QUALITY IN THE DOCKYARDS AND IN THE FLEET

BY

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Introduction

Quality Assurance has probably been around as long as Man himself, and certainly since he first engaged in engineering activities, that is since stone-age man started improving the means of fashioning his implements in pursuit of his foe or to overcome natural obstacles. His objective then was, and even in today's highly sophisticated technologies still is, to ensure that his products perform their intended purpose in a reliable manner, i.e. without premature failure.

This basic concept tends to get overlooked in modern society's preoccupation with economics, semantics and specialized jargon, but underlying the British Standard definition of Quality Control there can be detected the historical link with our engineering ancestors:

> 'Quality Control—a system for programming and *co-ordinating* the efforts of the various groups in an organization to *maintain* or *improve* quality at an *economic* level which allows for *customer satisfaction*.'

Customer satisfaction means not only that the product should meet contractual requirements such as cost, delivery, conformance to specification, etc.; it must also be fit for operational use in a safe, reliable and predictable manner. For the naval customer, the wartime damage control motto still holds: the ship must FLOAT; it must MOVE; it must FIGHT. When the red button is pressed the hardware must perform its designed function; it must do so first time and every time throughout its prescribed life cycle.

This article briefly describes how the dockyards aim to contribute to this objective in their role of supporting the Fleet.

Investment in Quality

Quality and reliability do not come about by chance; they must be planned for, designed in at the drawing board stage, built in at the shop floor, safeguarded by correct operation, preserved by careful maintenance and upkeep, and improved if necessary by updating and modification. Quality costs!—but not nearly so much as quality failures, breakdowns, accidents, lost availability, etc.

The name of the game is investment, and behind such bland phrases as 'optimization of resources utilization' lies the blunt truth that the customer can only get what he (or his investment agent) pays for. Customer needs can best be satisfied if proper investment is made in all stages of the quality process; the customer must finally judge whether he is getting value for money.

FIG. 1 illustrates typical steps in the industrial process and the quality thread linking them. This is a general concept which applies as much to private yachts or motor cars as to warships and weapon systems. It makes economic sense that the investment in quality at each stage is properly protected at succeeding stages and indeed that it is preserved throughout product life. Thus, inputs to the design stage in terms of technological development and innovation must be matched by the right level of build or repair capability. An obvious example is

