'ON-THE-JOB' TRAINING AT SEA

BY

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The following article is an edited version of a presentation given by the Authors in MOD(N) in London on the experiment carried out in H.M.S. Bulwark *of using Programmed Instruction for continuation training within the Weapons Electrical Department of a large ship.*

Commander Willcock is the W/E Officer of H.M.S. Bulwark *and Instructor Lieutenant Palmer was specially appointed to his staff for the purpose of carrying out the experiment.*

Introduction

The presentation covered four aspects:

(*a*) *Background*—The previous work that led to the experiment being launched.

(*b*) *Getting Started*—Our experience both of finding out how to work together to prepare and give Programmed Instruction (PI) in a running ship, and more particularly the critical task of gaining acceptance for the scheme by both senior and junior ratings. Programmed Instruction is intended to be a means of learning (rather than teaching) with no (or very little) contact with an instructor, using prepared material involving the learner in self-testing.

(*c*) *Writing Programmes*—Experience in Programme writing.

(*d*) *Results to date.*

BACKGROUND

H.M.S. 'Hermes'

The idea of the scheme first became apparent on hearing from Commander Windridge, the MEO of H.M.S. *Hermes*, about the use of tape recorders for teaching ratings at sea. His reports then available showed that the process was as follows.

The rating had to obtain an Auxiliary Machinery Watchkeeping Certificate before being given a particular job. The job was well defined and understood. They were fairly standard training courses given by a senior rating who could ill afford the time. So the teaching was tape recorded, thus freeing the senior rating. At a later stage more of the elements of programmed instruction were introduced.

Negotiations

Our interest in Programmed Instruction was stimulated by a lecture on computerised PI by Instructor Captain Huggett. We were encouraged and guided by much helpful discussion and advice including that from DNEdS in the persons of Instructor Commander Harper, Instructor Captain Coxon, and Rear-Admiral Bellamy, also from Instructor Captain Moreland, the Deputy Director of Fleet Work Study and Management, from Instructor Lieutenant Moore who worked on the *Hermes* project; and at *Collingwood* from Commander Baylis the Training Commander, Instructor Captain Huggett the Director of Studies, Instructor Commander Broome who was using PI in Basic Radio training; also from Instructor Lieutenant-Commander Budgett of the R.N. Programmed Instruction Unit; Mr. Elliott of the Training Research Unit, A.R.L., Teddington; and, back in London, with Captain Bruen in DGNT.

Thus we were able to build on a considerable body of experience and knowledge of training in general and programmed learning in particular, which also brought a most welcome fund of good will and active support.

Commander Willcock then wrote a paper on the subject which DNOA(E), for whom he then worked, docketed. This lead to DGNT sponsoring the experiment and, via the FOCAS, requesting Captain J. C. Templeton-Cottil, the Commanding Officer of H.M.S. *Bulwark*, to which Commander Willcock was designated as WE Officer, to undertake it.

Initial Concept

The initial concept of this scheme is summarized as follows:

Aims

(*a*) To improve the technical and management efficiency of the WE Department.

(*b*) To help prepare ratings for advancement.

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

There is no real clash here, though the Ministry Departments were understandably more interested in the experimental aspect while the ships staff were more concerned with the ship work. These aims were then seen to be compatible rather than competitive, and so it is turning out.

Means of Achieving these Aims

With many ratings to train we needed a formal training programme, and it was proposed to build this around Programmed Instruction. Hence we have the Means, to give Programmed Instruction as formal on-board training in the WE Department.

What was the justification for Programmed Instruction in the training programme? Because we thought it would be the most efficient means and offered the following advantages:

(*a*) Reduce the time spent by senior ratings in repetitive instruction.

(*b*) Reduce the non-effective time of a junior on joining a section.

(*c*) Hence facilitate the planned rotation of juniors through the various sections.

Requirements of this Training—What should the Programme Teach?

The requirements of a programme are as follows:

(*a*) In the ship we want the rating to DO something. *Collingwood* gives him technical knowledge, we wanted to complement that knowledge, not repeat it, by ensuring he is ready to use his screwdriver. Hence, to DO.

(*b*) The first problem he faces in a big ship is to find the kit he is supposed to do something to, its fuses and switches, so we work on ship knowledge, hence 'Teach the layout and location of the hardware'.

(*c*) The product of a maintenance department is not just well maintained equipment but successfully used equipment, so we want to develop a positive attitude to helping the user of the hardware, so he completes our work by achieving operational success.

(*d*) Develop a positive attitude to selected management techniques. With written programmes we have the chance to influence the programmes, and hence to influence men to work in the ways we want. We had in mind such ideas as:

(*i*) Management by exception, that is, who needs to be told about what and when, in both the maintainer and user hierarchies, and who does not want to know.

(*ii*) Ahead planning and parallel working, by use of networks, scheduling, critical paths, queuing theory, and so on.

(*iii*) Use of the ships standard documentation systems, such as job cards, check cards, switch-on cards, maintenance schedules, etc. Here the emphasis is more on fulfilling the normal management process than introducing more recent ones.

Summarizing the requirements, we need to tie together the ratings' technical knowledge of how things work, ship knowledge of where the kit and switches and fuses are, and administrative knowledge of the way we conduct business to fit him to DO what we want him to do in our ship. (FIG. 1)

