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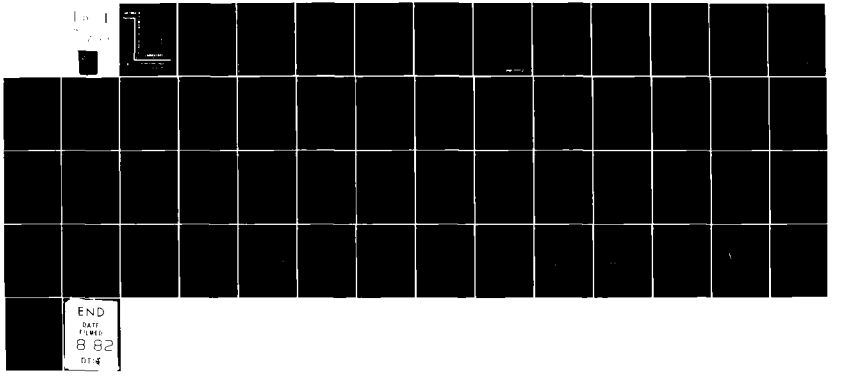

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AIR FORCE HUMAN RESOURCES LABORATORY

MAINTENANCE SUPPORT RESOURCE FORECASTING MODELS: EQUIVALENCE TESTING OF RELIABILITY AND MAINTENANCE MODEL AND EXPECTED VALUES MODEL

By

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June 1982

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Approved for public release: distribution unlimited.

AIR FORCE SYSTEMS COMMAND
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Air Force Human Resources Laboratory has worked with and developed three maintenance support resource forecasting models. They are the Logistics Composite Model (LCOM), Reliability and Maintainability Model (R&M), and the Expected Values Model (EVM). The objective of this study is to analyze these three models in terms of (a) how they relate to each other, (b) the minimal data requirements of each model, (c) how the models can best be used in the weapon system acquisition process, and (d) whether the models generate roughly equivalent results. In meeting these objectives, all three models were compared in terms of input requirements, method of processing, and output products. Volume I of this paper gives the analytic portion of the study. The results of the equivalence testing for the

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two average value models are included in Volume II. The second volume also contains a final section that discusses the conclusions from the study.

A new average value model should be developed to work in conjunction with LCOM, incorporating the network tracing capability of the EVM and the variety of output of the R&M. This new model should include the average turn-around time computations and outputs for each flightline maintenance network. That could give design engineers an idea of the readiness capability of the weapon system early in the weapon system acquisition process. As soon as a gross level maintenance network is ready for the complete projected weapon system, then the LCOM simulation should be run to check out (a) interaction of maintenance on resource requirements and (b) the overall weapon system readiness capability.

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MAINTENANCE SUPPORT RESOURCE FORECASTING MODELS: EQUIVALENCE TESTING OF RELIABILITY AND MAINTENANCE MODEL AND EXPECTED VALUES MODEL

I. INTRODUCTION

The Air Force Human Resources Laboratory (AFHRL) created the Maintenance Manpower Model which uses the Logistics Composite Modeling (LCOM) simulation software. Also the Laboratory has developed two average value models: the Reliability and Maintainability Model (R&M) and the Expected Values Model (EVM=EXPVAL). These three models basically address the same maintenance support resource needs--humans, spares, and equipment.

Volume I of this technical paper analyzes these three models in terms of (a) how they relate to each other, (b) the minimal data requirements of each model, and (c) how the models can best be used in the weapon system acquisition process (WSAP). This volume II of the technical paper gives the results and recommendations of the study after testing the two average value models. This limited equivalence of output testing is used to help determine whether the models generate roughly equivalent results.

II. TESTING RESULTS BETWEEN AVERAGE VALUE MODELS

The average value models R&M and EVM were run using the same basic *Extended Form 11 data bank.* Due to time and resource constraints, no LCOM tests were made. Furthermore, LCOM uses an operations scenario data input in addition to the maintenance action network which EVM and R&M do not require. (Appendix A includes examples from the R&M and EVM test results.)

One of the main difficulties with studying developing computer models, such as the EVM, R&M, and LCOM, is that any documentation of the models is out of date with the evolution of the program. Fortunately, LCOM is controlled and has stabilized after years of development. The R&M and Reliability, Maintainability, and Cost Model (RMCM) use the same R&M data base as input. RMCM has been developed further than the R&M to incorporate real number crew size input capability per task. Also, there are special versions of the R&M (only available on the Honeywell) that have special additional computation and printout capabilities.

Comment on the two versions of R&M used for this study

During this comparison study, minor modifications to the R&M were made in order to generalize its input and outputs. The first version of the R&M used for the test runs has changes 1 and 2 as listed in the following paragraph. The second version has all three changes. Because of problems described later, the second capability was only used as a crew size input, not for compressing the networks. Because R&M has a common database link with the RMCM, it was important to use the R&M database in the same manner as the RMCM. Another consideration has been that the interactive portion of the RMCM already

exceeds the daytime usage limit of the Aeronautical Systems Division (ASD) Computer Center operating procedures. Therefore, any change which causes an increase in core requirements is detrimental to the usability of the RMCM at ASD.

The following minor experimental adjustments were made to the R&M:

1. The Flight Line Support Equipment computations and printouts were included in the R&M. These were transferred from the specialized Honeywell version of the R&M to the Controlled Data Corporation (CDC) host computer version.

2. The real number crew size input computations were added to the R&M. Care was taken to ensure that the input card fields used for this new data were the same as those already being used on the latest version of the RMCM. Appendix B shows how the real number crew size field can be used to compress several different actions of the same kind into one. The input/outputs of this effort are shown as the first of the two trial runs of the R&M in Appendix A.

The real number crew size allows more complex networks to be compressed into R&M network structure. The maintenance manhours (MMH) for the compressed tasks compare favorably with the uncompressed network in the EVM except where extremes in the values encountered were too great, and where accuracy was lost because of only a three-column input field size. However, the mean time to repair (MTTR) and availability factor values for these compressed task networks are usually incorrect because they do not take into account the weighted crew sizes. Therefore, these two modifications to R&M did not prove to be sufficient. Although the MMH outputs of the modified R&M compare favorably with the MMH of EVM, most of the other output values are incorrect. The core requirement for this version is 125000_4 words on the CDC computer.

3. A second version of R&M was developed and allows more than one input card for the times and probabilities when there is greater than one task of the same kind of action. The previous two changes were retained in this second version. The task times and probabilities on the first card of a subsystem or Line Replaceable Unit (LRU) correspond with the Air Force Specialy Codes (AFSCs) on the first resource card for that subsystem or LRU. The times and probabilities on the second card correspond with the second card of AFSCs for the same subsystem or LRU, etc. This does not significantly change the structure and logic of the program, but it does enhance the outputs greatly. This is seen in the second of the two test runs of R&M input/output (I/O) in Appendix A.

The core requirement for this version is 142000_8 on the CDC. This is no problem for daytime batch jobs, but to include this capability in the RMCM interactive program would push the core requirement beyond any reasonable daytime interactive allotment on the ASD Computer Center CDC.

The results of these trial runs are that the subsystem availability, MTTR, and MMH figures are correct, except for the breakout of the remove/replace (R/R) flight line tasks where there is more than one R/R action represented,

and each action goes to a different shop entry. (See the plot for subsystem DUM1C2=1C200 in Appendix A). In addition, the flightline MMH summaries and cost values per 1000 hours are computed incorrectly because of the inherent method used to summarize values for the MMH per task type.

Table 1 shows a summary of the output results of the equivalence tests. Appendix A gives annotated examples of two of the five subsystems which were run through the EVM and through versions 1 and 2 of the R&M models. Appendix C shows the job flow used on the CDC host computer in order to make the test runs.

Types of Outputs	MMH	Spare Parts Requirements	MTTR	Line Printer Plot of Network	Subsystem Availability	FL SE Utilization	MMH/KFH per AFSC across WS
Model							
EVM	Values good.	Values good.	Doesn't have.	Visual aid shows network logic.	Doesn't have.	Values good.	Values (given per sorties) are good.
R&M Version 1	Values good for compressed network when input values not too extreme.	Doesn't have.	Values wrong for weighted crewsize tasks.	Doesn't have.	Values wrong for weighted crewsize networks.	Values wrong for weighted crewsize networks.	Values good for compressed network when input values not too extreme.
R&M Version 2	Good unless there are separate shop entries, then FL values are wrong.	Doesn't have.	Good unless there are separate shop entries, then FL values are wrong.	Doesn't have.	Values good.	Values good.	Flight Line summary values are wrong, so this output should be taken out of this version.

Table 1 R&M and EVM Test Results

III. DISCUSSION AND RECOMMENDATIONS

Within the limits of the structure of the R&M program logic, the inability to represent multiple parts going to several shops in a summary R/R task cannot be corrected without a great deal of programmer time and computer core expenditure. The error in computing R&M flight line MMH summaries and cost values could probably be resolved with about 40 hours programmer time and a small addition to the core requirement (or 10 hours programmer time and 20000$_8$ additional core requirement). In any case, the second modified version of R&M can be used quite successfully as long as the user is aware of these limitations of the inputs and outputs.

