Social Consequences of Maritime Technological Change

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Contents

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The past century has seen some remarkable increases in the standards of living of many people. Technological advance has clearly been a major contributor to this. But technology does not always lead to overall improvements: its benefits are not shared in equal measure, and there are often negative consequences. Increasingly policy makers acknowledge these effects, and some legislation now requires that social factors be taken into account through technological assessments in line with national conditions. The U.S. Fishery Conservation and Management Act of 1976 specifically states that regulations must consider social as well as economic and biological impacts, and this consideration—in various ways—now features in a few modern technological and planning approaches and in International Conventions and Recommendations.[1]

One of the fundamental problems lies in evaluating the short- and long-term consequences of technological change. Frequently it is assumed that benefits ultimately will accrue to the community, the region, or the nation as a whole, and that short-term sacrifices of some sector of employment, or social activity, or amenity will be compensated for. How, or whether, losses are compensated for depends on the perceived value of what has been lost and gained. Thus, it is essential to measure not only economic growth and changes in standards of living, but also changes in the quality of living and the way of life.

While it is difficult to separate precisely the factor of technological change in economic growth from, say, the effects of international trading conditions, it is nevertheless possible to attribute improvements in specific standards of living to particular technological changes. This may be done by retrospective comparisons of incomes, prices, patterns of consumption, working conditions, productivity, working hours, and so on. It is more difficult to agree criteria involving the value of, for example, the way of life in some remote fishing village, operating at lower than available levels of technology, which imposes on the community as a whole less than the maximum sustainable yield in fish landings, higher fish prices, or taxation. The very concept of "way of life" is problematic. It involves values of the human habitat and the socio-economic and physical environments as perceived by the people involved. It is often difficult for outsiders to truly appreciate these values, for their perception is partly a product of history and group culture.

A subjective element arises also in relation to the objectives involved in adopting new technology. The motives and aspirations can vary widely among interests. Aims may be to improve a competitive position; secure improvements in productivity; reduce prices; increase incomes, profits, employment, food supply, exports, or national prestige; stabilize communities; arrest rural-urban drift; or introduce new skills and encourage enterprise. Clearly, not all these objectives can be pursued at once: several are mutually incompatible, and some may conflict with the objectives of resource and environmental conservation policies.

Such problems are not new. The period of technological change during, say, the shift from wind and water power to steam was characterized by many such conflicts. But there was then less official concern for social impact. Technical changes had longer gestation periods, adopted techniques had a longer life, and demand for products and services grew so rapidly that for a long time the new and old technology, including the steamship and the sailing vessel, could co-exist.

This is not the case today. Technological change is rapid, the rate of obsolescence is high and the period is, for many countries, one of slow economic growth. The problems of social impact are therefore particularly acute, especially for the developing countries and some peripheral regions of developed countries. New technology may destroy the basis of many jobs, skills and possibly communities. On the other hand, it may also generate new jobs and skills and provide a renewed economic base in areas of decline. Always, however, major technological changes destabilize some ways of life, and, in some instances, political systems as a result of their social impacts.

New maritime technology has had significant impacts upon ports, shipping and fisheries worldwide. The international diffusion process in these sectors is often relatively fast. Maritime commerce between countries is based on a common transport system, and the political relationships and physical and biological interfaces between states at sea have been brought into greater proximity with recent changes in the legal regime of the ocean. This lecture concentrates on several of these aspects of maritime technological change and considers some of the social consequences involved and the solutions being attempted to ameliorate their more negative effects.

The Port Technological Revolution

One of the most striking examples of the social impact of technological change lies in and around ports throughout both developed and developing countries. Over the past two decades there has been an almost total transformation of port operations and a consequential quantitative and qualitative change in the composition and structure of port labor. The character of urban areas and communities around many major ports has also undergone significant transformation.

In the United Kingdom the number of port workers has been reduced from 60,000 to 16,000 in a little over 20 years. In Australia the number of workers has fallen from 17,688 in 1970 to 7,944 in 1982. Table 1 gives examples of the sharp decline in employment at a number of ports in developed countries over this period. The trend in developing country ports is similar, but with time-lags and anomalies which will be referred to later.