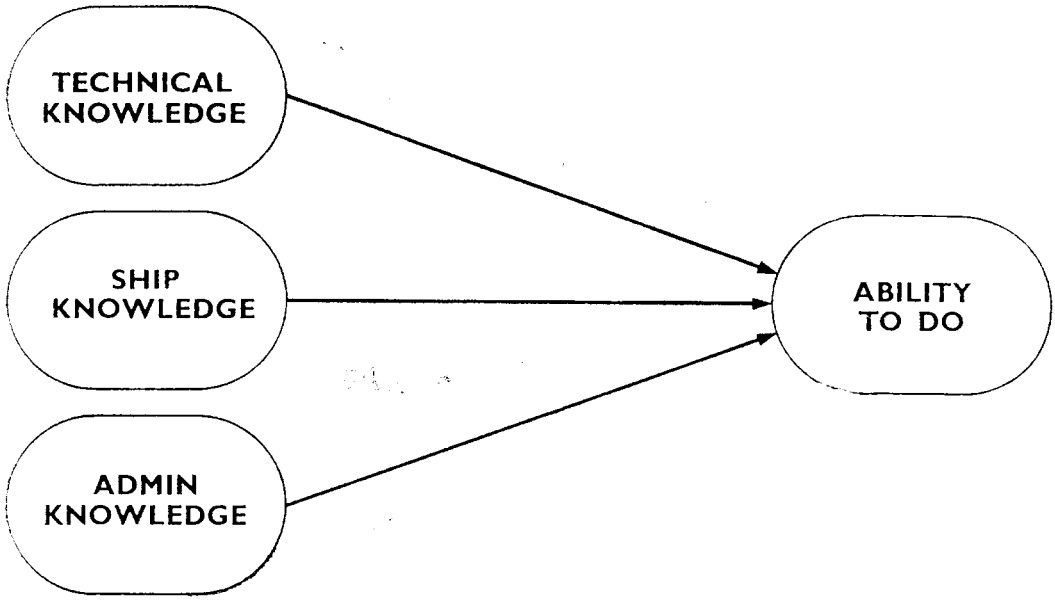

FIG. 1—SUMMARY OF REQUIREMENTS

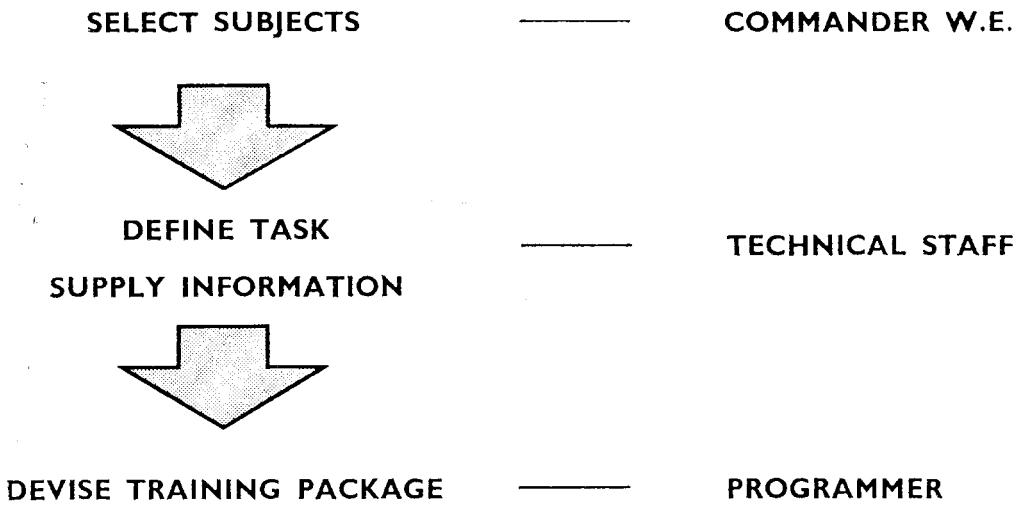

FIG. 2—PLANNED INSTRUCTION PROCEDURE

So much for the concept of the training scheme, but who would implement it? On the one hand the WE Officer must retain control and make the decisions without outside interference. On the other hand his departmental officers would be fully employed bringing the ship out of refit. Left to us little would be done to get such a scheme off the ground, so the offer of a skilled programmer, was gratefully accepted.

The procedure is shown in FIG. 2. The WE Officer would select the subjects; his technical staff would define what the trainee had to be able to do and the information needed; and from this the skilled programmer would produce a training package or programme.

As a programmer the Instructor Branch offered Lieutenant Palmer, the co-author of this paper. During his Royal Marine service he obtained professional electrical qualifications, and subsequently completed teachers training at Bolton College of Education, during which he specialized in Programmed Instruction and published Programmes, and has since done a job as an instructor in Electrical Technology. He was obviously the right man for our experiment.

Programmed Instruction Unit (PIU)

The Programmed Instruction Unit is based at H.M.S. *Collingwood* and is responsible to the Director-General Personal Services and Training (Navy) for introducing Programmed Instruction in the Royal Navy, operating on a consultancy basis.

The Unit provides technical advice and support for the *Bulwark* experiment and so, before joining the ship, Lieutenant Palmer was attached to them for briefing. During this time he was given the background to the *Hermes* experiment and introduced to the project officer in the PIU, Lieutenant-Commander Morse, who is on exchange service from the Royal Canadian Navy. Lieutenant-Commander Morse has great experience in deriving training requirements at sea and ashore with the RCN.

What is Programmed Instruction?

There are many different ideas about PI and it is worth going into it a little deeper and from the programmer's point of view.

The majority of people equate PI with teaching machines, but this is just one way of presenting material; there are many other ways, ranging from computer-based systems to conventional classroom arrangements. Each form of PI, however, is based on presenting the material in small steps or frames, each of which must be mastered before the next is presented. There are attendant advantages, self-pacing, less supervision, and so on, but these are more in the nature of by-products.

The stages of programme construction we use are as follows:

(1) Target Population
(2) Job Definition
(3) Task Analysis
(4) Enabling Objectives
(5) Pre-knowledge Needed
(6) Criterion Test
(7) Write Programme
(8) Validate
(9) Administer
(10) Feedback

In more detail, these stages are:

Establish the *target population* and find out who is to be trained and if they all have the same background, because different sorts of people may need quite different programmes to learn the same subject.

Job definition is a statement of the job or the end product; that is, what the trainee has to be able to do when we have trained him.

Task analysis is deciding all the correct steps needed to perform the job.

The *enabling objectives* mean the knowledge or skills the trainee will need if he is able to carry out the steps of the *task analysis* and perform the job.

Some of the knowledge or skills may already be present, and this *pre-knowledge* must be established to ensure that we do not repeat training.

We have just dealt with Job Denfiition, Task Analysis and Enabling Objectives, that is to say, 'what is to be done', 'each step involved', and the 'knowledge or skill to perform each step'. The example shown in FIG. 3 is taken from the Duty REM analysis. The overall task is to 'do rounds'; this means to check

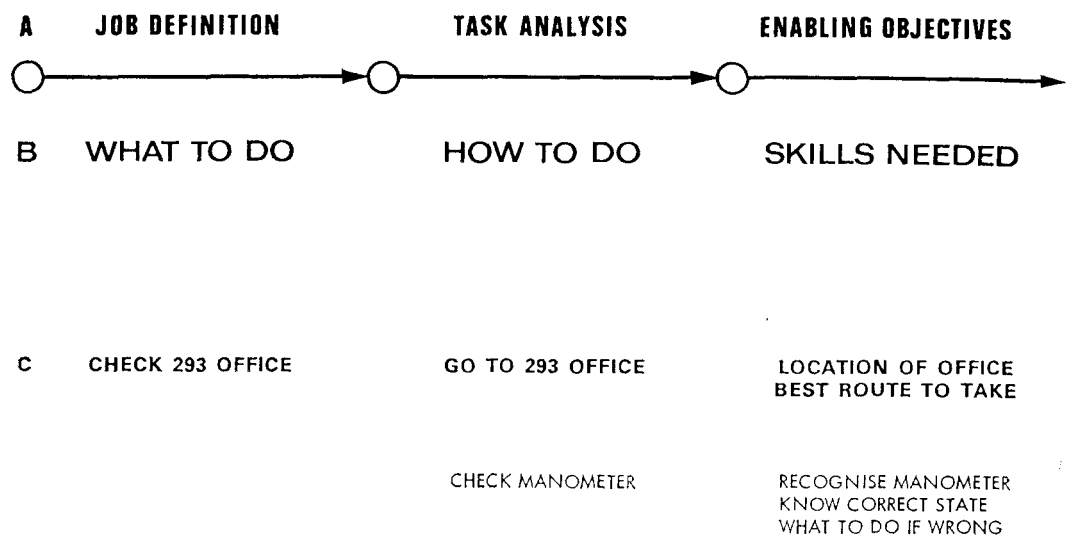

FIG. 3—JOB ANALYSIS

all radio and radar compartments. One such compartment is the 293 radar office, so part of the job definition is 'Check 293 Office'. In order to check correctly he has to do certain things, so the first part of the task analysis is 'go to the 293 Office'.