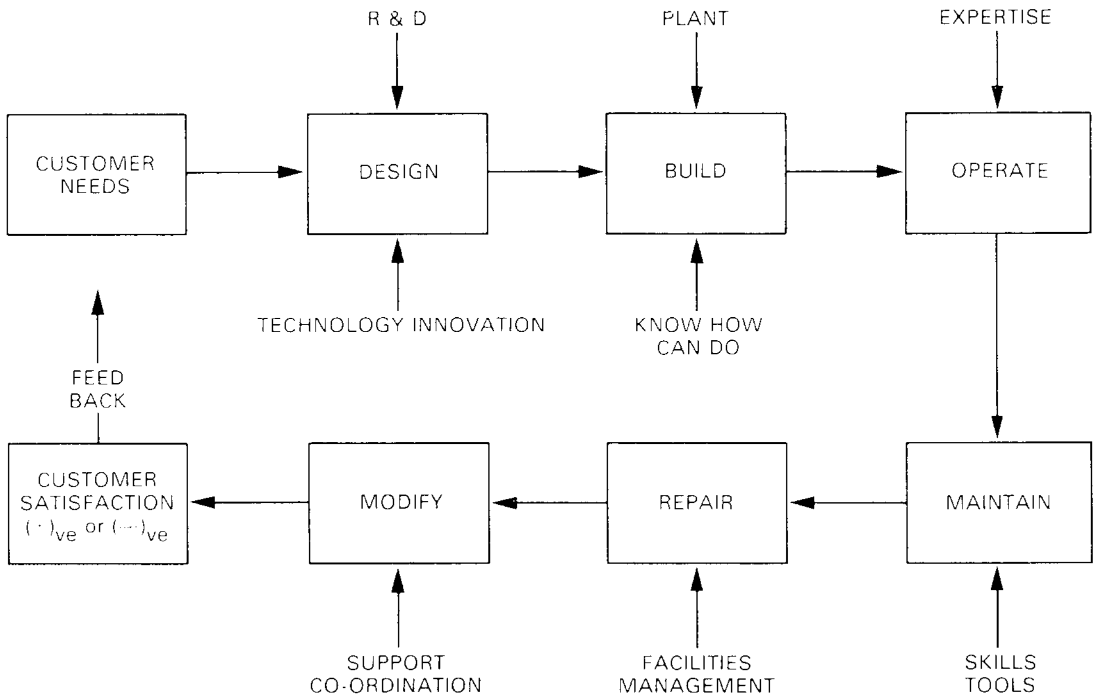

FIG. 1—INVESTMENT IN QUALITY

the development of nuclear propulsion, which calls for special facilities and special levels of expertise and competence in the building yards and in the Royal Dockyards.

Nuclear submarines are a special case of high performance technology attracting QA, and, to the extent that a great deal of nuclear QA has become associated with documentation, certification of procedures, and materiel traceability, there is a tendency to equate QA with paperwork. Documentation is in fact merely one facet of QA as the British Standard definition makes quite clear:

> 'Quality Assurance—*all* activities and functions concerned with the attainment of Quality.'

Is QA cost effective? The answer must be hedged with qualifications—depending on the nature of the product, the consequences of failure, the cost-benefits equation of a large number of factors which vary from case to case. The correct management of the Quality function, to the depth and extent determined by individual circumstances, is undoubtedly profitable to those nations or multinational corporations who have built their commercial success on their reputation for quality and reliability.

Is QA documentation worth the investment of effort? This again can only be answered indirectly by noting that the U.S.S. *Thresher* incident focused attention on the essential need for tight disciplines with technical records, and this is reflected in current SSBN/SSN procedures. It does not follow that such procedures are necessary or practicable throughout the Fleet, and the system developing for surface ships recognizes that initial investment in quality in terms of quality plans, configuration control, etc. must be matched as far as practicable in the upkeep stage.

For the 'old Ming' which were not built to such procedures, it is clearly impracticable to try to inject additional quality into ships at an advanced stage of their life cycle, other than for essential modifications, A.s and A.s, special fits, etc.