TABLE 1: Examples of port labor (longshore workers) changes, 1970s-1980s.

	1970s	1980s	Percent change
Amsterdam	3,540	1,906	−46.2
Liverpool	11,065	2,333	−78.8
London	17,000	4,200	−75.3
New York	18,651	9,657	−48.3
Rotterdam	12,443	9,598	−22.9
Seattle	1,170	770	−33.2
Sydney	4,479	1,821	−59.3

Source: A. D. Couper. *The Development of New Cargo Handling Techniques and the Implication from Employment and Skills in the World Port Industry.* International Labour Organisation (To be published).

These massive reductions in port labor stem from the introduction of advanced mechanical handling equipment in the bulk trades and the unitization of break bulk cargoes, particularly the introduction of containerization. The world container traffic increased from 47 million tons in 1970 to 280 million tons in 1981. Some 350 ports in the world now handle containers on a regular basis, many of them at specialized terminals.

As a result of the bulk, RoRo and container revolution, cargo handling rates per man have increased. In the case of Australia, while port manpower has been reduced by 55% in a little over a decade, the tonnage of dry cargo handled has risen by 28%. The Waterside Workers Federation estimated that if the 1980 volume of cargo were handled by the same techniques as in 1965 some 70,000 port workers would be required nationally, as compared with the 8,500 employed in 1980. Or, to take a typical example at port level, the dry cargo productivity per longshore worker in Seattle has risen from 1,896 tons to 7,390 tons over 10 years.[2]

The technological revolution at ports is still proceeding rapidly. It started with the box which dramatically speeded the turnround times of liners and reduced the number of ships in service. This first stage of containerization was characterized by a change from human physical effort to predominantly mechanical cargo handling. The standard unit employed and the operational procedures gave almost immediate opportunities for a second stage: the application of automation to mechanical handling, and the substitution of computer techniques for human operational dexterity. Now the micro-chip is bringing a third stage by, amongst other things, allowing fast flows and processing of information, decision making, and robotization in the system.

As yet there is no totally automated container terminal, but at various sectors of the system automation has been applied. In the ship-to-shore handling, for example, a skilled crane operator is still employed but is assisted by automated devices which improve and speed handling. In many ports the movements of containers from the ship side to stack, their retrieval from stack, and their repositioning is virtually a fully automated process—the human controller of the carrier primarily supervises.

Computer controlled systems are geared also to high speed transmission of information, logging of containers and transmitting instructions. Computers have replaced many manual functions in the preparation of documents and other clerical tasks.

By 1983 some 78% of the world's container terminals were using computers for administrative tasks and 43% for operation control. The increases in productivity from the application of computers are reflected in reductions in terminal idle time. It has been calculated that the average handling-time-to-idle-time ratio is 82.5% in a computerized terminal and 65% in a manually operated container terminal.[3]

The application of micro-chip technology to handling operations, plant maintenance, information flows, and the development of robotics, will move ahead. This technological development is one which will speed cargo but will also cause further social changes, particularly in developing countries where the technological revolution and its repercussions cannot be easily avoided. Some of the wider social impacts will now be considered.

Wider Social Impacts of Port Technological Change

Traditionally the port cargo-handling worker functioned in a gang. The ultimate objective of the work was to obtain a good, safe stow and to discharge safely at maximum speed. The work was often irregular, arduous, dirty, dangerous and paid by tonnage. Gang leaders had to show initiative when heavy and awkward loads were handled; supervisors (foremen, walking bosses) often made decisions regarding choice of gear, derrick systems, cargo sequence and overtime.

Traditionally dockers lived in close proximity to the port and many had other parttime jobs (especially during the period of casual employment). In several places, sons (or sons-in-law) succeeded fathers with an inalienable right to the job; in other ports, jobs were paid for in a corrupt call system. There was, and still is in places, a distinctive dockland community. Workers had a common lifestyle, high degrees of family and group cohesion, union solidarity, and a high propensity to strike.