The present R&M should be used with caution by those who need R&M types of output and who want access to the whole Coordinated Human Resource Technology

(CHRT). (Volume I of this technical paper, Figure 1, and Reference 4 provide information about CHRT.) The R&M can only be used when there is a simple network to deal with. If there are multiple parts that go to different shops represented in a summary R/R task, then the flight line breakout values by task are no longer valid.

If the third change necessary to correct the R&M logic were also incorporated into RMCM, it would require too much core. The user would not be able to run such an improved version of the RMCM interactively at the ASD Computer Center during the daytime. Therefore, it is recommended that a new average value model be written to work in conjunction with LCOM.

Until a new average value Model is developed, the EVM with its very simple MMH and parts usage outputs should still remain the average value model for LCOM users because of its direct interface with the LCOM Extended Form 11 input. However, LCOM users are often spoiled by the unlimited number of ways in which a weapon system network can be set up. To better satisfy the LCOM users, the EVM network tracing logic should be rewritten in Simscript II.5 to allow the EVM to interpret the Extended Form 11 data in the same way LCOM does. The more extensive R&M computations and outputs should also be added. Such a model could give the flexibility of network input to the user through the network node tracing capability of EVM, and provide the greater output capabilities of R&M.

Finally, the users of LCOM and R&M should have the average turn-around time computations and output added to the new average value model. At present, one of the main problems with using either of the average value models in the early stages of the WSAP is that there is no readiness testing capability. If the expected value turn-around times were calculated and listed in the R&M, this would be the expected mean time to repair along three different paths finishing at (a) cannot duplicate discrepancy, (b) minor maintenance on aircraft verification, and (c) R&R verification entering shop.

For the EVM, the turn-around times, or delta times, would be computed similarly, i.e., following any flight line network path either to the end or to where it enters the shop. Making this addition to each of the present models should be relatively easy.

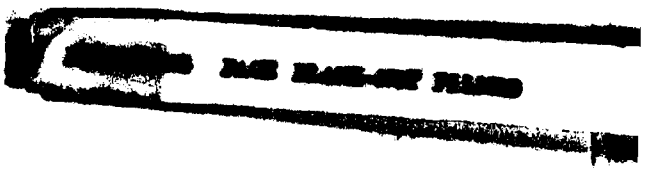
Until the networks are run in LCOM, the user cannot see all the effects of the interaction of the turn-around time of several pieces of equipment on the readiness capability. However, an expected value model could show that because of access constraints, the R&R path for a certain design line replaceable unit (LRU) takes 2.5 hours, while a proposed scenario lead time for aircraft preparation might only be 2 hours. An average value model, with the additional expected turn-around time output, could be a useful quick response, interactive design evaluation tool for catching basic design problems which impact the readiness capability of the weapon system.

Volume I of this technical paper concluded that, "LCOM can be used at gross levels of detail in early phases of the weapon system acquisition process (WSAP) to compare the impact of alternative maintenance and deployment

concepts. LCOM is the only model of the three which can show impacts of the design, support resources, and concepts on sortie generation/readiness capability. However, many design trade-offs do not require a full assessment of readiness impact. They may be at a detailed level which would be lost in the noise of a full system analysis, but individually contribute to reduce support costs and improve availability. Similarly, first cut looks at a variety of design options can be used on reliability and manhours. The full system impact need only be assessed for the final decision. The EVM and R&M models are designed to provide quick turnaround answers to isolate details, design differences and exploratory trade-offs."

By developing a new average value model that incorporates the best qualities of the EVM and R&M models and by adding the expected turnaround time calculation to it, a more accurate, usable average value model would be available to complement the computer simulation model, LCOM. This new, improved model would also give design engineers the reliability and maintainability figures of merit they need for design trade-off studies.

APPENDIX A: TWO SUBSYSTEM SAMPLE INPUT AND OUTPUT OF EQUIVALENCE TESTING OF EVM AND R&M



EVM INPUT PER SUBSYSTEM 1B100

```
(0 )F  25. (1 )E .710
    F1B100   / M1B100
             /    .60                                  LINE PRINTER PLOT FOR 1B100
             / 2431F0
             / 1DSE01
             /
           (1 )E .170
             / M1B101
             /   1.60
             / 2534XJ
             / 1DSE01
             /
           (1 )E .040
             / M1B102
             /   1.90
             / 2423XJ
             / 1DSE01
             /
           (1 )E .080(2 )D ....(T1)C ....(00)D ....
10             R1B100    SHOP      CDUM01  /*W1B100
                 .50                       /   6.60
               2431F0                      / 2534XJ
               1DSE02                      /
                                           /
                                         (00)D ....
                                            QPART
```

EXTENDED FORM 11 INPUT

PRENODE	TASK	NEXTNODE	SELECTION MODE	MSBF or PROB.	NCLOK	ELAPSED TIME IN TENTHS OF HOURS	CREWSIZE	AFSC	SE'S
AB100	F1B100	AB101	F	25	1B100			.95	
AB101	M1B100		E	.71	1B100	6	2	431F0	1 DSE01
AB101	M1B101		E	.17	1B100	16	2	534XJ	1 DSE01
AB101	M1B102		E	.04	1B100	19	2	423XJ	1 DSE01
AB101	R1B100	AB102	E	.08	1B100	5	2	431F0	1 DSE02
AB102	SHOP	STEST1	D		1B100				
STEST1	CDUM01	SAB100	C		1B100				
SAB100	W1B100		D		1B100*	66	2	534XJ	
SAB100	QPART		D		1B100				

EVM INPUT PER SUBSYSTEM CALL SECTION

PLOT FOR CDUM01

```
(01)E .340(1A)D ....(1B)D ....
  / PTSNOK    MFIX01    *GRELES
  /             1.20
  /           13265A
  /           1DSE05
  /
(01)E .660
  / PTSOK
  /
(01)C ....
    CTST01
```

PLOT FOR CTST01

```
(01)D ....(  )F 15.(  )D ....(  )D ....
   DCRMTQ    FTST     MFIXTS    *GRELES
                        5.00
                      13265A
                      23267B
                      1DSE07
```

EXTENDED FORM 11 INPUT

PRENODE	TASK	NEXTNODE	SELECTION MODE	MSBF or PROB.	NCLOK	ELAPSED TIME IN TENTHS OF HOURS	CREWSIZE	AFSC	AFSC or SE	AFSC or SE
CDUM01	FTSNOK	SDUM1A	E	.34	TDUM1 23					
CDUM01	FTSOK		E	.66	TDUM1 23					
CDUM01	CTST		C		TDUM1 23					
SDUM1A	MFIX01	SDUM1B	D		TDUM1 23	1.2 29L	1	3265A 1	DSE05	
SDUM1B	GRELES		D		TDUM1 *23					
CTST01	DCRMTQ	TST0	D		TEST 23					
TST0	FTST	TST1	F	15	TEST 23			.95		
TST1	MFIXTS	TST2	D		TEST 23	5.0 29L	1	3265A 2	3267B 1	DSE07
TST2	GRELES		D		TEST *23					

R&M INPUT PER SUBSYSTEM 1B100 - TEST ONE

COMPRESSED PLOT FOR R&M

```
(0 )F  25.(1 )E .980
    F1B100  / M1B100
            /   1.00
            /.926431F0                                          SEE EVM PLOTS FOR
            /.591534XJ                                          CDUM01 AND CTST01
            /.165423XJ                                          CALL SECTIONS
            /1.  DSE01
            /
            (1 )E .080(2 )D ....(T1)C ....(00)D ....
                R1B100    SHOP      CDUM01  /*W1B100
                   .50                      /   6.60
                 2. 431F0                   /2.534XJ
                 1. DSE02                   /
                                          (00)D ....
                                             QPART
```

														DESCRIPTION
CR	DUM1B1	-1		1B100	0							1		Cross Reference - WUC
CR	DMS1B1	-1		1B100	0									#LRU's in subsystem
SF	DUM1B1	-1				DSE02	DSE01		1					SE - Flightline (FL)
LF	DUM1B1	-1				431F0	431F0		3		2.926			AFSC per Flightline tasks
LF	DUM1B1	-2					534XJ		0		591			Real # crewsize on right
LF	DUM1B1	-3					423XJ		0		165			
LS	DMS1B1	-1		534XJ				3265A	3265A	2	2.	1.	1.	AFSC per Shop tasks
LS	DMS1B1	-2							3267B	0			2.	Real # crewsize on right
TS	DMS1B1	-1		6.6	0.0	0.0	0.0	0.0	1.2	5.0				Task time for shop tasks
TF	DUM1B1	-1	0.0	0.0	0.0	.5	1.0	0.0	0.0					Task time for flightline
PF	DUM1B1	-11.00001.00000.0000				.0800	.9200	.0800	.9200					Prob. of occurrence per FL tasks
PS	DMS1B1	-1		.08000.00000.00000.00000.0000					.0272	.0053				Prob. of occurrence per Shop task
SS	DMS1B1	-1		DSE05			0		DSE05	DSE07	1			SE - Shop
MF	DUM1B1	-1	25.0	0.0000										Reliability Mean Values per FL

