SOME AIDS TO SYSTEMATIC MANAGEMENT AT SEA

IN A W/E DEPARTMENT

BY

COMMANDER C. B. WILLCOCK, R.N., M.A., C.ENG., M.I.E.E., and
INSTRUCTOR LIEUTENANT R. H. PALMER, R.N.

Introduction

This article is an edited version of the final report on 'The *Bulwark* Experiment'. A progress report was published in the December, 1969, issue of the *Journal* under the title 'On the Job Training at Sea' which described the setting up of the experiment. This was concerned with applying what we then thought of as Programmed Instruction to on-the-job continuation training of WE ratings in the WE Department at sea. A little experience, tempered with the guidance of the training technologists translated this into large scale employment of the Objective Training approach, with strong affinities to Management by Objectives.

Indeed, while the experiment was successful in applying modern training methods at sea, the value to the Management, at Head of Department level, lay more in the natural way in which the work fostered various aspects of systematic management which, although simply explained in text books, can be difficult to put into action.

Synopsis

The present article comprises:

(*a*) *A brief summary of the previous article*, to make the terms, etc., clear

(*b*) *The product* or material produced to date

(*c*) *Use of the product*, and some evaluation of the gains

Development—Other uses of the analysis, i.e.

(*d*) *Linked monagement techniques*, to which the analysis inherent in training approach made a direct contribution

(*e*) *Other systematic management techniques* successfully used, which, while not directly stemming from the training work, were made easier to employ because of the attitude changes fostered by the training work

(*f*) *Conclusions and recommendations.*

Summary of Previous Article

Aim

The aim was threefold, with the accent upon the first:

(*i*) To improve departmental technical and managerial efficiency

(*ii*) To help prepare ratings for advancement

(*iii*) To carry out a training experiment.

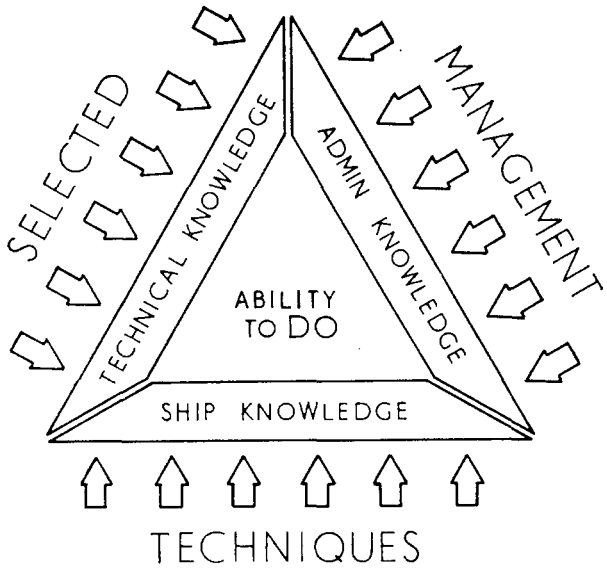


FIG. 1

Means

The means chosen was to apply the proved methods of Objective Training leading, where justified, to the use of Programmed Instruction.

Requirements of the Training

The requirements of the training, or its objectives, are summarized in FIG. 1.

Process

The processes of devising and administering the training are summarized in FIG. 2.

THE PRODUCT

A Programme

A 'programme' is a means of giving material to be learned in 'frames', i.e., bit by bit, with some means of self-test between each frame or between some of the frames. When the learner has finished, he then takes a 'terminal test', given by a senior rating, which may be written or, better still, practical, to make sure that the training objective has been achieved and that the learner can now DO what is wanted.

Most of the programmes produced in this experiment have been recorded on tape for replay on hand-held portable recorders, enabling the learner to move round the ship as he learns. The self test is by question sheets supplied with the recorders. An example of this is shown in FIG. 3. In a few cases Programmed Books were produced, where the self test is by question at the foot of one page and the answer at the top of the next, as shown in FIG. 4.

If we carry through the objective training approach to the extent of producing a piece of programmed instruction, or a programme, we gain a highly effective means of learning the material. However, they take a lot of work to produce and so one has to decide in each case whether it is worth it. The questions to ask are first, 'does the material suit the programming? Is it apt for the means?' And secondly, 'Is the target population large enough?' — that is, will there be enough men using the programme to give a reasonable pay-off, not only for the initial use to be made of the programme, but of the later uses to cope with job changes, reliefs, recommissionings, casual attachments for training, and so on.

Job Aids

In some cases it is helpful to support the actual programme with job aids. Thus the programme for introducing junior RE rates to one of the Radio Equipment Sections was accompanied by an Information Card showing the equipment layout and power supplies, as illustrated in FIG. 5, and by a Procedure Check Card, illustrated in FIG. 6.

Neither the information card nor the procedure check card was itself programmed, but they were associated with and referred to in a fully programmed tape.

Other forms of job aids included route cards, standing orders, algorithms,

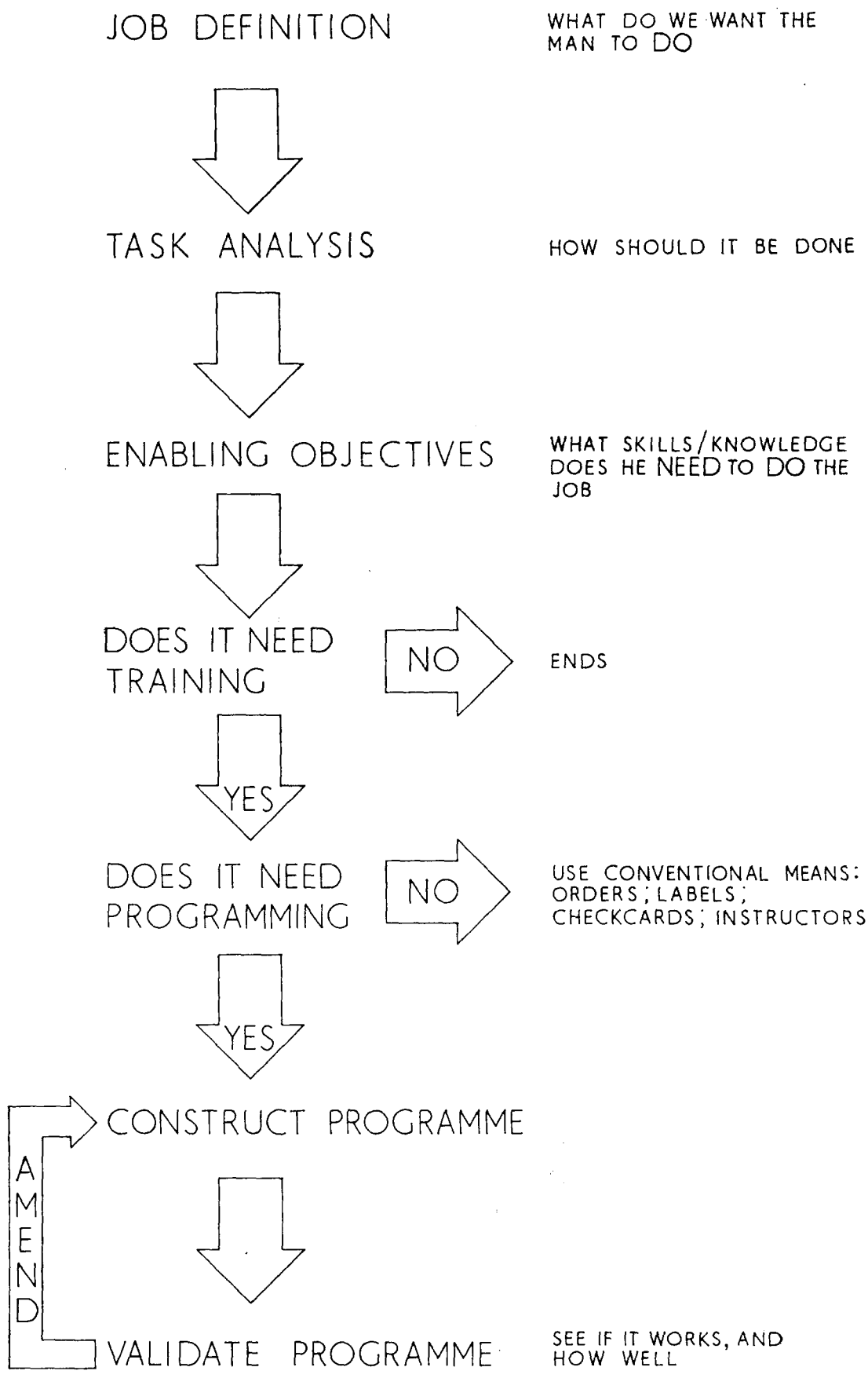

JOB DEFINITION
WHAT DO WE WANT THE MAN TO DO
TASK ANALYSIS
HOW SHOULD IT BE DONE
ENABLING OBJECTIVES
WHAT SKILLS/KNOWLEDGE DOES HE NEED TO DO THE JOB
DOES IT NEED TRAINING
NO
ENDS
YES
DOES IT NEED PROGRAMMING
NO
USE CONVENTIONAL MEANS: ORDERS; LABELS; CHECKCARDS; INSTRUCTORS
YES
CONSTRUCT PROGRAMME
AMEND
VALIDATE PROGRAMME
SEE IF IT WORKS, AND HOW WELL

FIG. 2

ELECTRICAL MARKING SYSTEM

OBJECTIVE: To enable junior ratings to trace circuits using the Marking System for Power Distribution

Extract from the tape script; at this point the trainee is learning to interpret the Location mark of a Junction Box.

