CoA Memo M and P No. 45

THE COLLEGE OF AERONAUTICS

CRANFIELD

POST NUBES LUX

A SYSTEMS APPROACH TO THE DESIGN OF PROCEDURES NECESSARY FOR THE ORGANISATION OF STUDENT TRAINING FLIGHTS

CoA Memo M and P No. 45

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THE COLLEGE OF AERONAUTICS

DEPARTMENT OF PRODUCTION AND INDUSTRIAL ADMINISTRATION

Ergonomics and Systems Design Laboratory

C R A N F I E L D

A systems approach to the design of procedures necessary for the organisation of Student Training Flights

S U M M A R Y

The project was designed to familiarise the group with the use of system design techniques. The objective was to synthesis a system which would be suitable for providing training flights for students at The College of Aeronautics, Cranfield.

Members of the group

I.D.C. Andrew (24)

H.N.C. (Mech. and Elect). Six year M.o.A. Apprenticeship at the Royal Aircraft Establishment, Farnborough.

D.R. Corkindale (23)

B.Sc. (Chemistry), Durham University. One year in the Work Study Department of Vitamins Ltd.

J.C. Dashper (23)

B.Sc. (Mech.). Leeds University.

L.R.C. Fellender (24)

H.N.C. (Mech.). Six years with Westland Aircraft Ltd.

I. Ferguson (24)

H.N.C. (Mech. and Elect.). Five year M.o.A. Apprenticeship at the Royal Aircraft Establishment, Farnborough.

M. Foster (23)

B.Sc. (Physics and Statistics). Nottingham University.

J.J. Fransman (24)

B.Sc. (Maths.). Southampton University. Two years with English Electric Co. Ltd.

R.V. Hill (22)

H.N.D. (Mech.). Five year apprenticeship with Hawker Aircraft Ltd.

J.D. Hobbs (22)

B.Sc. (Econ). London University.

D. Porch (22)

B.Sc. (Maths). Nottingham University.

T.J. Sherwood (23)

H.N.D. (Mech.). Six years with A.E.C. Ltd.

R.J. Talbot (23)

B.Sc. (Eng.). A.C.G.I. Eighteen months with English Electric Aviation Ltd.

B. Vaughan (23)

B.Sc. Tech. (Physics) Manchester A.M.C.S.T.

J. Wright (24)

H.N.C. (Mech.) Nine years with Bryan Donkin Ltd.

Duration of project

The group met once each week for eight weeks, during these meetings work was allocated to various groups and individuals for discussion at subsequent meetings.

Acknowledgments

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Introduction

Until recently designers have had no procedures to follow in determining the optimal and feasible solution to a systems problem.

The following report describes the procedure adopted for the design of a system, without reference to the details of the present system. It is however necessary to have a fundamental knowledge of system design procedure. This knowledge of methods and techniques was supplied from a series of twenty lectures given at the Ergonomics and Systems Design Laboratory, Cranfield, and the report is therefore based on this approach to systems design.

Under consideration is the colleges training flight system which is intended to give students some experience in handling aircraft. There are four Auster aircraft and two pilot/instructors, with only these resources available the number of students it is possible to train is limited, and hence it is necessary to have a system which gives the maximum number of flying hours possible for training flights at times when it is convenient for the students.

Systems procedures and terminology.

Terms of reference

The procedure is carried out on the assumption that the system is best designed with no investigation into the present system. Thus any problems encountered in the present system do not affect the new design.

Procedure

The standard recommended procedure is as follows:

a. Determination of inputs and outputs
b. Separation into sub-systems

c. Allocation of functions.
d. Determination of linkages within sub-systems.
e. Determination of inputs from other sub-systems.
f. Interface design
g. Design for maintenance
h. Design for production.

a. Determination of Inputs and Outputs

In considering any system it is necessary to determine what information is required from the outside world, in conjunction with what is sent out from the system. This is represented by a one block diagram with arrows pointing towards the block indicating inputs and arrows pointing away indicating outputs; the block representing the whole system.

b. Separation into Sub-systems

A system may contain many sub-systems. The sub-systems are described not as individual activities but as overall functions (e.g. maintenance). These denote what each sub-system does in order to fulfil the overall requirements of the system. If reference is made to the overall system diagram (Diag. 13) three dividing lines will be observed separating the three sub-systems; the circular line indicates a separation between the system and the outside world.

c. Allocation of Function

After the division into sub-systems it becomes possible to develop each independently of the others. The main difficulty in this is the allocation of functions. It becomes necessary to have a knowledge of what the sub-system represents and what it entails. (e.g.:- co-ordination of students, instructors and planes for flying). Hence it is necessary to ask the present system 'what does the sub-system do and what it is hoped it will fulfil?'

Having obtained this background information it is now possible to divide the sub-system into functions. This is represented by a block on the diagram with the function written inside. The functional blocks only indicate what it does and not how it is achieved (e.g. scheduling); again these functions are allocated without reference to the present system.

d. Determination of Linkage

Having decided what functions are necessary to achieve the objectives of the sub-system; it is now possible to decide on the objectives of each function and what information is necessary to achieve these objectives; in order to make each function operate efficiently and with the least amount of work involved. The lines from one functional block to another indicates this information, the arrows show in which direction it is flowing. At this stage no design of how it is conveyed takes place.

e. Determination of Inputs from other Sub-systems

When the sub-systems have been designed it is necessary to determine what information is required from other sub-systems and what should be conveyed to them. In order not to work at cross purposes and because each sub-system knows its own requirements, each sub-system describes the information linkages that flow into it from the other sub-systems. The information as before being indicated by the line, the direction of flow indicated by the arrow. These linkages are those crossing the sub-system division lines as shown in the overall system diagram (Diag. 13).

f. Interface Design

Having decided what information is needed by the functional block and which source this information is to come from, it is necessary to establish in what form the information is to be transferred. (e.g. wall charts, forms). For this purpose each sub-system designs its own interface without reference to the present system and other sub-systems. It is essential however to come to a basic agreement between sub-systems as to what are the criteria for any particular information transferring mechanism (e.g. forms, size of:- half quarto and quarto).

g. Design for Maintenance

This requires a consideration of how well the system envisaged will function if particular failures occur and in particular, how easily it may be adapted to suit changes of objectives.

h. Design for Production

This is the crucial stage at which the detailed practical problems encountered in implementing the new system are considered and the system is modified accordingly.

g. and h. were not completed on this project because of shortage of time.

Definition of objectives

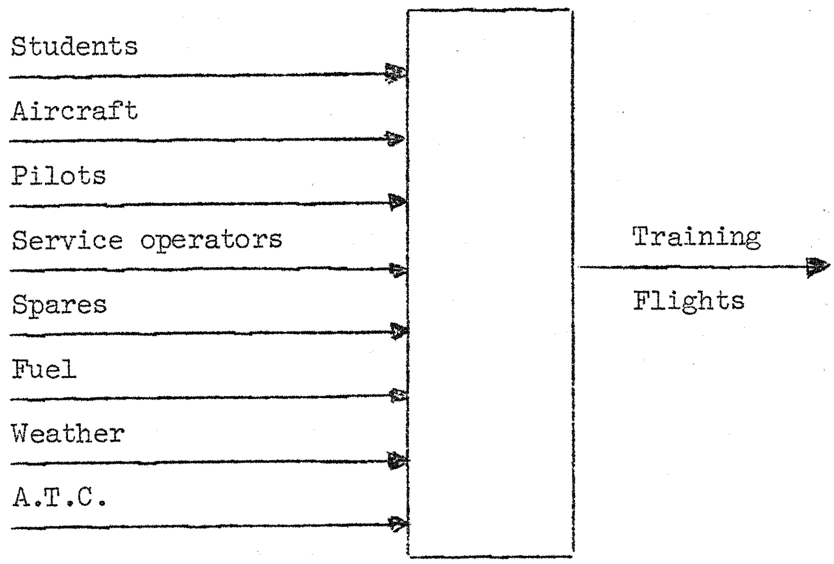
Overall Objective: To provide flying experience to those aeronautical students who are able and keen to learn to fly.

Aeronautical students are defined as those students on D.C.Ae. courses.