The profile of the port worker under the new technological system is entirely different, and the location of the work is generally well removed from the traditional social environment around the older docks. Many of the latter have closed, and the areas are places of unemployment and urban blight.

The port worker is now an operator and technician; he is often multi-skilled and moves between related tasks; he works more on his

own, takes individual responsibility, is on time rates and predetermined shifts, has a guaranteed income, and is less union conscious and dependent than previously. There has been an erosion of social distinctions, and in several terminals all port employees, including senior managers, eat in the same port dining room.

Because the nature of the work at modern terminals calls for new skills and mental attitudes there are difficulties in many places in transferring and retraining workers from the old break-bulk system. In the case of supervisors there have also been major changes in functions, which require redefinition with each subsequent major advance in technology. Some of the commercial activities traditionally found around ports have moved away from port areas to the proximity of freight stations and inland container depots, thereby reducing the local multiplier employment effect which characterized the old break-bulk system.

There were various forms of resistance to this new technology with its threats to jobs and lifestyles. In the United Kingdom, London dockers refused to handle Overseas Containers, Ltd. and Associated Container Transportation, Ltd. ships at Tilbury during 1969-1971 unless terms negotiated for them were applied elsewhere. In the USA, demarcation disputes over who should man freight depots have been widespread. Some of these problems have been partially resolved by agreements on "no compulsory redundancies", and by offers of high voluntary severance payments. These agreements have resulted in both overmanning and high costs at large numbers of ports. But not all ports have been able to afford such solutions, nor can local authorities always find the means to redevelop the deriliction left behind in older urban dock lands. These problems are difficult enough in developed countries, but they are major causes for concern in developing countries.

The Problem for Developing Countries

The transfer of advanced cargo-handling techniques from the more developed countries (MDCs) to many of the less developed countries (LDCs) has occurred rapidly. This process was inevitable since container ships linking trading partners require compatible facilities at each end of a trade route. All the impacts seen in MDC ports have been reproduced in most of the LDCs, sometimes with time-lags but almost always with more social problems to overcome than in the MDCs.

Many LDC ports do not as yet show the same degrees of labor decline as the MDC ports. Table 2 provides a few examples drawn from the LDC ports. The differences between the MDCs and LDCs have been due primarily to two factors:

- Cargo from and to containers is still handled within many LDC ports, so that while container ships enjoy fast turnround some of the break-bulk port labor has been retained. The full loss of jobs at these ports will take place when sufficient through-transportation infrastructure has been provided in the hinterlands, with inland container depots

TABLE 2: Developing country port labor (longshore workers) changes, 1970s-1980s

	1970s	1980s	Percent change
Alexandria	7,000	5,000	− 28.6
Aqaba	400	3,000	+ 650.0
Bombay	12,738	13,725	+ 8.0
Colombo	13,522	12,896	− 5.3
Freetown	4,697	4,576	− 2.6
Port Kelang	1,206	1,138	− 5.6
Tauchung	731	703	− 3.8

Source: A. D. Couper. *The Development of New Cargo Handling Techniques and the Implication from Employment and Skills in the World Port Industry.* International Labour Organisation (To be published).

(ICDs) for less-than-container-load (LCL) and full-container-load (FCL) cargo.

- Labor unions—and politicians dependent on union and port urban votes—in LDCs have succeeded in retaining full break-bulk gang sizes in the new system even when it is possible to move containers beyond the port.

The current and potential loss of jobs, and the related impact on port communities, represents a massive problem for many LDCs. What has been sought for in LDCs are labor-generating developments and technology with high multiplier effects. Port technology offers these possibilities in most LDCs almost only by improving the overseas trade prospects of agriculture and manufacturing. While reducing the costs of seaborne trade for these sectors is vital for LDCs as a whole, the necessary labor-replacing technology may, literally, be disastrous for port workers in situations where alternative employment opportunities are zero, and where there are no official social security systems. In turn, as more complex advances—including micro electronics—are made in port technology, the multiplier effect accrues primarily to the MDCs producing the equipment and spares, so little is gained for LDC industries.