This is the first junction box in the circuit, so it has the identification number F1–31–J1.

The first juntion box in a circuit, if one is used, is usually a type J2 box, because this type of box has a larger capacity. It is always given the location mark J1.

Note that the diagram also gives the location of junction box F1–31–J1.

Q7. Where is this juntion box?

Extract from Self Test Question Sheet

5. A box marked SR5 means *10″ Sig Projector Resistance*
6. J2 means *JB 4 way NWT 40/100 amp HRC fuses*
7. F1–31–J1 is at.....
8. The J1 boxes are numbered....., ..., and.....

FIG. 3—A TYPICAL TAPE-RECORDED PROGRAMMED SCRIPT

THE RING MAIN SYSTEM

OBJECTIVE: To enable senior ratings to operate the Main Switchboard controls

There are two basic conditions: using ship's generators or using shore supplies. The routines are given in the form of algorithms* for which this programmed text explains each step in turn.

Example: (page 10 of the text)

The first statement on Card A is:

Put Generator Selector
switch to required number

*All boxed statements are instructions, and you have to do something.

*Statements which are not boxed are questions.

*All questions are in RED, and are arranged so that the answer can only be NO or YES.

There is a *Generator Selector Switch* on each side of the meter panel.

The switch on the right is numbered 1—4, and the switch on the left is numbered 5—8.

If the generator is G*1*, the right hand switch should be at position 1.

If the generator is Q *7* the left hand switch should be at position 7.

A point to remember is that if there was a complete failure (it has happened) this action would restore lighting to the MSB compartment.

Question 4 Which switch would you operate for K 3 generator?

The answer is given at the top of the next page

(page 11 of the text)

Answer 4 Use the right hand switch for K3 generator.

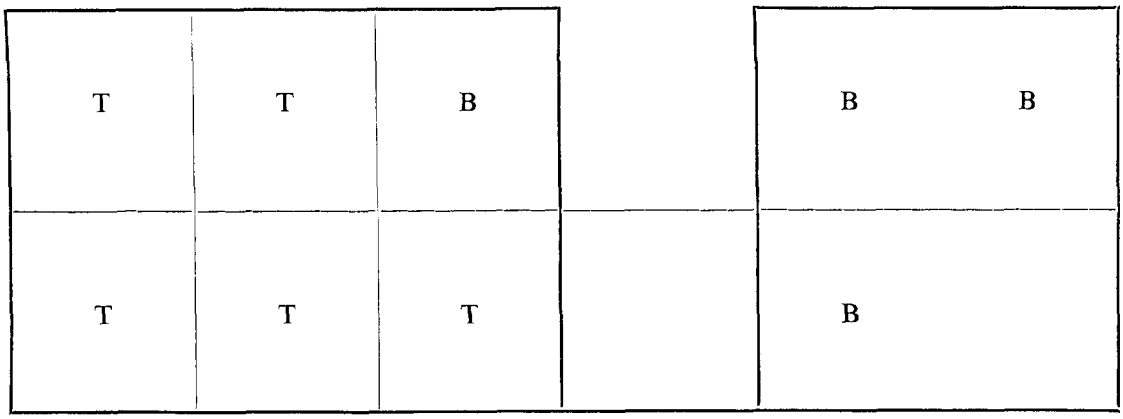
The next instruction is:

Check for + and — earths

The ring main voltage of 225 volts DC is carried by two cables, one at $+112\frac{1}{2}$ and the other at $-112\frac{1}{2}$ volts with respect to earth.

Above each selector

FIG. 4—AN EXTRACT FROM A PROGRAMMED BOOK



Power supply is 115V 60Hz for all teleprinters.

All teleprinters in BWO are supplied from J–03–11 (in BWO) via an isolating transformer and local fuse box (on aft bulkhead of BWO).

Other teleprinters are located in:

Assault Operations Room (Tactical) under Helicopter State Board	Supplied from J–03–11 (in BWO) via an isolating transformer and local fuse box (under the teleprinter).
Main Signal Office (Tactical)	Supplied from J–03–11 (in BWO) via an isolating transformer and local fuse box (in BWO).
Met. Office (Broadcast)	Supplied from J–03–1111 (in BWO via an isolating transformer and local fuse box (in Met. Office).

FIG. 5—EXAMPLE OF AN INFORMATION CARD SHOWING EQUIPMENT LAYOUT AND POWER SUPPLIES

extra labelling of equipment, test sequences, switching on/off sequences, fault diagnosis charts, emergency procedures, and so on.

A job aid usually has a longer useful life for each learner than the programme itself which, when completed and its terminal test passed, will be put away. The job aid is often useful kept in the pocket or posted on the bulkhead, or on the equipment panel.

Often the job aid is enough by itself, without any introductory programme. One such job aid, in the form of a diagnosis chart, is illustrated in FIG. 7. A liberal use of Dynatape on control and switch panels can prove a potent eliminator of the need to know or learn. Being so much cheaper than programmes, such job aids by themselves are always to be preferred if they will accomplish the objective. Equally, when a programme is needed, it is still better to suppress as much data as possible to the job aid level, programming only the really rewarding portions of material. The aim is always to achieve a training objective, which means that the man is able to DO the required task and not generate endless programmes. There is a real danger that the aim may be distorted to having the men do all their learning through programmes. This may prove something or other but it makes little sense to a manager responsible for the economic use of resources.

It can be argued that much of the beneficial product of the experiment is in the form of job aids, and that with the production of job aids there is no need to bother about programmed instruction. Whether this is true or not, there is the need to bother about the training objectives; to decide what the men are to do, how they should do it and what knowledge and skills they require in order to do it that way, and it is necessary to check that it is happening as you intended. This means that the same full analysis procedure has to be carried out

PATCHING A BROADCAST BAY

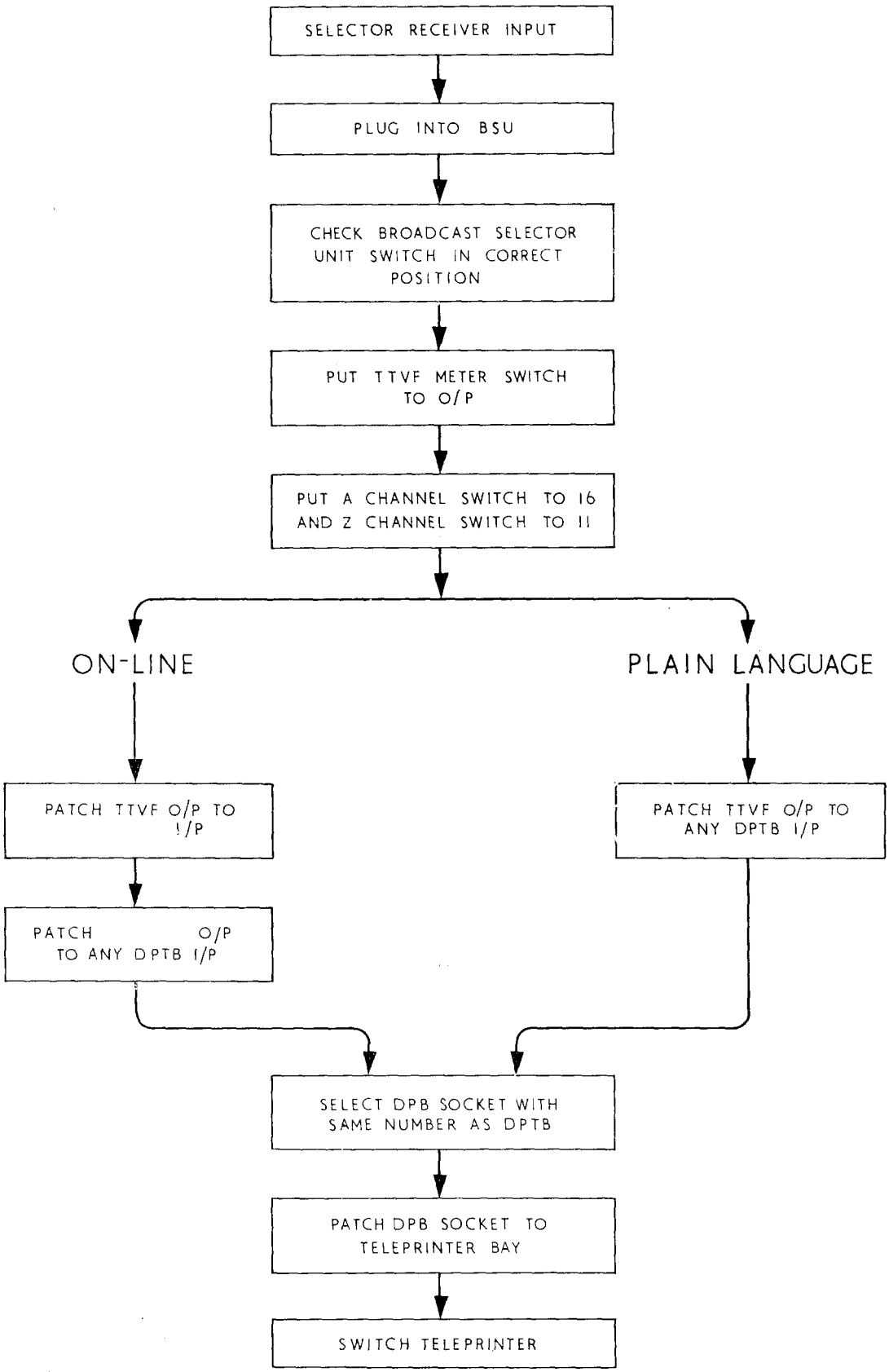
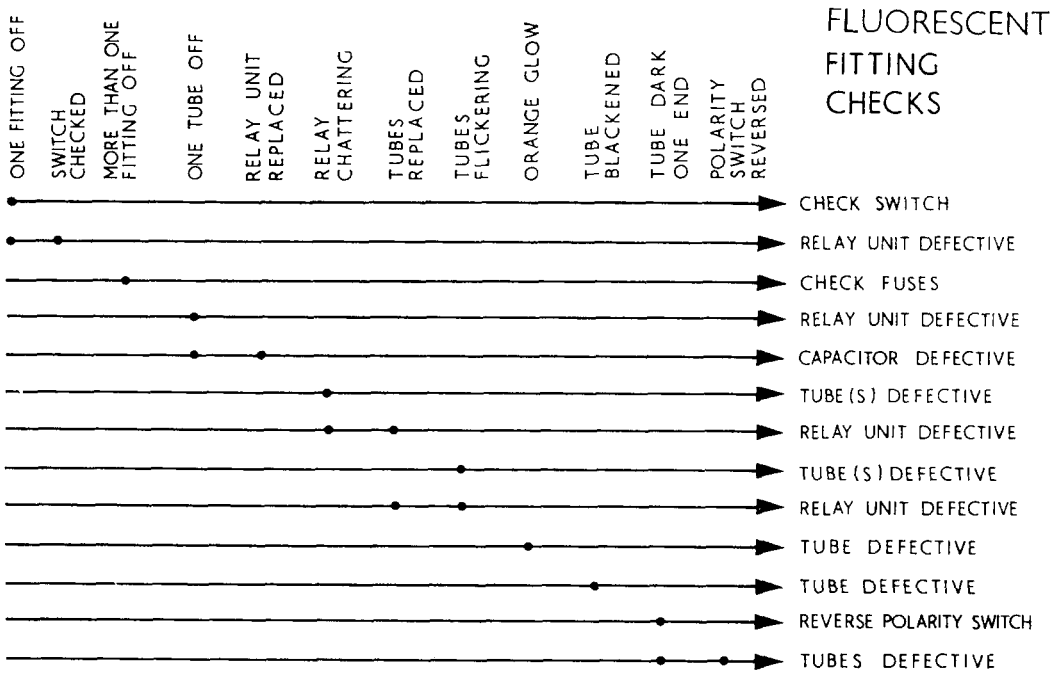