The diagram below shows the various inputs to the system on the left hand side and the output from the system on the right hand side. The inputs of Students, Aircraft, Pilots, and Service Operators are similar in that they all concern physical inputs and availability information inputs. The spares and fuel are similar in that these inputs are made up of actual delivery of spares and fuel from an outside supplier, and information concerning delivery dates, etc. The weather and 'air traffic control' are obvious factors which will affect the output of training flights, and therefore information concerning these must be fed into the system.

The output is training flights, the optimum number being such that each keen and able student can have as much flying as he wishes up to a maximum of 40 hours.

Objective Diagram for Training Flight System



Objectives: to co-ordinate aircraft students and instructors so as to optimise the number of flying hours available for training flights, subject to the following limitations:-

(i) 4 aircraft
(ii) 2 instructors
(iii) the existing facilities of maintenance and spares departments
(iv) weather conditions.

The inputs to the operations sub-system are:-

(i) aircraft
(ii) pilot-instructors
(iii) students
(iv) weather

The output is a training flight.

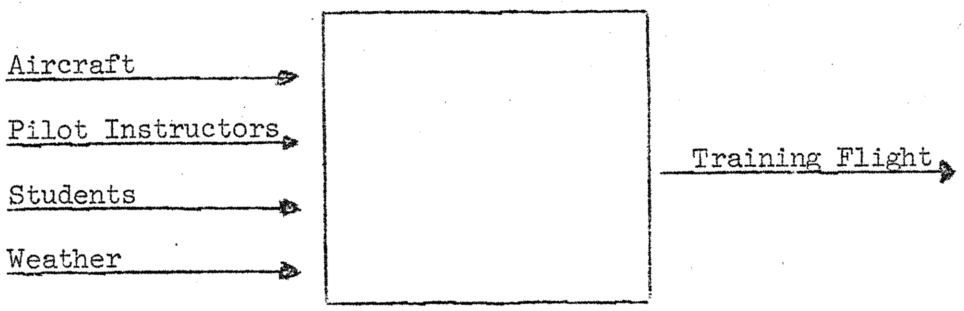


Diagram 1. Objectives of operations sub-system

Division into and definition of functions (see Diagram 2)

(1) Information - so as to retain information required to perform the other functions. The information stored will be:-

(a) long-term availability of pilot-instructors
(b) long-term availability of students
(c) long-term availability of aircraft
(d) long-term training flight schedule
(e) aircraft condition and demand (from maintenance)

(2) Comparator - this function is one of assimilating the relevant data from information store, so as to facilitate the decision making function.

(3) Decision Maker - uses information from the comparator and the information store to affect re-scheduling as and when necessary.

The inputs to the decision making function are not all of the same order of importance. The order of importance finally decided on was:-

(i) weather and aircraft
(ii) students
(iii) instructors

The sub-system (see Diagram 3), is represented using electronic logic circuit symbols, each symbol being a decision making function.

(4) Scheduler - from the data in the information store, the scheduler organises a timetable showing long-term obligations of pilot-instructors and students.

(5) Re-scheduler - the re-scheduler is activated by the decision-maker function, and on the basis of information on short-term obligations of students and pilots.

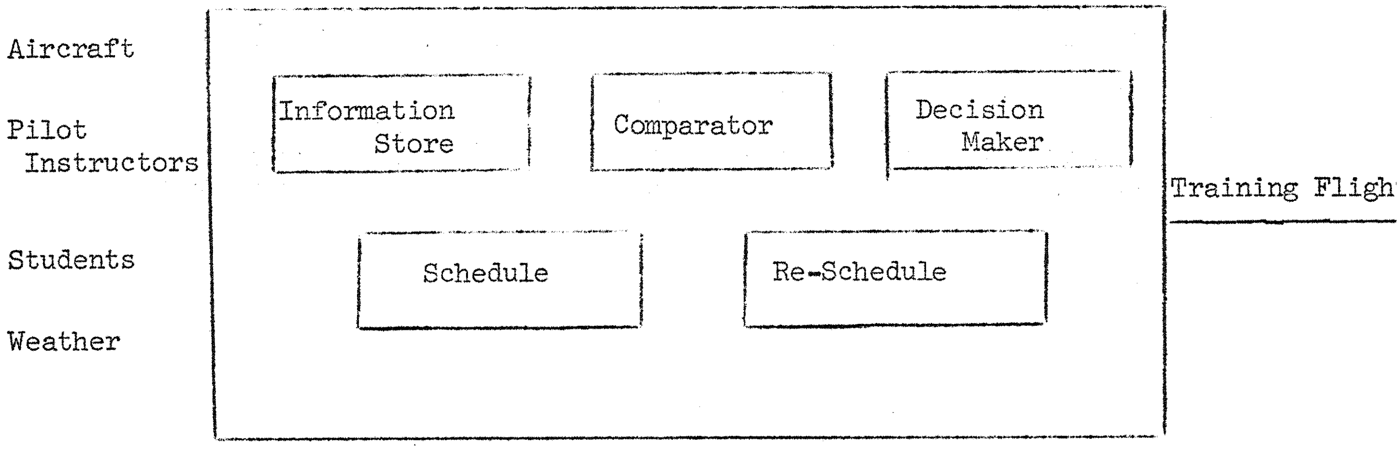


Diagram 2. Functions necessary in operations sub-system

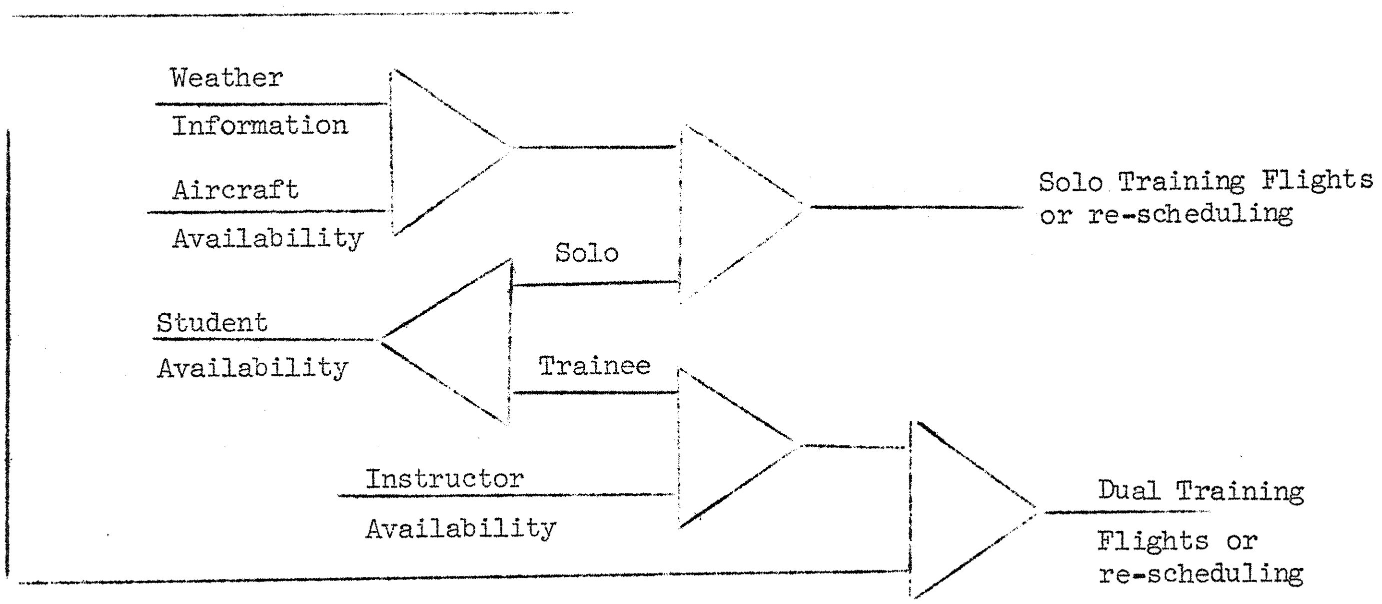


Diagram 3. Information flow in decision making block

Definitions and Design of Interface Elements (see Diagram 4)

