ENGINEERING TRADE PLANNING AT ROSYTH

BY

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PREFACE

Introduction

An article on planning, and dockyard planning at that, sounds soporific. Sufficient leavening, it is hoped, has been injected into this one to interest at least some of those whose ships will soon be due for a Rosyth Dockyard refit, others in dockyards abroad (who so far have not been officially obliged to develop planning techniques), or in the larger dockyards at home as a contrast to their necessarily more elaborate schemes, and even the Air Engineering Specialists, whose apparently clear lead down this avenue may have lulled them into ignoring the advancing avalanche !

Planning basically means preparation. In all normal modern industrial enterprises elaborate advance arrangements are necessary, but the temptation to overdo this planning effort must be resisted, *as the job still remains to be done*. It is in this balance between planning and production effort for *optimum overall output* that, in the Author's opinion, the real fascination of this subject lies. For the manufacturing repetitive industries this balance point can be accurately determined, for instance, by costing. For an overhaul, seldom repetitive business of which a dockyard is a diverse extreme example, even the zone of balance is elusive in the continually varying conditions.

Rosyth Dockyard, fortunately, has considerable natural advantages in developing an effective planning organization. It is not too big. There are only 4,700 industrial personnel, divided between the four main professional departments, and one Basin, three dry docks, and two floating docks. Its task is varied and, to the usual extent, unpredictable, but not complicated like those of Chatham, Portsmouth, and Devonport. Then departmentally, before Trade Planning was worth introducing, it was mandatory to have both a high class organization, and an efficient machinery layout for the pattern of task in prospect. My predecessor bar two put the finishing touches to the first requirement (*Journal of Naval Engineering* Vol. 8, No. 3, Article 3) and my immediate predecessor expedited new shop layouts from method-study principles and various far seeing production control basic steps, reflecting his B.J.S.M. Washington experiences. So the stage was all set for sowing the Trade Planning seeds, and wondering whether they were planted the right way up ; but before describing this agricultural process, where did this urge for dockyard planning originate ?

Background

In October, 1956, at their famous Sundridge Park Conference, the Directorate of the Dockyard Department (as it then was), and 18 managers of the various dockyards, representing about 400 man-years of dockyard experience, made a series of dockyard reorganizational recommendations as their contribution towards the smaller post-war Fleet of unexcelled efficiency with which the Royal Navy and Nation must henceforth be content. These recommendations, evolving mainly from visits of the top Dockyard Directorate team to the U.S.N. and

British commercial shipyards, and doubtless influenced by a study of the functional organization then in force at R.N. Aircraft Yard, Fleetlands (*Journal of Naval Engineering* Vol. 10, No. 4) put a dockyard focus to the general trend of thought in the Battersby, Marshall, and Nihill Committees of 1954-56. They soon became official Admiralty policy.

THE NEW DOCKYARD ORGANIZATION POLICIES

Their Aim

The aim of the new organizational changes is to improve drastically the refitting/conversion ship production of all dockyards. What this involves has already been fully described in the *Journal of Naval Engineering* Vol. 8, No. 4, Article 6.

While the present appreciable backlog persists of modernizing the remnants of ships of the last war for atomic threat conditions the main dockyard problem is to do all the work required per ship, within the expenditure approved, without extending the time allowed by the Operational Authorities ; or, in dockyard parlance, stop the slide to the right. Exceptionally there are a few categories, with reserves, like Boom Defence Vessels, where reduced cost of refit is the criterion.

As the proportion of New Construction ships increases the emphasis must strengthen on reducing the refit times of these harder hitting more sophisticated ships to secure adequate operational availability.

This aim must be achieved without detriment to the ability of dockyards to accept unprogrammed emergency ship work, at least on its present scale, to provide a wide range of workshop support for the new Navy Works Department (see next paragraph), to continue to self-maintain their Yard services, and manufacture spares, items, and equipment for stock as required by the Admiralty.

A challenge with a vengeance !

Their Approach

These new Admiralty policies aim to replace the traditional dockyard departmental organization with a larger Functional Top structure, consisting of Production, Planning, Personnel, Yard Services Managers, with appropriate assistance (not according to Parkinson's Law !), all co-ordinated by a General Manager with authority and overall responsibility for the work of all divisions ; this change to be fully explored at one pilot Yard first,Chatham being selected : concurrently all shore establishment work outside or not connected with the dockyards to be transferred to a new Navy Works Department, the dockyard remaining responsible for its workshop support ; *each home dockyard meanwhile to introduce three tier planning at Yard, ship and support centre level*, the Assistant Director Management Techniques at the Admiralty being responsible for advice and co-ordination within the overall policy.

Reservation

Although the detailed working and results of the Yard and ship levels of planning is largely beyond the scope of this article, their main features are now mentioned since Trade Planning, the bottom tier of the three, must be the foundation of the entire new Planning set up.

YARD PLANNING

The function of the Yard Planning Office (Y.P.O.) is work acceptance ; very broadly it decides *what* is to be done for *ships* (but not yet shore, repayment, or depot task work) in agreement with the production departments. Its main tasks are to agree, and review constantly with D.G.D. and M., the current and sub-

