" THEN
RETURN
3360 LSET F$ = CHR$(255)
3370FORI=1TO 100
3380 PUT #1,1
3390 NEXT I
3400 RETURN
3410 CLS:
3420 LOCATE 5,15:PRINT " EXIT TO OPEN MENU "
3430 LOCATE 10,10: PRINT " ARE YOU SURE [Y/N]: ", YN$
3440 IF YN$ = "Y" OR YNS = "y" THEN 270
3450 IF YNS = "N" OR YNS = "n" THEN 2660
REM QUIT TO SYSTEM
CLS: LOCATE 15,5: INPUT "DO YOU WANT TO QUIT TO SYSTEM
[Y/N]:"YN$
CLS: LOCATE 15,15: "ARE YOU SURE [Y/N]:", YNS
IF YN1$ = "N" OR YN1$ = "n"11 THEN GOTO 270 SYSTEM

```