FIG. 6—EXAMPLE OF AN INFORMATION CARD SHOWING A PROCEDURE



EXAMPLE OF A JOB AID NEEDING NO PROGRAMMED INSTRUCTION SUPPORT

FIG. 7

whether or not the product turns out to be a programme, a programme supported by job aids, job aids by themselves, or indeed that you prove that no training is needed. It is helpful to have a set standard approach to analysis; this enables much of the study to be delegated, and we concluded that we might just as well use a properly thought out analysis procedure such as that evolved in the Programmed Instruction (or Objective Training) field.

Material Produced

The experiment ran for eighteen months. The material produced in that time is illustrated diagrammatically in FIG. 8. This may be summarized as follows:—

Material was produced and put in use for 44 subjects and a further 8 subjects were in various stages of completion at the time of this report. 28 subjects were programmed, usually with supporting job aids. 16 subjects were covered with job aids alone. A selection of the subjects, their objectives, and an indication of their method of use are tabulated in Annex. A.

Future Work

While the experiment is coming to an end and the Programmmer/Chief Analyst is leaving, it is clear that there is no visible end for suitable subjects for study within the WE Department and that the activity could well be continuous. Outside the Department a comparable experiment is progressing in the ME Department following the work in H.M.S. *Hermes*, and some exploratory work in NBCD showed this to be a field ripe for exploitation both from the School, with whom liaison was established, and also in the ship.

Quite apart from new ground, there is benefit in the regular review of material, programmes and job aids, both in the light of experience of their use and as a result of further analysis. Also the men doing the work change their methods of their own accord, quite apart from any intentions of the management, and

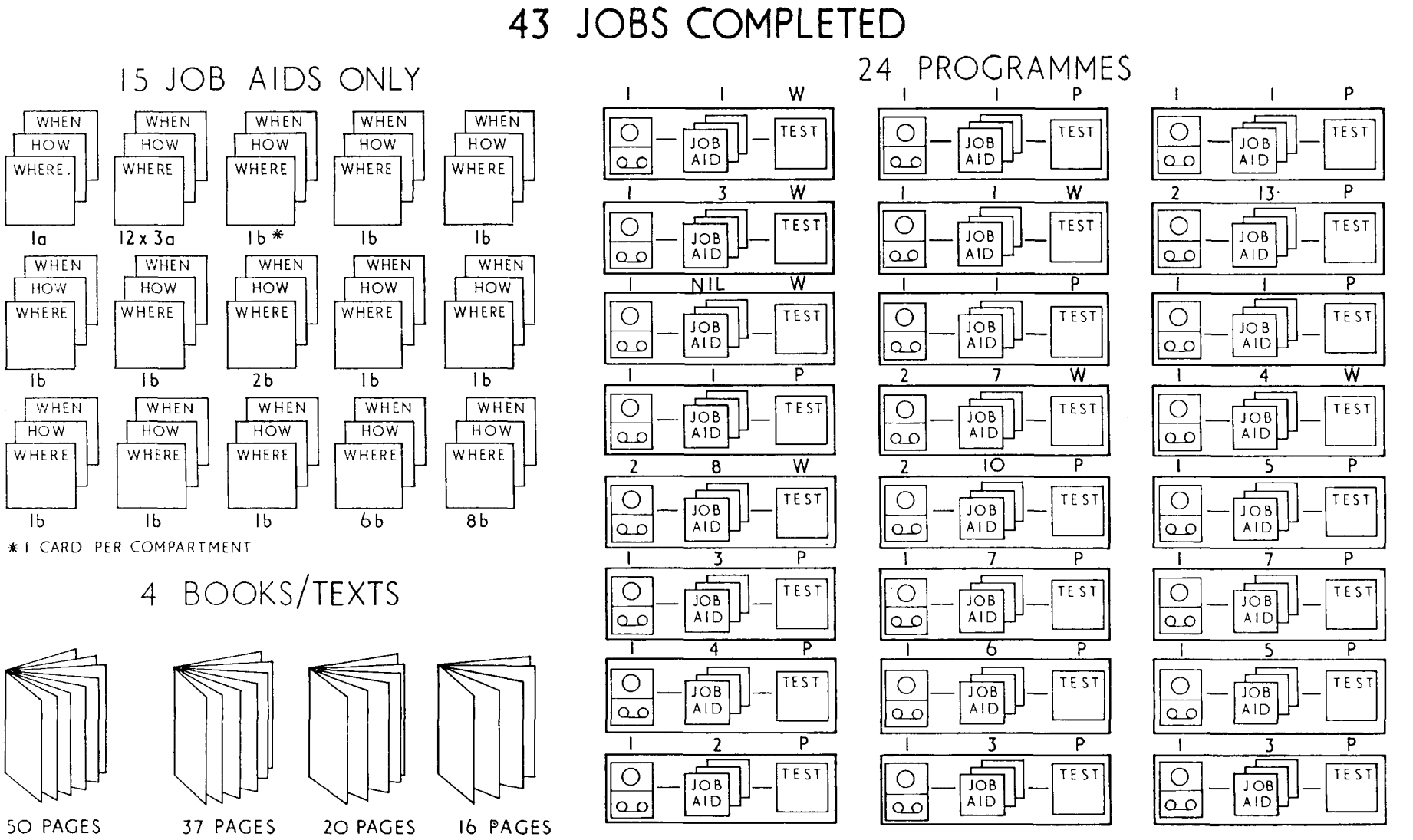
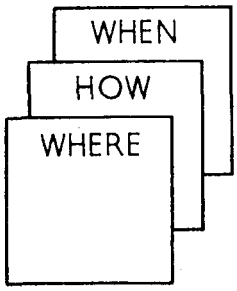
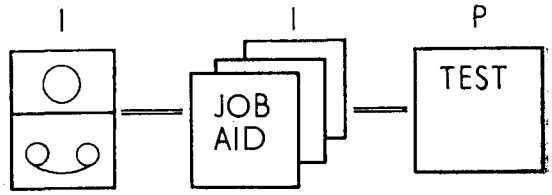


FIG. 8—MATERIAL PRODUCED





Key to Fig. 8

Job Aids

Two sizes of card are used:

(a) 10 in. × 8 in.

(b) 7 in. × 5 in.

Fig. shows No. of cards per aid

Programmes

Figures show No. of tapes (20 mins each) or No. of job aids.

P = Practical test

W = Written test

Job aids are kept by trainee.

Tapes are returned after learning.

to continue to command attention and respect the learning material needs to be amended to take account of this 'unofficial leadership' where this is judged to be beneficial.