R&M INPUT PER SUBSYSTEM 1B100 - TEST TWO
PLOTS FOR 1B100 AND CALL SECTIONS SAME AS EVM

```
                                                                                      DESCRIPTION
CR DUM1B1 -1       1B100  0                                                 1         Cross Reference - WUC
CR DMS1B1 -1       1B100  0                                                           # LRU's in subsystem
SF DUM1B1 -1                   DSE02  DSE01             1                             SE - Flightline (FL)
LF DUM1B1 -1                   431F0  431F0             3            2.  2.           AFSC per Flightline tasks
LF DUM1B1 -2                          534XJ             0                2.
LF DUM1B1 -3                          423XJ             0                2.
LS DMS1B1 -1       534XJ                       3265A   3265A   2  2.        1.    1.  AFSC per shop tasks
LS DMS1B1 -2                                           3267B   0                  2.
TS DMS1B1 -1         6.6  0.0    0.0   0.0   0.0   1.2   5.0   1                      Task time for shop tasks
TF DUM1B1 -1   0.0   0.0  0.0     .5    .6   0.0   0.0  3                             Task time for flightline corres-
TF DUM1B1 -2   0.0   0.0  0.0    0.0   1.6   0.0   0.0  0                             ponding with each AFSC on LF card
TF DUM1B1 -3   0.0   0.0  0.0    0.0   1.9   0.0   0.0  0
PF DUM1B1 -11.00001.00000.0000 .0800 .7100 .0800 .7100  3                             Prob. of occurrence per FL tasks
PF DUM1B1 -20.00000.00000.0000 .0000 .17000.0000 .1700  0                             corresponding with each AFSC on
PF DUM1B1 -30.00000.00000.0000 .0000 .04000.0000 .0400  0                             LF card
PS DMS1B1 -1       .08000.00000.00000.00000.0000 .0272 .0053   1                      Prob of occurrence per shop tasks
SS DMS1B1 -1       DSE05               0         DSE05 DSE07   1                      SE - Shop
MF DUM1B1 -1    25.0 0.0000                                                           Reliability Mean Values per FL
```

EVM OUTPUT FOR SUBSYSTEM 1B100[9]

WUC	431FQ[1]	DSE01	534XJ	423XJ	DSE02	3265A	DSE05	3267B	DSE07	AFSC[5] TOTAL	AGE[6] TOTAL
1B100											
ON	37.28[2]	30.96	21.76	6.08	1.60[4]	2.37	1.31	2.13	1.07	69.93	34.93
OFF	0.00	0.00	42.24[3]	0.00	0.00	0.00	0.00	0.00	0.00	42.24	0.00
ACC[7]											
ON	87943.05	30.96	52721.01	7224.08	1.60	2.37	1.31	2.13	1.07	147892.64	34.93
OFF	0.00	0.00	44.74	0.00	0.00	0.00	0.00	0.00	0.00	44.74	0.00
WUC SUM	37.28	30.96	64.00	6.08	1.60	2.37	1.31	2.13	1.07	111.87	34.93
ACC SUM	87943.05	30.96	52765.75	7224.08	1.60	2.37	1.31	2.13	1.07	147937.38	34.93

PART[8] = QPART HAS ACTION TAKEN CODE OF Q WITH ACCUM. FREQUENCY = 3.20000 FOR NCLOK = 1B100

1. Resources required to maintain work unit code (WUC) 1B100.
   a. Those beginning with numbers are Air Force Specialty Codes (AFSC), i.e. human.
   b. Those beginning with letters are Aerospace Ground Equipment (AGE) which is also called Support Equipment (SE).
2. Expected maintenance manhours (MMH) per AFSC for On-equipment maintenance.
3. Expected MMH per AFSC for Off-equipment maintenance.
4. Expected AGE (or SE) utilization time for On-equipment.
5. Summary of expected MMH for all AFSC's working on subsystem 1B100 - broken out be On- and Off-equipment.
6. Summary of expected AGE (or SE) utilization time for all AGE being used to maintain subsystem 1B100 - broken out by On- and Off-equipment.
7. Various levels of summaries including accumulative summary across the weapon system.
8. Spare parts expected frequency of use for Subsystem 1B100.
9. An optional output of EVM is a line printer network plot of the Extended Form 11 input. See the EVM input for an example of the optional plot.

EVM OUTPUT FOR CALL SECTION SUBSYSTEMS CDUM01 and CTST01

WUC	3265A[1]	DSE05	3267B	DSE07	AFSC[4] TOTAL	AGE[5] TOTAL
CDUM01						
ON	.74[2]	.41[3]	.67	.33	1.41	.74
OFF	0.00	0.00	0.00	0.00	0.00	0.00

WUC	3265A	3267B	DSE07	AFSC TOTAL	AGE TOTAL
CTST01					
ON	.33	.67	.33	1.00	.33
OFF	0.00	0.00	0.00	0.00	0.00

1. Resources required to maintain work unit code (WUC) 1B100.
   a. Those beginning with numbers are Air Force Specialty Codes (AFSC), i.e. human.
   b. Those beginning with letters are Aerospace Ground Equipment (AGE) which is also called Support Equipment (SE).
2. Expected MMH per AFSC for 1 failure requiring On-equipment maintenance.
3. Expected AGE utilization time for 1 failure requiring On-equipment maintenance.
4. AFSC summary MMH for 1 failure.
5. AGE summary utilization time for 1 failure.

R&M OUTPUT FOR SUBSYSTEM 1B100 - TEST ONE FLIGHTLINE SE UTILIZATION

SE - DSE02
CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY MODEL

MEAN TIME TO REPAIR

SUBSYS.	AGE	TS	CND	R+R	MAC	VR+R	VMAC	TOTAL
DUMTBT	0.0000	0.0000	0.0000	.0400	0.0000	0.0000	0.0000	.040

SE - DSE02
CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY MODEL

MEAN TIME TO REPAIR PER 1000 FLIGHT HOURS

SUBSYS.	AGE	TS	CND	R+R	MAC	VR+R	VMAC	TOTAL
DUMTBT	0.0000	0.0000	0.0000	1.6000	0.0000	0.0000	0.0000	1.600

SE - DSE01
CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY MODEL

MEAN TIME TO REPAIR

SUBSYS.	AGE	TS	CND	R+R	MAC	VR+R	VMAC	TOTAL
DUMTBT	0.0000	0.0000	0.0000	0.0000	*.9200	0.0000	0.0000	*.920

SE - DSE01
CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY MODEL

MEAN TIME TO REPAIR PER 1000 FLIGHT HOURS

SUBSYS.	AGE	TS	CND	R+R	MAC	VR+R	VMAC	TOTAL
DUMTBT	0.0000	0.0000	0.0000	0.0000	*36.8000	0.0000	0.0000	*36.800

*Points out problem for requiring weighted crewsize for AFSC but not for SE's when merging, only if not all crews use the SE.

R&M OUTPUT FOR SUBSYSTEM 1B100 - TEST TWO FLIGHTLINE SE UTILIZATION

SE - DSE02
CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY MODEL

MEAN TIME TO REPAIR

SUBSYS.	AGE	TS	CND	R+R	MAC	VR+R	VMAC	TOTAL
DUMTBT	0.0000	0.0000	0.0000	.0400	0.0000	0.0000	0.0000	.040

SE - DSE02
CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY MODEL

MEAN TIME TO REPAIR PER 1000 FLIGHT HOURS

SUBSYS.	AGE	TS	CND	R+R	MAC	VR+R	VMAC	TOTAL
DUMTBT	0.0000	0.0000	0.0000	1.6000	0.0000	0.0000	0.0000	1.600

SE - DSE01
CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY MODEL

MEAN TIME TO REPAIR

SUBSYS.	AGE	TS	CND	R+R	MAC	VR+R	VMAC	TOTAL
DUMTBT	0.0000	0.0000	0.0000	0.0000	.7740	0.0000	0.0000	.774

SE - DSE01
CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY MODEL

MEAN TIME TO REPAIR PER 1000 FLIGHT HOURS

SUBSYS.	AGE	TS	CND	R+R	MAC	VR+R	VMAC	TOTAL
DUMTBT	0.0000	0.0000	0.0000	0.0000	30.9600	0.0000	0.0000	30.960

R&M OUTPUT FOR SUBSYSTEM 1B100 - TEST ONE AND TEST TWO SE REPAIR TIME (Continued)

SE-DSE05 CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY MODEL

		-MTTR-			-MMH-			-MMH/1000 FH-		
	TD#	TD REP	TS REP	TOTAL	TD REP	TS REP	TOTAL	TD REP	TS REP	TOTAL
DMS1B1	0	.0326	.0265	.0591	.0326	.0795	.1121	1.3056	3.1800	4.4856
DUM1B1		.0326	.0265	.0591	.0326	.0795	.1121	1.3056	3.1800	4.4856

-MTTR/1000 FH-			*UP/KFH
TD REP	TS REP	TOTAL	
1.3056	1.0600	2.3656	21.12000
1.3056	1.0600	2.3656	21.12000

*Expected TD uptime per 1000 FH, i.e. expected SE usage time per 1000 FH.
$(1000./MFHBMA)*(MTTR_W+MTTR_K+MTTR_N)$

TD = Test drawer
TS = Test station

R&M OUTPUT FOR SUBSYSTEM 1B100 - TEST ONE (Continued)