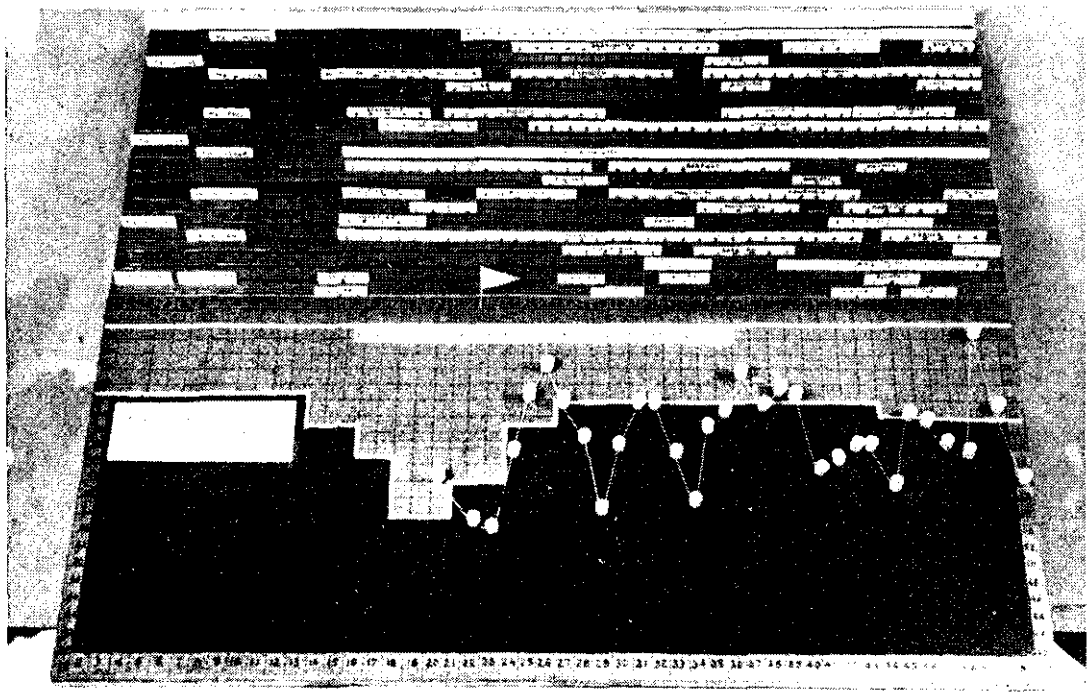


FIG. 1—TYPICAL (STEAM) FITTER AFLOAT REFIT PLAN

sequent financial year's ship programme (including the Port Marine Services), based on the trade manpower available ; to assess the effect of unprogrammed ship work ; to keep topical docking and berthing programmes ; to make effective pre-refit *advance arrangements* regarding Defect Lists, Alterations and Additions lists, supply of Admiralty items, availability of drawings and materials ; to prepare a key schedule showing all important dates for the particular refit (e.g. docking, gunnery test, controlling A. and A.s, raising steam, preliminary sea trials, terminal and completion dates).

The Y.P.O. was established at Rosyth in January, 1958, and is sited in the Main Administrative Building. It is manned by an interdepartmental team of ten (including S.N.S.O. liaison), and the engineering contribution is one foreman and one draughtsman. At present it has a constructor in charge, and its services are excellent. For example, the engine fitters' (afloat) steam propelled ship task/manning programme, as produced by Y.P.O. is shown on FIG. 1.

The labour loadings for the tasks accepted are kept for 21 of the 31 constructive/engineering/electrical trades. The decision whether to accept additional work is normally taken on the available capacity in the shipwrights, engine fitters, and electrical fitter/wiremen afloat sections ; at present these estimated labour loadings are found often to be insufficient by the engineering production afloat sections, as, by the time the ships refit conference is over, the work content of the refit has usually grown. Happily the Class Authorities Planned Maintenance Scheme, by reducing the incidence of breakdown defects, is gradually achieving more standard and reliable defect lists, and less lengthy supplementary lists, all of which is a bonus for planning.

The Y.P.O. finishes work on a ship when production work on that ship starts. The key schedule will then have to be transferred to the Refit Planning Office for detailed development.

SHIP PLANNING

General

Ship refit and conversion planning at Rosyth is done in the Refit Planning Office (R.P.O.) by another interdepartmental organization. It was created in June, 1958, in the heart of the ship refitting area.

The R.P.O.'s main function, when it receives the Key Schedules from Y.P.O., is first to develop a Master Ship Schedule to suit the production afloat teams of the three professional departments, either by avoiding major interferences between them in the ship, or alternatively to arrange assistance between them, as required.

Over simplifying, R.P.O. decides *when* it is to be done.

Due to the weight of ships' equipment good usage of dock and berth craneage is essential: so one of R.P.O.'s most important subsidiary roles is to allocate the required number and type of cranes to each refitting dock and berth. (The foremen in charge of the ship's refit then arranges their hour by hour usage with the departmental production sections concerned).

Once the Master Ship Schedule for a particular ship is agreed, the R.P.O. sections evolve from it their own departmental trade refit plans *as a service to their afloat production teams*. At present, ship refit engineering plans are only prepared for the controlling trade—the afloat engine fitters—but, before they can be completed, R.P.O. must negotiate the necessary support from the other engineering shop, and afloat centres involved, e.g. factory (engine fitting shop), pipe shop, boilermakers shop and afloat centres, foundry. Then much must be added to the information list supplied by the Y.P.O. with the Key Schedule, particularly about drawings and materials. R.P.O. also arranges any contract assistance required, and spare gear replenishments.

Thus for each Planned Ship the engineering section in the R.P.O., consisting of one inspector, two chargemen, six progressmen technical (includes one B.M. trade), prepares a detailed Fitter Afloat Departmental Plan showing, on a calendar basis, the order and time allowed for doing all the main Defect List and A. and A. work. An example is shown in FIG. 2.

Fitter Afloat Planning

To implement this engineering trade plan the R.P.O. issues from it the next fortnight's work schedule (in weeks, each in duplicate) to the chargeman concerned, *signed by the Production Inspector*. For each item described on this work schedule is shown the estimated 45 per cent J.P.C. incentive scheme time (as assessed, and negotiated as necessary by the Estimator and transcribed by the Technical Progressman), and a complementary space for recording the man hours expended by the end of the week. These duplicate work schedules serve as the *routine feed back* for amending the subsequent work schedules and recording progress on the departmental plan.

Thus the Engineering Department keeps only one refit plan, in the R.P.O., for each of its planned ships, but it is in a continually up to date state.

This routine feed back of progress does not absolve the Production Chargeman from *warning* his inspector, and thence the R.P.O., of any inabilities to meet his current work schedule.

The scheme also provides that the Production Chargeman keeps the original of the Work Schedule on his person at all times, and instructs the R.P.O. Progressman Technical for that ship, one week in advance, what J.P.C. incentive scheme specifications (each totalling normally about 100 hours of work) are to be transcribed from the Work Schedule items for the men doing the work. (*Note* : In dockyard establishments all incentive schemes are optional.)