This amendment is a big task and, in that it reflects improving learning and work methods, we consider it a good thing. To help the Programmer/Analyst we had two senior rates trained in Task Anlaysis and employed them sufficiently on this work to demonstrate the value of such support. However, we think that to keep an objective training system with programmed instruction fully alive and developing, a programmer/analyst must be available, at least on an occasional or consultant basis. In an LPH, one programmer/analyst might service several departments if the support within each department were properly developed.

Transferability

We did no work on transferring the *Bulwark* training to other ships and took no account of this as a possible development in analysis or design. A great deal of the actual material produced is ship knowledge largely unique to the ship and not necessarily even common to other ships of the class. On the other hand, the earlier processes of the objective training approach are common enough. The sorting out of the tasks to be done, how they should be done, what knowledge and skills are needed and what is a fair terminal test, seem more a matter for the schools and the design establishments. If they carried out this work, it should easily be possible for a ship to clothe the resulting training framework with the local knowledge of the ship's geography and layout, together with any local administrative procedures. To set up such a programme would require the schools to examine in a much more direct fashion than hitherto what work is actually done at sea, and we might be able to avoid the present state of affairs when junior WE ratings join the Fleet with fat notebooks full of theory, but largely incapable of performing their duty. Knowledge is only a means to an end; the end is the ability to do the work. In a DC ship this tends to comprise switching things on and off, replacing fuses, tracing earths, bedding in brushes, fixing faults on lighting fittings, and using the standard system of nomenclature. All these we needed to teach very nearly from

scratch. This criticism is of course aimed mostly at the initial training of mechanic ratings. At a later stage in their career they do need to know more theory but, in the writer's opinion, a good course in practical weight-lifting would be of more use than a lot of the theory still being taught to juniors in the schools.

USE OF THE PRODUCT

Use of the Programmes

When the ship recommissioned, a significant quantity of programmes were available and these were used by the new ships company during the first week, when time was made for this. The recommissioning proceeded smoothly and the subsequent shake-down and full set of sea trials that followed were particularly successful and technically trouble free. The initial use of programmes certainly contributed to this.

Since then, more programmes have been produced, new men have joined, two complete cycles of junior rates' job changes have been carried out, and a number of senior rate job changes have been possible. The programmes were used for these changes, the administrative problems being well within the compass of a competent Regulating Chief Electrician.

The programmes are also employed for the occasional trainees, such as midshipmen, constructor officers, and so on.

So far the 44 programmes have accounted for about 455 nominal student exposure hours, representing about 9 weeks' instructor time. The success rate is 100 per cent in that men failing the terminal test repeat the learning until they pass. This repeat instruction and the repeats learners do before presenting themselves for terminal tests are not included in the time estimated above.

Use of Job Aids

The 142 job aids produced, some associated with programmes and others which stand by themselves, have probably occupied more student hours than the programmes themselves and while programmes are put away after use and only got out again for a new man, many of the job aids remain in constant daily use.

Use of the Analysis

So far we have considered the use of the product as a means of communicating to the learner the skills and the knowledge that he needs to carry out his duties. In our experience a greater use or benefit of the experiment has been the process of task analysis that it has forced upon the management, that is, the officers and senior rates. Setting a clear objective is a demanding challenge, while the attitude changes required of analysis are invaluable. We tend to be brought up to *know* our job, to know what to do and how to do it. In an era of slow change this was perhaps possible, but when material and men change so fast, yesterday's solutions that we *know* are useless today, and a positive menace tomorrow. The process of arguing out objectives, analysing work methods, sifting the skills and knowledge which must be mastered to do the work from those which are only desirable, and therefore expensive luxuries to be discarded, is a first class education for management at all levels from Head of Department to Leading Hand. This change of attitude from *knowing* to confident use of analysis techniques with which to find out, cannot be achieved by exhortation or command. The biggest pay-off we found in the experiment was that it encouraged just this attitude change by supplying the framework of

analysis within which questioning becomes a practical means of solving practical problems.

Does It Work?

Programmed instruction certainly works as a means of learning and, provided you select with care what you are going to programme, is economic. The training objectives approach certainly works, which is not surprising as it is only a common-sense way of making sure that your training effort is geared to helping the men to learn how to do their duties. The process of analysis also works as it substitutes facts for opinions. The whole experiment certainly worked but how well, and was it worth it? One can add up specific time savings such as, the 9 weeks' reduction in instructor time, the Prepare for Sea study which halved the size of the team saving the equivalent of about 3 man-days work each time we sailed, the Fan Rounds study which saved the equivalent of about one OEM full time, the NBCD investigation which doubled the productivity of the State 1 and State 2 patrols, and so on.

Our overall judgment would be more that the Department has been successful in its tasks, producing equipment availability figures of the order of 95 per cent with the equipment working better than at any time for three years, and the Far East cruise of the new commission has been highly successful. How much of this is due to the experiment must remain a matter for conjecture, but at least the experiment has been associated with success and, in our view, has made a contribution to our Department that we have been glad to have.

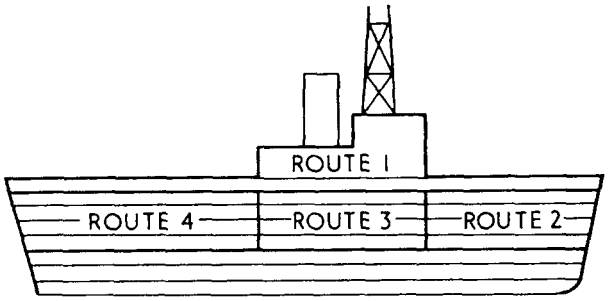
DEVELOPMENT—OTHER USES OF THE ANALYSIS—LINKED MANAGEMENT TECHNIQUES

The process of analysis as shown in FIG. 2 was also used on problems which, it was clear, did not require programming but would benefit from 'sorting out'. Examples of this are the Sea Communication Checks and the REM of the Watch Rounds, both mentioned in the earlier article, and the Ventilation Fan Rounds. The latter employed work-study to determine the optimum routes round some 335 fans (one of the route cards is illustrated in FIG. 9), while the general analysis yielded other benefits. These included the establishing of varying periodicities for the inspection of different sizes of fan, job aids for deciding the work to be undertaken by the Rounds OEM (illustrated in FIG. 10), materials and tools to be carried, and a brief indoctrination for the junior rates who were to use the complete package. Use of the system was one of the measures which enabled us to recover from a harassing series of breakdowns during tropical service.

This sort of scheme can of course be devised without any thought of programmed instruction. However, using the accepted form of analysis (and the familiar and accepted programmer/analyst), helped considerably in gaining acceptance by the operatives on the job. This is more important than the system design if real gains are to be made.

Departmental Orders

The process of task analysis, leading to check and procedure cards, forms a natural base for writing Departmental Orders. The cards themselves can be photographed straight into the orders, together with an introductory section on Aim, Policy and Organization, most of which will have evolved during the analysis. An example is shown in FIGS. 11(*a*) and (*b*).



The ship is divided into 4 routes:

1. 2 deck and above
2. A—G sections, 3 deck and below
3. H—N sections, 3 deck and below
4. P—V sections, 3 deck and below

Each route is covered 4 times per fortnight as follows:—

Day 1. All fans, small, medium and large
Day 2. Small fans only
Day 3. Small and medium fans
Day 4. Small fans only

Each route has a set of cards for each day — average 3 cards per day.

	Fan Inspection Rounds		Route 1	Day 1		Sheet 1 of 5	
Item	*From*	*Way*	*To*	*Key*	*Fan No.*	*Ladder*	*Other Info.*
1	4 M Fan W/S	Cross to 4 M port lobby. Up 2 ladders to 2 M 4. Go Forward.	2L2 passage	No	2L–46	Yes	Fuses: L16-31 -D31 at 3L port lobby. Starter: by fan.
2	2L2 passage	Go Forward	2K2 mess	No	2K–64	No	Fuses: J10–22 –J4 at 3L port lobby. Starter: 3J port passage.

FIG. 9—FAN ROUNDS AND DETAIL FROM A ROUTE CARD

OTHER SYSTEMATIC MANAGEMENT TECHNIQUES SUCCESSFULLY USED

The main aim of the ships staff in this experiment was to improve the technical and management efficiency of the Department. In part this was achieved by formal training, using a mixture of programmes, job aids and conventional instruction.

Associated with these, there developed a growing acceptance of the systematic management approach. The concepts of aim, organization, plans, procedures, communication, control and feedback became more familiar. In this way the climate became receptive to other applications which had nothing whatsoever to do with training, objective training or programmed instruction and which used rather different processes of analysis.

The interest for the experiment was that these applications were more easily set up because of the parallel working of the experiment. The applications are not original (we certainly benefited from published accounts of other ships' experiences in these fields), but as the forms found to be successful, and some found to be unsuccessful, may be of interest, a few are summarized below.

Man-Hours Accounting

The scarcest commodity is men, so it helps to know how they are used. In terms of money, a CPO with eight men is spending:

Ventilation Section *Fan Check Card*

1. Locate fan and check correct operation (LOOK, LISTEN, SMELL, TOUCH)
2. Locate starter and switch off. (Route card will warn if 'users' need to be consulted first)
3. Locate fuses and remove them.
   (If the starter is remote from the fan, someone may switch on while your fingers are inside)
4. Remove brush covers and terminal covers.
5. Check: a. No burning or scoring of commutator.
   (If in doubt report to head of section)
   b. Brush length adequate, free to move, correct pressure, bedded in correctly.
   (if new brushes are needed, bed them in and make sure you use correct Pattern and Grade)
   c. Clean between commutator segments as necessary.
   d. Clean carbon/copper dust from brush gear and commutator using soft brush and/or vacuum cleaner.
6. Carry out insulation resistance test. (Minimum 1 Mohm)
   (When ordered by CPO)

7. Clean ventilator grills if fitted.
8. Check internal wiring and connectors for chafing and tightness.
   Include terminal box also.
9. Replace fuses and switch on.
10. Check for: a. Irregular noises.
    b. Burning smell.
    c. Sparking of brushes.
    d. Bearings not 'knocking'.
11. Replace covers.

