controlled? Pilotage is obviously impractical and should be unnecessary. The masters concerned know the area all too well, but they do not know so much about routing or radio control. Nor are they always particularly amenable to instruction or advice when they get it, for the control system would have to be extended to such crafts as fishing boats, whose present habits in congested waters leave much to be desired. It seems probable that some sort of licensing for masters and skippers now serving would have to be introduced, with oral examinations on routing and traffic control. Ultimately this could become an extension of the masters' or skippers' certificate of competency, and it should be made law that if the route arrangements, collision regulations or traffic flow instructions were flouted, the licence could be withdrawn with consequent loss of job. Due to the flagrant disregard for the rules all too often shown by the local users, stringent measures of this nature would be necessary; they have brought it on themselves. Ships operating locally with licensed masters would have to be suitably equipped to operate under routing control, and ultimately, if not so equipped it could be necessary to require that they take pilots.

To sum up: Control of the area is rapidly becoming imperative. Control without pilotage is impracticable and their present system is inadequate. The concept of control and pilotage would have to be one supranational unified body, whose pilots meet ships well off-shore, control them through using shore station control, and deliver them into the hands of harbour pilots at their destinations.

Local users of the area would have to be licensed for that specific area and trained in the new concepts emerging in it.

A Note on Manning Reductions and Navigation

J. King

In recent years attempts have been made to reduce the manpower requirements of merchant ships and, largely as a consequence of technological advances, some measure of success has been achieved. Indeed, there is now no technical obstacle which prevents the construction and operation of an unmanned ship. With this knowledge perhaps the time has come to reflect on the wisdom of excessive enthusiasm for technological innovation and to consider objectives.

During the 1960's the nature of the major forms of ship operation was such that it was clear that significant cost savings could be achieved by reducing the size of crews. Crew costs were a major item in the total annual costs of operating ships at that time, and the reduction in manpower made possible by more efficient shipboard organization and investment in a certain amount of automatic and remote control equipment promised potentially substantial savings. Whether this is so today is arguable; in many cases the structure of ship operating costs has changed to such an extent that crew costs are no longer as significant as a decade ago. Figure 1 is based on information given by Fasse[1] and illustrates the relative costs of maintaining a given liner service with three different types of ship. If it is accepted that the ship types are arranged in chronological order in the diagram, it is clear that crew costs are declining both in absolute magnitude and as a proportion of total costs. It would be rash to postulate a general principle from a

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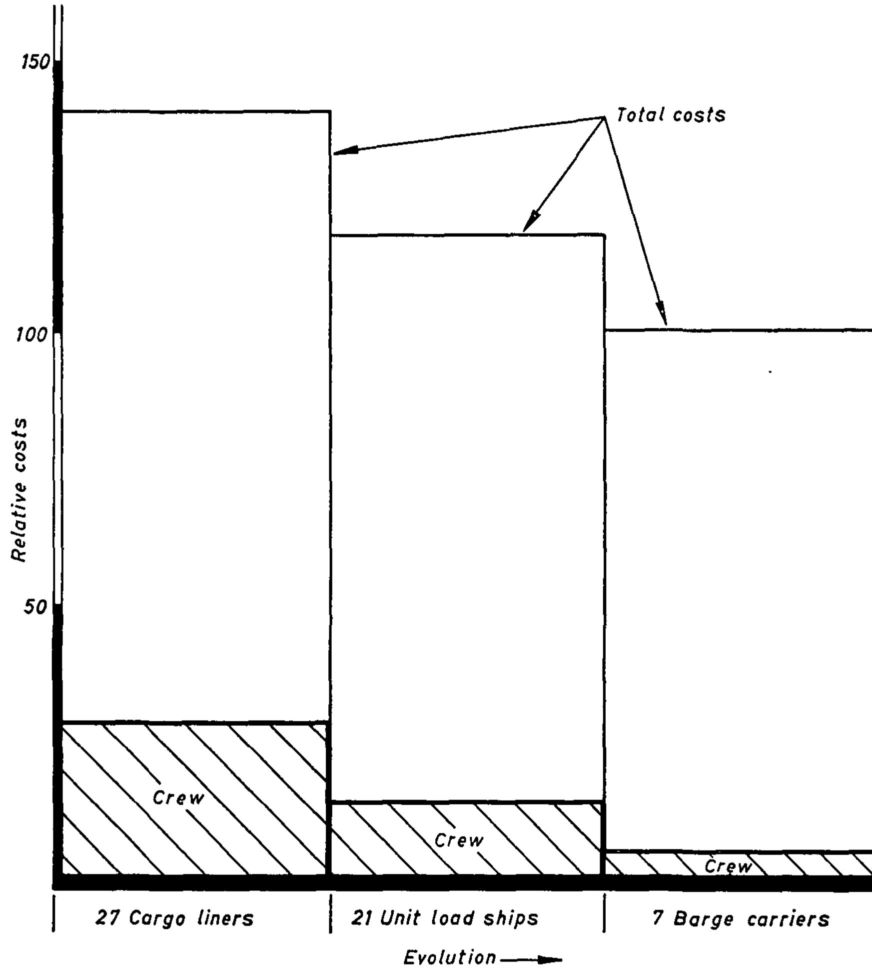