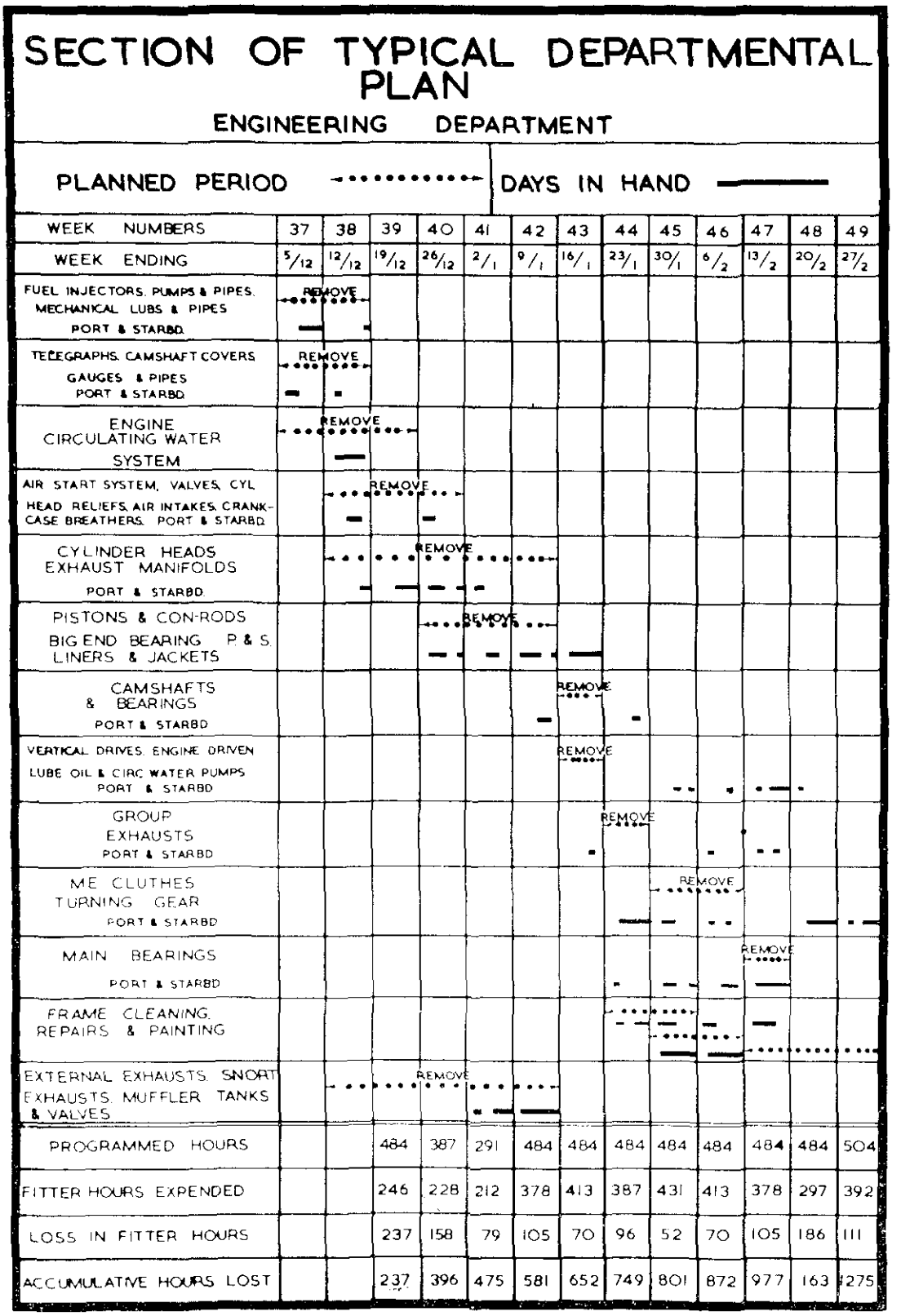


FIG. 2—TYPICAL (I.C.E.) FITTER AFLOAT REFIT PLAN

Departmental Ship Policy

It is the Engineering Trades' master policy to remove the economical maximum amount of auxiliary machinery requiring refit from the inaccessible dirty confines of their ships to the factory for overhaul and test. Thus the engineering afloat team's chief tasks are to refit the immovable main machinery and to remove and later, re-install its auxiliaries complete.

In practice it is not always economical to open up the ship everywhere for the removal of auxiliaries, particularly in largely reciprocating engined ships like *Bar* vessels, and certain R.F.A.s, and, almost always, some auxiliaries have to be refitted *in situ* to keep the afloat teams busy throughout the refit.

The Constructive and Electrical Departments do not pursue similar master policies to the same extent, because most of the hull, and its attachments, normally must remain integral throughout the refit.

Yard-wise the main tangible results from R.P.O., so far, is a progressive increase in the number of ships refit completion dates being kept. Due to the utter absence of a standard ship task, however, (as elaborated in the *Journal of Naval Engineering* Vol. 9, No. 1, Article 1) and decreasing accessibility in the latest ships, particularly when Base and ships staff are also working in them, reliable precise ship production statistics are at present unobtainable.

Also the introduction of planning must mean some hardening in production flexibility ; so, while the top priority task dates become more reliable, the low priority task dates have to give way before a surfeit of more important unprogrammed work which, in the case of Rosyth, usually means the Marine Services (absorbing nearly 30 per cent of the Engineering Department's afloat labour).

Departmentally the same welcome decline in major refitting crises has been heartening ; this feature has allowed the Engineering Trade Production Afloat Inspectors extra time to supervise the planned progress of the ship work, and even more so their chargemen, whose paper burden has been so much lessened.

SHOP PLANNING

Much of a dockyard's equipment is sited in the trade workshops (over £250,000 in the case of the Engineering Department). It follows that the foundation for successful ship planning must be effective shop planning.

Again baldly, centre planning decides *what* is to be done, and not only for ships.

The staffing, duties, and organization of shop planning centres differ radically with the size of shop, its trade, and whether the afloat section operates directly from that shop or separately. So far Rosyth is developing eleven shop planning centres —plumbers, M.C.D. joiners, ship fitters, blacksmiths, shipwrights (part), painters, electrical workshop, radar base, factory (engine fitting shop), coppersmiths, boilermakers ; of these the most elaborate is the factory, and it is with these latter three that the remainder of this article is chiefly concerned.

Although each engineering trade planning centre has its distinctive organization their production control schemes all contain the following essential common features, viz.—

(*a*) To forward load the various shop specialist sections to as near full capacity as practicable—by loading boards

(*b*) To control the flow of work through the entire shop to meet the planned completion dates—by job cards (based on master schedules where repetitive)

(*c*) To leave the responsibility for doing the work within the planned dates with production—by making production responsible for warning

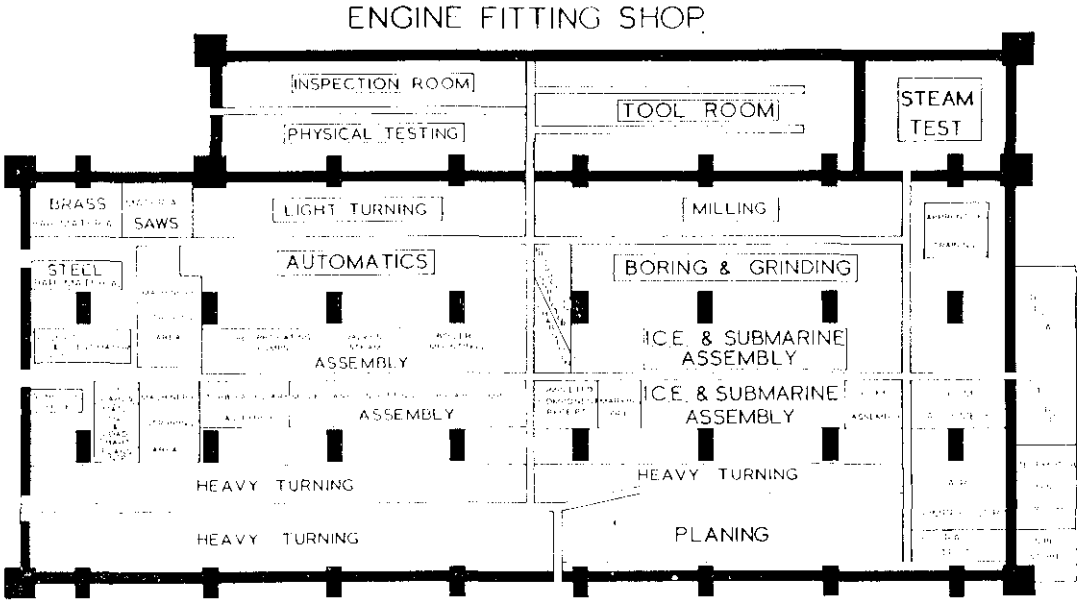


FIG. 3—ENGINE FITTING SHOP LAYOUT

planning of impending delays, and for returning to planning the actual completion dates achieved

Note: This system is known as '*Progress by Exception*' as distinct from '100 per cent progressing', the latter being uneconomical for dockyard business.