IF IN DOUBT AT ANY POINT, MAKE A NOTE AND REPORT TO HEAD OF SECTION.

FIG. 10—FRONT AND BACK OF FAN CHECK CARD

Daily Gross Rate		£	*s*	*d*
1 × £5 12 0		5	12	0
8 × £3 19 0		31	12	0
	per day	37	2	0
			×365	
	or per annum	13,541	10	0
× 2 for, say 100% on cost		27,083	0	0

Twenty-seven thousand pounds a year is quite a budget, and the realization that he is spending such a sum is an eye-opener to the supervisor; so we asked him how he spent it.

SECTION 13 — TEST

13.1 **Test Commando Communications**

Aim

To ensure that the internal communication systems needed to call forward the Embarked Force are correct for an Assault

Policy

The systems will be checked before hand by personnel from the embarked Commando, supervised by the Detachment Sergeant Major. The WE Department will provide one Junior Rate to record defects and initiate the Defect Routine. Checks will be timed to allow defect rectification before the systems are needed.

Procedure

Details of personnel required, their locations, and the test procedures, are given in Annex Romeo.

FIG. 11(a)

ANNEX — ROMEO

TEST COMMANDO COMMUNICATIONS

LOAD CONTROL POSITION

1. Wait for call on Assault telephone from Q Desk
2. Check communications
3. Call LCVP B1 on Walkway Intercom
4. Check communications to B1 LCVP
5. Repeat steps 3, 4 and 5 for LCVP B2, B3 and B4
6. Wait for call on Q Desk Talkback
7. Report state of Walkway Intercom
8. On completion, return this card to Q Desk

PERSONNEL REQUIRED FOR TESTS

Load Control Postition:	1 i/c
B1, B2, S1, S2 Walkways:	1 at each position
Total	5

The equipment on this card is essential for the successful operation of an Assault Operation.

The checks have been designed to check this equipment in a logical way.

Complete each check in the order shown. If you do not follow this order you will increase the time needed to complete the checks.

You may also miss a check completely.

If any equipment is defective, mark the card.

Go straight to the next check, and report all defects to the WE representative *at the end.*

FIG. 11(b)—EXAMPLE OF A DEPARTMENTAL STANDING ORDER BASED ON A CHECK CARD

WEEK 1st July DIVISION RADIO

MANHOURS

Section	*Available (Theoretical)*	*Spent on Maintenance*	*Spent on Defects*	*Spent on Husbandry*	*Spent on Communal*	*Spent on Exercises*	*Total Hours*	*Lost (Recorded)*	*No. of Cards*
W.T.	744	PM 31 SP 115	486	68	Nil	34	734	37	PM 22 JC 1
RADAR	320	PM 3 SP 29	92	40	Nil	161	325	22	PM 5 JC 1
MISC.	81¾	PM 3¾ SP Nil	37	32	Nil	Nil	72¾	9	PM 14 JC 3
TOTAL	1145¾	PM 37¾ SP 144	615	140	Nil	195	1131¾	69	PM 41 JC 5

FIG. 12—MAN-HOURS ACCOUNTING—WEEKLY TOTE FOR ONE OPERATING DIVISION

Note: PM = Planned Maintenance
SP = Servicing Plan

WEEK 1st July
TARGET 41%

MONTH July (2nd of 4-MONTHLY)

Division	*No. of Cards Completed*	*% Completed so far this Period*	*Spent on Maintenance*	*Manhours*				*Total*	*Hours*
				Spent on Defects	*Spent on Husbandry*	*Spent on Communal*	*Spent on Exercises*	*Available (Theoretical)*	*Spent Usefully*
RADIO	41	34	PM 37¾ / SP 144	615	140	Nil	195	1145¾	1131¾
ATTACK	62	31	PM 157½ / SP 142½	406	151	125½	4½	1053	987
LOWER 'L'	124	28	PM 296¾ / SP Nil	949¼	116	29	8	1368¾	1399
COMMON SERVICES	NA	NA	ADMINISTRATION 413¾	39	9	Nil	Nil	450¼	461¾
TOTAL FOR DEPT.	227		PM 832 / SP 699¼	2009¼	416	154½	207½	4017¾	3979½

HOURS LOST:— (Recorded)

RADIO	— 68
ATTACK	— 96
LOWER L	— 55¾
COMMON SERVICES	— 29

SIGNED .....

DATE .....

FIG. 13—MAN-HOURS ACCOUNTING—WEEKLY TOTE FOR THE WHOLE WE DEPARTMENT

Notes: Time spent usefully + Time recorded lost − Time available = Overtime
Arrowed line is transferred from Radio tote

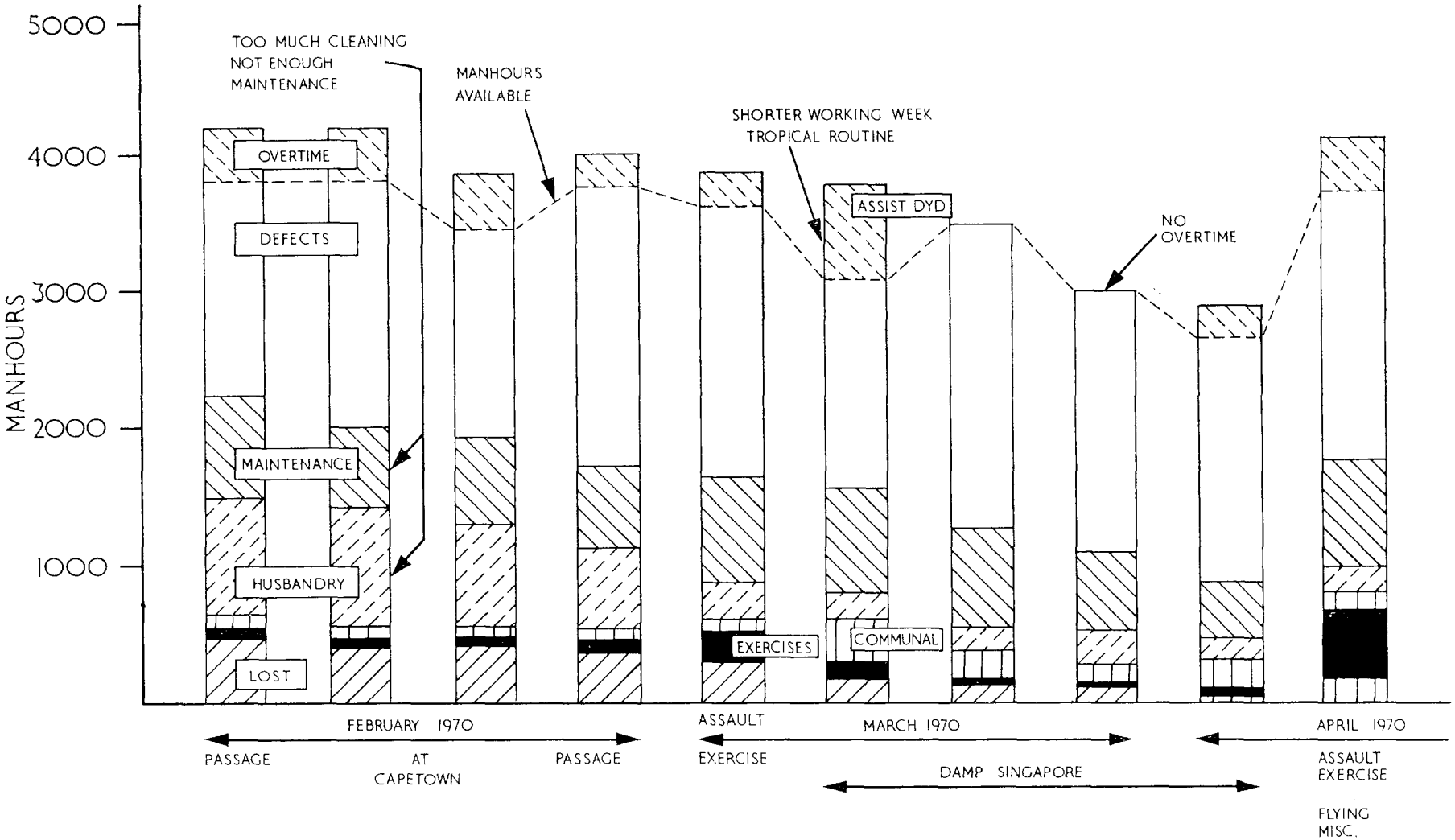


FIG. 14—WE DEPARTMENT—USE OF MAN-HOURS WEEK BY WEEK

Seven categories of usage were defined:

(*a*) Maintenance

(*b*) Defect rectification

(*c*) Husbandry (cleaning and compartment improvement)

(*d*) Communal (occasional storing parties, etc.)