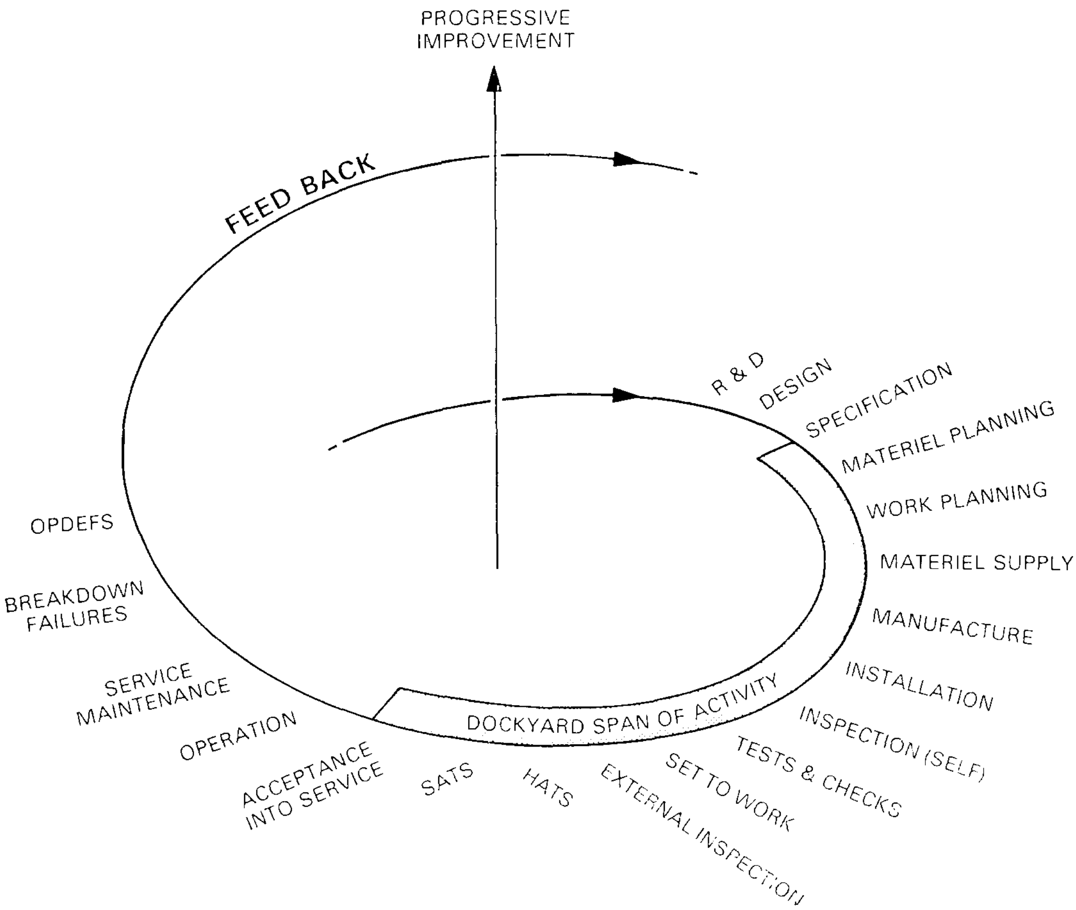

FIG. 2—QUALITY LOOP THROUGH DOCKYARD WORK

Quality Loop through Dockyard Work

FIG. 2 illustrates a specific example of the concepts embodied in FIG. 1 applied to the engineering of ships and equipment for the Fleet. The shaded area shows a span of activities covering the dockyard operation, interfacing with design authorities at the beginning of the sequence, and interfacing also with Fleet acceptance authorities at the end of the sequence.

It is the responsibility of the dockyard to control properly all planning and production activities within the loop, but clearly the interface activities must involve co-operative effort with the other authorities concerned. It is vital, for example, that the specifications and standards set by the design authorities before the start of the refit are acceptable to the Fleet customer at the end of the refit. This is one of the objects of the Dockyard Refit Conference, which formalizes the basis on which the dockyard undertakes the refit work package.

Another important feature shown on the chart is the provision of feedback on quality failures from any stage to the appropriate upstream authority. This applies equally to the dockyard operation, where practical difficulties encountered in meeting particular quality requirements can be resolved by concession procedures aimed at strictly controlling and recording any significant deviations from specification. The overall aim is to maintain quality performance at acceptable and realistic levels or to engineer specific improvement where this may be cost effective.

Quality Objectives

In common with other large defence contractors, the Chief Executive Royal Dockyards has prescribed general and specific quality objectives for the organization that he controls, that is essentially the four home dockyards at Rosyth, Chatham, Devonport, and Portsmouth. In summary these objectives are:

Primary Quality Objectives

(*a*) to provide a service to the customer that meets his specified requirements;

Notes: (*i*) 'Service' in the Dockyard/Fleet context means refitted ships, repaired equipments, new manufactured products, shore supplies, etc.

(*ii*) 'The customer' usually means the Ships' Staff in the Dockyards' single supplier/single customer relationship with the Fleet.

(*b*) to minimize quality costs.

Secondary Quality Objectives

(*a*) to manage the quality function on a cost-effective basis through all stages of dockyard activity;

(*b*) to plan quality into the product at the early stages to avoid inspecting errors and omissions out of the product at a late stage of the refit;

(*c*) to develop, install, and maintain a quality organization that is viable and effective;

(*d*) to motivate managers and workforce to optimize quality performance on a *right-first-time* basis;

(*e*) to control quality to the *right* levels.

Quality Policy

The cornerstones of CED's policy for the Royal Dockyards' quality control system are in brief:

(*a*) to accept the principles enshrined in Defence Standard 05–21 as good management control applicable to the dockyard operation on a yard-wide basis;

(*b*) to apply the appropriate clauses, suitably interpreted, to all dockyard activities:

(*i*) selectively,

(*ii*) cost effectively,

(*iii*) progressively.

(*c*) to be contractor assessed and registered on the Defence Contractors List.