FIG. 1. Total costs of maintaining a given service with different types of ships showing the importance of crew costs

single specific example. Nevertheless where, as a result of the introduction of new concepts in sea transportation, the number of ships required to maintain a service is reduced, so too is the manpower necessary to operate them reduced. This suggests that in such cases crew costs may become relatively unimportant as a consequence of fleet reorganization, without necessarily involving further reductions in the size of crew for each ship.

As a further example, Fig. 2. illustrates total transportation costs of oil and the proportion of these which may be attributed to the crew, given as a function of tanker deadweight. The size of tanker crews does not increase significantly with increasing deadweight and even allowing for the economies of scale associated with tanker operations, it appears that crew costs may become less important items in the total costs of the largest (and broadly speaking the latest) oil tankers.

A feature of the changing pattern of ship operating costs is the increasing importance of insurance. This is especially so for the largest vessels.[2] Because

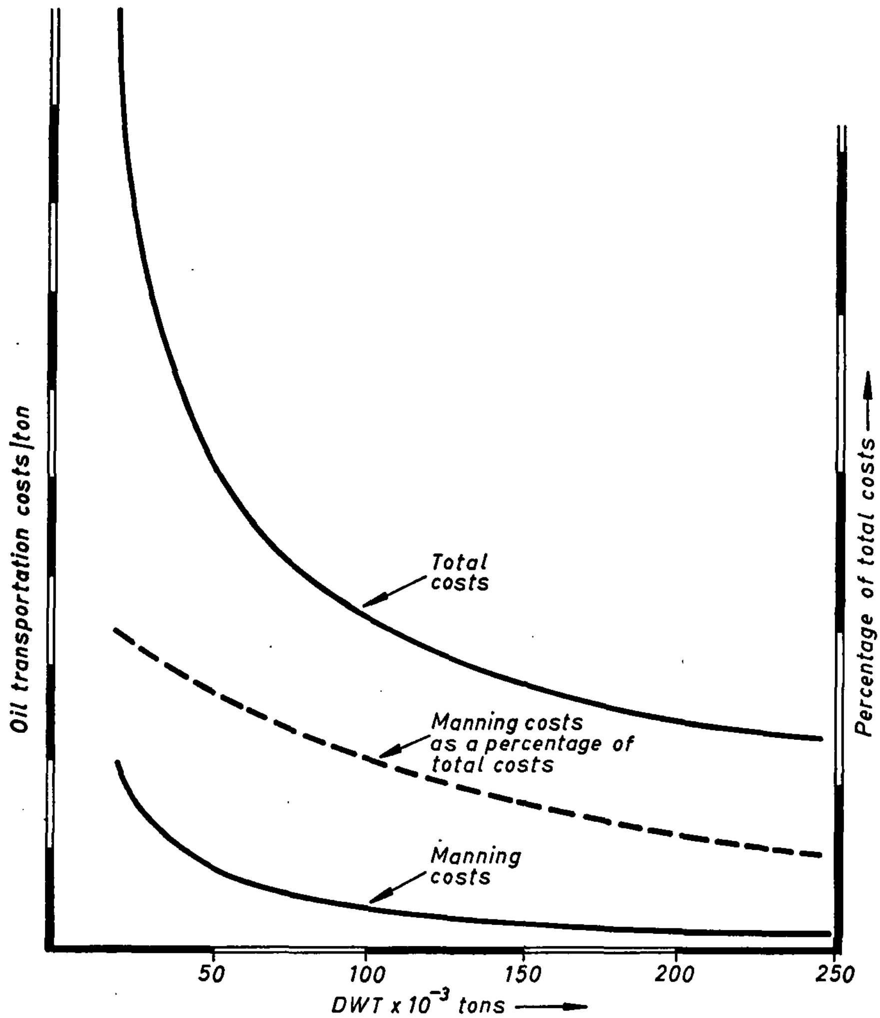

FIG. 2. Effects of scale on total costs and manning costs for tanker operations

large sums are at risk it is reasonable that underwriters demand high premiums. It is also reasonable that they should take an interest in the standards of operational efficiency on board which relate to safety. Thus the attitude of underwriters must be considered if any attempt to further reduce crew numbers and hence costs is made. It is probable that insurance charges will become yet higher in the near future[3] and this trend may only be halted if significant improvements in safety standards can be demonstrated. Whether underwriters would see a reduction in crew size as compatible with such improvements is debatable.