To make matters worse, in several of the terminals of LDCs it has been even more necessary than in the MDCs to recruit container terminal labor from outside the port. This has been due to a general lack of technical skills amongst break-bulk workers; their high levels of illiteracy and lack of numeracy; and their difficulties in adapting to a psychology of work involving shifts, new types of physical strain on eyes and tendons, mental stresses and operational loneliness, as well as insufficient training skills and proper facilities at ports for retraining selected break bulk workers.

In Nigeria, for example, new container terminals have been established at locations beyond the older ports and new workers recruited.

As a result the total port work force in Nigeria has increased. In Bombay containers are handled with the same numbers of workers as in the break-bulk system, thereby giving rise to the new phenomenon of "in service unemployment." This situation is made worse by the refusal of workers to engage in alternative necessary tasks of maintenance and cleaning, for which they were not originally engaged, due to the fine distinctions of job status. In the port of Bombay there are some 160 grades of employees.

Solutions Available

Many solutions have been offered for the problem of labor displacement and in-service unemployment due to technological change. These include curtailing new technological developments by, for example, retaining cargo handling from and to containers in the port and not proceeding with through-transportation. Earlier retirement is often proposed, but in countries such as Kenya workers already retire at the age of fifty-five, which is itself a problem.

Unions have advocated such alternatives as a reduced working week, more holidays with pay, and job sharing at current, or even lower incomes. Employers have argued cost problems and competitive constraints and are skeptical that job and income sharing will not result, within a short time, in demands and actions for higher wages for reduced hours. Job creation in the fields of container repairs and cleaning, or in freeport industries, and application of more labor to port safety, amenity, and environmental quality, are all proposed. The fact remains that to be efficient the new port technology requires only a few skilled operators. For developing country ports and port communities this is one of the most serious consequences of the technological revolution emanating from the developed world. Any beneficial effects are more likely to be felt in the ports' hinterlands.

The Technological Revolution in Shipping

The revolution in shipping has centered on the size and design of ships and types of shipboard equipment. The motives for change have been to achieve economies of scale in sea transport and develop new forms of cargo containment and cargo handling to reduce time in port. The motives for onboard operating technology have been to conserve energy, improve safety, and reduce manning costs.

Ship Size and Functions

The improvements in ship productivity arising from economies of scale and cargo-handling developments have contributed to the world shipping surplus and also have resulted in some reductions in the total world tonnage of shipping. It is difficult to separate very precisely the impact of technological change on the size of the world fleet from both the fall in demand for shipping services as a result of the world economic recession, and from the recent reductions in route mileage in international seaborne trade.

From 1979 to 1984, for example, the ton miles performance for world shipping fell by over 25%. As a small response to this, the world fleet was reduced from 686.0 M DWT 1983 to 674.5 M DWT in 1984, but it remains seriously overtonnaged, particularly in the tanker sector and now to an increasing extent in container shipping. The latter is the fastest growing sector of shipping (a 40% increase in capacity is expected by 1986). Overtonnaging here will be due also to the greater economies of scale of recent container vessels, the efficiency of the new port technology, and to development of around-the-world services.

On-Board Equipment

On the shipboard side several technological changes have been introduced in response to rising fuel costs. In the 1950s the fuel cost for ships amounted to about 30% of voyage costs; it is now in the region of 50%.[4] Technological change in this respect is toward more energy efficient engines, the use of exhaust gases, better hull and propellor design and improved anti-fouling. There have been some changes in the use of energy by a return to coal burning (on the Australian Coast) and wind power to supplement engine power (on the cross Pacific trades).

The rising cost of manning (including wages, leave, repatriation, catering and social security) in high-labor-cost countries has given rise to the introduction of more onboard automation. In the 1950s a 10,000 DWT vessel had a crew of about 50, in the 1970s a 100,000 DWT bulk carrier was crewed by 25 and at present by 22. There are large vessels of various types in operation designed for a total complement of 13.