(*e*) Exercises (time spent closed up at NBCD State 1, or in support of flying, assaulting, shoots, etc.)

(*f*) Hours lost (time not accounted for — disregarded if less than 6 per cent)

(*g*) Miscellaneous (mostly spent on administration by senior rates — only reported exceptionally).

Weekly totes are compiled by each of the 13 CPOs in charge of Operating Sections, by addition for the Operating Division, and by more addition for the Department as a whole. FIG. 12 shows a weekly tote for the Radio Division and a tote for the whole department is shown in FIG. 13. FIG. 14 shows a graphical representation found useful for displaying the resulting data.

The first lesson we drew from these figures was that husbandry (mostly cleaning) was taking more effort than maintenance, and in a maintenance department which was not completing its maintenance. A little thought showed that whereas a great amount of design effort and management were being devoted to maintenance, cleaning was largely undesigned and ill-directed. You are supposed to *know* how to clean; the formal training in cleaning, although good, is something to be got through before getting down to the important things of life. Thus cleaning is a field ripe for exploitation. There are very great savings available to anyone who takes its management seriously, as do firms of contract office cleaners. The difficulty here is the attitude changes needed as traditional naval methods do not always suit changing circumstances of ever reducing manpower. Formal rounds where inspecting officers feel duty bound to point out what has not been done, regardless of whether it was intended to be done, can be counter productive. This also applies to the 'paint it' mania which afflicts ratings told that their compartment is to be inspected. Equally mischievous is the fiction that all spaces should be at equal 'rounds standard.' Some, such as gyro compass compartments, should be spotless; others, like wet workshops, need never be so polished.

Our first attempt at systematic cleaning was to introduce 'planned cleaning', arguing that everyone was accustomed to using the planned maintenance system and so should take easily to an analagous approach to cleaning. The job aids were clear and opened the eyes of many to such 'new and advanced' concepts as to clean down the deckhead before the deck. However, the scheme foundered on the resentment aroused amongst supervisors. By giving the job aid to the worker we had upset the command chain. We had also tried to impose a whole system with insufficient preparation.

Some success was gained through a looser system based upon decentralization, insistence on no overcleaning, and a restructuring of the organization so that the Section Heads (senior rates) had both specific compartment cleaning responsibilities coupled with full authority over the disposal of the hands who were to do the cleaning. The supervisor must not have to rely on obtaining hands from someone else and in this we obtained useful section level initiatives.

The methods we used are less important than the realization about the magnitude of the proportion of our scarcest resource—men—being spent on husbandry. It is too important to be left to the traditional methods of the Both Watches—from here to here cloud-sweeping party—variety. It was our use of man-hours analysis that really brought this home to us, and led us to bring

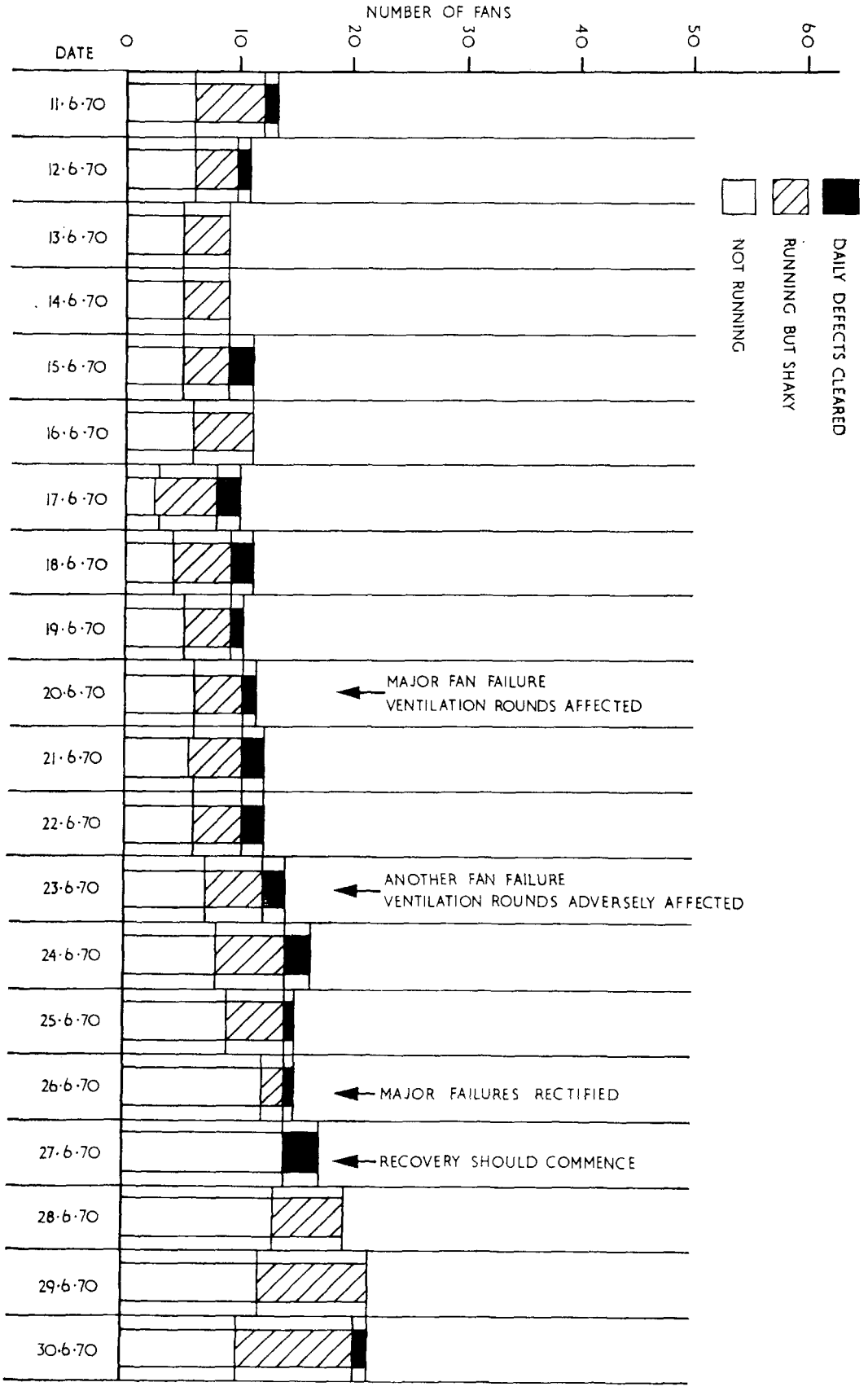


FIG. 15—DAILY RECORD OF FAN MOTOR DEFECTS

down the time so spent from 25 to 10 per cent with improved cleanliness standards.

Over half the time was spent clearing defects. This knowledge clarified the need for achieving 100 per cent preventive maintenance, and for seeking dockyard and shipyard assistance at all opportunities for overhaul of sub-standard equipment. Defect lists written with this aim contributed to extending the intended length of AMPs with consequent improvement in the ship's material and operational standards.

About a quarter of the time was needed for maintenance. This left a quarter for exercises, communal tasks, training, husbandry (which could not be allowed to fall below about 10 per cent), and any other schemes. Thus there is little disposable surplus of labour which can be used on schemes or initiatives, however desirable. If you give a make and mend, that is 10 per cent, or the equivalent of your entire week's cleaning bill. We aimed at 95 per cent usage of manpower, leaving 5 per cent in hand for such extras. Hands can only be made available in excess of this at the expense of defects (lights left unfixed) or maintenance left undone (paying the Dane Geld with a vengeance).

An understanding of the logic of this sort of figure puts one in a much better position to discuss rationally the various demands for effort that arise, such as, landing parties, flying experience, helping paint the ship's side, etc. Also, in such discussions, they lend to your voice a much greater weight of authority, as you know what you are talking about. We found these figures valuable both in helping good broad-brush discussions at Head of Department level, and in fostering a sense of responsible use of man-hours at Section Leader level, which after all is where the work is done and where the key resource allocation decisions are taken.

Planned Maintenance State

While many lessons can be derived from man-hours analysis alone, more are available when it is read in conjunction with other totes. Thus the weekly graph of maintenance cards achieved Division by Division demonstrates what use was made of the time recorded spent on maintenance.

Some critical maintenance areas justify their own analysis. Thus in a DC ship in the tropics, keeping the fan motors turning is a major problem. Too much time spent on mending fans at the urgent request of sweltering customers halts routines, with disastrous results in terms of further consequential breakdowns. It is helpful to keep a daily eye on this situation at Head of Department level, and for this purpose the histogram shown in FIG. 15 was developed. This recognizes three categories of defective fans: those that will not turn, those that need nursing and those that gave trouble but were fixed the same day. In this example all went well until the failure of an axial-flow fan on 20th June. This needed a big 'rip out' squad, which monopolized all the repair hands in the fan repair party. Rounds continued, but when a second axial-flow fan failed three days later the decision was incorrectly taken to work on both fans together. Rounds stopped, and while both axial-flow fans were repaired by 26th June, the temporary reduction of effort on rounds had contributed to an increased breakdown rate and the number of non-runners rose from 6 to 14, with significant disruption to habitability. On a previous occasion this sort of escalation had led to over 30 fans stopping. In this case the histogram showed us all very clearly what was happening and we took various exceptional measures to get the rounds going again before the position got out of hand. The recovery between 27th and 30th June was maintained.