		Information flow along channel	Interface Design
1		Short-term availability to comparator	
	a.	to pilots - present or ill, etc.?	a) phone
	b.	students - turned up or excused	b) verbal or phone
	c.	how many useable, has pilot made occurred?	c) verbal information
2.		Comparator to Decision maker - consists of making a mental note of information in (1)	memory storage
3.		Decision maker to Re-scheduler - if (2) is affirmative, need to re-schedule (or scrap a flight)	thought process
4.	a.	Re-schedule to pilots } flying on/off	a. to pilots - verbal message or phone.
	b.	Re-schedule to students } flying on/off	b. to students - phone to Lanchester Hall and parties to broadcast 'until further notice flying on/off', and also Stafford Cripps bldg. to record flying on/off - and time on blackboard.
5.		Long-term availability to information store	
	a.	pilots	a. pilots decide among themselves.
	b.	students	b. timetable - students preference. (Fig. 4 and 5 Fig. 6 posted on Flight notice board weekly.
	c.	aircraft condition and demand	c. chinagraph chart. Fig. 1.
			d. verbal or phone

Diagram 4. Complete sub-system for operations

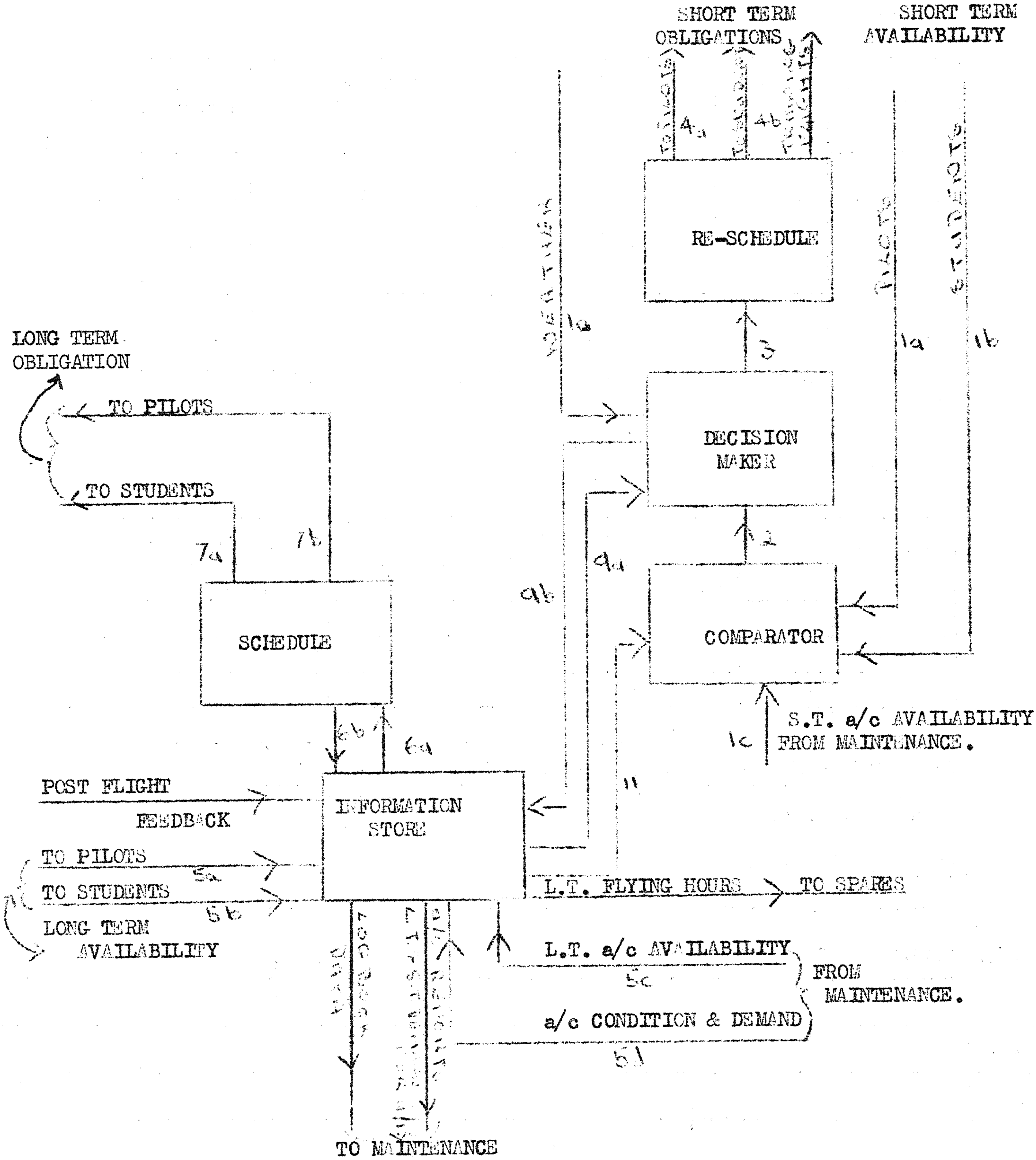


Figure 1 18″ × 12″

Aircraft	Hours to Check 1	Hours to Check 2	Hours to Check 3	Hours to Check 4	Hours to Check 5	C.of M. Expires	Date

WALL CHART (PERSPEX COVERED) - DETAILS FILLED IN DAILY USING CHINAGRAPH PENCIL.

Figure 2 36″ × 30″

STUDENTS NAME	EXERCISES									Total Dual Hours	Total Solo Hours	Hours to Solo Flight
	1	2	3	4	5		18	19	20			

WALL CHART (PERSPEX COVERED, DETAILS ENTERED IN CHINOGRAPH PENCIL). DUAL 'TICKS' BLUE, SOLO 'TICKS' RED. TIME UP TO FIRST SOLO FLIGHT ENTERED IN APPROPRIATE BOX.

Figure 3 30″ × 18″

FLYING HOURS	9.15-10.00	10.00-10.45	10.45-11.30	11.30-12.15	14.15-15.00	15.00-15.45	15.45-16.30
MON.							
TUES.							
WED.							
THURS.							
FRI.							

WALL CHART WITH SLOTTED BOXES. CARDS BEARING STUDENTS NAME INSERTED IN SLOT (BLUE - DUAL S^{ts}., RED - SOLO S^{TS}.) TWO CARDS/BOX WHERE POSSIBLE.

Information flow along channel (continued)				Interface design (continued)
6	a.	Information store to schedule		
	b.	Schedule to information store i.e. information on students, pilots and aircraft sorted and tabulated into a schedule.		wall charts (Fig. 3)
7.	a.	Schedule to students, i.e. information on weekly obligations	a.	printed notice - weekly on Lanchester Hall notice board (Fig. 6)
	b.	Schedule to pilots - information on weekly obligations	b.	printed rota weekly (Fig. 7).
8.		Post-flight feedback to information store.		
	a.	Information on students - amending information store chart.	a.	wall chart (Fig. 2) and verbal.
9.	a.	Information store to Decision Maker and back - review of students progress	a.	colour code schedule chart
	b.	to alter training programme - i.e. remove students from training flights if not up to standard or change their colour code if now solo, thus causing schedule changes. If a student is removed - communication to individual in question.	b.	change colour coded card or remove completely. If removed, written communication to student (or verbal).
10		Weather condition and forecast from A.T.C. to Decision Maker		Written bulletin Also inspection of barometer (experience).
11.		Information store to comparator. Collection of data in order to facilitate decision making.		Wall charts and various schedules already noted.

Figure 4 Students Proforma ($\frac{1}{2}$ quarto) issued once per term

TRAINING FLIGHT

The training flight programme is being arranged, please complete the proforma below showing free periods and free afternoons. Alternate week free periods are not to be shown. If programmed for a period shown as free, the student should be available and report to the flight. Missing a period programmed can mean suspension from flying training. Consideration should be given to any sports team commitments in completing the proforma.

NAME: .... HALL AND ROOM NO.: ....

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
0900-1000					
1000-1100					
1100-1200					
1400-1500					

Figure 5 Students' Proforma for Wednesday afternoon and week-end flying ($\frac{1}{2}$ quarto)

Training Flights

Please enter your name in the appropriate space below if you would like to be considered for a training flight at these times.

Flying schedule for week ....