The enabling objectives here are, first, to know the location of the office and, second, to know the best route to take. The next part of the task analysis is 'check manometer'. For this he needs to know what it is, hence 'recognize manometer', to 'know the correct state' or what it should look like, and, finally, 'what to do if there is something wrong'.

At this stage we designed a *criterion test* to test the material presented in the programme, and that only, to test that the trainee can do the job. In other words, to find out if we had achieved our objectives.

When the programme is *written* it must be *validated.* This is the proof of the pudding. Can a sample population pass the criterion test, that is, show they can do the job after receiving the training. If not, the programme is modified until they can.

Even then during the *administration* of the programme, that is, using it on the trainees, it may prove necessary further to modify part of the material, and so *feedback*, or programme maintenance, takes place.

Using this approach, a programme can be designed to teach any subject but obviously it is a time-consuming and expensive process. Because of this the PIU advised us to use the method of approach shown in FIG. 4. First we look at the job, then we decide if we need training. If the answer is yes, we devise training which may be conventional or programmed instruction. If the answer is no, there is no training, though there may be something else. The significance of the PIU advice lay in the middle steps of the approach: do we *need* training. With the large number of subjects we wanted to teach it was not practicable to programme every one. We were therefore advised to produce a training package only if it were really necessary and, secondly, only to use programmed instruction as a final resort. There are several alternative and more conventional methods of passing on the necessary information, which we shall consider later.

Gaining Acceptance

By this time we were engulfed in the problems of bringing *Bulwark* out of the refit, and it was clear that Lieutenant Palmer would have but slender access

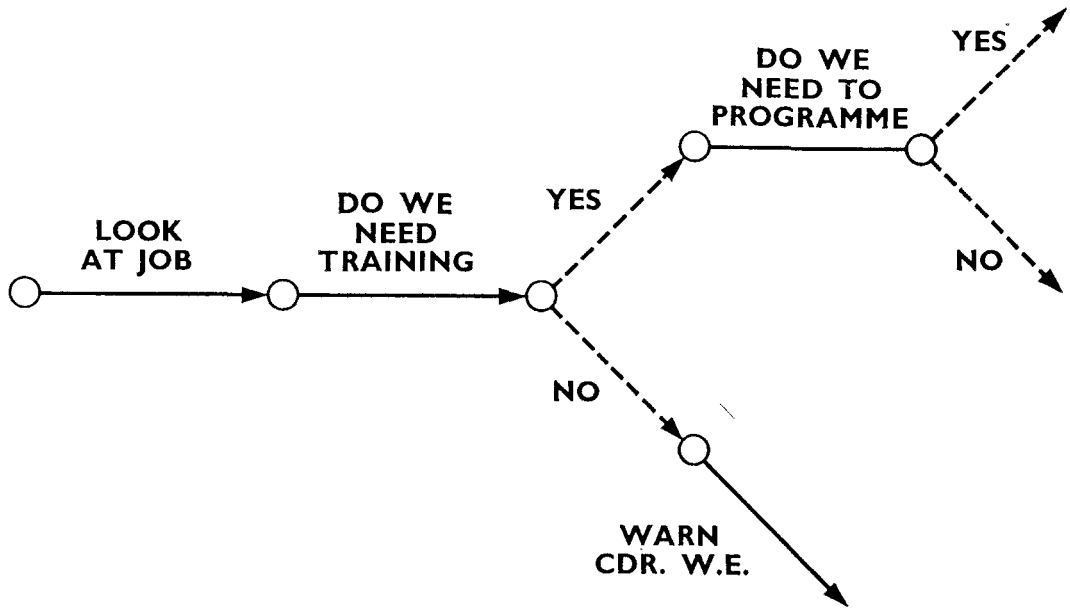

FIG. 4—METHOD OF APPROACH

to WE officer time. He would have to use WE ratings. It was therefore most important to gain these ratings' confidence and win their acceptance of the scheme, and the key to this was through the Chief Petty Officers. This was surprisingly successful and not so difficult as expected. The Chief Petty Officers, on whom we relied for advice and information, had long felt that more use should be made of their hard won knowledge and experience. Of particular help here was the Chief EA, who was working in part on Quality Control for the Department. The scheme proved a natural vehicle for him to do this. On the receiving end the juniors under instruction were pleased that someone was taking an interest in their work, and taking the trouble to help them to do it well.

Contributory factors to the quick success in obtaining acceptance included:

(*a*) Personal qualities of the particular Instructor, who is a very persuasive and competent operator.

(*b*) Our determination to generate enthusiasm in the staff.

(*c*) The inherent soundness and good sense of the approach—which makes a natural appeal to the classes.

As a start we picked the duties of the switchboard watchkeeper. We changed these watchkeepers every few months, and taught the new ones mostly by having them 'sit by Nellie', that is, double-banking them with experienced watchkeepers until the Chief judged they were safe to be left by themselves. It seemed a good starting job, as we were confident we knew all about switchboard watchkeeping. However it did not turn out quite like that.

The problem we found was that the first eleven people asked to define the switchboard watchkeepers' job came up with eleven different answers, and these divergencies were not settled by the Departmental Orders or the Books of Reference. The bulk of the work in writing this programme was in sorting out what the switchboard watchkeeper should really do, what his relationship should be to the Duty Senior Rate and the Senior Rate of the Supply Section, and what role he should play in clearing emergency defects.

These discussions were most productive and led both to a number of changes of practice and to standardization of practice. We all learned a lot. For instance, it emerged that the switchboard watchkeeper, in control of the

LIST OF JOBS

1. Switchboard Watchkeeper
2. WE Petty Officer of the Day
3. REM of the Watch
4. WE CPO of the Day
5. WE Officer of the Day
6. EM of the Watch
7. LEM of the Watch
8. Duty LREM (Sea)
9. Duty Senior 'R' Rating
10. Gyro Failure
11. 'L' Section Joining Routine

FIG. 5—PART OF LIST ONLY

generation and distribution of all the electric power in the ship, did not need to know anything about electrics. So we tried out the programme with success on an engineering mechanic and a marine.