(*d*) To offer virtually all work to the workpeople for the Job Price Contract Incentive Scheme—by ensuring that, in equity, improved output should be matched by increased earnings

(*e*) To ensure more thorough production supervision—by relieving it of almost all the routine paper work.

THE FACTORY (ENGINE FITTING SHOP)

General Arrangement

FIG. 3 shows the improved layout used by a production labour force of 180, and containing :

The Receipt and Despatch Bay (R. and D.), operated by centre planners who receipt all incoming items, and obtain signatures for all outgoing items:

The Stripping Bays, where all dirty work is dismantled, cleaned and inspected. The requirements for all material, drawings and spare gear are then determined before any work is started;

The Assembly Sections—10 in No.—where clean work, when ready, is put together by a variable labour force, which is deployed accordingly;

Dimensional Inspection, which completes the necessary gauging charts and checks the quality of the work, as requisitioned by the Planning Centre;

Retail/Tool Stores, which provide the necessary material ; the former is run by a S.N.S.O. storekeeper to ensure effective stock control, and the latter by the trade storekeeper for ease of identification, and also for replenishing the 'help yourself' bins of common user material surrounding the assembly sections;

Unit Test Bays. The Steam Test Section deals with conditions up to 500 lb/sq in., 950 degrees F. and 2,500 lb/hour. The Telemotor Test Section copes with all necessary submarine work including 220 volt D.C. motor

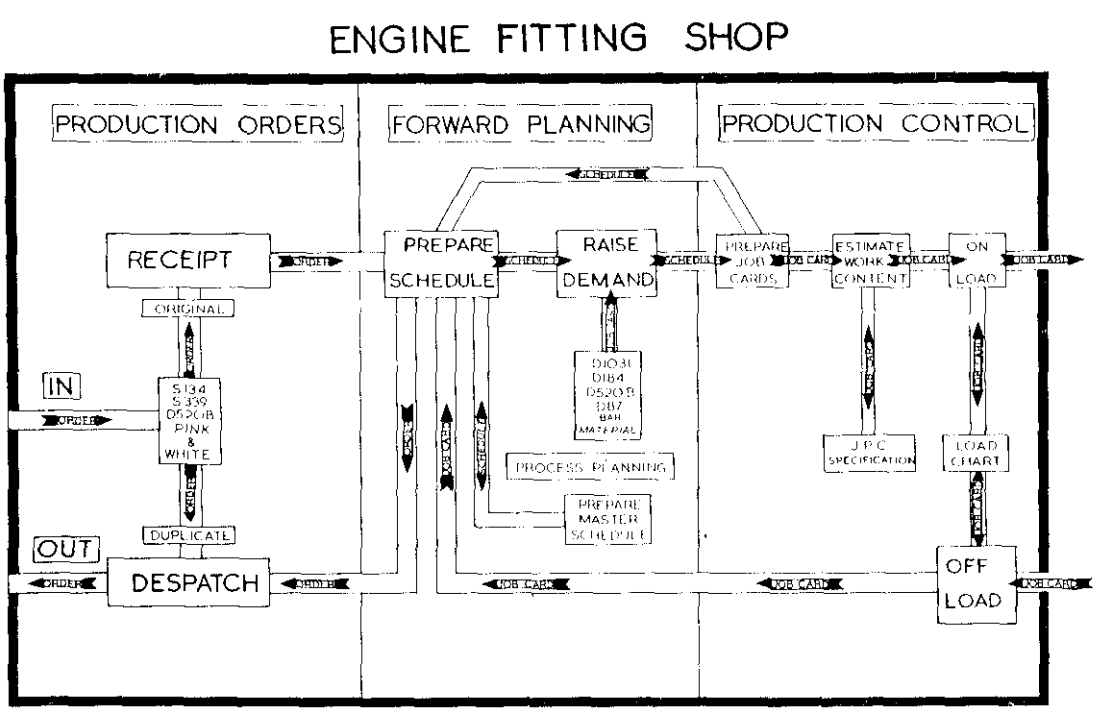


FIG. 4—ENGINE FITTING SHOP PRODUCTION CONTROL

driven pumps (soon a 440 volt A.C. supply will also be available). To prove the end products, completed auxiliaries, valves, etc., are always tested light in these factory sections, unless time genuinely does not permit, to avoid possible laborious rectification later in the inaccessible confines of a ship.

THE FACTORY PRODUCTION CONTROL SCHEME

General

The engine fitting shop centre planning staff consists of one inspector, one chargeman, seven progressmen technical and non-technical, two estimators and three writers, total 14, or under 8 per cent of the corresponding production force. It was instituted in April, 1958.

FIG. 4 shows the centre planning routine for issuing defined job cards to the shop floor from the various sorts of production orders received through the agency of schedules ; and also the essential link between job cards and the incentive payment scheme.

Schedules

There are two varieties of schedules : working, and master. All work received has a working schedule prepared for it by a progressman technical (working to the instructions of the Stripping Bay Chargeman where relevant), having regard to its routeing to the various specialist sections in the factory. These working schedules are retained in the Centre Planning Office as progress documents, and subsequently for two years as a record of the work done.

Where the work is repetitive, and, in fact, repeats at least ten times, a pre-printed Master Schedule is derived for use with future orders. The extremely wide variety of work done by the factory is stressed by only twelve master schedules having been produced so far in sixteen months' operation of the scheme !

Preparation of Job Cards

The job cards are derived from the working schedules, one elemental card for each of the factory specialist sections involved. (FIG. 3). These elemental job