CH3E UNSCH AFSC-431FO $ 1.00 CH3E UNSCH

	MMH/KFH	COST/KFH
FL	37.27680	37.27680
DUM1B1	37.27680	37.27680

AFSC-534XJ $ 1.00

	MMH/KFH	COST/KFH
DMS1B1	42.24000	42.24000
FL	21.74800	21.74800
DUM1B1	63.98880	63.98880

CH3E UNSCH AFSC-423XJ $ 1.00 CH3E UNSCH

	MMH/KFH	COST/KFH
FL	6.07200	6.07200
DUM1B1	6.07200	6.07200

AFSC-3265A $ 2.00

	MMH/KFH	COST/KFH
DMS1B1	2.36560	4.73120
FL	0.00000	0.00000
DUM1B1	2.36560	4.73120

AFSC-3267B $ 2.50 CH3E UNSCH

	MMH/KFH	COST/KFH
DMS1B1	2.12000	5.30000
FL	0.00000	0.00000
DUM1B1	2.12000	5.30000

R&M OUTPUT FOR SUBSYSTEM 1B100 - TEST TWO (Continued)

AFSC-431FO	$ 1.00	CH3E UNSCH
	MMH/KFH	COST/KFH
FL	65.12000*	65.12000
DUM1B1	65.12000	65.12000

AFSC-534XJ	$ 1.00	CH3E UNSCH
	MMH/KFH	COST/KFH
DMS1B1	42.24000	42.24000
FL	61.92000*	61.92000
DUM1B1	104.16000	104.16000

AFSC-423XJ	$ 1.00	CH3E UNSCH
	MMH/KFH	COST/KFH
FL	61.92000*	61.92000
DUM1B1	61.92000	61.92000

AFSC-3265A	$ 2.00	CH3E UNSCH
	MMH/KFH	COST/KFH
DMS1B1	2.36560	4.73120
FL	0.00000	0.00000
DUM1B1	2.36560	4.73120

AFSC-3267B	$ 2.50	CH3E UNSCH
	MMH/KFH	COST/KFH
DMS1B1	2.12000	5.30000
FL	0.00000	0.00000
DUM1B1	2.12000	5.30000

*Incorrectly computed values. They are much too big.

R&M OUTPUT FOR SUBSYSTEM 1B100 - TEST ONE (Continued)

CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM INHERENT FLIGHTLINE AVAILABILITY

SUBSYSTEM	AVAILABILITY
DUM1B1	.9630[1]

[Report Option #13 Part 1]

MTTR FOR ALL SUBSYSTEMS CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYS	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
DUM1B1	0.0000	0.0000	.0400	0.0000	0.0000	.9200[2]	0.0000	.5280	1.4880

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[Report Option #13 Part 2]

MMH FOR ALL SUBSYSTEMS CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYS	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
DUM1B1	0.0000	0.0000	.0800	0.0000	0.0000	1.5474	0.0000	1.0560	2.6834

1. Value should be .9685
2. Value should be .774

R&M OUTPUT FOR SUBSYSTEM 1B100 - TEST TWO (Continued)

CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM INHERENT FLIGHTLINE AVAILABILITY

SUBSYSTEM	AVAILABILITY
DUM1B1	.9685

[Report Option #13 Part 1]

MTTR FOR ALL SUBSYSTEMS CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYS	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
DUM1B1	0.0000	0.0000	.04000	0.0000	0.0000	.77400	0.0000	.52800	1.34200

[Report Option #13 Part 2]

MMH FOR ALL SUBSYSTEMS CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYS	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
DUM1B1	0.0000	0.0000	.0800	0.0000	0.0000	1.5480	0.0000	1.0560	2.6840

R&M OUTPUT FOR SUBSYSTEM 1B100 - TEST ONE (Continued)

MTTR BY TASK PER LRU CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM-DUM1B1 (1B100) MFHBMA= 25.0

	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT	
LRU-DMS1B1 (1B110)										
W	0.00000	0.00000	.04000	0.00000				.52800	.56800	
K	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	[Output Option #1]
N	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	
SUB	0.00000	0.00000	.04000	0.00000				.52800	.56800	
CND	0.00000				0.00000				0.00000	
M	0.00000	0.00000				.92000[1]	0.00000		.92000	
TOT/TSK	0.00000	0.00000	.04000	0.00000	0.00000	.92000	0.00000	.52800	1.48800	

MMH BY TASK PER LRU CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM-DUM1B1 (1B100) MFHBMA= 25.0

	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT	
LRU-DMS1B1 (1B110)										
W	0.00000	0.00000	.08000	0.00000				1.05600	1.13600	
K	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	[Output Option #3]
N	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	
SUB	0.00000	0.00000	.08000	0.00000				1.05600	1.13600	
CND	0.00000				0.00000				0.00000	
M	0.00000	0.00000				1.54744[2]	0.00000		1.54744	
TOT/TSK	0.00000	0.00000	.04000	0.00000	0.00000	1.54744	0.00000	1.05600	2.68344	

1. Should be .774
2. Should be 1.548

R&M OUTPUT FOR SUBSYSTEM 1B100 - TEST TWO (Continued)

MTTR BY TASK PER LRU CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM-DUM1B1 (1B100) MFHBMA= 25.0

	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT	
LRU-DMS1B1 (1B110)										
W	0.00000	0.00000	.04000	0.00000				.52800	.56800	
K	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	[Output Option #1]
N	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	
SUB	0.00000	0.00000	.04000	0.00000				.52800	.56800	
CND	0.00000				0.00000				0.00000	
M	0.00000	0.00000				.77400	0.00000		.77400	
TOT/TSK	0.00000	0.00000	.04000	0.00000	0.00000	.77400	0.00000	.52800	1.34200	

MMH BY TASK PER LRU CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM-DUM1B1 (1B100) MFHBMA= 25.0

	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT	
LRU-DMS1B1 (1B110)										
W	0.00000	0.00000	.08000	0.00000				1.05600	1.13600	
K	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	[Output Option #3]
N	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	
SUB	0.00000	0.00000	.08000	0.00000				1.05600	1.13600	
CND	0.00000				0.00000				0.00000	
M	0.00000	0.00000				1.54800	0.00000		1.54800	
TOT/TSK	0.00000	0.00000	.04000	0.00000	0.00000	1.54800	0.00000	1.05600	2.68400	

R&M OUTPUT FOR SUBSYSTEM 1B100 - TEST ONE (Continued)

MMH PER 1000 FH CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM-DUM1B1 (1B100) MFHBMA= 25.0

	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT	
LRU-DMS1B1 (1B110)										
W	0.000	0.000	3.200	0.000				42.240	45.440	
K	0.000	0.000	0.000	0.000				0.000	0.000	[Report Option #5]
N	0.000	0.000	0.000	0.000				0.000	0.000	
SUB	0.000	0.000	3.200	0.000				42.240	45.440	
CND	0.000				0.000				0.000	
M	0.000	0.000				61.898[1]	0.000		61.898	
TOT/TSK	0.000	0.000	3.200	0.000	0.000	61.898	0.000	42.240	107.338	

MAINT. INDEX X 1000 CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM-DUM1B1 (1B100) MFHBMA= 25.0

	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT	
LRU-DMS1B1 (1B110)										
W	0.0000	0.0000	1.6000	0.0000				21.1200	22.7200	
K	0.0000	0.0000	0.0000	0.0000				0.0000	0.0000	[Report Option #6]
N	0.0000	0.0000	0.0000	0.0000				0.0000	0.0000	
SUB	0.0000	0.0000	1.6000	0.0000				21.1200	22.7200	
CND	0.0000				0.0000				0.00000	
M	0.0000	0.0000				36.8000[2]	0.0000		36.8000	
TOT/TSK	0.0000	0.0000	1.6000	0.0000	0.0000	36.8000	0.0000	21.1200	59.5200	

1. Should be 61.92
2. Should be 30.96

R&M OUTPUT FOR SUBSYSTEM 1B100 - TEST TWO (Continued)

MMH PER 1000 FH CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM-DUM1B1 (1B100) MFHBMA= 25.0

	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
LRU-DMS1B1 (1B110)									
W	0.000	0.000	3.200	0.000				42.240	45.440
K	0.000	0.000	0.000	0.000				0.000	0.000
N	0.000	0.000	0.000	0.000				0.000	0.000
SUB	0.000	0.000	3.200	0.000				42.240	45.440
CND	0.000				0.000				0.000
M	0.000	0.000				61.920	0.000		61.920
TOT/TSK	0.000	0.000	3.200	0.000	0.000	61.920	0.000	42.240	107.360

[Report Option #5]

MAINT. INDEX X 1000 CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM-DUM1B1 (1B100) MFHBMA= 25.0

	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
LRU-DMS1B1 (1B110)									
W	0.0000	0.0000	1.6000	0.0000				21.1200	22.7200
K	0.0000	0.0000	0.0000	0.0000				0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000				0.0000	0.0000
SUB	0.0000	0.0000	1.6000	0.0000				21.1200	22.7200
CND	0.0000				0.0000				0.00000
M	0.0000	0.0000				30.9600	0.0000		30.9600
TOT/TSK	0.0000	0.0000	1.6000	0.0000	0.0000	30.9600	0.0000	21.1200	53.6800

[Report Option #6]