This framework for action is directly related to the objectives referred to previously and is worthy of attention by Fleet customers to the extent that it is angled towards the interests of the operational Fleet.

Defence Standard 05–21

This is a MOD-wide standard entitled *Quality Control System Requirements for Industry* setting out a comprehensive set of requirements to be met by Defence industries (whether in the public or private sector) which are operating at the highest levels of performance for defence procurement or support. The Royal Dockyards are developing their existing systems to align with this standard on an evolutionary basis, i.e. proceeding step by step to ensure a smooth transition into the new control mode.

The standard covers in detail such functions as design control, material control, manufacturing control, calibration control, inspection, documentation control, and corrective action, all of which should lead to better customer confidence in the contractor (the dockyard for the Fleet) and assurance that the end product will not only perform correctly when it is required, but also that the

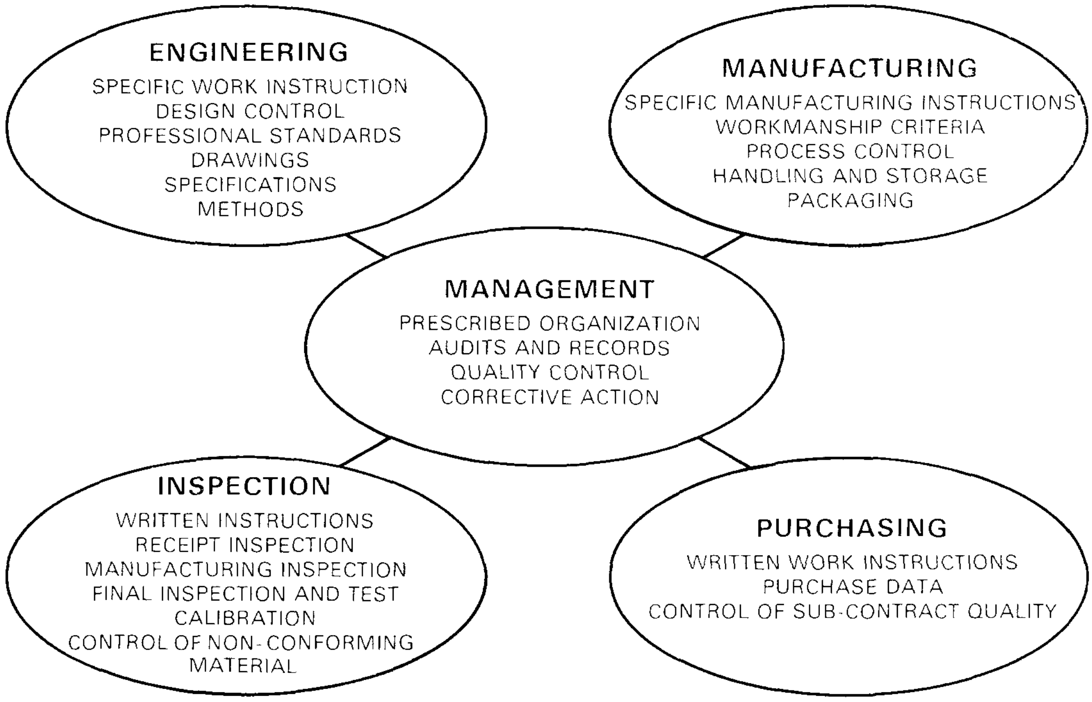

FIG. 3—APPLICATION OF DEFENCE STANDARD 05–21

work put into it will have been achieved cost effectively with minimum wastage of resources.

FIG. 3 illustrates the broad areas of activity comprehended by the Standard.

Contractor Assessment

All Defence contractors who can claim to be operating at the high level set by the Defence Standard 05–21 are required to be assessed by an independent MOD team to verify their claim, and are then registered on a National list of approved Defence contractors. This is known as contractor assessment, and the Home dockyards have submitted themselves to this independent examination, in the same way as other industries, over the period July 1978 to January 1979.

Subject to further development in specific areas all Home yards have now been registered to Defence Standard 05–21 for the type of work currently undertaken. This should reinforce the Fleet customers' confidence in the capability of dockyards to control the quality of work performed on ships and equipments. It does not mean, of course, that the dockyards have reached the perfect state of zero defects, but it should mean that the system of control is more responsive to correcting errors and omissions.