Job Definition

Having decided that our prime need was for extensive job definition, we set about revising the original list of subjects which had, of necessity, been compiled subjectively. That is to say, it was based on personal opinions. Analysis showed a good deal of interdependence between subjects, for instance, we need to know the switchboard layout in the watchkeeper programme, before learning how to parallel generators in the senior rates' main programme. At the same time the number of subjects was increased from 23 to 49, partly due to new subjects uncovered by the analysis, and partly due to the Department policy of constructing each package as a number of small, discrete lessons, each about 40 minutes' duration.

This is to enable a trainee to complete a lesson in a single session. It is also easier administratively; firstly, because amendments can be made without re-writing a complete package and, secondly, training can be tailored to a rating's immediate need. Thus the list of 49 subjects includes several of the originals which have been expanded into several sections.

Original List

FIG. 5 shows only a part of the list provided by the ships staff at the beginning of the experiment. One example of a subject which grew into several sections is the 'L' Department joining routine. The original programme was to have included only the location marking system and an introduction to the more important WE compartments. All technical instruction was to be part of the individual section joining routines elsewhere. Later it was found useful to include some technical instruction, such as earth tracing, which is common to all sections, and also some instruction on fire-fighting and equipment.

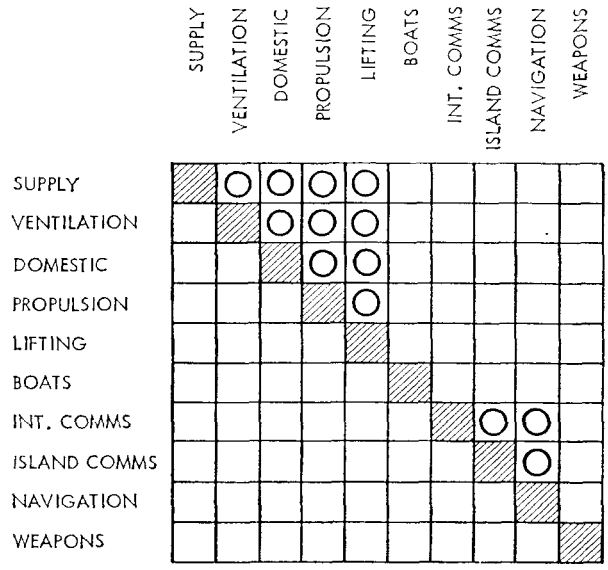

FIG. 6—SUBJECT DEPENDENCIES

Revised List of Jobs

The revised list of jobs was arranged in three groups, Radio section, Electrical section and a Duties and

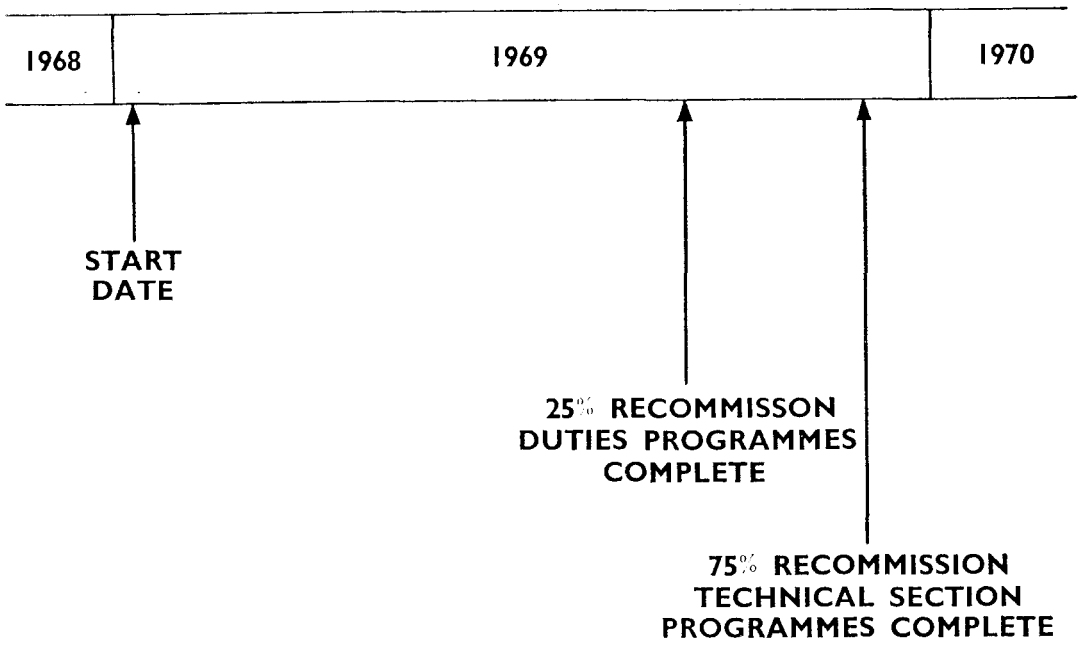

FIG. 7—TARGET PROGRAMME

Miscellaneous section. Dependencies were then established by constructing a matrix.

Subject Dependencies

FIG. 6 shows the matrix for the L Section joining programmes. A dot means there is a dependency, a common ground, between two subjects. Obviously there is common ground between Island and Internal Communications.

There are two communications sections because it is geographically convenient, but both use the same sort of equipment. The internal communication section, however, has fewer types of equipment, basically telephones and the main broadcast, while the Island section has Talkbacks and Intercomms, and the Telebrief system as well. For this reason it is advisable to complete the internal communications training package first, and use this as a basis for the Island section training package.

It is also useful, though not always possible, to arrange the planned job changes to follow this same order, and the departmental regulator has been briefed accordingly. A similar situation exists with this other group of subjects, which are best dealt with in the order shown.

On the other hand the boats section, and the weapons section are more or less isolated, and may be tackled at any time.

Target Programme (FIG. 7)

We now had to decide what we wanted doing first, accepting that job analysis was necessary, and that this took a long time. Our decisions were constrained by the subject dependencies and the ship's programme. The duty structure seemed most important, as we were engaged in building it up and it affected a great many people. So we decided to aim to complete this by the time we were due for a 25 per cent change of men in August. The work on the technical sections we aimed to complete by the end of the commission in November, as we wanted to capture the accumulated 'knowhow' of the fully experienced senior ratings before they left the ship. This was given as a directive and Lieutenant Palmer went into the Data Capture part of the exercise. So we come to the third part, Writing Programmes.