EVM INPUT PER SUBSYSTEM

EXTENDED FORM 11 INPUT

PLOT FOR 1C200	PRENODE	TASK	NEXTNODE	SELECTION MODE	MSBF or PROB.	NCLOK	ELAPSED TIME IN TENTHS OF HOURS	CREWSIZE	AFSC	SE
(0)F 25. (1)E .750	AC200	F1C200	AC201	F	25	1C200			.95	
F1C200 / M1C200	AC201	M1C200		E	.75	1C200	9	2	431F0	
/ .90	AC201	M1C201		E	.04	1C200	1	2	534XJ	
/ 2431F0	AC201	M1C202		E	.04	1C200	22	2	423XJ	
/	AC201	R1C200	AC202	E	.13	1C200	10	2	431F0	
(1)E .040	AC201	SHOP	AC203	E	.04	1C200	19	2	423XJ	
/ M1C201	AC202	SHOP	SAC200	D		1C200				
/ .10	SAC200	QPART		D		1C200				
/ 2421XB	SAC200	W1C200		D		1C200*	23	2	531XJ	1 DSE03
/	AC203	SHOP	SAC201	D		1C200				
(1)E .040	SAC201	W1C201		D		1C200*	30	2	423XJ	1 DSE03
/ M1C202	SAC201	QPART		D		1C200				
/ 2.20										
/ 2534XJ										
/										
(1)E .130(2)D ....(00)D										
/ R1C200 SHOP / QPART										
/ 1.00 /										
/ 2431F0 /										
/ 1DSE02 /										
/ (00)D										
/ *W1C200										
/ 2.30										
/ 2531XJ										
/ 1DSE03										
/										
(1)E .040.....(3)D ....(01)D										
R1C201 SHOP /*W1C201										
1.90 / 3.00										
2423XJ / 2423XJ										
/ 1DSE03										
/										
(01)D										
QPART										

R&M INPUT PER SUBSYSTEM 1C200 - TEST ONE

```
COMPRESSED PLOT FOR R&M

(0 )F  25.(1 )E .830
    F1C200 / M1C200
           /   1.00
           /1.6431F0
           /.01421XB
           /.212534XJ
           /
          (1 )E .170(2 )D ....(00)D ....
              R1C200    SHOP      QPART
                 2.00              /
              .765431F0            /
              .447423XJ           (00)E .765
                                   / *W1C200
                                   /    2.30
                                   /2. 531XJ
                                   /1. DSE03
                                   /
                                  (00)E .235
                                     *W1C200
                                        3.00
                                    2. 423XJ
                                    1. DSE03
```

R&M INPUT PER SUBSYSTEM 1C200 - TEST ONE (Continued)

```
                                                                                                                    DESCRIPTION
CR DUM1C2 -1        1C200  0                                                                                2      Cross Reference - WUC
CR DMS1C2 -1        1C210  0                                                                                       #LRU's in subsystem
CR DMT1C2 -1        1C220  0
CR DMT1C2 -2        1C220
SF DUM1C2 -1                                                                  0                                 SE - Flightline (FL)
LF DUM1C2 -1                      431F0  431F0                               3            7651.6               AFSC per Flightline tasks
LF DUM1C2 -2                      423XJ  421XB                               0            447010               Real # crewsize on right.
LF DUM1C2 -3                             534XJ                               0              212
LS DMS1C2 -1        531XJ                                                                 1  2.                AFSC per Shop tasks
LS DMT1C2 -1        423XJ                                                                 1  2.                Real # crewsize on right.
TS DMS1C2 -1          2.3  0.0    0.0   0.0   0.0   0.0   0.0                                                  Task time for shop tasks
TS DMT1C2 -1          3.0  0.0    0.0   0.0   0.0   0.0   0.0
TF DUM1C2 -1   0.0    0.0  0.0    2.0   1.0   0.0   0.0                                                        Task time for Flightline
PF DUM1C2 -11.00001.00000.0000 .1700 .8300 .1700 .8300                                                         Prob. of occurrence per FL tasks
PS DMS1C2 -1        .13000.00000.00000.00000.00000.00000.0000                                                  Prob. of occurrence per Shop task
PS DMT1C2 -1        .04000.00000.00000.00000.00000.00000.0000
SS DMS1C2 -1        DSE03*                 0                                  1                               SE - Shop
SS DMT1C2 -1        DSE03*                 0                                  1
MF DUM1C2 -1    25.0 0.0000                                                                                    Reliability Mean Values per FL
```

*Not valid input of data. If DSE03 is used to do work bench repairs in shop, then DSE03 should be entered in the test drawer repair field on this card to allow for repair of the SE DSE03. Therefore, there is no output reflecting the repair time or use of DSE03.

R&M INPUT PER SUBSYSTEM 1C200 - TEST TWO

PLOT FOR R&M (Cannot have flightline tasks go to unique shop tasks.)

```
(0 )F  25.(1 )E .750
    F1C200 / M1C200
           /    .90
           /  2431F0
           /.01421XB
           /
          (1 )E .040
              M1C201
           /     .10
           /  2421XB
           /
          (1 )E. 040
           /  M1C202
           /    2.20
           /  2534XJ
           /
         (1 )E .130(2 )D ....(00)D ....
           / R1C200    SHOP    / QPART
           /   1.00            /
           / 2431F0            /
           /                   /
           /                 (00)D ....
           /                   /*W1C200
           /                   /   2.30
           /                   / 2531XJ
           /                   / 1DSE03
           /                   /
           /                 (00)D ....
           /                    *W1C201
           /                      3.00
           /                     2423XJ
           /                     1DSE03
           /
         (1 )E .040(2 )SEE
             R1C201    ABOVE
               1.90
              2423XJ
```

R&M INPUT PER SUBSYSTEM 1C200 - TEST TWO (Continued)

```
                                                                                                                    DESCRIPTION
CR DUM1C2 -1        1C200  0                                                                          2            Cross Reference - WUC
CR DMS1C2 -1        1C210  0                                                                                       #LRU's in subsystem
CR DMT1C2 -1        1C220  0
CR DMT1C2 -2        1C220
SF DUM1C2 -1                                                    0                                              SE - Flightline (FL)
LF DUM1C2 -1                      431F0  431F0                  3                                 2.    2.     AFSC per Flightline tasks
LF DUM1C2 -2                      423XJ  421XB                  0                                 2.    2.     Real # crewsize on right.
LF DUM1C2 -3                             534XJ                  0                                       2.
LS DMS1C2 -1        531XJ                                                        1  2.                          AFSC per Shop tasks
LS DMS1C2 -2        423XJ                                                        1  2.                          Real # crewsize on right.
TS DMS1C2 -1          2.3  0.0    0.0   0.0   0.0   0.0   0.0   1                                              Task time for shop tasks
TS DMT1C2 -1          3.0  0.0    0.0   0.0   0.0   0.0   0.0   1
TF DUM1C2 -1   0.0    0.0  0.0    1.0    .9   0.0   0.0   3                                                    Task time for flightline
TF DUM1C2 -2   0.0    0.0  0.0    1.9    .1   0.0   0.0   0                                                    Corresponding with each AFSC on
TF DUM1C2 -3   0.0    0.0  0.0    0.0   2.2   0.0   0.0   0                                                    LF card
PF DUM1C2 -11.00001.00000.0000 .1300 .7500 .1300 .7500  3                                                    Prob. of occurrence per FL tasks
PF DUM1C2 -20.00000.00000.0000 .0400 .0400 .0400 .0400  0                                                    Correspondence with each AFSC on
PF DUM1C2 -30.00000.00000.0000 .0000 .0400 .0000 .0400  0                                                    LF card
PS DMS1C2 -1        .13000.00000.00000.00000.00000.00000.0000   0                                            Prob. of occurrence per Shop task
PS DMT1C2 -1        .04000.00000.00000.00000.00000.00000.0000   0
SS DMS1C2 -1        DSE03*                0                     1                                          SE - Shop
SS DMT1C2 -1        DSE03*                0                     1
MF DUM1C2 -1    25.0 0.0000                                                                                    Reliability Mean Values per FL
```

*Not valid input of data. If DSE03 is used to do work bench repairs in shop, then DSE03 should be entered in the test drawer repair field on this card to allow for repair of the SE DSE03. Therefore, there is no output reflecting the repair time or use of DSE03.

EVM OUTPUT FOR SUBSYSTEM 1C200[9]

WUC	431FO[1]	421XB	534XJ	423XJ	531XJ	DSE03	AFSC[5] TOTAL	AGE[6] TOTAL
1C200								
ON	64.40[2]	.32	7.04	6.06	0.00	0.00	77.84	0.00
OFF	0.00	0.00	0.00	9.60[3]	23.92	16.76[4]	33.52	16.76
ACC[7]								
ON	89092.22	4422.50	52755.40	7233.80	0.00	0.00	152501.92	0.00
OFF	0.00	0.00	52.37	16.60	23.92	16.76	92.89	16.76
WUC SUM	64.40	.32	7.04	15.68	23.92	16.76	111.36	16.76
ACC SUM	88096.22	4422.50	52807.77	7250.40	23.92	16.76	152600.81	16.76

PART[8] = QPART HAS ACTION TAKEN CODE OF Q WITH ACCUM. FREQUENCY = 6.80000 FOR NCLOK = 1C200

1. Resources required to maintain work unit code (WUC) 1C200.
   a. Those beginning with numbers are Air Force Specialty Codes (AFSC), i.e. human.
   b. Those beginning with letters are Aerospace Ground Equipment (AGE) which is also called Support Equipment (SE).
2. Expected maintenance manhours (MMH) per AFSC for On-equipment maintenance.
3. Expected MMH per AFSC for Off-equipment maintenance.
4. Expected AGE (or SE) utilization time for Off-equipment.
5. Summary of expected MMH for all AFSC's working on subsystem 1C200 - broken out be On- and Off-equipment.
6. Summary of expected AGE (or SE) utilization time for all AGE being used to maintain subsystem 1C200 - broken out by On- and Off-equipment.
7. Various levels of summaries including accumulative summary across the weapon system.
8. Spare parts expected frequency of use for Subsystem 1C200.
9. An optional output of EVM is a line printer network plot of the Extended Form 11 input. See the EVM input for an example of the optional plot.