CED Customer Link Team

In parallel with contractor assessment, CED has set up a small Naval Customer Team to span the interface between the Fleet user and the dockyard supplier, investigating 'pain' areas where quality problems carry over. This team has been operating upwards of twelve months with a complement of one lieutenant-commander (ME), one lieutenant (WE), and one CREL. It has produced some thirty studies of various equipments and systems ranging from machinery spaces to EW equipments and the quality of shore supplies.

The current Leader of this team is Commander M. N. Collis, and MEOs and WEOs of ships under dockyard refit who encounter significant quality problems are invited to contact him informally in the Portsmouth Naval Base*. The formal

*Postal Point 22, Extension 23161.

route for representations and feedback on dockyard quality performance in general is through the Dockyard Quality Manager or Refit Project Manager as appropriate.

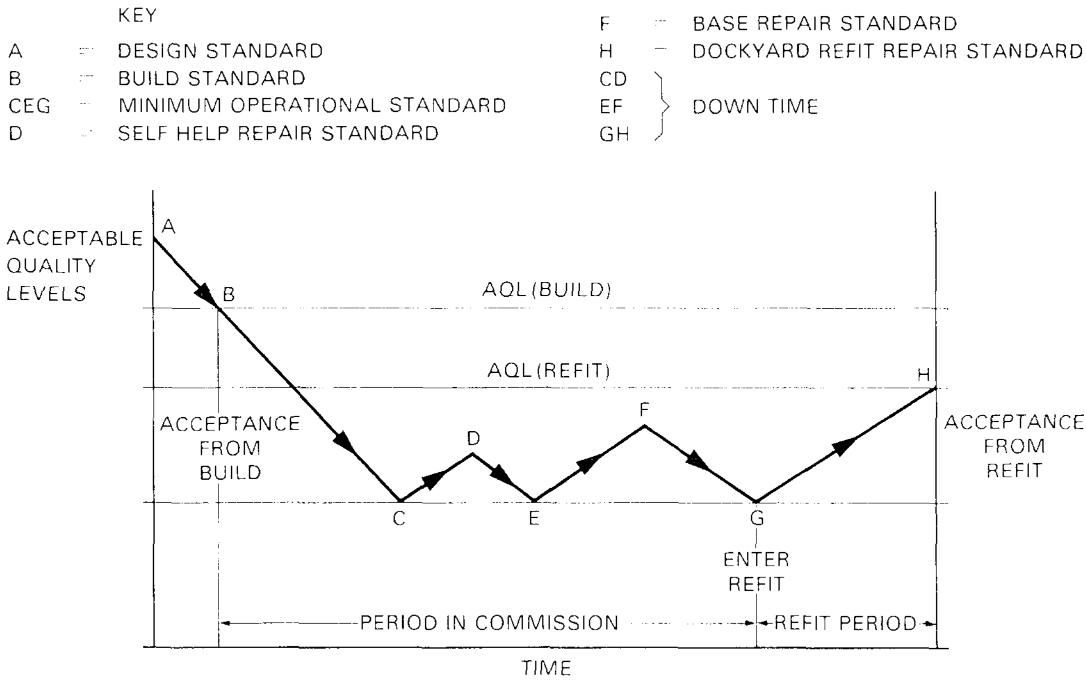

FIG. 4—REPAIR STANDARDS

Repair Standards

One of the aims of the CED customer link team is to investigate cases where current standards or specifications, whilst appropriate to initial procurement, are uneconomic or unrealistically high in the repair situation.

FIG. 4 depicts the manner in which the quality level of a product varies over a typical part of its life cycle. Ideally the design Standard A and the build or as-manufactured Standard B are coincident, but in practice there will be drop-offs due to manufacturing imperfections, lack of conformance, production permits, or concessions. During the operational period BC the product will be subject to normal life degeneration, albeit checked from time to time by routine preventive maintenance. At Stage C breakdown or unacceptable loss of performance will require first-aid repair or corrective action, represented by D which may be regarded as a unit repair standard. Similar action at Stage E will result in restoration to an intermediate or base repair Standard F. The ship will finally enter dockyard for normal refit at Stage G and be restored to full repair Standard H, i.e. 'fighting and seagoing efficiency'.