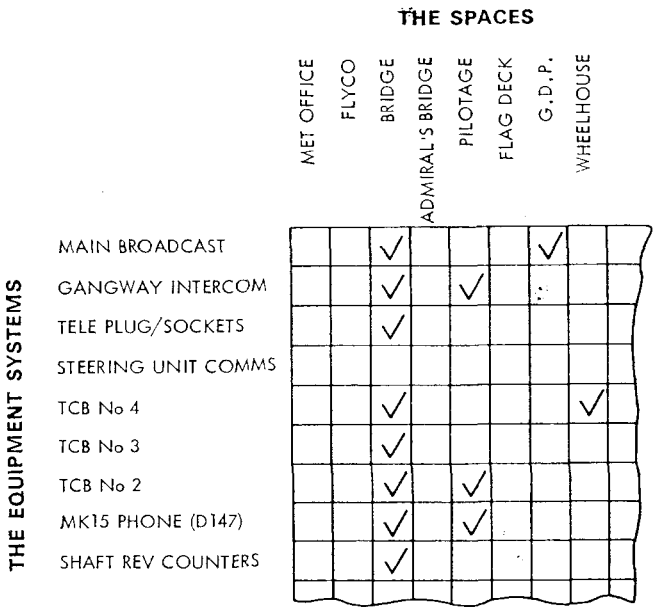

FIG. 8

WRITING PROGRAMMES

The finished product can take one of several forms. These are:

No training package
New WE orders
Check Cards
Cards and Instruction Tape
Text

More sophisticated means, such as teaching machines, were not considered on advice from the Programmed Instruction Unit.

Our method is to analyse the subject, establish the training need, and then decide the form the instruction is to take. In several cases we found no training was needed and so we produced no training package, despite some initial pressure to produce something. For example, one of the original subjects was the routine for gyro failure. Basically this can take place at sea or in harbour. At sea the gyro expert will be on board so there is no problem. In harbour, when the expert may be ashore, the Departmental Orders require the WE Petty Officer of the Day to shut down the gyro and then report to the WE Officer of the Day. The routine for shutting down the gyro is displayed on a chart in each gyro compartment, and each step is well within the ability of the Petty Officer. This analysis was clear enough to enable us to see that what we really wanted was a competent department and not complicated training. The second alternative is the production of a new departmental order. An example here is the WE Officer of the Day, whose duties are administrative. Although department officers complete certain of the training packages, the duties are clearly defined in the orders so no training programme is needed. The analysis did show, however, that the original orders needed to be re-written. Our third alternative is a set of check cards, a good example of which are those used for the Test Sea Communication routine. This routine needed revising because it amounted to a major evolution, with the result that we were reluctant to test sea communications after only a short period at anchor. We needed a routine which did not disrupt the whole department. At the time we had the active help of a team from the Training Research Unit, namely Lieutenant Commander Hawketts and CPO Hissey, who is work-study trained and who joined us for a most welcome and productive period. CPO Hissey was given the job of analysing the Test Sea Comms routine. His results, of which only part is shown in FIG. 8, are given below.

Test Sea Communications

The chart is arranged to show equipment systems against locations. Some equipments such as intercoms may involve several locations. For example, the man on the Pilotage has to check, among other things, the Gangway Intercom, TCB No. 2 and a Mk 15 phone (No. D147). On the other hand, the Gangway Intercom must be checked from the Bridge as well as the Pilotage. Altogether there are 160 checks, spread around 38 locations. The checks were allocated according to location and importance, and this decided the number of

TEST SEA COMMUNICATIONS

	Tick here on Completion
Operate all 5 KCV screens and check for correct function. They are as follows:- Stbd., Stbd inner, Midships, Port inner, Port.	
Wait until you are contacted from the bridge. On instruction from the bridge on the designated comm. link, you will be required to check and report:	
On visual signal i/c (port)—Port compass bowl repeat	
On command i/c (midships)—Midships compass tape repeat	
On visual signal i/c stbd.—Stbd. compass bowl repeat	
On flag i/c (midships)—Wind speed reading, wind direction reading, report state of KCV screens	
Contact the wheelhouse—check rudder indicators	
When all the above items are completed:	
Report to 'Control PO' in Flyco	

FIG. 9—MAN 'B'—ADMIRAL'S BRIDGE

men needed. Each man needs only a card listing the checks for which he is responsible. The checks are self explanatory.

One of these is the card for Man B, who is responsible for the Admirals Bridge.

Man B (FIG. 9)

Man B completes the first check, of the 5 Kent Clear View (KCV) screens, then waits until contacted by the bridge. He then uses the communication link designated to check the following equipment:

On the Visual Signalling Intercom (Port)—the port compass bowl repeat.

Out the Command Intercom (Mid)—the midships compass tape repeat.

Out the Visual Signalling Intercom (Stbd)—the stbd compass bowl repeat.

He checks the compass repeats by reading off the ship's head bearing to the Navigation EA, who is on the bridge. The readings are checked against the pelorus. He puts a tick against each correct item, and a cross if there is something wrong. The cards are collected at the end and defect repairs organised by the Flyco PO, who controls the checks. Next he uses the Flag intercom (Mid) to report the windspeed readings, the wind direction reading, and the state of the KCV screens, to the Bridge LEM.

On completion he is told to report back to the PO in charge.

The work study experience of CPO Hissey was invaluable in making up this routine. We are now able to use the Duty Watch plus three key ratings, instead of three sections as before. The checks are completed more quickly; the record is 12 minutes though 15 to 20 is more usual. An odd result is that less defects seem to occur.

The next alternative product is to use both cards and an instructional tape, where a good example is the Bomblift Driver. He is given an instruction card,

BOMBLIFT—CASEVAC AND STORE SHIP ROUTINE

Preparing the Bomblift

Draw the CASEVAC key from the MSB—this key fits all Bomblift locks

Remove locks from levers G and I (Upper Lift Console), and from lever F (Transfer Console)

Check lever J (Upper Console) is at the SUPPLY position

Wait for pressure to reach 1000—gauge by Dispensary

Clearing Away Bogie and Wire Cage

Move lever K away from Bogie to remove Bogie Locking Bolt

Move lever F fully LEFT and close hinged flap again

Remove wire mesh gate on left of Upper Console

Tie back rest of wire cage against Bogie rail

Operating the Bomblift

Call Flight Deck on TCB at left of Transfer Console—tell operator to open Upper Hatch

Move lever H to FREE and hold till lever I is moved—use left hand

Move lever I past first hinged flap—close hinged flap—release lever H—lock hinged flap

Raise Interlock Coverplate on left of Upper Console

Wait till all interlocks (steel pegs) are flush with brass plate

Move lever G to RAISE to raise lift

Wait till all interlocks are flush again

Move lever G to LOWER to lower lift

Wait till CASEVAC is completed

Closing Down

Replace all wire cage parts

Return Bogie to stowage position by moving lever F to Right of centre position —move the Bogie slowly till it is in line with the Bogie Locking Bolt

When Bogie is in position move lever K towards Bogie to insert Locking Bolt—slight movement of the Bogie may be needed to correctly house the Locking Bolt