The trends in ship automation are continuing in bridge control of main engines, unmanned engine rooms, food and drink dispensers, application of satellites to position fixing and to monitoring ship performance and cargo conditions from the shore. In the future, robotics technology may well be applied to mooring, painting and tank and hold cleaning.

Social Consequences of Technological Change in Shipping

The increased size of ships in the tanker and dry bulk trades has had its impact on ports and on the location of raw material-using industries. The economies of scale in marine transport have contributed to the migrations of industries to proximity of deep-water sites. The reductions in costs per ton in the carriage of raw materials in bulk have also contributed to the continued predominance of the market-orientation of bulk-using industries in the MDCs rather than resource-oriented locations in the LDCs.

The container revolution has, as noted, had most of its impact

on the spread of container ports and the decline in the workforce. The increasing size of container vessels is now exercising pressures toward concentrating containers at fewer high capacity ports. At the time of the initial investments in container terminals during the 1960s, a container vessel carried 1,000 TEUs (twenty-foot equivalent units); in the 1970s the range was 1,500 to 2,000; in the early 1980s 2,500 to 3,000. More recently United States Lines has been operating 4,200 TEU-capacity vessels on round-the-world services. The 6,000 to 10,000 TEU ship is possible in the future.

The enormous cost, productivity, size and routing of new generations of container ships mean that many ports with limited hinterlands, relatively low TEU capacities, and a requirement for frequent calls, will be served by feeder vessels. These requirements for feeder services may, in fact, give opportunities for more of the LDCs to provide lower cost container services on a national and regional basis. The greater economies of scale will also affect interport (and within port) competition in the MDCs leading to fewer and bigger container terminals.

The on-board technological advances will reduce employment of seamen. But while these are labor saving, they are not skill saving. Most of them require more highly trained and educated managers, officers and technical staff for their efficient and safe operation. This puts increased demand on the educational and training facilities of LDCs if they adopt such vessels.

Several of the LDCs have, of course, already been increasing their shipping activities, and there has been a significant shift in shipowning from the developed to the developing countries in the recent period. If flags of convenience (FOCs) are attributed to MDC ownership, then in 1970 about 7% of world shipping was under flags of LDCs. By 1984 this percentage had risen to about 16%.

This shift has been due on the one hand to promotion of national shipping in LDCs through cargo reservation and subsidies, and on the other by the comparative advantages inherent in lower crew costs and the rise of new entrepreneurs and joint ventures in the newly industrialized countries (NICs) of South Korea, Hong Kong and Singapore. It is partly to counter this shift that there has been the move on the part of the MDCs toward bigger more highly automated capital-intensive vessels. These vessels will ultimately erode part of the comparative advantage of lower labor costs in LDCs. Another round of measures by the LDCs to match these capital intensive technologies (and especially those that become mandatory or highly efficient) will add to the pressures on the high social opportunity costs of LDC capital and skill resources. This is a reactive technological race which most of the lower income LDCs cannot afford.

The solution conceived by several countries is to combine the capital and shipping experience of the MDCs with the lower cost labor of

LDCs in the form of joint ventures, or FOCs, or both. This is seen as minimizing unnecessary over investment in technology on the part of MDCs and retaining employment for some LDCs. The dilemma for trade unions in MDCs is thus: the displacement of some labor with the adoption of highly automated shipping under own flags, or displacement of some labor with employment of LDC manpower under FOC or LDC joint ventures.