Further investigation is necessary to determine whether smaller crews is still a worthwhile objective. At first sight it seems to be no longer quite so pressing. During the last ten years reductions have been achieved, both directly and indirectly, as a consequence of improvements in operational efficiency. The same period has also seen changes in patterns of manpower recruitment and turnover to such an extent that the availability of adequate crews may exercise a

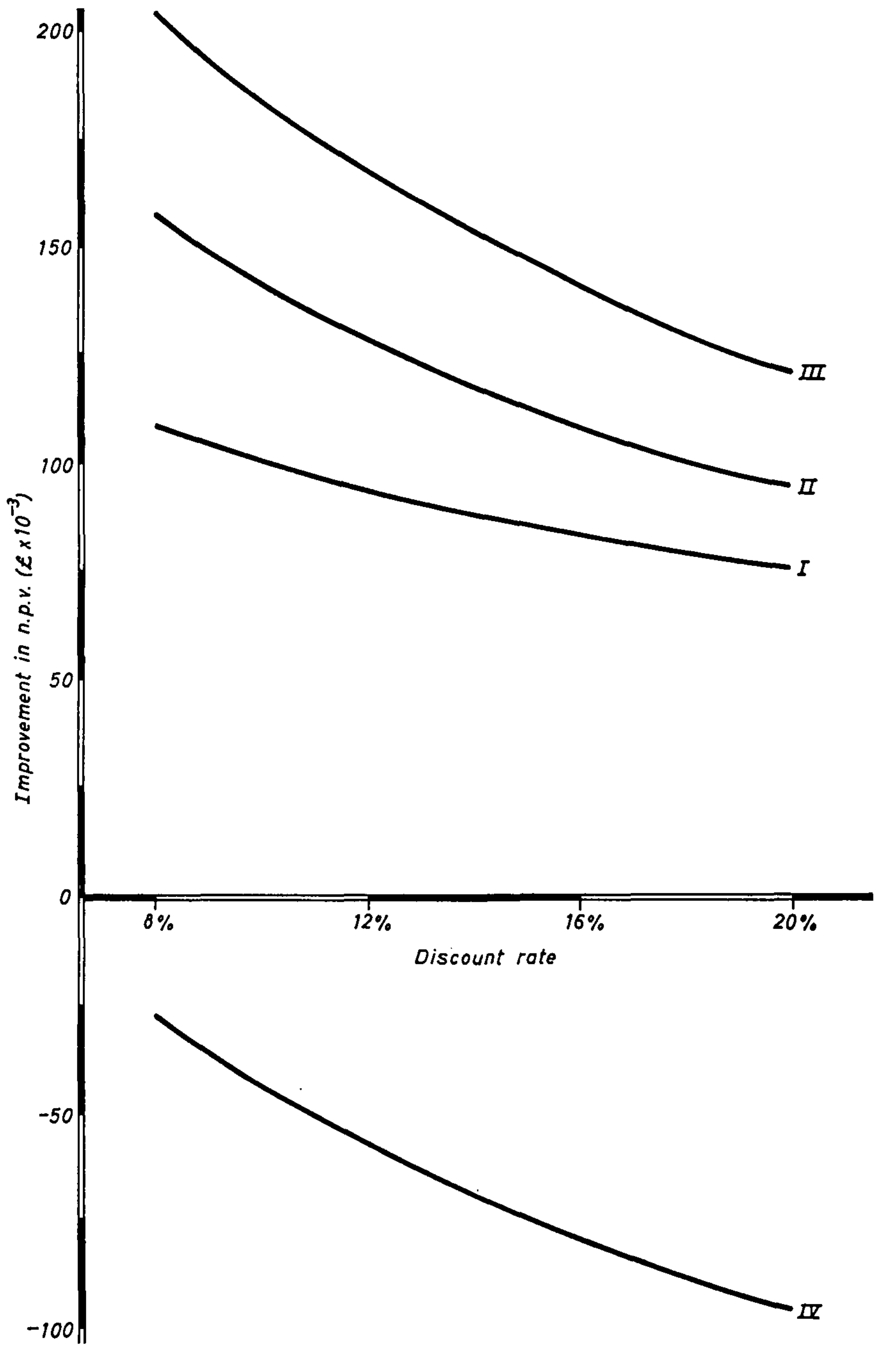

FIG. 3. Improvement in net present value achieved by investment in various degrees of automation of the navigation function

constraint upon the efficient operation of ships. Consequently, it may no longer be a case of trying to make cost savings by employing fewer men; rather it is a case of trying to operate efficiently subject to the constraint of a declining labour source. This is a completely different situation. Whereas previously the ship-owner was faced with the decision to invest in hardware to reduce the cost of men, now he can still invest in hardware (which becomes increasingly expensive as fewer men remain), but he can also consider making social investments to stimulate such recruitment as is necessary to maintain the level of manpower needed to keep his ships at sea. The optimum decision depends on the circumstances of the individual ship operator and how he defines his needs.