Move lever I to SHUT FLASHDOOR position to lower Flashdoor

Lock all levers again

Close the Interlock Coverplate

Ring Flight Deck on TCB and tell operator to close Upper Hatch

Ring Hydraulic Pump Room (ext 458) and stop pressure to the Bomb Lift

Return CASEVAC key to MSB

FIG. 10

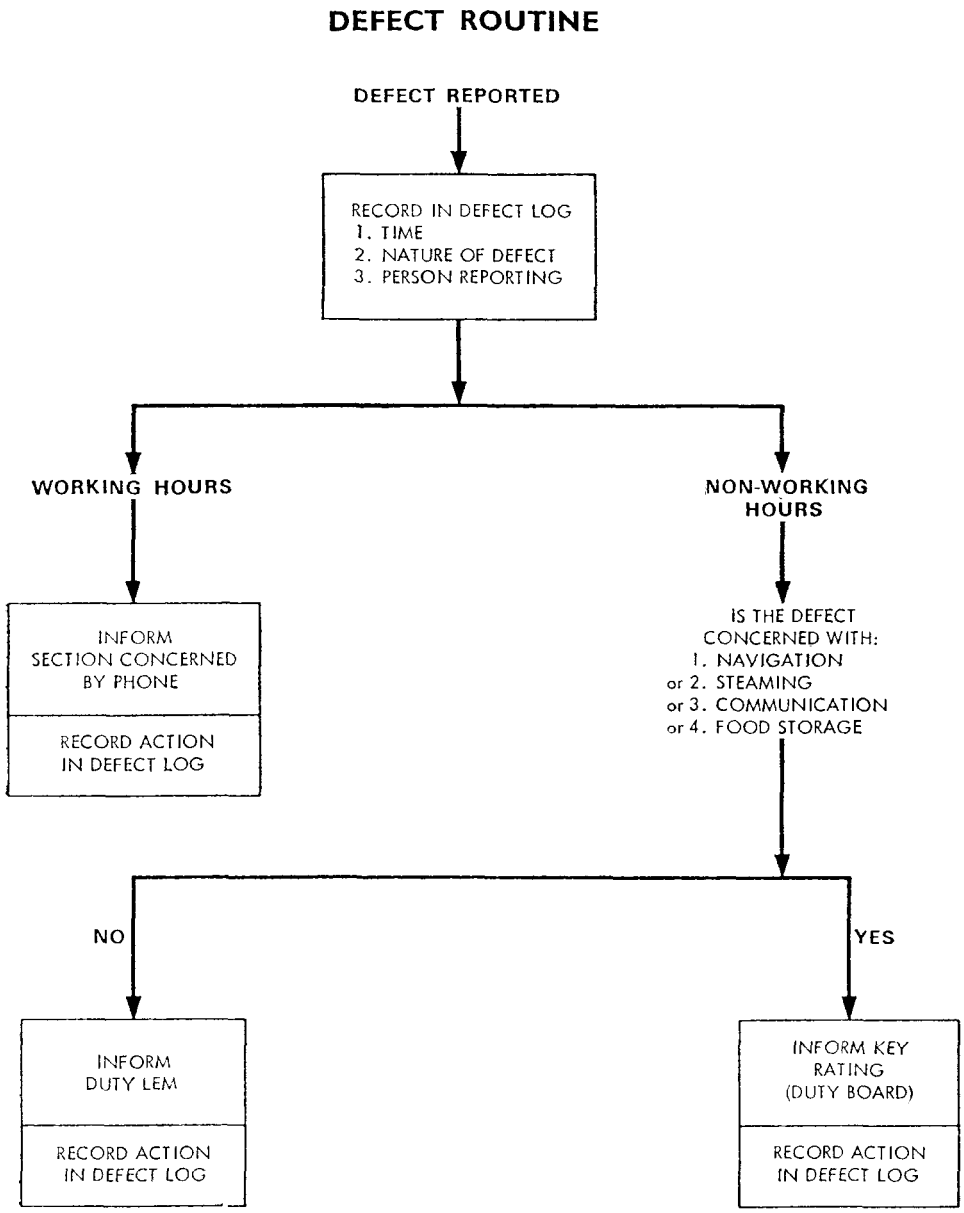

FIG. 11—DEFECT ROUTINE

which is shown in FIG. 10. This lists the sequence of actions needed. Different colours are used for alternate lines to make the card easier to follow, but this does not mean that one instruction is more important than another. The card is accompanied by an instruction tape. In other cases, where a decision must be made, a simple algorism, or mathematical notation, is used, an example is the switchboard watchkeeper (see FIG. 9). FIG. 11 is the defect routine. First the defect is reported, and the watchkeeper records the details in the Defect Log. In working hours he informs the Section by phone, then records his action in the Defect Log. In non-working hours he has to decide if it is a defect affecting the safety of this ship, that is navigation, steaming or communication equipment. If the answer is no, he follows the left hand path; if the answer is yes, he follows the right hand path. Either way he has to tell someone, and who he tells depends on whether it is working or non-working hours.

Finally there is the programmed text. As far as possible we have avoided these, as they take so much effort, although we have produced two. One is for the senior rating who has to operate the ring-main switchgear, and the other is part