Similar monitoring was used for telephone, internal broadcast and domestic

WE DEPARTMENTAL ORGANISATION BASED ON MARKETING

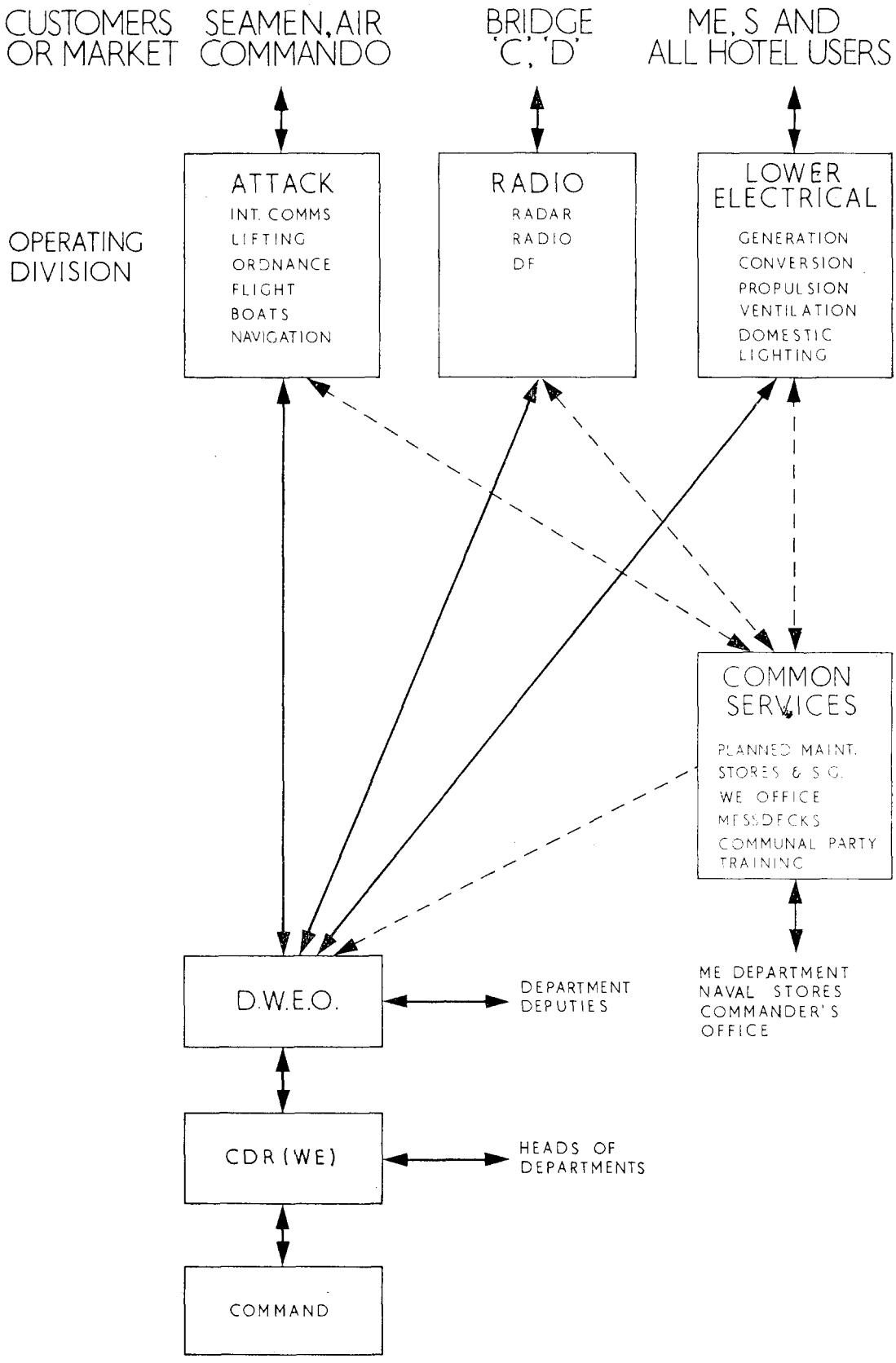


FIG. 16

ISSUE ..... 2 ..... DATE ....28/7/70....

H.M.S. BULWARK POST-REFIT TRIALS — DEVONPORT 1971

TEST FORM No.....9/71..... EQUIPMENT.....UHF Sea Trial.....

Aim — To check performance of UHF equipments and aerial systems.

Principle — Aircraft opens and closes on each quadrant to 90 miles at 10 000 ft while UHF transmitter/receivers are used to establish communication.

Product — Performance figures for UHF equipments on various frequencies. Results entered in master card.

CONTROLLING OFFICER: ASCO

TRIALS ENGINEER: Lt. Smith

REFERENCES: BR 4050(2) Appendix 2 – Type 692/3/CUJ and CAW outfits, EAH, EAP and EAQ, Sheet R81.

Preliminary Actions

Staff — ASCO : WEO(R) : RS in UHF office : LRO(G) in UHF office; LRO(G) in UTR : 'R' senior rate of V/UHF Section in UHF office: D and Air Watch of RPs in Assault Ops. Room.

Briefing — By ASCO of staff detailed.

Equipment — (1) Successful completion of HATS by SS iaw BR 4050(2) Appendix 1, Sheets R82 and R82A (693/3/CUJ), Sheets R81 and R81A (691/CUH).
(2) Successful completion of UHF Harbour Trial (TF 8/71).

Consort — FRU aircraft fitted with UHF communications.

Time — Three 2-hour sorties plus three spare 2-hour sorties.

Dependencies — (1) To be carried out before S Band radar trials (TF 3/71).
(2) After completion of VHF harbour trials (TF 8/71).

Procedure

(1) Aircraft opens to 90 miles at 20 000 ft on each quadrant.
(2) Each TX/RX tested on 3 frequencies with aircraft between 50 and 90 miles while opening and closing.
(3) Four runs required on each quadrant.

Safety Precautions

(1) Guard frequency (243 Mc/s) available on FUI.
(2) Second channel of FUI manned on control frequency.
(3) Ops. to advise FRU to arrange own surveillance.

Complan

(1) ASCO to produce as an Annex.
(2) Complan to ensure that all aerials and feeders are used.

FIG. 17—TEST FORM

defects, where fault incidence was high and there was difficulty in judging whether the balance of priorities had been set correctly.

Post-Refit Trials

Formal trials of radio, radar and other systems need detailed planning. On the Polaris programme this was done using the Test Form concept, where the essential parameters are defined in standard form, agreed and published. The

SECTION 4—PLANNING AND PROGRESS

4.5 DOCKYARD REPAIR — PROGRESS CHASERS

(*a*) *Aim*

To provide guidance, support and acceptance of dockyard work, to ensure the timely and correct completion of Dockyard work.

(*b*) *Policy*

For refits and Maintenance periods, whenever Dockyard work is arranged, for each defect a Progress Chaser will be appointed. He is to provide to the Dockyard all guidance and support they need, and to carry out acceptance tests on completion. A progress Book is to be maintained in which full details of each defect, the progress chaser and progress are entered. Where leave or working hours require it, assistant Progress Chasers will be appointed in opposite leave parties or watches. They are to act in all respects as the Progress Chaser when they are on board, and he is not.

(*c*) *Procedure*

The duties of Progress Chaser (and Assistant Progress Chaser) include:—

(*i*) Knowing where the item is
What is wrong with it.
Where it is supplied from.

(*ii*) When the Dockyard workers come aboard:—

Show as above.
Isolate the equipment
Provide drawings
Obtain access (key routine)
Arrange to avoid collisions with other work in progress.

(*iii*) On completion of the job:—

Restore supplies.
Recover drawings, and unconsumed spare gear.
Attend on Dockyard Tests.
Carry out inspections and acceptance tests, to the satisfaction of the senior rating or the Operating Division having charge of the equipment, whose ultimate authority and responsibility for the equipment remain unchanged.

(*iv*) Throughout:—

Keep the progress book marked up with the progress, step by step as it occurs, representing to seniors when such progress is not taking place.

FIG. 18—EXTRACT FROM DEPARTMENTAL ORDERS

final document is used as the action document by all the departments and authorities concerned. We successfully used a simplified version of this both for post-refit trials and for similar trials carried out after Dockyard Assisted Maintenance Periods, and on recommissioning.

The gains were reduced confusion and consistently trauma-free trials. Another benefit lies in the flexibility such detailed specifications confer, as when programme changes are proposed it is easy to check from the forms which trials can or cannot fit the changed circumstances. A typical Test Form is shown in FIG. 17.

Marketing Approach to Organization

The departmental organization we inherited was a mixture of tradition and the personal qualities of a number of departed officers and senior rates. A major weakness we found was the need for a customer to deal with more than one Section and Officer within the Department. Our reorganization was based on a marketing concept of identifying the customers. The resulting organization is shown in FIG. 16.

PROGRESS RECORD

DEFECT ITEM

WE. 16 (A Division) AMPLIFIERS (AUDIO) — 5L

1 × 300 Watt, 1 × 50 Watt, 1 × 16 Watt amplifiers to be bench-tested. Defective components made good. Re-align and set up by SEEL. SS to remove and replace in ship

Serviceable: PRIORITY 2 : NOT LAST WEEK (time constraint)

	Rating Responsible (in 4 watches)	*Signature (to show they understand)*
i/c 1.	1S CEM RICHARDS	1. *A. Richards*
2.	2S LCEM HOME	2. *B. Home*
3.	1P CEM FERGUS	3. *C. Fergus*
4.	2P CEM JACK	4. *D. Jack*

Before signing 'Master Record Write Up' ensure that:

(a) Kalamazoo is written up

(b) All relevant drawings have been amended

(c) Planned Maintenance Office has been informed. This is important where there is an A & A carried out.