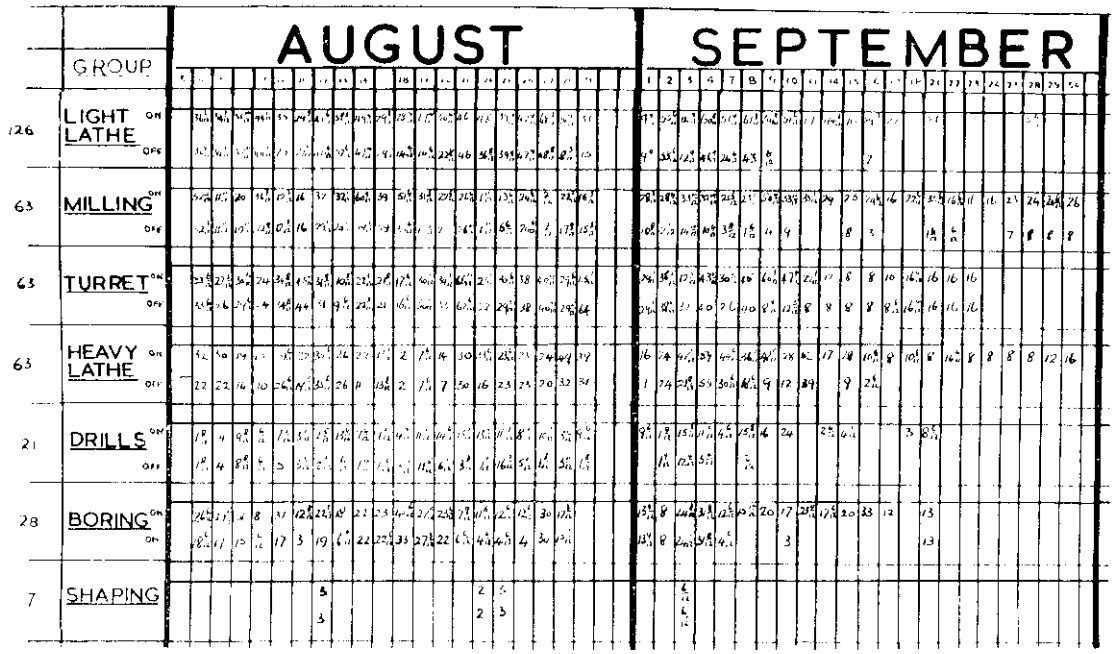


FIG. 5—TYPICAL CENTRE PLANNING LOADING BOARD

cards are all linked by the same reference number, and control date for assembly, this date in turn having been determined, in conjunction with the R.P.O., from the date the work is required back in the ship, and the factory capacity available.

These job cards pass through the estimating section of the centre planning office for assessment of their 45 per cent J.P.C. incentive times, it being a cardinal feature of all Rosyth engineering trade schemes that the 45 per cent J.P.C. time is taken as the planned time, being sufficiently accurate for the purpose; not the daywork time or the 75 per cent J.P.C. time normally achieved.

Forward Loading

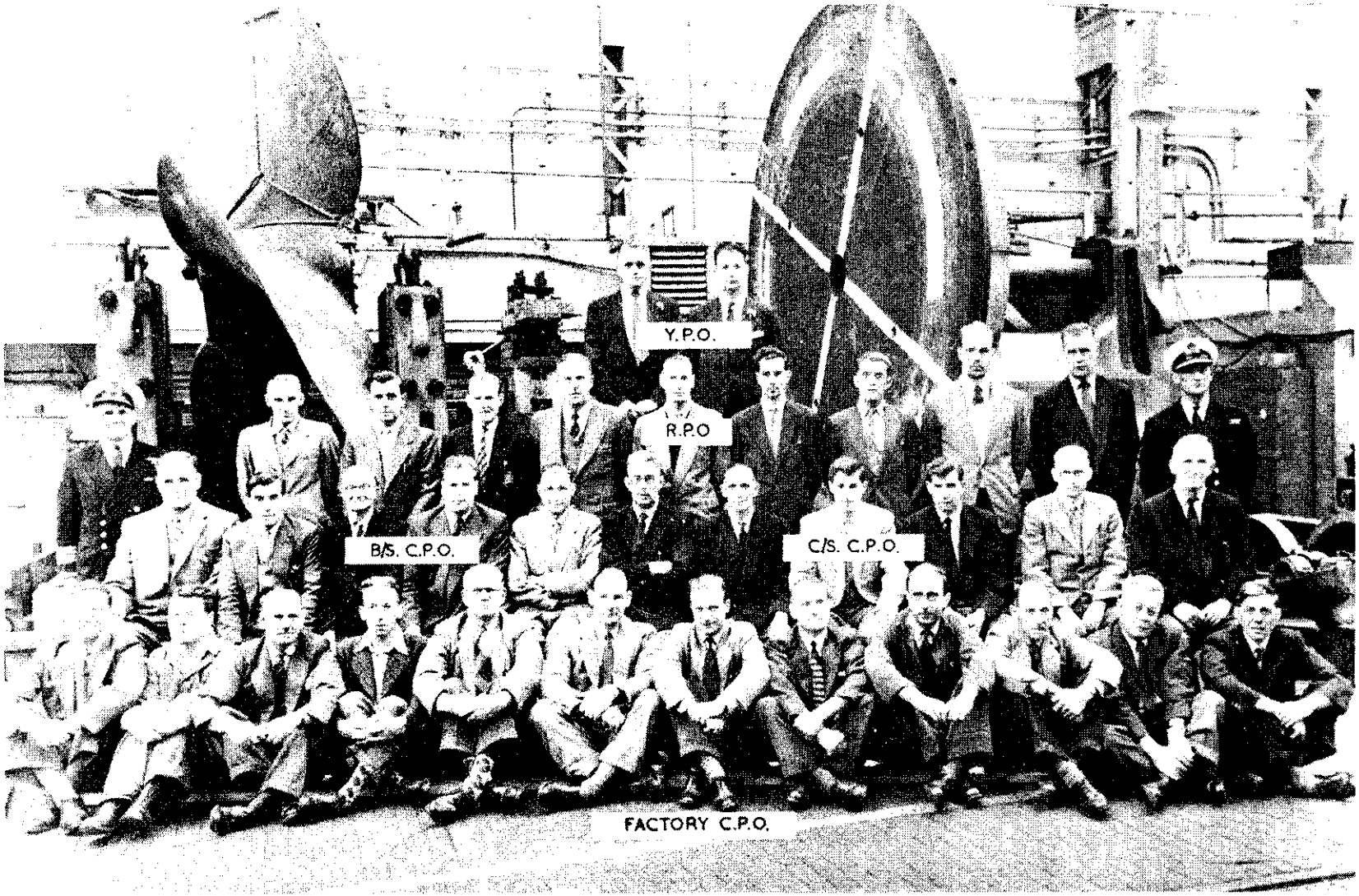
Thence the job cards pass to the shop loading section where their estimated times are recorded on the appropriate shop loading board (FIG. 5).

The machine loading board shows the capacity available with each group of machines, less 20 per cent uncommitted for emergencies. Jobs are ' loaded on ', working back from the control date of completion for all elements. If the section concerned is lightly loaded the work will be completed ahead of plan, and the necessary adjustment to the available loading capacity is made when the job card feed back occurs, as described in the next paragraph. Difficulty has occurred assessing the true machine capacity available because of the variable time necessary to change chucks, obtain different tools etc. *between* jobs, but this is being overcome with experience.

The fitter bench loading arrangements operate similarly, except that over-loaded sections are relieved from those lightly committed by moving the labour accordingly.

Marriage of Job Card and Job

These job cards, *when ready with the job, necessary material, drawings, and tools*, are then issued by centre planning to the production chargeman concerned who assesses the start date for the job, and hangs them on the hooks provided near the machine or bench concerned, each craftsman normally having four job cards ' behind ' him. At present the actual time taken for the jobs is not recorded on the cards, in deference to Union objections prior to an entirely new Admiralty incentive scheme being negotiated.