R&M OUTPUT FOR SUBSYSTEM 1C200 - TEST ONE

AFSC-431FO	$ 1.00	CH3E UNSCH
	MMH/KFH	COST/KFH
FL	*63.52400	63.52400
DUM1C2	63.52400	63.52400

AFSC-534XJ	$ 1.00	CH3E UNSCH
	MMH/KFH	COST/KFH
FL	7.03840	7.03840
DUM1C2	7.03840	7.03840

AFSC-423XJ	$ 1.00	CH3E UNSCH
	MMH/KFH	COST/KFH
DMT1C2	9.60000	9.60000
FL	6.07920	6.07920
DUM1C2	15.67920	15.67920

AFSC-421XB	$ 1.00	CH3E UNSCH
	MMH/KFH	COST/KFH
FL	.33200	.33200
DUM1C2	.33200	.33200

AFSC-531XJ	$ 1.00	CH3E UNSCH
	MMH/KFH	COST/KFH
DMS1C2	23.92000	23.92000
FL	0.00000	0.00000
DUM1C2	23.92000	23.92000

*EVM value is 64.40

R&M OUTPUT FOR SUBSYSTEM 1C200 - TEST TWO

AFSC-431FO	$ 1.00	CH3E UNSCH
	MMH/KFH	COST/KFH
FL	77.84000*	77.84000
DUM1C2	77.84000	77.84000

AFSC-534XJ	$ 1.00	CH3E UNSCH
	MMH/KFH	COST/KFH
FL	61.36000*	61.36000
DUM1C2	61.36000	61.36000

AFSC-423XJ	$ 1.00	CH3E UNSCH
	MMH/KFH	COST/KFH
DMT1C2	9.60000	9.60000
FL	16.48000*	16.48000
DUM1C2	26.08000	26.08000

AFSC-421XB	$ 1.00	CH3E UNSCH
	MMH/KFH	COST/KFH
FL	61.36000*	61.36000
DUM1C2	61.36000	61.36000

AFSC-531XJ	$ 1.00	CH3E UNSCH
	MMH/KFH	COST/KFH
DMS1C2	23.92000	23.92000
FL	0.00000	0.00000
DUM1C2	23.92000	23.92000

*Incorrectly computed values. They are much too big.

R&M OUTPUT FOR SUBSYSTEM 1C200 - TEST ONE (Continued)

CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM INHERENT FLIGHTLINE AVAILABILITY

SUBSYSTEM	AVAILABILITY
DUM1C2	.9553[1]

[Report Option #13 Part 1]

MTTR FOR ALL SUBSYSTEMS CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYS	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
DUM1C2	0.0000	0.0000	.3400[2]	0.0000	0.0000	.8300[3]	0.0000	.4190	1.5890

[Report Option #13 Part 2]

MMH FOR ALL SUBSYSTEMS CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYS	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
DUM1C2	0.0000	0.0000	.4121	0.0000	0.0000	1.5123[4]	0.0000	.8380	2.7623

1. Value should be .9625
2. Value should be .2060
3. Value should be .767
4. Value should be 1.534. Is not, because of decimal accuracy lost with extreme values to compress.

R&M OUTPUT FOR SUBSYSTEM 1C200 - TEST TWO (Continued)

CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM INHERENT FLIGHTLINE AVAILABILITY

SUBSYSTEM	AVAILABILITY
DUM1C2	.9625

[Report Option #13 Part 1]

MTTR FOR ALL SUBSYSTEMS CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYS	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
DUM1C2	0.0000	0.0000	.20600	0.0000	0.0000	.76700	0.0000	.41900	1.39200

[Report Option #13 Part 2]

MMH FOR ALL SUBSYSTEMS CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYS	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT
DUM1C2	0.0000	0.0000	.4120	0.0000	0.0000	1.5340	0.0000	.8380	2.7840

R&M OUTPUT FOR SUBSYSTEM 1C200 - TEST ONE (Continued)

MTTR BY TASK PER LRU CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINT

SUBSYSTEM-DUM1C2 (1C200) MFHBMA= 25.0

	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT	
LRU-DMS1C2 (1C210)										
W	0.00000	0.00000	.26000[1]	0.00000				.29900	.55900	
K	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	[Report Option #1]
N	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	
SUB	0.00000	0.00000	.26000[1]	0.00000				.29900	.55900	
LRU-DMT1C2 (1C220)										
W	0.00000	0.00000	.08000[2]	0.00000				.12000	.20000	
K	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	
N	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	
SUB	0.00000	0.00000	.08000[2]	0.00000				.12000	.20000	
CND	0.00000				0.00000				0.00000	
M	0.00000	0.00000				.83000[4]	0.00000		.83000	
TOT/TSK	0.00000	0.00000	.34000[3]	0.00000	0.00000	.83000[4]	0.00000	.41900	1.58900	

1. Value should be .1300
2. Value should be .0760
3. Value should be .2060
4. Value should be .7670

R&M OUTPUT FOR SUBSYSTEM 1C200 - TEST TWO (Continued)

MTTR BY TASK PER LRU CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM-DUM1C2 , (1C200) MFHBMA= 25.0

	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT	
LRU-DMS1C2 (1C210)										
W	0.00000	0.00000	.15753[1]	0.00000				.29900	.45653	
K	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	[Report Option #1]
N	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	
SUB	0.00000	0.00000	.15753[1]	0.00000				.29900	.45653	
LRU-DMT1C2 (1C220)										
W	0.00000	0.00000	.04847[2]	0.00000				.12000	.16847	
K	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	
N	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	
SUB	0.00000	0.00000	.04847[2]	0.00000				.12000	.16847	
CND	0.00000				0.00000				0.00000	
M	0.00000	0.00000				.76700[4]	0.00000		.76700	
TOT/TSK	0.00000	0.00000	.20600[3]	0.00000	0.00000	.76700[4]	0.00000	.41900	1.39200	

1. Value should be .1300 because in R&M FL must go to same SHOP entry.
2. Value should be .0760 because in R&M FL must go to same SHOP entry.
3. Value is correct
4. Value is correct

R&M OUTPUT FOR SUBSYSTEM 1C200 - TEST ONE (Continued)

MTTR AS % OF TOTAL CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM-DUM1C2 (1C200) MFHBMA= 25.0

	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT	
LRU-DMS1C2 (1C210)										
W	0.000	0.000	16.362[1]	0.000				18.817	35.179	
K	0.000	0.000	0.000	0.000				0.000	0.000	[Report *Option #2]
N	0.000	0.000	0.000	0.000				0.000	0.000	
SUB	0.000	0.000	16.362[1]	0.000				18.817	35.179	
LRU-DMT1C2 (1C220)										
W	0.000	0.000	5.035[2]	0.000				7.552	12.587	
K	0.000	0.000	0.000	0.000				0.000	0.000	
N	0.000	0.000	0.000	0.000				0.000	0.000	
SUB	0.000	0.000	5.035[2]	0.000				7.552	12.587	
CND	0.000				0.000				0.000	
N	0.000	0.000				52.234[4]	0.000		52.234	
SUB	0.000	0.000	21.397[3]	0.000	0.000	52.234[4]	0.000	26.369	100.000	

*For this run, only subsystem 1C200 was selected to have this output report.

1. Value should be 9.339
2. Value should be 5.460
3. Value should be 14.799
4. Value should be 55.101

R&M OUTPUT FOR SUBSYSTEM 1C200 - TEST TWO (Continued)

MTTR AS % OF TOTAL CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM-DUM1C2 (1C200) MFHBMA= 25.0

	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT	
LRU-DMS1C2 (1C210)										
W	0.000	0.000	11.317[1]	0.000				21.480	32.797	
K	0.000	0.000	0.000	0.000				0.000	0.000	[Report* Option #2]
N	0.000	0.000	0.000	0.000				0.000	0.000	
SUB	0.000	0.000	11.317[1]	0.000				21.480	32.797	
LRU-DMT1C2 (1C220)										
W	0.000	0.000	3.482[2]	0.000				8.621	12.103	
K	0.000	0.000	0.000	0.000				0.000	0.000	
N	0.000	0.000	0.000	0.000				0.000	0.000	
SUB	0.000	0.000	3.482[2]	0.000				8.621	12.103	
CND	0.000				0.000				0.000	
N	0.000	0.000				55.101[4]	0.000		55.101	
SUB	0.000	0.000	14.799[3]	0.000	0.000	55.101[4]	0.000	30.101	100.000	

*For this run, only subsystem 1C200 was selected to have this output report.