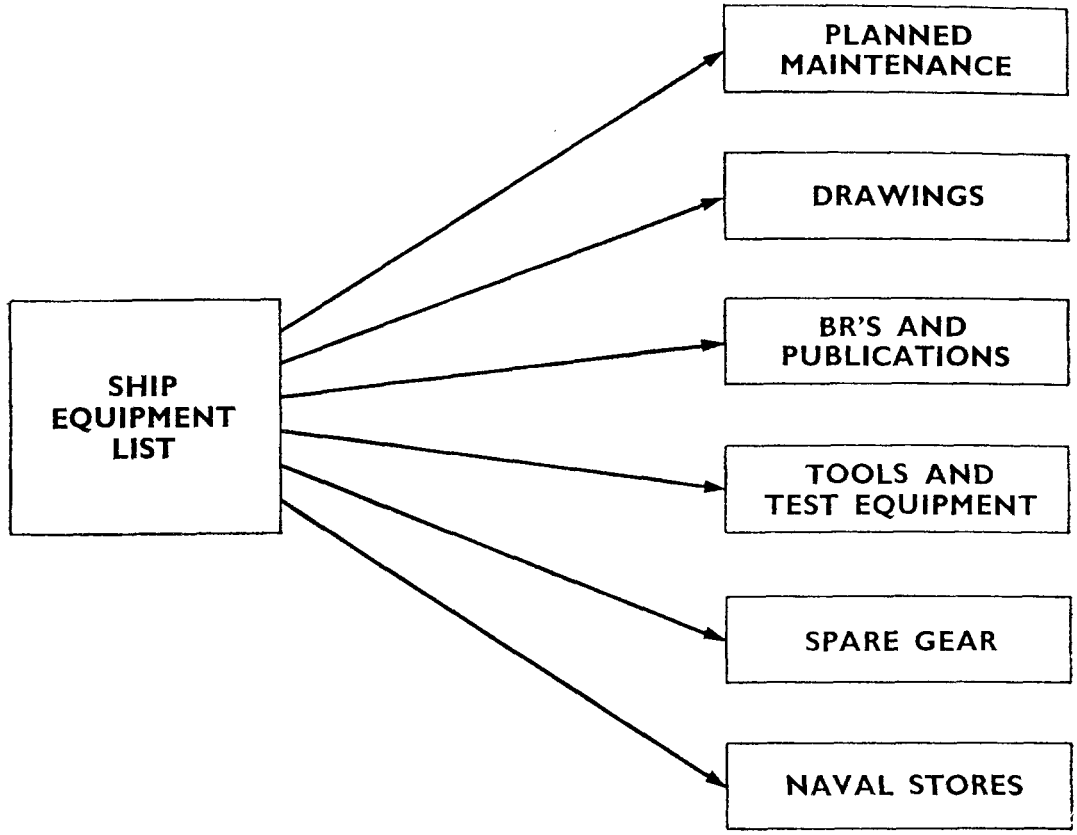

FIG. 12—BASIC ADMINISTRATION

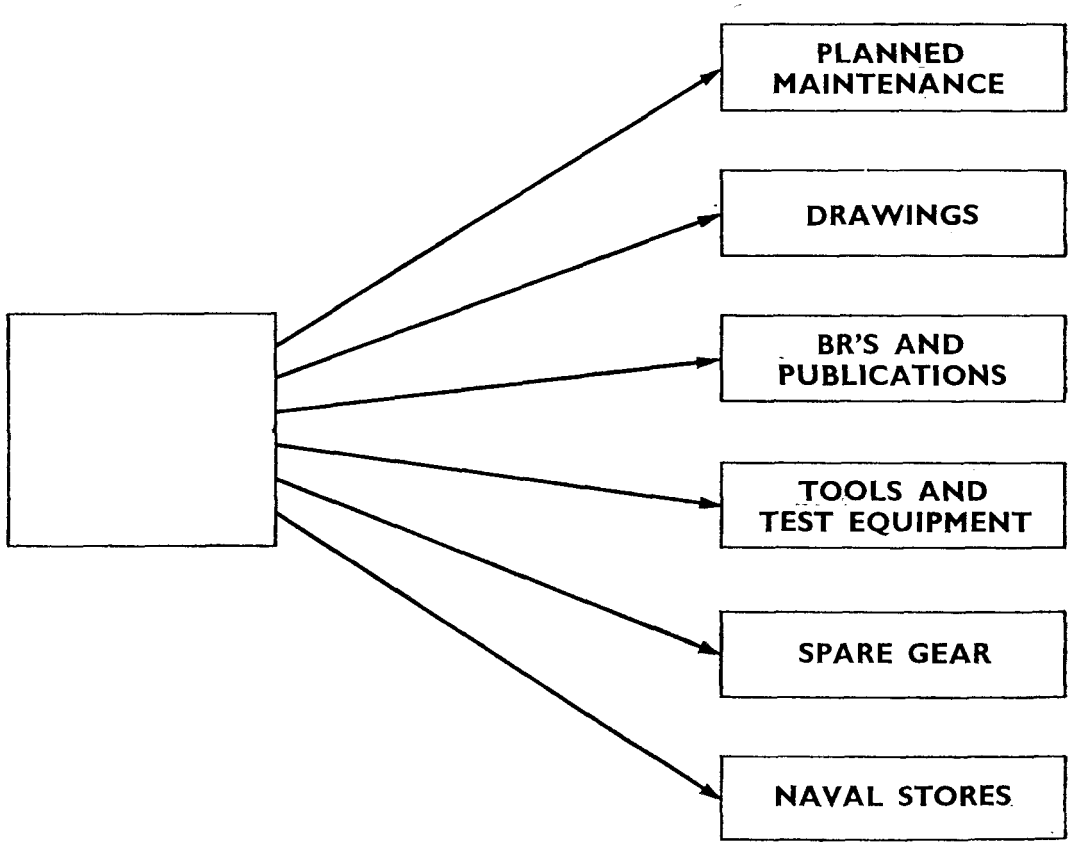

FIG 13—BASIC ADMINISTRATION

of the administration package. This text is interesting because it uses the mathematical approach, as far as we know for the first time in the Royal Navy (FIG. 12). This is the basic diagram which the trainee is required to learn. The starting point is the Ship's Equipment List. To maintain this equipment the ship needs:

Planned Maintenance Routines,

Documents and BRs and Publications, to locate the equipment and provide information.

Tools and test equipment, to carry out the maintenance, and Spare gear and naval stores, to replace defective parts.

In FIG. 13 he has to complete the missing detail. This is followed by an explanation of the missing detail, then another frame where he has to complete a little more information. As he proceeds through the programme he has to complete more and more of the diagram, until finally he completes the whole diagram himself. The psychology is that success depends on motivation, and motivation depends on the satisfaction of completing the job. Therefore you learn better by completing the whole diagram at each step than by working to construct an unknown diagram one step at a time.

Progress

At the moment (August, 1969) the state of play is as follows:

State of Programmes

Completed	8	Analysis	5
Validated	2	Data Capture	27
Construction	4	Not Needed	3

Using the completed programmes we have trained the following numbers:

Numbers Trained

Switchboard Watchkeeper	11	Bomblift Driver	8
Ring Main	8	REM Rounds	15
Location Marking	5	WE Main Compartments	5

Twenty-five per cent of the new ships company is joining now, and the remainder joins in November. This gives a training task of 11 senior and 30 junior ratings in August, and 10 senior and 60 junior ratings in November, many of whom need to complete more than one programme.

So we reach the final part, the Results To Date.

RESULTS TO DATE

Value

We have all been very conscious that we were spending a lot of high grade effort in the *Bulwark* experiment both in terms of outside staff, and our own Departmental Officer and Senior Rate time. It is important to ships officers that we get a good return for this in terms of improved departmental efficiency, while, from the Ministry point of view, it is important to know whether this type of approach is worthwhile using on a larger scale.

What can we say now about our experiment? First, if the aim of training, or rather learning, is to alter behaviour we are certainly doing this. For instance, our REM of the Watch does rounds of radio compartments every hour to check for correct operation and to detect incipient outbreaks of fire. Since introducing Programmed Instruction for this task the REMs complain that

rounds now take twice as long as in those halcyon days of a quick glance through the compartment door. Now they check meter readings, and know what they should be because they have been taught it, and it is all down on their check card. They also check that the fire extinguisher is there, and thus they learn just where the extinguishers are, which is a great help in the vital first minutes of an incipient fire. In this case the change of behaviour we speak of is that the REMs now carry out their duty more thoroughly than before, and one of them snuffed out a fire last week. We could of course obtain the same improvement in job performance by other means, but we find the PI approach a suitable, convenient and effective means.

We have a gain in stimulation of interest and discussion at all levels. The tape recorders, adopted partly as a gimmick, really *do* appeal, and also make good training aids. Ratings *do* learn thoroughly what they need, and we think that they learn it a lot quicker.