THE ENGINEERING TRADE PLANNING TEAM—SEPTEMBER, 1959

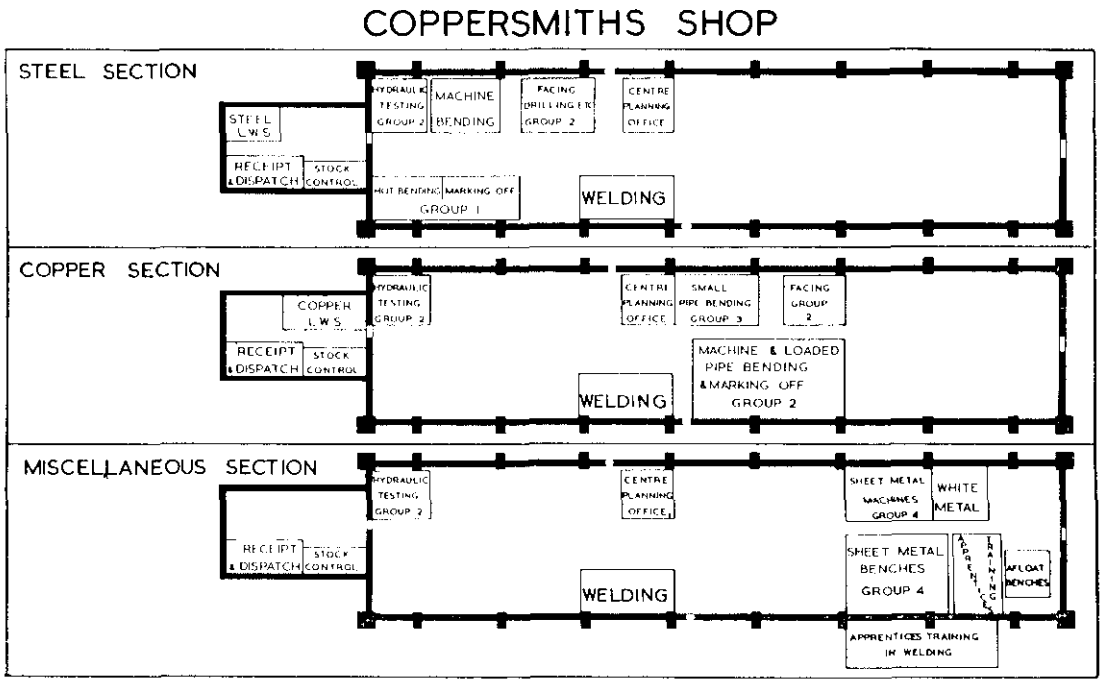


FIG. 6—COPPERSMITHS' SHOP LAYOUT

When the job is finished in a particular section the stub from the appropriate elemental job card is returned to the centre planning office, and the element itself is forwarded by this section's chargeman to the next section for further operations, or to the assembly point, if the work is complete. By means of their control date all elements of each job arrive at the assembly point on the same day, and are moved to the appropriate assembly section by a non-technical progressman. He also chases any 'mismusters'.

Finally, the collection of elemental job cards returns to the Centre Planning Office, and the schedule concerned is endorsed complete.

THE COPPERSMITHS' SHOP (PIPE SHOP)

General Arrangement

The attractive layout devised by my predecessor is shown on FIG. 6. It includes cold bending power facilities up to 4½ in. bore steel, and 6 in. bore copper, a stemming vibrator for the more rapid sand filling of pipes before bending, high speed hydraulic testing facilities and aqua blast tube cleaning apparatus.

Separate steel and copper sections are necessary, in any case, to avoid possibly disastrous intergranular penetration of molybdenum steel pipes (G13 N26) during bending operations.

Unfortunately, little of the current work uses standardized fittings, and much of it needs to be bent more accurately than the machines allow; hence full benefit of this reorganization cannot yet be realized.

This shop differs fundamentally from the other engineering shops in that its afloat party, responsible for pipe templates preparatory to manufacture, must be based on it.

Limited Working Stock

An essential preliminary before starting production control in this shop was to expand greatly the material supply arrangements. Thus a limited working stock of patternized tubing ferrous and non-ferrous in standard lengths was

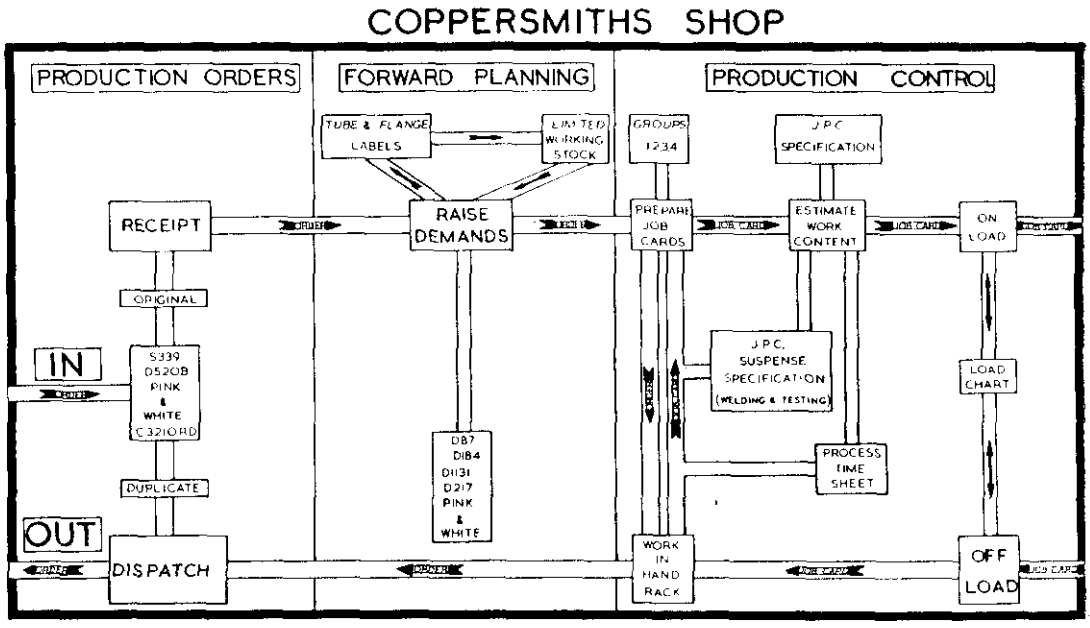


FIG. 7—COPPERSMITHS' SHOP PRODUCTION CONTROL

agreed with S.N.S.O., non-patternized material being ordered by the shop Production Inspector on local purchase order as hitherto; this stock was supplemented by a wide range of standard flanges made in the factory, the whole of this material being controlled by a non-technical progressman in the R. and D. bay, together with 'bought out' extruded tube turns already available.

Help yourself racks of common user items were arrayed around this shop, as for the factory.

PIPE SHOP PRODUCTION CONTROL SCHEME

General

The pipe shop centre planning staff consists of one inspector (also for production), two progressmen technical, and one non-technical progressman, or less than 4 per cent of the corresponding production force.

FIG. 7 shows the centre planning routine, which, although similar to that already described for the factory, differs from it in that scheduling (there being no stripping) is not required, the material demanding, and incentive scheme procedures are more elaborate to suit the trade, and a 'work in hand' rack is essential to let the afloat section, in particular, know the current position.