TIME	WEDNESDAY	SATURDAY	SUNDAY
10.00-11.00			
11.00-12.00			
12.00-13.00			
13.00-14.00			
14.00-15.00			
15.00-16.00			
16.00-17.00			

Figure 6 Students' Schedule (½ quarto)

STUDENTS NAME	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
	Flying Hours	Flying Hours			

Figure 7 Instructors Schedule (½ quarto)

INSTRUCTORS NAME	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
	Flying Hours	Flying Hours			
	Flying Hours				

Maintenance Sub-system

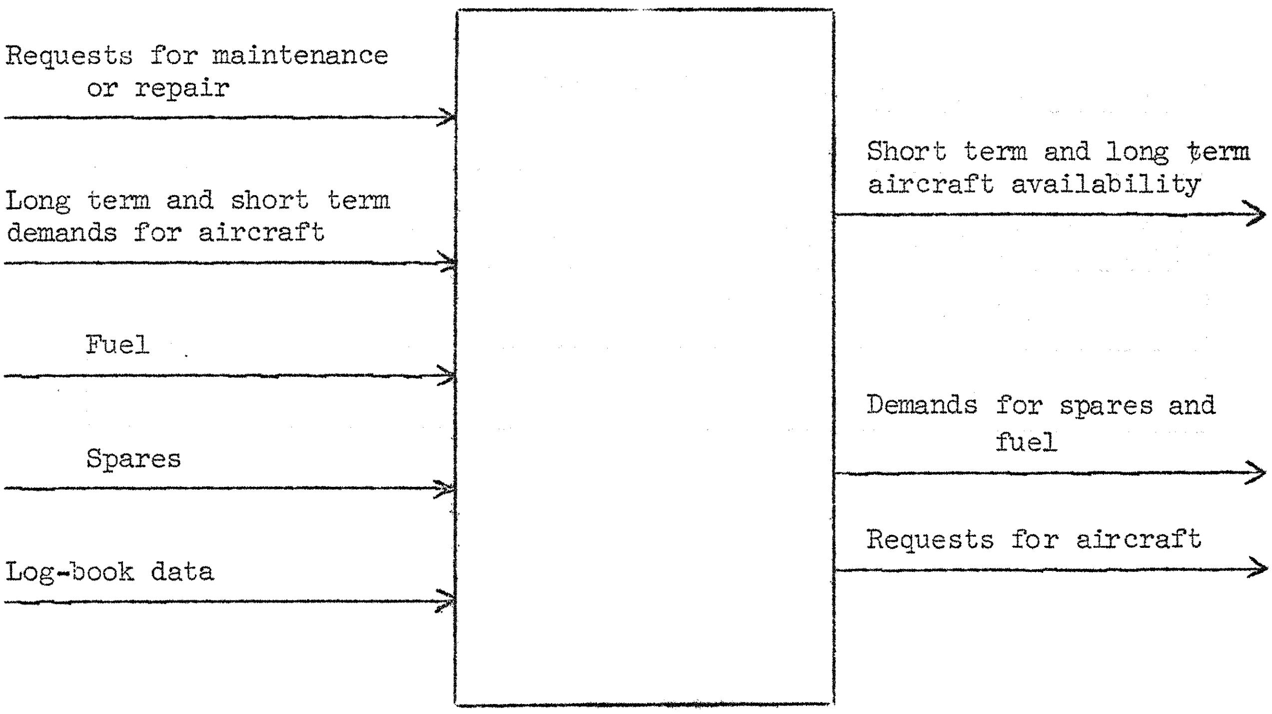
Objectives

a) To keep at least two aircraft operational,

b) To meet the requirements of the Air Registration Board.

This entails doing both routine maintenance and emergency repairs. The necessary inputs and outputs are shown opposite.

Diagram 5. Objectives of Maintenance Sub-systems



Division into Functions

The functions included within the maintenance section are; to a large extent, governed by existing requirements such as A.R.B. specifications. However, an attempt has been made to determine the functions which are necessary to carry out the objectives of the sub-system as well as to meet other requirements which are unavoidable.

The following functions were found to be necessary:

1. Routine Maintenance Scheduling:

Aircraft have to be serviced at regular intervals of both flying time and calender time. This function ensures that A.R.B. servicing time requirements are met.

2. Examination:

In the event of damage or a breakdown, aircraft will have to be examined in order to determine the correct course of action.

3. Repair:

The aircraft must be maintained and repaired by skilled mechanics to ensure that they are air-worthy.

4. Inspection:

Apart from being a common sense function, inspection must be carried out to meet A.R.B. specifications.

5. Refuelling:

Aircraft must have adequate and readily available supplies of fuel so that they are prepared for flight when required, provided that they are otherwise air-worthy.

6. Spares Inspection:

Although most spare parts are accompanied by an approval certificate from the manufacturer, there is the possibility of damage in transit. This function provides another check to prevent a faulty replacement part being fitted to an aircraft.

7. Co-ordinator/Scheduling:

This function comprises an information store and a decision-maker and is the key liaison function between all the other functions.

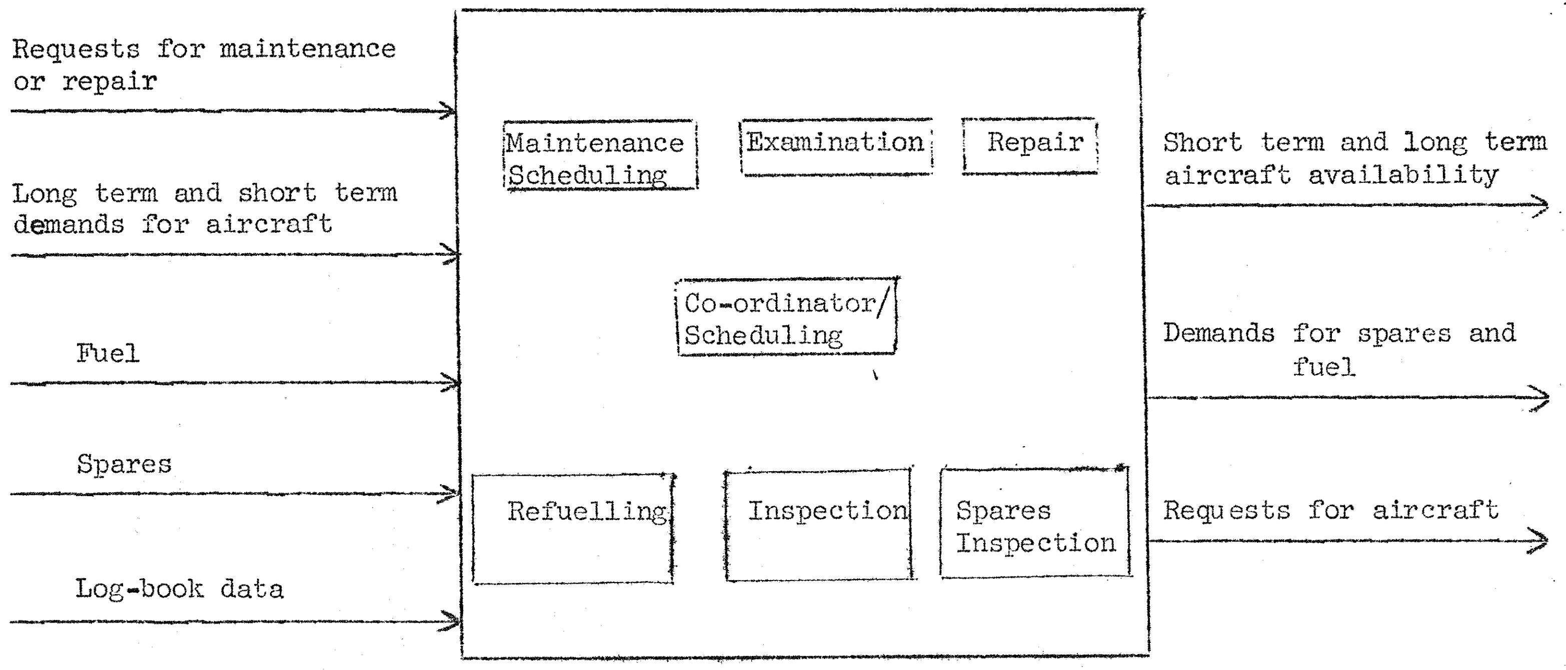


Diagram 6. Functions necessary in maintenance sub-system.

Definitions of Functions and Interfaces

In order to ensure that all functions had been fully considered each was defined in more detail.

1. Routine Maintenance Scheduling.

Receipt of information from operational department concerning all aircrafts and to log this. From this information to determine when and if aircraft are due for maintenance.

Decision: whether or not the aircraft need scheduled maintenance.

Information required: flying hours and Air Registration Board approved maintenance schedules.