We have learned that programmes cannot be constructed without job analysis, and that few of our jobs are sufficiently well defined to justify omitting such job analysis. Far from being a drawback this has been our biggest gain so far, as we are led to examine the way we work, how we do our jobs, and how we conduct our business, and to a depth and with a thoroughness that we would not otherwise achieve. This is first class, and the ratings have asked why it was not done years ago. This experience has also changed our attitude towards the experiment. Our initial main aim was to improve the departmental efficiency by running a formal training scheme based on programmed instruction. We were judiciously warned that we needed first to develop an analysis of our training needs, and not to jump into production of training programmes of every job in sight. This was good advice. But what we did not foresee was this need to examine the jobs themselves in depth and, from such examination and analysis, to restructure the jobs before considering how to train for them. This is a good activity in its own right, regardless of whether or not it leads to any programmed instruction, or for that matter whether it leads to any training.

Again you can achieve the same result of better thought out work by other means. The particular value of PI in this analysis phase is that if you aim to produce PI, clearly you need exact analysis. So you have to do the analysis properly. The PI itself imposes a discipline. This is rather like the discipline imposed by a computer. If you computerise your affairs you must first put them in a logical well thought out posture, and you do this by carrying out systematic analysis. This leads to you altering your work methods. Having done this you can usefully reconsider whether or not you still need to order the computer, as you may have achieved most of the benefit of the operation just by this analysis and job reorganization. There the computer imposes the discipline. With a PI training scheme the PI imposes the discipline, and for a similar reason. Both the computer and PI demand yes/no answers, and these demand exact definition.

So we now recognise PI as providing us with two benefits. Firstly, it is one of a number of training or communication tools at our disposal and a very good one. Secondly, it is a splendid vehicle for introducing method study or job analysis within a WE Department at sea.

Thus the main aim has now evolved to a threefold activity: firstly to carry out a systematic study of the jobs our ratings do, recognizing that this will usually lead to our changing those jobs in some way. Secondly, to develop from this a departmental training scheme, and thirdly to employ PI for suitably rewarding portions of this training scheme.

We still are meeting our other aims of helping to prepare our ratings for advancement, and carrying out a training experiment.

We do not want to oversell PI. It will not do all our on-board training.

We aim to use it for selected jobs, or parts of jobs where it will be particularly profitable. Thus we hope to use programmes or other formal training to introduce ratings to their jobs. Their subsequent training will continue to be by the precept and example of their seniors. Many programmes aim just to have the juniors become useful to their new sections rather earlier than otherwise. You quickly profit from this as a little sum shows.

Each junior spends about 17 weeks nominally on a section before a job change to another section. This is to give him the wide experience of the ships equipment to fit him for advancement, and to provide flexibility in employment in Action Stations and so on within the ship. We lose about three of those weeks on leave, etc., leaving fourteen weeks actually at work. Now when he joins the section he is normally quite useless, until the hardpressed senior rate in charge has trained him up. This is a vicious circle, as the uselessness of the junior rate forces the senior rate to do all the work, and hence have even less time to teach the junior how to do the work.

The junior may well be ineffective for weeks. We would look to a reduction in this non-effective time by about two weeks. Out of a total available time on the section of fourteen weeks, this is the equivalent of an addition to the effective working strength of about 14 per cent. This is an attractive gain in these days of staff shortages and temporary manning standards.

Turning to the initial process of preparing PI, the preliminary method study or job analysis does not of course need a skilled programmer. The work is akin to work study, and we have had good success with a work study CPO. This could prove a most attractive field for exploiting the talents of work study senior rates. They would work closely integrated with ships staff in such a way that their work leads naturally to immediate changes in work patterns. The whole process of referring bulky reports for consideration of recommendations is short-circuited. We are currently investigating training some of our senior rates in these analysis techniques.

One last qualification. We have no intention of method studying the entire Department. We try to select those jobs that look like giving us a high profit of increased efficiency in relation to the study we put into them. We look for opportunities of exploiting the PI approach, and do not seek to apply it wholesale.

As we are trying to carry out an experiment whose results could have validity outside our own ship, we have looked at the problem of quantifying the efficiency of PI in the ship. To do this fully would demand a test group trained by PI, and a control group trained by a more conventional method. We have not done this for a number of reasons. Firstly, we had no conventional training scheme, we have not been willing to spend departmental time setting up a training scheme that we did not want. Next, the problems of ensuring valid side by side comparisons are very great and we have been advised that where these have been attempted and results obtained, these results do not have the demonstrable accuracy needed to be accepted as scientific measurements. But quite apart from these practical difficulties it is felt that this is no longer the real interest. PI is a collection of the best intructional techniques, hammered out by trial and error. We do not really need to re-prove these quantitively in a new environment, while the interest for us has, as outlined earlier, moved much more to the job analysis area. This is where we are getting a big pay-off, and this is observable by inspection.

We will of course collect statistics of prepared and administered training but do not expect to provide much other quantified data.

Thus our results to date are qualitative, and based on subjective judgements. Also it is early days, and this is only a first progress report. It is felt however that some conclusions and recommendations, based on the initial aims of the *Bulwark* experiment, can usefully be put forward.

CONCLUSIONS

1. It is practicable to prepare and give Programmed Instruction for 'on-board' WE work. We have done it and it works.
2. It is popular with senior and junior ratings, in fact, quite surprisingly so.
3. It appears to lead to earlier/better job performance. We have more confidence that ratings know what they are about, and that they are doing what we want.
4. It provides an ideal vehicle for 'know-how' data capture.
5. Suitable Instructor Officers do this well within a WE department with no infringement of prerogative. By this it is meant that there is no clash between ships staff and outsiders. Management decisions are referred to the WE Officer, matters of content to his staff, and training decisions are taken by the Programmer.
6. Productivity is improved by the support of a Work Study CPO or PO to help with the job definition and analysis.
7. Most people who come in contact with the experiment like it. This includes the staff helping to prepare the programme material, those receiving instruction, and the various visitors we have had.

RECOMMENDATIONS

Lastly, and remembering that this is only the first progress report of an experiment at its half-way stage, two recommendations are made:

(*a*) We should continue the *Bulwark* experiment. It is rolling; it has a lot of support in and out of the ship and a big investment in captured data ripe for editing into programmes. We have put a lot of work into the scheme and now it is beginning to work for us. But the big profit for us will come next year as we train up the new commission who joined us in November. Within the Department the experiment is good news, and we want to get on with it.

(*b*) Consideration should be given to trying some such approach to a small ship class. This could seek to produce both standard operating and administrative procedures as well as the hoped for training efficiency.

(*Tailpiece*) There is a lovely advertisement in one of the management magazines, showing a very pregnant young lady who is the guest of honour at an official party. She is leaving to have her baby.

The caption reads: 'Don't let Mary Jones take your filing system with her! No one else will be able to find the papers next week'.

Similarly, we would say: 'Don't let your departing Chief Petty Officers take your departmental organization and skills with them when they go on draft'. Little is ever transferred during a normal turn-over. If you subject the section to PI you can capture a lot of their hard-won knowledge and put in it a form that the new lot can use.