This scheme started for the steel side in October, 1958, and for the remaining copper and miscellaneous commitments in May, 1959.

Routeing of the Work

Organizationally the shop is divided into four groups :—

(1) Steel pipes (setting up templates to boards, sand filling and hot bending, machine cold bending, fitting flanges, etc., jacketing)

(2) Steel and non-ferrous pipes (welding of flanges and pipes, etc., machining, etc., flame cutting, testing)

(3) Non-ferrous pipes (setting up templates to boards, annealing, resin

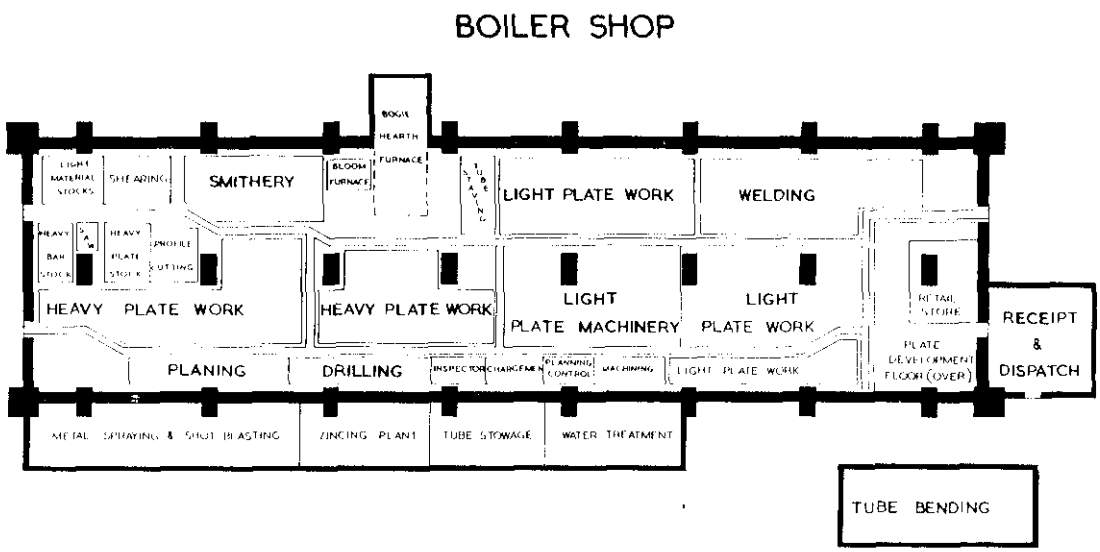


FIG. 8—BOILER SHOP LAYOUT

filling, machine and hand bending, fitting and brazing)

(4) Miscellaneous (white metalling, sheet metal work, etc.)

and is kept forward loaded and the work routed between groups by production control in much the same way as stated for the factory.

THE BOILER SHOP

General Arrangement

The current shop layout, subsequent to extensive method study, is shown in FIG. 8. For production control purposes this shop also divides itself naturally into four specialist sections, viz. general boilermaking, welding, smithing, and metal spraying.

Like the engine fitters, and unlike the coppersmiths, the boilermakers have a separate afloat section, on which is centred nearly half the total productive labour force of 120.

THE BOILER SHOP PRODUCTION CONTROL SCHEME

General

The centre planning staff consists of one inspector (also for production), one progressman technical, and one progressman non-technical. As previously stated, the R.P.O. has another P.T. for afloat work ; so this planning effort represents about 3 per cent of the corresponding production force.

Such is the heavy nature of the work that it has so far proved unnecessary to reorganize the existing material supply arrangements other than has resulted from the new layout.

Details

This shop's production control scheme is the latest for the engineering trades, having started in August, 1959. It is simpler than either those of the factory or pipe shop, as shown in FIG. 9, but is fully consistent with them in meeting the five essential features mentioned under ' Shop Planning '. It is too early to assess the first results from it, except that they are most promising.

FURTHER EXTENSION OF ENGINEERING CENTRE PLANNING

Programme

The present intended order of introducing the remaining necessary engineering

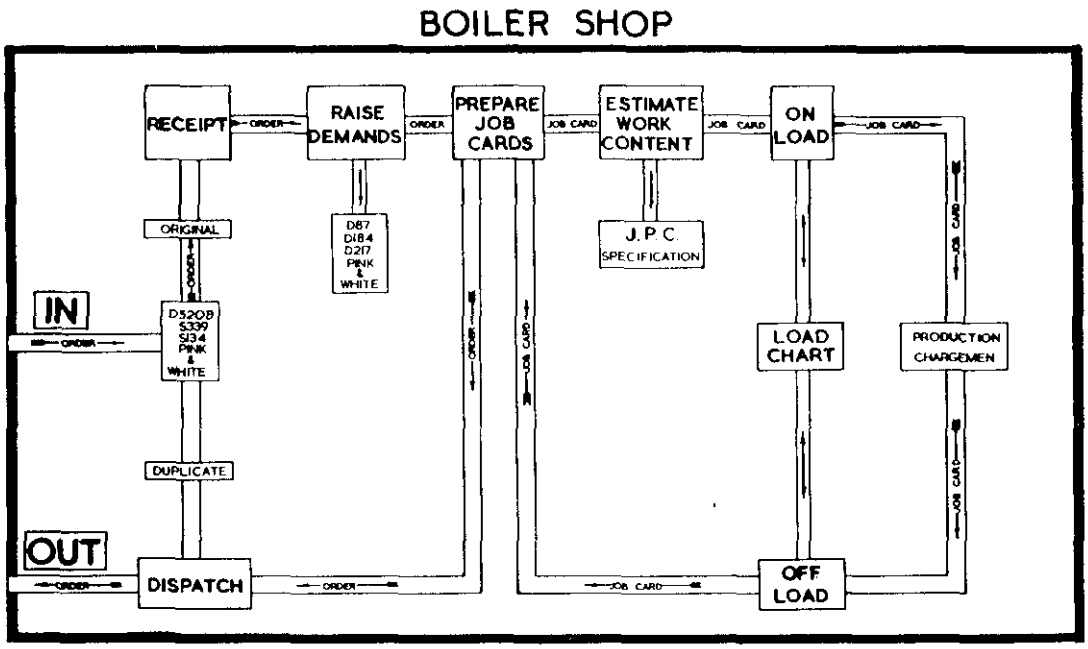


FIG. 9—BOILER SHOP PRODUCTION CONTROL

trade planning centres is : combined weapons shop, foundry, I.C.E. shops, and Yard machinery section, but their reorganization, accompanied by some change of location, must first take place to cope with impending major expansion or contraction in their tasks.

In the meantime reinforcing the planning service to the afloat link with the factory and boiler shop will be closely studied, having regard to the satisfactory R.P.O. set up, and the promising development of afloat inter-trade *production* liaison offices, which the constructive trades are pioneering.

THE DRAWING OFFICE

Its Role

The continued importance of the drawing office in this expanded planning set up must not be forgotten simply because its constitution has not changed.