MASTER RECORD WRITE UP SIGNATURE i/c:

A. Richards

Decision	*By Whom*	*Notes*
Yes	Sect.	SS R × R

1 × 300 — Spare
1 × 50 — Mach.
1 16W — HSI

21/5/70	Units being prepared to land — a.m. 22/5
22/5	Units landed at SEEL
23/5	Units still in D/yd. Not expected back before Tues. or Wed.
28/5	Will collect units Saturday 30/5
30/5	Units not ready. Will collect Monday 2/6
1/6	Units ready 2/6
2/6	Collect units Tuesday — SEEL
2/6	Units collected and accepted.

Acceptance signature: *C. Fergus.*

FIG. 19

This naturally led to a systems-engineering approach and we had some mixing of the three categories, OE, CE and RE within Sections. This particular aspect, while clearly holding out large potential benefits, was not very successful as it aroused opposition at working level, and we had not enough sales effort to put it across.

The organization benefits gained included first, good working relations with customer departments and secondly an increasing sensitivity to the needs of the customers from both officers and senior and junior rates. It also clarified the attitude change needed when joining a Landing Platform Helicopter (LPH) to realize that the Commando are the main armament and that their needs must take precedence.

A maintenance department makes no profits, as it produces no operational output. It only incurs costs by spending men and material. It is helpful therefore to organize a maintenance department to align it to the profit centres of groups of customers who do produce a profit in terms of operational output, by the use of the material and services that we provide. It is of no value to complete a 100 per cent maintenance cycle, or to make a piece of equipment work, if it is not there when the customer wants to use it. This was summarized in the Department's formal aim stated as:

'The provision of equipment and services to the users, the aim only being achieved by the successful use by the users of these services.'

We are not interested in alibis such as, 'it was right when we tested it'; we are interested in success, and this is achieved only when the user and maintainer work together. From our experience, we believe that this approach to departmental organization helps to get this togetherness.

Dockyard Defect Progressing

It is customary to record the progress of dockyard defect items in a Progress Book. This method was developed into a fully delegated support, progress and acceptance system. Junior ratings were given charge of jobs, with extensive terms of reference shown in FIG. 18. These Progress chasers were in watches. so that support would be available to the dockyard at any hour in the week without interrupting the ship aim of man-maintenance through tropical routine. While some of the bigger jobs could not be left to juniors, a good spread was achieved across the Department, and for the 612 defect items cleared in two DAMPs, 57 different ratings were brought into the progress chasing. These included 13 1st Class Artificers, 7 2nd Class Artificers, 3 PO Mechanics, 12 Leading and 22 Able Rates, from all the sub-specializations of RE, CE and OE. A typical page of the book is shown in FIG. 19.

The Dockyard liked it as they were well supported through weekends and shift working, with little waiting time for problem solving. The men liked it as they had their time in the *Terror* bathing pool undisturbed and when at work they had responsibility. The officers and chiefs liked it as their task was very much eased. As Head of Department, I liked it, as with the aid of daily histogram presentation we could tell day by day the progress of the DAMP, without time-wasting progress meetings.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

As a result of our experiment we arrived at the following conclusions:—

1. The Objective Training approach, concentrating on what you want men to DO, makes sense, and works, in a WE Department at sea.
2. Programmed Instruction has its place among the various communication

tools available and, when used with discrimination, can be most cost effective and rewarding.

3. Junior ratings leaving the schools lack the ability to do the work required of them in an LPH.
4. While selection and training of Programmer/Analysts and other specialist staff deserves care, management enthusiasm is the first condition for success in Objective Training and acceptance at the Chief Petty Officer level is the second.
5. We do not 'know' how to do our work at sea. We need constantly to find out, and a systematic approach enables us to delegate this finding out to the Senior Rate level.
6. Management techniques, as taught in the school and elaborated in the voluminous literature, can be applied with success at sea and can more than repay the effort put into them.
7. To introduce management techniques a 'lead technique' such as Objective Training is a great help.
8. It is much easier to introduce a series of small measures aimed at systematic management, rather than attempting to force the whole operation to fit some master system. At the same time it is helpful to keep a clear picture of the theoretical management 'model' always before you when designing such schemes.

Recommendations

The following recommendations are offered:—

1. Management education should cover the use of Objective Training and its close relation to Management by Objectives should be emphasized.
2. Objective Training should be developed in the schools with the aim of:
   (*a*) Teaching the juniors how to DO the tasks they will be called upon to do at sea.
   (*b*) Providing the ships with outline analyses which, when clothed with local knowledge of ship geography and layout, will serve as the basis for follow-on On-The-Job training at sea. This should make use of all communication techniques including that of Programmed Instruction.
   (*c*) (*a*) and (*b*) should be structured so that the rating receives progressive training which is at each stage directly geared to the work tasks he is about to undertake, while providing the schools with a systematic and shorter time constant feedback from sea.
3. That training of Programmers and Analysts be developed.
4. That we temper our obsession with technical knowledge with a real study of how work should be managed.

Acknowledgement

We should like to thank the Authorities who gave us the facilities and support for what to us has been a most fascinating experience. We live in a time of accelerating change, when no tool which will help us to respond can be left unused. Objective Training is one such tool which, like other forms of analysis, helps us to form the habit of using Kipling's

> '. . . six honest serving men . . . . .
> What and Why and When,
> And How and Where and Who.'

ANNEX A

EXTRACTS FROM THE INDEX OF MATERIAL PRODUCED DURING THE EXPERIMENT

No.	*Subject*	*Objective*	*Consists of*	*How to Use*
1	Completing Job Cards	To enable ratings to construct acceptable Dockyard Defect Items on Job Cards.	Example of job card with explanations.	Given to all SRs — self-explanatory
2	Fan Rounds (2)	To carry out rounds of all fans as follows:— Up to 5″ —Twice weekly Up to 15″ —Weekly 17½″ and over —Fortnightly	Four sets of Route Cards, each consisting of three cards.	Held by CPO i/c Ventilation Section and issued to individual EMs as required.
8	Hangar Spray Pumps	To enable safe working on the equipment by the maintainers.	Job Aid — Information card giving circuit arrangement and layout of equipment.	Available in Hangar workshop.
9	Test Commando Communications (1)	To check the internal communications used during an Assault.	2 check cards for Q Desk and Local Control Position.	Cards held and issued by the Det. Sergeant Major. Det. Sgt. Major details personnel. WE Dept. supplies one JR to note and clear defects.
10	Island Lighting	To ensure lighting is switched red/white or white/red as reqd.	Check card	Available in MSB. Issued to Duty Part of the Watch.
12	DC Risk Markings	To enable newly joined personnel to recognize DC Risk Markings.	Tape List of States/Conditions Test	Trainees complete tape as part of joining routine.

ANNEX A—*Continued*

No.	*Subject*	*Objective*	*Consists of*	*How to Use*
14	Bedding-in carbon brushes	To enable JRs to master the routine for bedding in carbon brushes.	Tape and Job Aid.	Trainee to complete tape, using a fan nominated by the CPO i/c Ventilation Section. Job Aid to be available in the Ventilation workshop and MSB.
16	Fluorescent Light Fittings	To anable JRs to clear faults on fluorescent fittings.	Job Aid in the form of a fault diagnosis chart.	Issued to all EMs in the Domestic Section, also available in the MSB. Read from left to right; dots indicate symptoms. For each combination of dots there is a possible defect indicated.
21	L Markings	To teach newly joined ratings the way round the power distribution system.	Tape, questionnaire on the electrical marking system for power distribution.	EM completes tape as part of joining routine. O/c he must be able to trace a cct from DB or equipment to JB1.
24	RE Department Joining (1)	To teach newly joined RE ratings their way round the RE Division, offices and equipment.	Introduction sheet plus 4 data sheets.	REM to read introduction completing sheets B—D. Answers checked by R Dept. SR. Short oral test on equipment function and users.

ANNEX A—*Continued*

No.	*Subject*	*Objective*	*Consists of*	*How to Use*
25	REM Rounds (2)	What to check, where it is and how to get there.	Tapes (2), Rounds book.	REM completes tape and book. Book to be used at all times when on rounds.
26	LTR (2)	Introduction to LRR/LTR equipment, function, users and power supplies; for RE rating joining the Section.	Tapes (2) 4 equipment pictures 1 equipment layout 2 power supply check lsts 1 questionnaire.	REM completes questionnaire. O/c questioned by Section PO.
30	689 (1)	Operation of 689 Tx.	Tape, 3 check lists, 2 equipment diagrams.	REM completes tape. O/c he must set up the equipment to frequency and facility given by Section PO. He may use the check lists and diagrams.
35	CJA (1)	Operation of CJA Rx.	Tape 5 check lists, 1 equipment diagram.	REM completes tape. O/c he must set up the equipment to frequency and facility given by PO i/c of Section. He may use check lists and diagram.
41	293/982 (1)	Switch-on routines for 293/982 Switch-off routines for 293/982	Switch-on card Switch-off card	REM given cards. Operates equipment with SR in vicinity on first occasion.