2. Examination

Incoming aircraft examined prior to any work being done on them to ascertain exactly what needs to be done. This information given to the co-ordinator/ scheduler so that work can be planned.

Decision: to determine the exact source and nature of the breakdown.

Information required: which aircraft need examination, the symptoms and circumstances and fault finding information.

3. Repair

The carrying out of maintenance work, information and schedules given to service operators, control of work.

Decision: what repairs and maintenance are to be carried out and what extra spares and equipment are required.

Information required: instructions as to the type of repair, then time required, the repair procedure and mechanics report.

4. Inspection

After work has been done an aircraft inspected to A.R.B. specifications. Inspection informed by co-ordinator/scheduler as to what has been done to aircraft. Inspection report back results of their tests so that rework can be scheduled, etc.

Decision: whether A.R.B. specifications have been achieved or not.

Information required: details of repairs, time of completion of repairs and A.R.B. specifications.

5. Refuelling

To have fuel available and supply it to aircraft when needed.

Decision: what aircraft to be refuelled, quantity, stocks required.

Information required: request for refuelling, records of quantities.

6. Spares Inspection.

Spares visually checked on receipt from stores. Results of check sent to co-ordinator if unsatisfactory.

Decision: whether or not the spares are visually acceptable.

Information required: past experience and/or handbook.

7. Co-ordinator/Scheduling Block

This function is the key to the running of the maintenance department. Its purpose is to co-ordinate all the other activities and schedule when work should be performed and to control these operations.

Decision: what aircraft, what maintenance and/or repairs, what spares, what equipment, what inspectors, when report, when examine, when inspect, when request aircraft and when request spares.

Information required: request for repairs and priorities, which aircraft due for maintenance, what maintenance required on each specific aircraft, examination results, repair completion time, inspection results for aircraft and spares, spare parts list, request for extra spares, equipment list and request for equipment.

Definitions and Design of Interface Elements (see diagram 7)

1. Daily flying hours etc.
containing: aircraft registration number, date, flying hours, signature of instructor.

2. Details of examination
containing: aircraft registration number, date, description of malfunction, signature of examiner.

3. As 5

4. An output (request for aircraft)

5. Malfunctions
containing: details of aircraft, date of requests, breakdown description, signature of instructor.

6. An output (request for spares, equipment and fuel).

7. Details of delivery of spares
containing: requisition number, details of spares delivered which are destined for the maintenance section, date of delivery, signature.

8. Results of inspection of spares
containing: requisition number, spare part description, result of inspection, signature of inspector, date. (Only used if spares are sub-standard).

9. Instructions for repair
containing: aircraft registration number, description and procedure of repair or check, sequence of operations, priority, co-ordinator's signature, date.

10. Feedback on repairs,
containing: request for extra spares and equipment, progress report on operations.

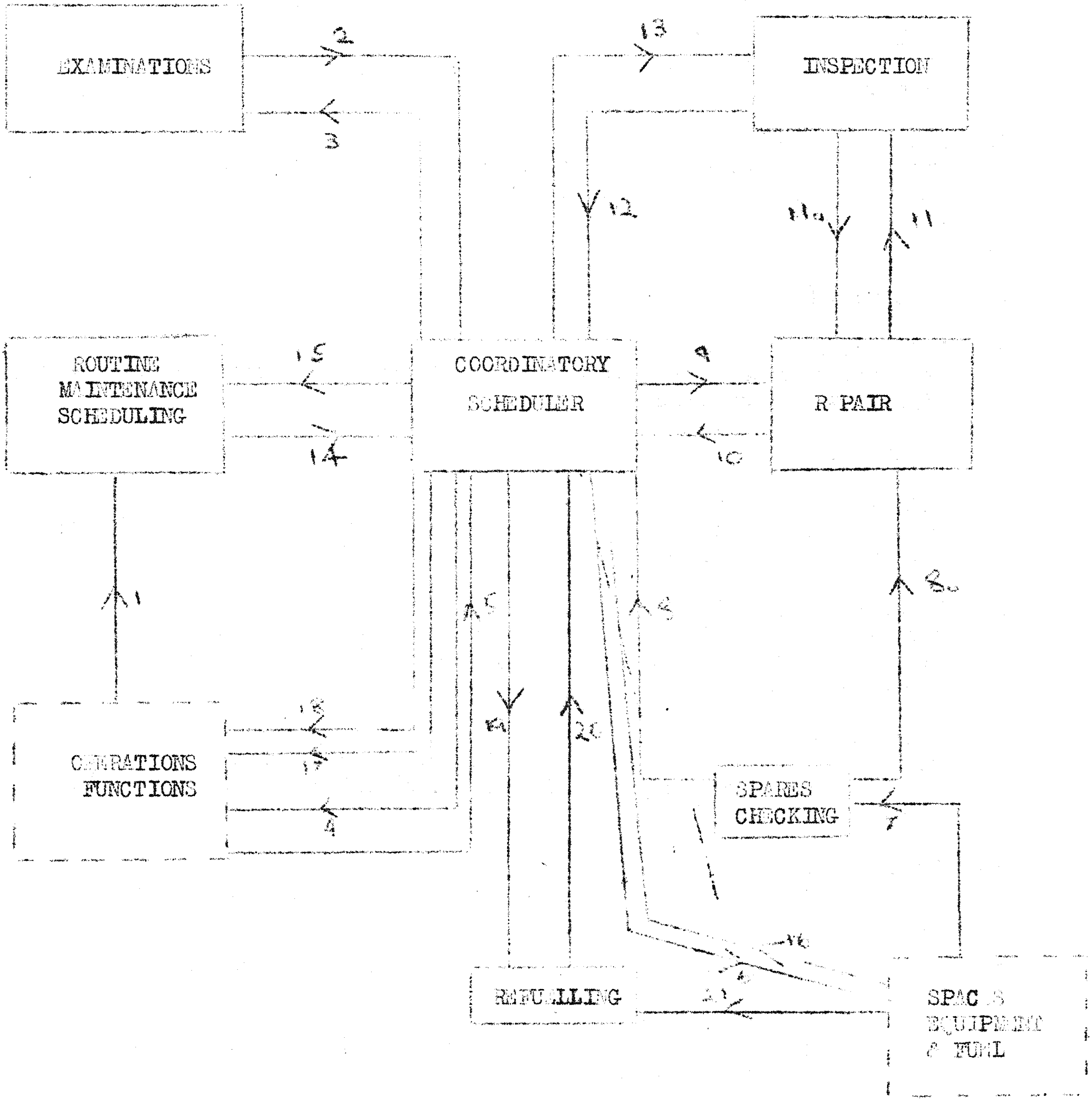
11. Request for immediate inspection on minor operations and feedback.

12. Results of inspection of aircraft,
containing: aircraft registration number, details of inspection, signature of inspector, date.

13. Request for inspection,
containing: aircraft registration number, details of operations carried out and time of completion, signature of co-ordinator, date.

14. Notice of routine maintenance,
containing: aircraft registration number, type of routine maintenance, when due, signature, date.

Diagram 7. Block Diagram of Functions



Design of Interface Elements

An interface is an imaginary plane across which information passes. All the necessary information which must pass from one function to another has been determined and the best method of conveying it and presenting it must now be decided.

This information passes between man and man and the usual methods of transferring information are: verbally, e.g. 'phone; written, e.g., forms; and mechanically, e.g. teleprinters. We considered each link along which information was transferred and decided the most practical way of carrying this information and the best way of presenting it.

Link 1: this was considered best to be a form; it would contain various figures which might be distorted if carried verbally. It would be a copy from the aircraft log book and would be a routine procedure to fill it in at the end of each day. One such form would be completed for each day, Form 8 shows the proposed form.

Links 2, 3, 5, 9, 10, 12 and 15

All these links deal with information regarding the processing of the aircraft through the maintenance schedule and were considered best to be put on one form. This saves much duplication of information necessary to various sections. See figure 10.

Link 5, conveys a request for repairs to an aircraft. For speed this was considered best done by 'phone. The details of the aircraft and its malfunctions would be copied onto Section A of the form 6B together with the reporter's name. The aircraft would be first sent to the examination section who would give it a preliminary check. They would receive all the relevant details of the breakdown in part A of Figure 10. Link 3. The results of the examination would obviously be best recorded below the description of malfunctions and hence Link 2, is part B of Figure 10. Provision is made for the examiners signature and a date for programming. Mext the co-ordinator considers the examination report and details when best to start repairs. His instructions to the maintenance section would best be listed below the details of malfunctions and examination so that the reader is familiar with the particulars before reading the general instructions. Link 9 is therefore part C of Fig. 10. Provision is made for the co-ordinators signature and a date, for progressing.