Y.P.O. and R.P.O. help by ensuring that a precise schedule for drawing preparation is now available. Adherence to Defence Ministry Specification No. 33 (A.F.O. 1104/58) is resulting in a far wider range of drawings being produced for A. and A. work, to the potential advantage of R.P.O. when agreeing component availability with the shops.

Moreover the drawing office retains its key role in planning the development of the dockyard itself, mainly by means of Machinery Proposals and the machinery side of Works Proposals. Equally vital, its continued influence on the finished ship remains undiminished in its capacity as design and contract agent.

SELLING PLANNING

Any plan is useless unless it is effective. Since all dockyard plans are a service to production it is fortunate that production must be convinced of the merits of each production control scheme before it is installed.

For the engineering trade planning described, the invariable practice has been for Commander II, the Method-Study Foreman, and the Production Control Inspector to produce a detailed control scheme for the Manager's approval ; subsequently it is further debated and adjusted by the centre Line Management

	FACTORY OUTPUT				
	1ST.	2ND.	3RD.	4TH.	QUARTERS
UNITS PER MONTH		2·0	1·8	3·0	1958
PER TRADESMAN	2·7	2·8	3·9	3·8	1959

FACTORY INCENTIVE SCHEME			
CONTRACTS	VALUE	VALUE PER CONTRACT	FIRST 39 WEEKS
1043	£10598	£10- 3/-	1958
1420	£11973	£8-9/-	1959

	STEEL PIPE OUTPUT				
	1ST.	2ND.	3RD.	4TH.	QUARTERS
PIPES PER MONTH				10	1958
PER TRADESMAN	12	15	18	20	1959

COPPERSMITHS INCENTIVE SCHEME (SHOP & AFLOAT)			
CONTRACTS	VALUE	VALUE PER CONTRACT	FIRST 39 WEEKS
320	£3825	£12-0/-	1958
428	£4652	£10-17/-	1959

	COPPER PIPE OUTPUT				
	1ST.	2ND.	3RD.	4TH.	QUARTERS
PIPES PER MONTH		*			
PER TRADESMAN		21	32	36	1959

* EQUIVALENT

	BOILER SHOP OUTPUT				
	SEPT.	OCT.	NOV.	DEC.	MONTHS
JOBS PER MONTH	8·4	10·8	10·1	10·7	1959
PER TRADESMAN					

TABLE I—FACTORY AND PIPE SHOP PRODUCTION RESULTS

concerned, this edition being then displayed on the centre notice board for several weeks for the information of the workpeople before discussion with its Whitley centre committee. The final version of the production control scheme, representing the best that trade knowledge, local features, and managerial experience can devise, is duly installed on an agreed vesting date. It cannot fail to be an improvement and should be a winner ; even so it will need steady detailed development by the team of three already mentioned.

The production craftsmen concerned so far have accepted these schemes with alacrity, since virtually all jobs are now issued ready to start and are available for the incentive scheme ; also they take genuine pride in their section not being backward in adopting modern techniques.

Line management is less unanimous, particularly afloat, where many of the chargemen, harassed by such irritations as their ship not always being ready for refit on the start date, competing craneage arrangements, and occasionally insecure shop dates, feel that these recurring faults should be utterly eliminated before planning is further elaborated.

To overcome this natural resistance, production and R.P.O. planning centre/ production control chargemen and inspectors are being interchanged at about yearly intervals, and a demonstration room, on the lines exploited successfully by R.N. Aircraft Yard, Donibristle, is available for displaying the systems, *and their results* (the latter is also valuable for training planning replacements for leave and sickness, etc.).

RESULTS

It is certain that appreciably improved total engineering trade production has resulted from the five planning innovations described (Y.P.O., R.P.O., factory, pipe shop, boiler shop), but the precise degree of improvement must be conjectural. Apart from complete absence of a standard ship task, the production force available oscillates throughout the year, because of the extended summer leave period (obsolete commercial practice !), the spring 'flu epidemic, and fluctuating wastage ; their hours vary with the limited amount of overtime applied to clear unavoidable dislocations ; their effort varies with the frozen north, and generous rainfall climatic effects ; and there are always a number of other live interacting forces, e.g., changes in labour balance and key personnel, the advent of new machines and buildings, delays with Admiralty supply items, etc., etc.

The U.S.N. has a standards branch in their elaborate Navy Yard planning organizations for assessing performance, but whether a similar team of analysers will ever be worth while for Dockyards is dubious, and is certainly premature.

The factory and pipe shop production results consolidated to date are shown in TABLE I. They are based on the conception that the general run of work, although intensely variegated, follows the same pattern sufficiently to allow the *total number of jobs to be used as a productivity indicator*. On this basis, which is the best available, factory output seems to have risen by a third since production control started, and the preliminary output figures for copper and steel pipes show gains of at least a half.

These startling results are difficult to believe ; nor should they be, in degree, until sufficient annual cyclic performance data has been accumulated. Fortunately collaborating evidence of substantial improvements is abundant.

In the case of the factory, an analysis of a few apparently identical jobs before and after production control had been instituted showed that 15 out of 19 jobs were quicker by about 10 per cent. Far more convincing, however, is the absorption of the perpetual Yard machinery low priority backlog, the air compressor refitting task transferred from the Gunnery Equipment section, and certain work no longer done by '*Caledonia*' and '*Safeguard*' without increase of men, and with up to one third less overtime.

The forty-odd coppersmiths have long been the critical engineering trade often causing ships' completion dates not to be kept, and always limiting the amount of A. and A. work which was accepted. Their great productive improvement seems to have banished both these limitations ; indeed, 'coming events cast their shadows before'. Already the planned completion of the modernization of H.M.S. *Caesar* has been advanced six weeks, and a seven weeks' lag in the engine conversion of H.M.S. *Bronington* has been recovered, largely because of this marked gain in coppersmiths' tempo ; humble feats perhaps, but rare, if not unique, in the memory of Rosyth.

Where is all this extra work coming from? Y.P.O. and R.P.O. undoubtedly are reducing the waiting time experienced by the afloat teams providing the shop work, and the shop centre planning offices described are keeping a more even flow going through the shops by production control, and ensuring that the work gets off to a quicker start.

CONCLUSION

The four chief engineering trade planning centres, out of the family of nine eventually required, have been successfully established, and the incredibly com-

plex afloat planning problem has been scratched,—even stabbed, but certainly not slain.

The engineering trade planning team which has played a major part in this production advance is shown on p. 201 ; commendably small, and vigorously enthusiastic.

Such is the obsolescence of shipbuilding manufacturing standards, the incompatibility of the traditional dockyard departmental system, the increasing inaccessibility in H.M. ships, the penalties of the frozen north, and the erratic arrival of Admiralty supply items, that only the major crises from the current chaotic refitting conditions in the ships have so far been eliminated ; but at least the main engineering trade planning foundations have been surely laid from which this obstinate many sided obstacle to shorter ship refits can be successfully assaulted, to the lasting benefit of the Atomic Age Navy.