H is shown below the level of B because it will not, in general, be practicable to restore all ships systems to 'as-new' condition. Exceptionally it may be necessary to align H with B for specific equipments whose safety, reliability, or difficulty of access within the ship justify the additional expense and time.

It will be evident that the higher the repair standard set the greater the downtime and hence less availability. Various current developments such as DRACS extension, condition monitoring, revision of planned maintenance schedules, etc. may be linked with these concepts.

Quality Costs

One of the primary objectives mentioned earlier of minimizing quality costs is not so easy to accomplish as might appear. The solution is neither to drive up

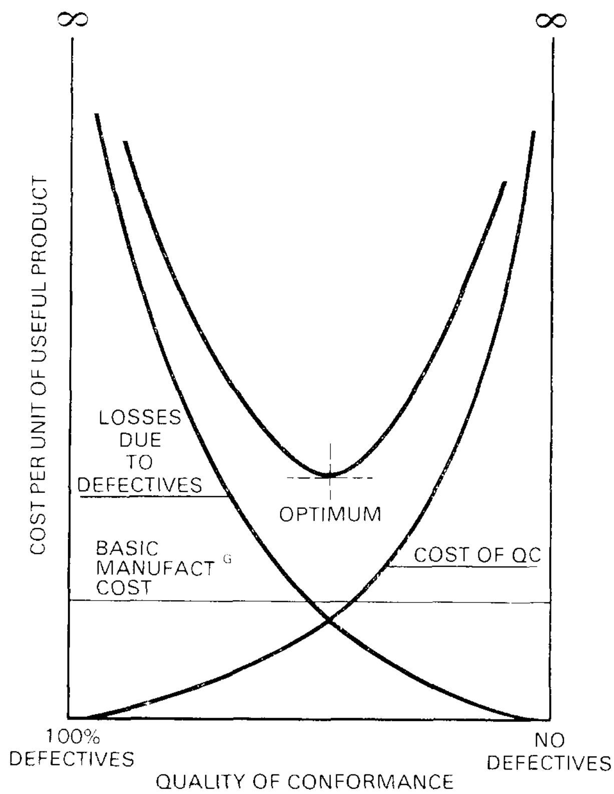

FIG. 5—QUALITY COSTS

standards into the zone of perfection leading to prohibitive production costs, nor to cut investment (and particularly resources) to the bone until the reject and failure rate is driving up the unit cost of acceptable product. This is illustrated diagrammatically in FIG. 5.

More specifically quality costs can be broken down into well-defined categories and sub-heads as shown in TABLE I. In the Royal Dockyards appraisal costs are in general well below those in industry, and current resource constraints affect the extent to which these and the prevention costs can be balanced with the failure costs to give the optimum return on the investment. Losses due to quality failures do not of course show up solely as monetary figures; lost availability due to delays and downtime of one sort or another is a problem that confronts dockyards more severely than most other industries.

TABLE I—*Quality costs*

Appraisal	*Losses (Quality Failures)*	*Preventive*
Material Inspection Monitoring Equipment Product Inspection Installation Checks Shop Tests Ship System Tests Setting to Work Acceptance Trials Quality History Records (Traceability) Quality Audit Review and Evaluation	Scrap and Wastage (ex arisings) Disposal Costs Rework: Work in Wake Deficiency Rectification Downtime Disruption due to delays Domino effect on programme (Knock-on 'Bow waves') Downgrading (concessions) Warranty Claims (Unprogrammed work) Operational Defects Lost Availability	Quality Planning Specification of Standards Field Failure Analysis Education and Training Corrective Action: Management Controllables Operator Controllables Improvement Action Design Review Effective Feedback Executive Reporting

Conclusion

This article has attempted to do little more than bring to the attention of the dockyards' naval customers some of the efforts being made to enhance customer satisfaction by good quality control disciplines. Those who are interested in following up specific points are cordially invited to get in touch with the local officers mentioned, or to send in written comments to CED's Head of Quality Management, MOD Offices, Block F, Foxhill.