When the repair is completed Link 10 serves to give the co-ordinator notification of this. Hence the fitter must detail what he has actually done on the aircraft. This naturally follows on from the original instructions and is part D of Fig. 10. The co-ordinator can then check easily how instructions and what actually was done tie up. Provision is made for fitters signature and date. The inspector must then be notified of what has been done to particular aircraft. To save rewriting the fitter's report part D of Fig. 10 can be sent, this forms Link 13. Hence part D must be a tear-off slip and contain provision for the aircraft registration number. In order that it may also serve as a feedback on the result of the inspection, Link 12 it must contain provision for the inspectors remarks, his signature and the date. Link 4 is an output and not dealt with by us. Link 6, is also an output, the 'Spares/Fuel requisition'. It was decided that since a form existed for this it would also serve as Link 7, i.e., inform the co-ordinator when spares are delivered by returning his original request plus any remarks as to delivery of non available parts.

Link 11, a request for immediate inspection of minor operations, was considered best to be verbal for speeds sake. The feedback would also be verbal for the same reasons.

Link 14 is a request for information where the answer is of the yes/no type. In view of this it was decided that a verbal link was all that was necessary and hence Link 15, the reply, is, also verbal Link 16 is to enable the spares people to inform the co-ordinator when certain spares he has requested are unavailable. This will not be detailed information but will allow him to reschedule work which would require the spares. Hence a verbal link is all that is necessary, probably by 'phone.

Links 17 and 18 are outputs and designed by the Operations group.

Link 19 is an instruction to the refuelling unit to refuel a certain aircraft either after maintenance or purely as routine. Speed will probably be desirable, especially in the latter case, and a verbal link, by telephone will serve adequately.

Link 20 is the feedback from the instructions in 19 and must list all fuel issued to aircraft. This will be totalled weekly hence is best recorded on a form. The form will also provide for the receivers signature against each issue and the aircraft registration number. The proposed form is Fig. 9.

Link 21 is associated with the bulk issue of fuel from the main fuel store (part of the spares functions), to the refuelling units. The receipt of fuel can also be recorded on Fig. 9 so that the receipt and issue can be checked. For receipt of fuel the form must provide for recording the quantity, the date and the issuers signature.

Form 6B also caters for routine maintenance in that section A will not list breakdown details but the details of the particular service to be carried out, e.g., '50 hours clock'. It will still be routed the same way.

Figure 8

THE COLLEGE OF AERONAUTICS, CRANFIELD DAILY FLIGHT RECORD					
Aircraft Reg. No. ----------------			Day --------	Month --------	Year --------
Flight No.	Flying Hours: Hours	Flying Hours: Min^s^	Flight No.	Flying Hours: Hours	Flying Hours: Min^s^
1			12		
2			13		
3			14		
4			15		
5			16		
6			17		
7			18		
8			19		
9			20		
10			21		
11			22		
Total Flying Hours Hrs.......... Min^s^.............			Instructors Signature		

Figure 9

THE COLLEGE OF AERONAUTICS, CRANFIELD WEEKLY FUEL RECORD					
IN			OUT		
QTY.	DATE	ISSUED BY	AIRCRAFT REG. NO.	DATE	RECEIVED BY

Figure 10

THE COLLEGE OF AERONAUTICS, CRANFIELD 1234

MAINTENANCE DEPT.

REPAIR SHEET

Aircraft Reg. No. ______________ Date Requested ______________

A

REQUEST FOR EXAMINATION

Breakdown description:-

Reported by ______________

B

EXAMINATION DETAILS

Description of malfunctions

Examiners Signature ______________ Date ______________

C

INSTRUCTIONS FOR REPAIR/MAINTENANCE

Co-ordinators Signature ______________ Date ______________

D

Aircraft Reg. No.

DETAILS OF REPAIRS/MAINTENANCE CARRIED OUT

Fitters Signature ______________

Completion date ______________

Inspectors remarks

Inspectors Signature ______________

Date ______________

Spares Sub-system

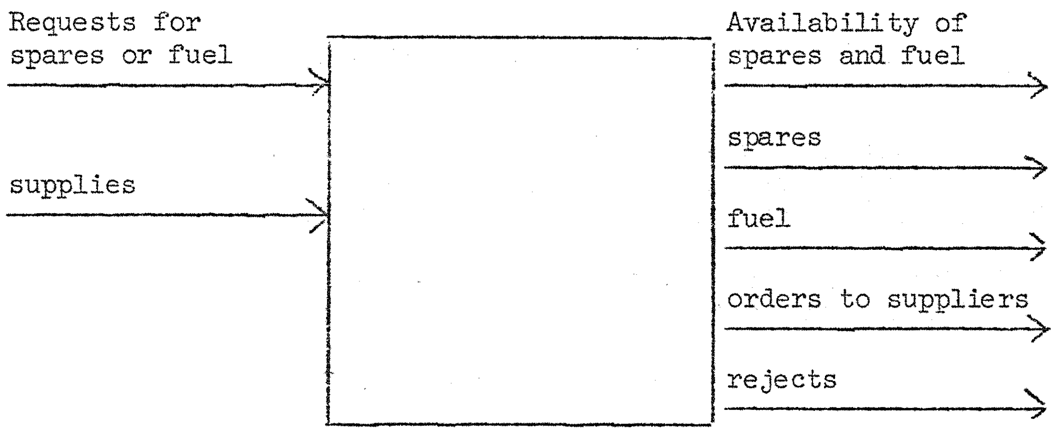
Objectives: to provide stores on demand, as economically and with as little delay as possible.

Economic aspects were outside the field of our investigation and so the investigation has been concerned primarily with providing stores on demand. The economies will have to be considered if the 'fixed order quantity' system is introduced, as advised.

The inputs are requests for supplies from the maintenance sub-system and the spares and fuel from suppliers.

The outputs are information about supplies available, orders to suppliers and supplies to the maintenance sub-system.

Diagram 8. Objectives of Spares Sub-system



Division into Functions

This entailed determination of basically necessary procedures and arranging them in a systematic manner. Functions reviewed are deemed of importance were:-

(a) Inspect records and co-ordinate
(b) Order
(c) Inspect articles
(d) Place into stock
(e) Issue article
(f) Adjust records.

These functions are shown in Diagram 9.

Requests for spares: Action taken by requester, i.e. maintenance group, to inform stores that he requires the spares.

Inspect records: Action taken by storekeeper to see if, where, and how many of requested spares are kept in store.

Order: Action taken by storekeeper to inform supplier that spares are wanted.

Inspect: Action to ensure (i) that the spare received from supplier is the same as was requested on order, (ii) spare has not been damaged in transit, (iii) functional inspection of instruments.

If inspection shows spare does not meet requirements then it is rejected and returned to supplier.

Into Stock: Placing of spare into desired position in store.

Records: consist of (i) suppliers record
(ii) 'fixed order quantity' for the different spares
(iii) quantity of spares left in store
(iv) time needed to deliver certain spares, i.e. lead time.

The inter-relation of these considerations and their effect on any decision made as to when demand can be satisfied is shown in Diagram 10.