1. Value should be 9.339
2. Value should be 5.460
3. Value is correct
4. Value is correct

R&M OUTPUT FOR SUBSYSTEM 1C200 - TEST ONE (Continued)

MMH BY TASK PER LRU CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM-DUM1C2 (1C200) MFHBMA= 25.0

	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT	
LRU-DMS1C2 (1C210)										
W	0.00000	0.00000	.31512[1]	0.00000				.59800	.91312	
K	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	[Report Option #3]
N	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	
SUB	0.00000	0.00000	.31512[1]	0.00000				.59800	.91312	
LRU-DMT1C2 (1C220)										
W	0.00000	0.00000	.09696[2]	0.00000				.24000	.33696	
K	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	
N	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	
SUB	0.00000	0.00000	.09696[2]	0.00000				.24000	.33696	
CND	0.00000				0.00000				0.00000	
M	0.00000	0.00000				1.51226[4]	0.00000		1.51226	
TOT/TSK	0.00000	0.00000	.41208[3]	0.00000	0.00000	1.51226[4]	0.00000	.83800	2.76234	

1. Value should be .2600
2. Value should be .1520
3. Value is correct
4. Value should be 1.53400

R&M OUTPUT FOR SUBSYSTEM 1C200 - TEST TWO (Continued)

MMH BY TASK PER LRU CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM-DUM1C2 (1C200) MFHBMA= 25.0

	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT	
LRU-DMS1C2 (1C210)										
W	0.00000	0.00000	.31506[1]	0.00000				.59800	.91306	
K	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	[Report Option #3]
N	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	
SUB	0.00000	0.00000	.31506[1]	0.00000				.59800	.91306	
LRU-DMT1C2 (1C220)										
W	0.00000	0.00000	.09694[2]	0.00000				.24000	.33694	
K	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	
N	0.00000	0.00000	0.00000	0.00000				0.00000	0.00000	
SUB	0.00000	0.00000	.09694[2]	0.00000				.24000	.33694	
CND	0.00000				0.00000				0.00000	
M	0.00000	0.00000				1.53400[4]	0.00000		1.53400	
TOT/TSK	0.00000	0.00000	.41200[3]	0.00000	0.00000	1.53400[4]	0.00000	.83800	2.78400	

1. Value should be .2600
2. Value should be .1520
3. Value is correct
4. Value is correct

R&M OUTPUT FOR SUBSYSTEM 1C200 - TEST ONE (Continued)

MMH AS % OF TOTAL CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM-DUM1C2 (1C200) MFHBMA= 25.0

	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT	
LRU-DMS1C2 (1C210)										
W	0.000	0.000	11.408[1]	0.000				21.648	33.056	
K	0.000	0.000	0.000	0.000				0.000	0.000	[Report* Option #4]
N	0.000	0.000	0.000	0.000				0.000	0.000	
SUB	0.000	0.000	11.408[1]	0.000				21.648	33.056	
LRU-DMT1C2 (1C210)										
W	0.000	0.000	3.510[2]	0.000				8.688	12.198	
K	0.000	0.000	0.000	0.000				0.000	0.000	
N	0.000	0.000	0.000	0.000				0.000	0.000	
SUB	0.000	0.000	3.510[2]	0.000				8.688	12.198	
CND	0.000				0.000				0.000	
M	0.000	0.000				54.746[4]	0.000		54.746	
TOT/TSK	0.000	0.000	14.918[3]	0.000	0.000	54.746[4]	0.000	30.337	100.000	

*For this run, only subsystem 1C200 was selected to have this output report.

1. Value should be 9.340
2. Value should be 5.460
3. Value should be 14.799
4. Value should be 55.101

R&M OUTPUT FOR SUBSYSTEM 1C200 - TEST TWO (Continued)

MMH AS % OF TOTAL CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM-DUM1C2 (1C200) MFHBMA= 25.0

	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT	
LRU-DMS1C2 (1C210)										
W	0.000	0.000	11.317[1]	0.000				21.480	32.797	
K	0.000	0.000	0.000	0.000				0.000	0.000	[Report* Option #4]
N	0.000	0.000	0.000	0.000				0.000	0.000	
SUB	0.000	0.000	11.317[1]	0.000				21.480	32.797	
LRU-DMT1C2 (1C210)										
W	0.000	0.000	3.482[2]	0.000				8.621	12.103	
K	0.000	0.000	0.000	0.000				0.000	0.000	
N	0.000	0.000	0.000	0.000				0.000	0.000	
SUB	0.000	0.000	3.482[2]	0.000				8.621	12.103	
CND	0.000				0.000				0.000	
M	0.000	0.000				55.101[4]	0.000		55.101	
TOT/TSK	0.000	0.000	14.799[3]	0.000	0.000	55.101[4]	0.000	30.101	100.000	

*For this run, only subsystem 1C200 was selected to have this output report.

1. Value should be 9.340
2. Value should be 5.460
3. Value is correct
4. Value is correct

R&M OUTPUT FOR SUBSYSTEM 1C200 - TEST ONE (Continued)

MMH PER 1000 FH CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM-DUM1C2 (1C200) MFHBMA= 25.0

	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT	
LRU-DMS1C2 (1C210)										
W	0.000	0.000	12.605[1]	0.000				23.920	36.525	
K	0.000	0.000	0.000	0.000				0.000	0.000	[Report Option #5]
N	0.000	0.000	0.000	0.000				0.000	0.000	
SUB	0.000	0.000	12.605[1]	0.000				23.920	26.525	
LRU-DMT1C2 (1C210)										
W	0.000	0.000	3.878[2]	0.000				9.600	13.478	
K	0.000	0.000	0.000	0.000				0.000	0.000	
N	0.000	0.000	0.000	0.000				0.000	0.000	
SUB	0.000	0.000	3.878[2]	0.000				9.600	13.478	
CND	0.000				0.000				0.000	
M	0.000	0.000				60.490[4]	0.000		60.490	
TOT/TSK	0.000	0.000	16.483[3]	0.000	0.000	60.490[4]	0.000	33.520	110.494	

1. Value should be 10.400-W_1 Separate path from R's to shop
2. Value should be 6.080-W_2 Separate path from R's to shop
3. Value is correct
4. Value should be 61.36. Accuracy down because of extremes in values to compress.

R&M OUTPUT FOR SUBSYSTEM 1C200 - TEST TWO (Continued)

MMH PER 1000 FH CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM-DUM1C2 (1C200) MFHBMA= 25.0

	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT	
LRU-DMS1C2 (1C210)										
W	0.000	0.000	12.602[1]	0.000				23.920	36.522	
K	0.000	0.000	0.000	0.000				0.000	0.000	[Report Option #5]
N	0.000	0.000	0.000	0.000				0.000	0.000	
SUB	0.000	0.000	12.602[1]	0.000				23.920	26.522	
LRU-DMT1C2 (1C210)										
W	0.000	0.000	3.878[2]	0.000				9.600	13.478	
K	0.000	0.000	0.000	0.000				0.000	0.000	
N	0.000	0.000	0.000	0.000				0.000	0.000	
SUB	0.000	0.000	3.878[2]	0.000				9.600	13.478	
CND	0.000				0.000				0.000	
M	0.000	0.000				61.360[4]	0.000		61.360	
TOT/TSK	0.000	0.000	16.480[3]	0.000	0.000	61.360[4]	0.000	33.520	111.360	

1. Value should be 10.400-W_1 Separate path from R's to shop
2. Value should be 6.080-W_2 Separate path from R's to shop
3. Value is correct
4. Value is correct

R&M OUTPUT FOR SUBSYSTEM 1C200 - TEST ONE (Continued)

MAINT. INDEX X 1000 CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM-DUM1C2 (1C200) MFHBMA= 25.0

	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT	
LRU-DMS1C2 (1C210)										
W	0.0000	0.0000	10.6000[1]	0.0000				11.9600	22.3600	
K	0.0000	0.0000	0.0000	0.0000				0.0000	0.0000	[Report Option #6]
N	0.0000	0.0000	0.0000	0.0000				0.0000	0.0000	
SUB	0.0000	0.0000	10.4000[1]	0.0000				11.9600	22.3600	
LRU-DMT1C2 (1C210)										
W	0.0000	0.0000	3.2000[2]	0.0000				4.8000	8.0000	
K	0.0000	0.0000	0.0000	0.0000				0.0000	0.0000	
N	0.0000	0.0000	0.0000	0.0000				0.0000	0.0000	
SUB	0.0000	0.0000	3.2000[2]	0.0000				4.8000	8.0000	
CND	0.0000				0.0000				0.00000	
M	0.0000	0.0000				33.2000[4]	0.0000		33.2000	
TOT/TSK	0.0000	0.0000	13.6000[3]	0.0000	0.0000	33.2000[4]	0.0000	16.7600	63.5600	

1. Value should be 5.200
2. Value should be 3.040
3. Value should be 8.240
4. Value should be 30.680

R&M OUTPUT FOR SUBSYSTEM 1C200 - TEST TWO (Continued)