Clearly some means must be available to allow comparison of various policies. Goss[4] has pointed this out on several occasions and defines the Net Present Value of each possible investment as a criterion for comparison where

$$\mathrm{NPV} = \sum_{i=1}^{i=n} (R_i - C_i)\,(1+r)^{-i} - C_0$$

In the above expression

R_i = revenue in year i

C_i = cost in year i

C_0 = capital cost assumed in this case to be paid off immediately

r = discount rate obtained from the expression

$$r = (1 + r_r)(1 + r_p) - 1$$

where

r_r = discount rate in real terms

r_p = rate of change of prices due to inflation.

In long-term investments it is essential to take account of the time value of money if any meaningful comparisons are to be made. It is not sufficient to say that a certain saving may be expected during a given period as a result of a suggested expenditure pattern, since a quite false impression could be gained therefrom. Figure 3 illustrates the improvement in NPV which arises out of investment in the various stages of shipboard automation defined by McKenzie.[5] Clearly Stage IV, which represents an unmanned ship, is a poor investment on McKenzie's figures even though he estimates a saving of £80,000 over the life of this particular ship compared with a vessel conventionally manned.

In general, the investment policy decision must be based on the solution to an expression of the form

$$U = \max(f(X_{1,n},\ Y_{1,m}))$$

where

U = value of the investment policy

$X_{1,n}$ = revenues and costs over which the ship operator can exercise control

$Y_{1,m}$ = consequential and other costs and penalties over which the ship operator has no influence.

The solution to the above expression can be found subject to the satisfactory definition of whatever constraints apply.

REFERENCES

[1] Fasse, J. (1969). Some considerations by a shipowner on the selection of main machinery, *T.I. Mar. E.*

[2] Abrahamsen, E. (1971). Shipping in the 1970's. Blackadder Lecture, *N.E.C.I.E.S.*

[3] Chester, H. (1971). *International Symposium of Nor-Shipping '71.*

[4] Goss, R. (1967). The economics of automation in British shipping. *T.R.I.N.A.*

[5] McKenzie, J. (1971). Manning reductions and the cost of navigation. This *Journal*, 24, 123.

'The Master in Changing Times'

D. Breedveld

A SITUATION as presented in the article by Buzek/Wepster (24, 35) is hard to imagine in the quite different atmosphere of another international shipping operation, such as the Continental European river systems of Rhine and Danube.

Before going into more detail, it is of course realized that the scope of this international river system is smaller and so is the variety in national interests, standards of living and industrialization. Of course this restriction in scope and size has made the solution easier. Nevertheless it is felt that this example of international shipping cooperation can serve as a stimulus in finding a solution for ocean shipping on a world-wide scale.

For both rivers, Rhine and Danube, there exists a legislative and an executive/supervisory committee. These two committees are constituted of representative members of the countries immediately bordering these rivers or economically involved in the inland waterway traffic of these rivers. For the Rhine the member states are Switzerland, France, Germany, the Netherlands as direct Rhine border states and Belgium as an economically involved state.

The river Rhine is presently Europe's inland waterway with the highest traffic density. The type of craft plying this 625 statute mile long river between Basel and Rotterdam range from pleasure craft via towed barges, motor barges of 1000 tons and passenger vessels, to 4000 h.p. push convoys of some 600 ft. in length and 75 ft. in width with a carrying capacity of some 10,000 tons. In 1969 100 million tons of cargo moved on this river in international trade. From these figures it is obvious that without common policy and joint management there would be chaos.

This desirability of a common policy was already recognized in 1816 during the Vienna Congress. During this congress a treaty was concluded by which the affiliated countries were obliged to participate in the joint management of the Rhine river with regard to maintenance and waterworks, transport, customs &c.

The first treaty dealing with these particular river Rhine problems was concluded in 1831 in Mainz and the second one, which is still in force, in 1868 in Mannheim.

This so-called Act of Mannheim records in 48 articles the rights and duties of the participating countries, the skippers and crews of craft as well as of the Central Rhine Committee.