Diagram 9. Definition of functions

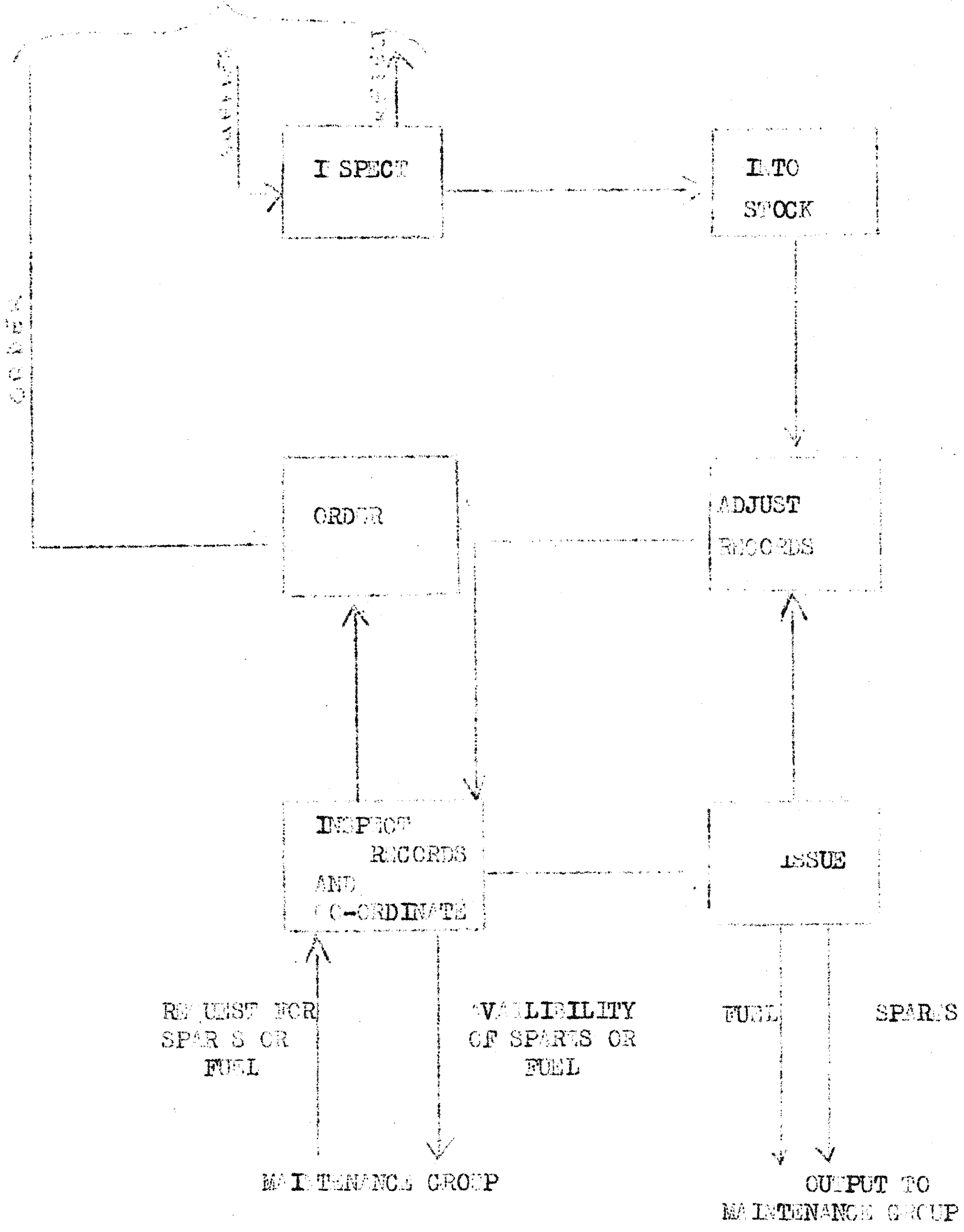
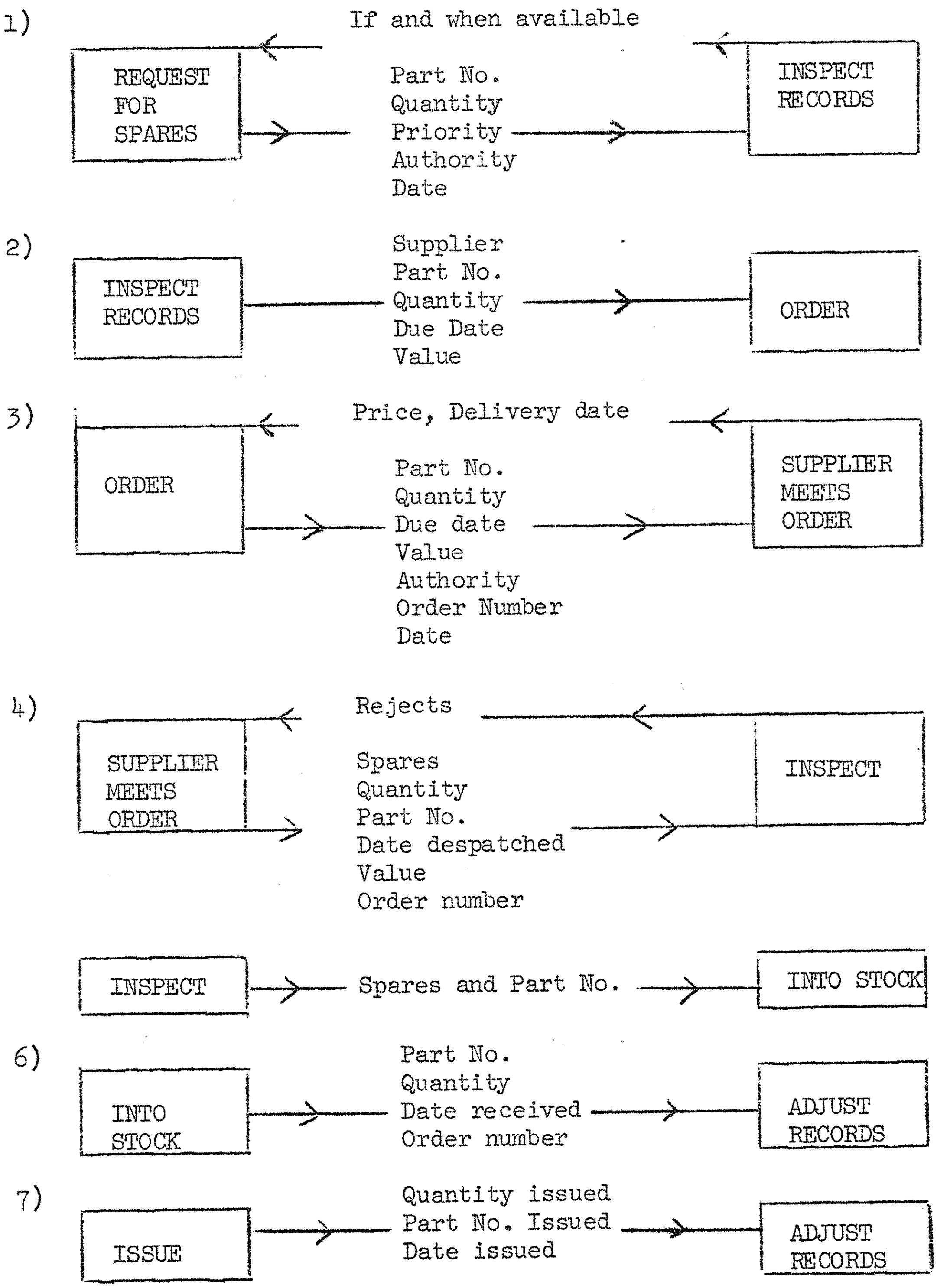


Diagram 11

4.9 INTERFACE DESIGN

Information Flow Across Interface:



Design of Interface Elements

After the functions had been considered and decided upon, it was necessary to consider the information needed to be carried across the interfaces between the functions.

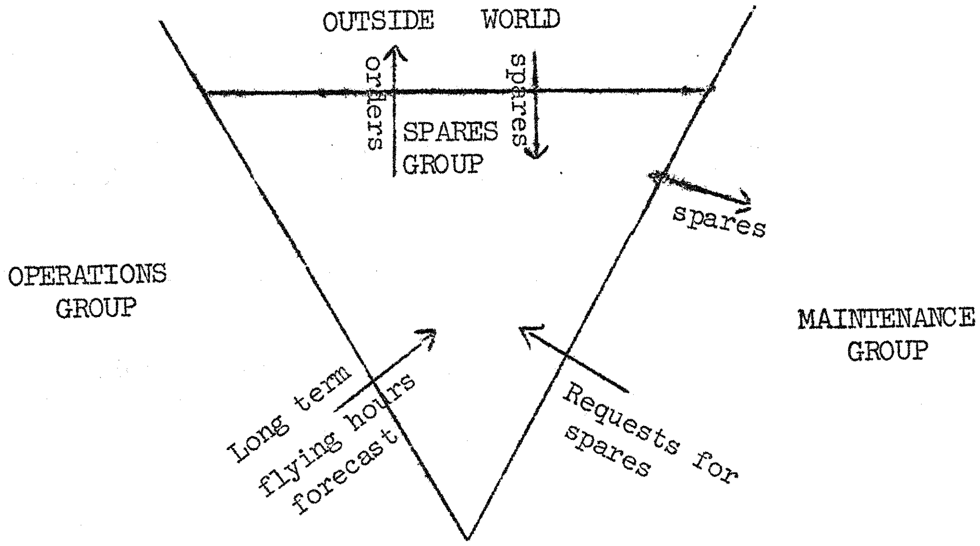
These are explained fully in Diagram 11. At this point it was not necessary to design the means of transporting this information.