MAINT. INDEX X 1000 CH3E UNSCHEDULED MAINTENANCE RELIABILITY AND MAINTAINABILITY

SUBSYSTEM-DUM1C2 (1C200) MFHBMA= 25.0

	AGE F/L	TS/FL	R+R	VR+R	CND A/C	M A/C	VM A/C	SHOP	TOT/OUT	
LRU-DMS1C2 (1C210)										
W	0.0000	0.0000	6.3012[1]	0.0000				11.9600	18.2612	
K	0.0000	0.0000	0.0000	0.0000				0.0000	0.0000	[Report Option #6]
N	0.0000	0.0000	0.0000	0.0000				0.0000	0.0000	
SUB	0.0000	0.0000	6.3012[1]	0.0000				11.9600	18.2612	
LRU-DMT1C2 (1C210)										
W	0.0000	0.0000	1.9388[2]	0.0000				4.8000	6.7388	
K	0.0000	0.0000	0.0000	0.0000				0.0000	0.0000	
N	0.0000	0.0000	0.0000	0.0000				0.0000	0.0000	
SUB	0.0000	0.0000	1.9388[2]	0.0000				4.8000	6.7388	
CND	0.0000				0.0000				0.00000	
M	0.0000	0.0000				30.6800[4]	0.0000		30.6800	
TOT/TSK	0.0000	0.0000	8.2400[3]	0.0000	0.0000	30.6800[4]	0.0000	16.7600	55.6800	

1. Value should be 5.200
2. Value should be 3.040
3. Value is correct
4. Value is correct

APPENDIX B: COMPRESSING NETWORKS USING CREW SIZE FIELD FOR TEST ONE OF R&M

An attempt was made to allow more than one of the same kind of task to be entered into the same network in the R&M program. For example, this would be most valuable for a fuselage network where several different AFSCs may have similarly coded tasks on different components. Users would still have to limit their task actions codes to those of the Generalized Maintenance Action Network of the R&M model, but could then compress the similarly coded tasks for different AFSCs into one summary task entry with the weighted crew sizes. This conversion from Figure B-1 to B-2 is accomplished by computing

$$CW(i) = \frac{E(i) \times C(i) \times T(i)}{\sum_{1}^{i} E(i) \times Tc}$$

where CW(i) = the weighted crew size value for AFSC (i)
E(i) = mutually exclusive conditional probability of task (i)
C(i) = crew size for AFSC (i) on task (i)
T(i) = time for task (i)
Tc = time to be used on compressed task

This approach produced correct maintenance manhour output values; however, the mean time to repair, subsystem availability, and other outputs which did not use the weighted crew size in their computation were then invalid.

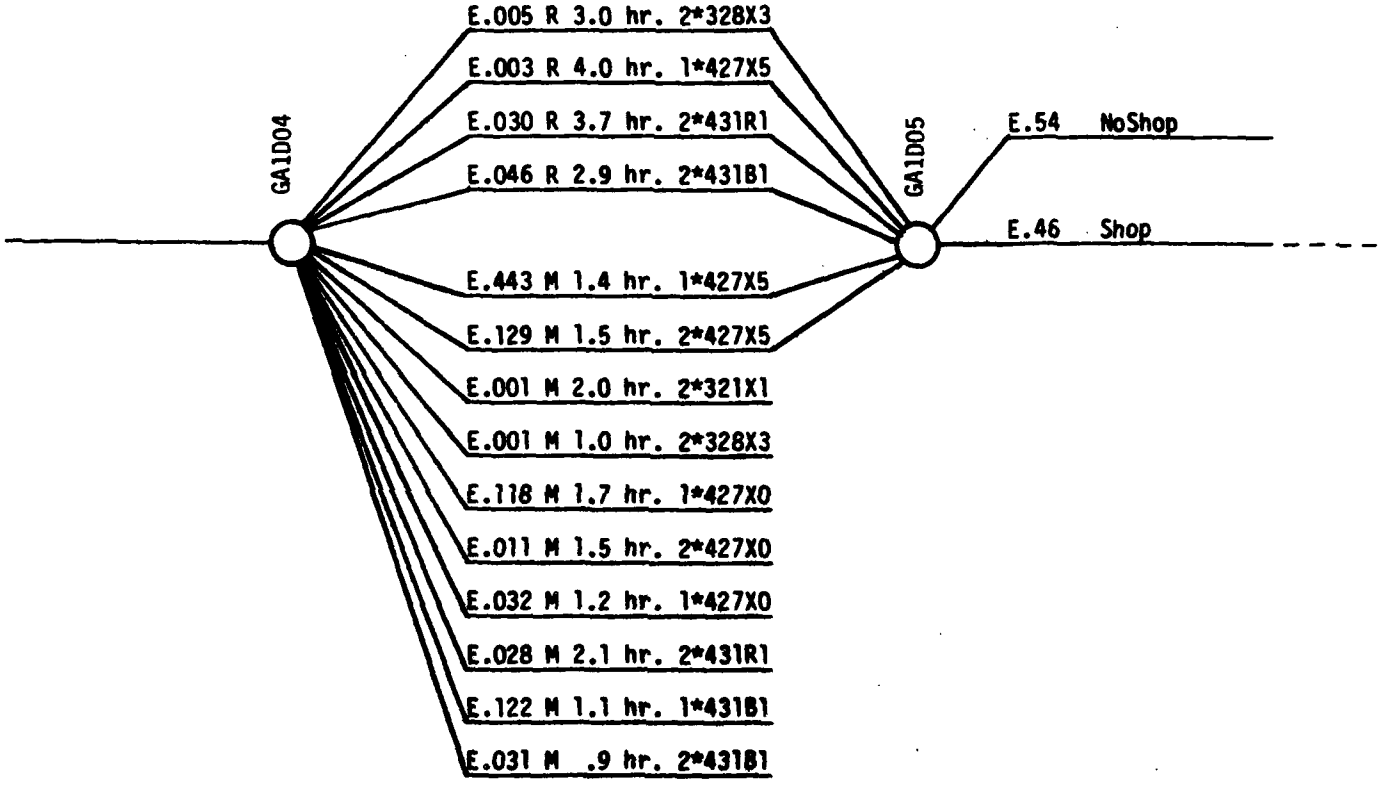

Figure B-1 Portion of Fuselage Network For LCOM From Extended Form 11

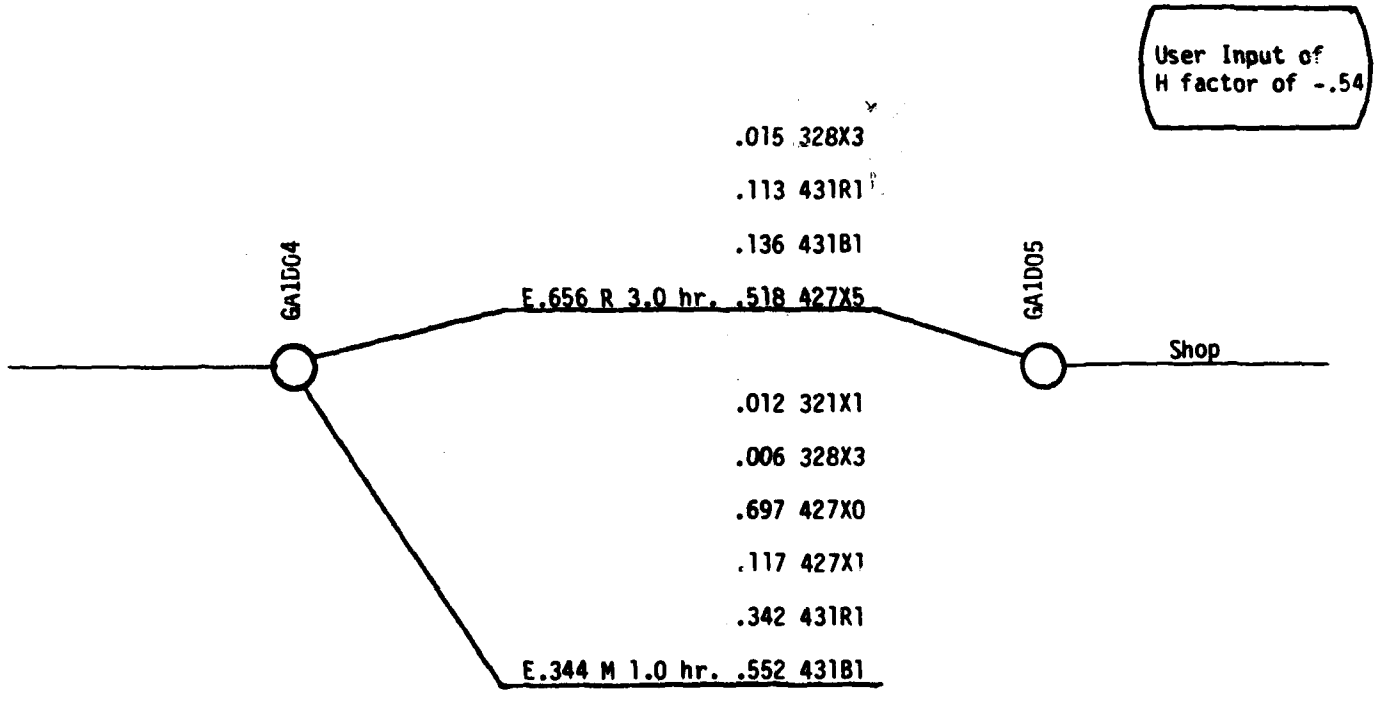

Figure B-2 Portion of Fuselage Network Compressed for R&M

APPENDIX C: JOB FLOW FOR TEST RUNS OF R&M