To ensure that all requirements had been met a diagram showing the interfaces throughout the system was drawn, diagram 12, and it could be seen that all possibilities had been considered.

It is the flow of information across the interfaces of this diagram that has to be catered for in the design of the interface channels. These will consist, for the main part of forms, but may be verbal or written. Before the actual design was considered it was agreed that an attempt should be made, both between and within the three groups to standardise the size of the forms. Quarto or half quarto were suggested as possible form sizes.

Diagram 12

Interface Diagram for Spares Group



The forms shown as Fig. 11 and 12 were designed to satisfy:

(i) the input 'Requests for spares',
(ii) the output 'Orders'
the input 'Spares'

Fig. 11 is a form that functions solely within the internal system of the stores. It is simply a request for spares or fuel. It was felt that the input 'Long Term Flying Hours Forecast', was in effect a request for fuel and that this Requisition Form could be used to convey the information regarding long term fuel requirements.

The Order Form, fig. 12 has a dual aspect. It is a request to the supplier for purchase of goods and is also used to check the goods against when they return from the supplier. For this reason a second copy of the form is sent to the supplier, which is returned with the spares.

The information to be found on the requisition and order forms satisfies the necessary internal information channels within this group with the exception of the initial feedback concerning the availability of spares. This will be conveyed verbally.

A further output, in theory, occurs when an item is rejected either because it is damaged or because it was not the one ordered. The item may also be rejected because of malfunctioning. This would generally take the form of a letter or a telephone call.

The entries on the forms will be self explanatory with the possible exceptions of:

(a) Estimate price - the price inserted on the form by the stores when ordering as the price that was anticipated with reference to quotations or a catalogue.

(b) Date despatched - this to be filled in on the order form returned by the supplier.

The remaining interface designs that had not been considered were those concerning the record keeping system, it was decided that the standard Shannon cards already in use were suitable.

Figure 11.

The College of Aeronautics, Flight Dept. Stores   Date:

SPARES/FUEL REQUISITION

To: Chief Storeman

Please supply the following by: (Date)

Description	Part No.	Quantity

Requested by: Authorised by:

Figure 12.

The College of Aeronautics, Cranfield, Bedford.   Order No.

Date

ORDER FORM

From: Chief Storeman, Flight Dept. Stores
To: Supplier's Name
Supplier's Address:

Please supply the following by: (Date)

Description	Part No.	Quantity	Estimated Price	Actual Price
		Totals:		

Date Despatched
Date Received
Received by

9) CO-ORDINATION OF SUB-SYSTEMS

As the sub-systems develop the requirements of each sub-system from the others and also the outside world is established. By surveying the information flow it is possible to decide what to convey along these linkages between sub-systems. Also as the system develops, certain functions will be found, that are difficult to fit into; this is a problem of co-ordination only. A particular case of this occurred in this report where re-fueling could be done by either maintenance or spares. After much discussion it was finally fitted into the maintenance sub-system the determining factor being that when the pre-flight check is made the fuel tanks of the aircraft can be filled at the same time.

In drawing up the co-ordinated system diagram it is possible to see if duplication has taken place. An example of this is where spares sub-system sends goods to maintenance sub-system; in each department there exists an inspection; this at first was a total inspection by both systems but the functions were modified and restated so that duplication did not in fact take place.

Using this approach it was therefore possible to obtain relevant information for sub-system linkages, make decisions about difficult functions and eliminate duplication.

DISCUSSION

In its present form the system represents a theoretical solution to the problem.

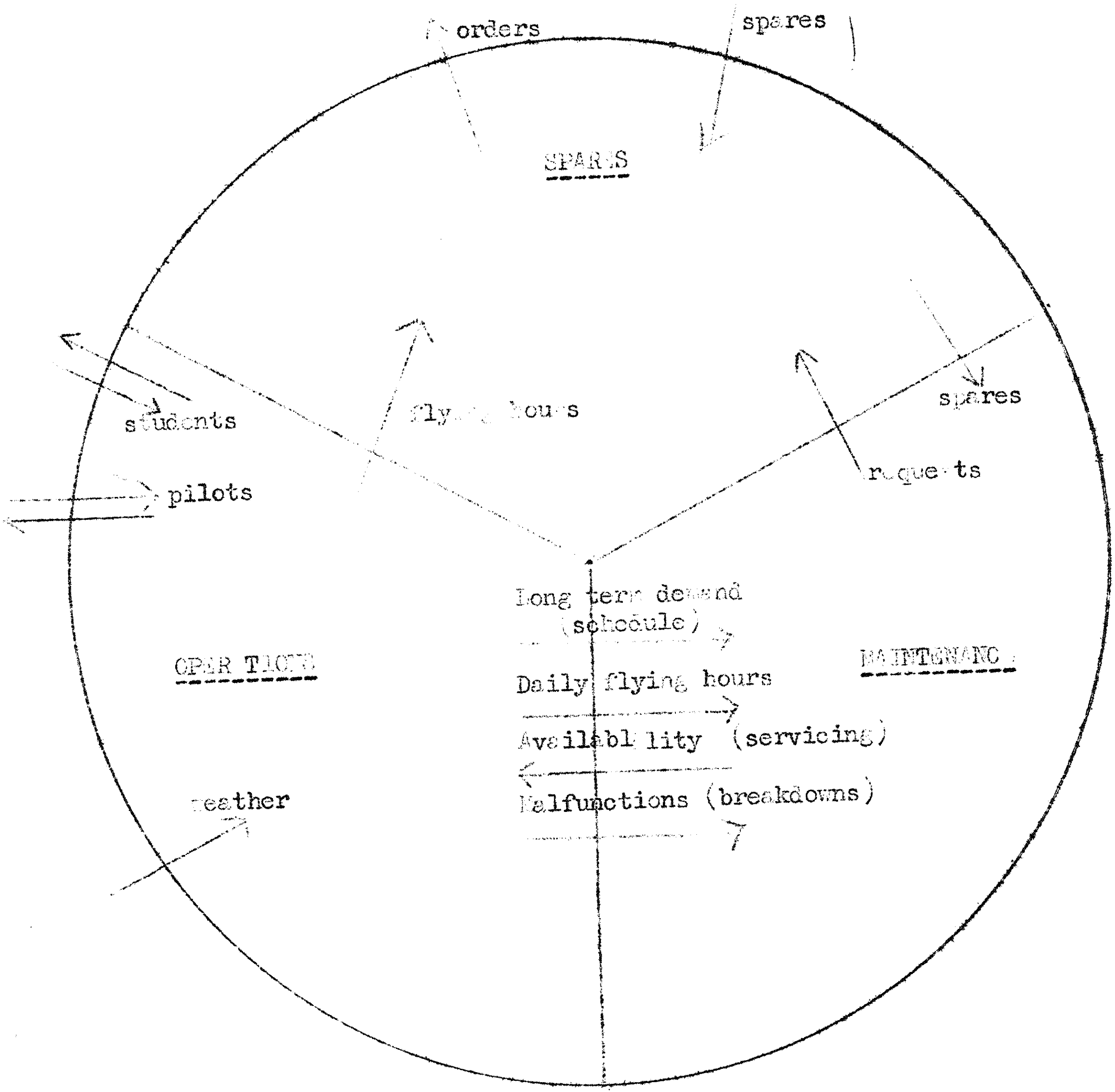
Owing to the lack of time the following stages in the procedure had to be omitted:-

1. No consideration has been given to the problem of tailoring the synthetic system to fit the existing system.

2. The implementation stage was not reached so that no measure of the effectiveness of the new system could be determined.

Since it is on the latter point that the value of the new system would be assessed, it is felt that no conclusions can be drawn.

Diagram 13 Interface between the groups



Note : The Maintenance Group is a closed system in that there is no connection with the outside world.