The problem of finding the right socio-economic and technological mix in shipping may be exemplified at a lower level by reference to services for poor remote areas. For example, in the islands of the Indonesian Archipelago, parts of the Philippines, and other island regions, there are several thousands of local vessels. These small craft, some entirely under sail, have many complex direct and indirect relationships with outer island communities. These areas are often in need of the most urgent attention in development plans. The adoption of new ship technology often destroys the outer island village basis of vessel building, owning, repairing and operating. It also removes opportunities for young men in a primarily peasant economy to engage temporarily on such vessels, and to save money to purchase land and marry; it breaks the links between seasonal patterns of cultivation and trade; and it concentrates ownership into the hands of fewer more wealthy urban businessmen. One of the unintended net results of improved ship technology in island feeder services may be to accelerate rural-urban drift which is counter to the objectives of development policies.

The search for appropriate ship technology, and the most economic and socially beneficial roles for low income LDCs in the various links of international through-transport, is compounded by LDC perceptions of national prestige, strategic considerations and mistrust of some of the motives of MDC shipping interest. But wider socio-economic appraisals of types of shipping and manning arrangements in several trades have become particularly necessary in a world where energy costs are increasing and many sectors of sea transport have become closely geared to advanced technolgical industries.

Technological and Social Changes in Fisheries

The third maritime sector in which new technology has exerted both positive and negative influences is fisheries. In many of the LDCs most fishermen are still village based, small-scale and artisanal. In South East Asia alone there are 3.5 million small scale fishermen with some 21 million people dependent on their activities.[5] In India there are about 2,000 fishing villages; in 17 West African countries around 220,000 fishermen operate 40,000 canoes, only 35% of which were powered in 1980.[6] Even in Canada there are 1,339 small fishing communities in Newfoundland and the Maritimes.[7]

Many of the poorer fishing villages in LDCs share several characteristics. Family life, cultural traditions, and divisions of labor center on the fishery. The community utilizes small craft and employs a diversity of simple gear. Fishing is mainly on a daily basis, often in lagoons and inshore waters which are sometimes (especially when indigenous methods of conservation have broken down) seriously depleted of stock. Boats are frequently family owned and operated and a portion of the catch, or catch value, is shared on a kinship basis. Fishing is often part-time and combined with agriculture, and there may be seasonal rhythms of activity. In coral islands fishing may predominate and is the only source of animal protein, while copra supplements cash incomes. A vertical integration may exist at village level in fishing, boat building and repairing, and in a division of labor based on age and sex in activities related to bait, reef gleaning, preserving and distributing catches.

In general small-scale fishing communities have relatively lower standards of living, more variable incomes, and higher debts than corresponding fulltime agricultural communities. Fishermen are exposed to greater physical and economic risks and have less political influence than agriculturalists. Even in developed regions such as Atlantic Canada it is reported that a significant proportion of families of fulltime and parttime fishermen have incomes near or below the poverty line for rural Canada.[8]

Given that at least several of these conditions apply in combination to most small-scale fishing communities in LDCs, there is considerable incentive to seek solutions to the social problems, and to increase the fishing contribution to the national economy, by technological improvements.

The application of new technology has actually brought about some remarkable increases in fish catches by several countries in recent years, but it has also, in places, depleted stocks and acted to the detriment of the small-scale fishermen. In Sri Lanka fish catches more than doubled in a few years, but as Alexander shows, "employment opportunities have diminished, social inequalities have been exacerbated, and many peasant fishing households have been further impoverished..."[9] There are many such examples.

The fundamentals of the problem lie in the human ecology of the fishery unit. A small-scale fishing community is often limited in its choice of fishing grounds and spatial extension of activities by its traditional gear and boats. The introduction of bigger more seaworthy mechanized craft, and more advanced gear, means higher capital and replacement costs, more time away from families and from traditional social activities and community obligations, and a neglect of agriculture. Bigger craft may raise needs for new berthing arrangements, repair facilities, and ice making and transport infrastructure.

Small-scale fishing communities cannot always respond in these ways to new technology. This leads to the centralizing of activities at fewer places, the concentration of vessel ownership into urban businesses and the separation of ownership from skipper and crew. There will also be the further marginalizing of small-scale fishing communities with the shifts of boat building, repairing and other ancillary services from vertically integrated village activities to separate commercial functions at ports.

The numbers of fishermen are thus often reduced by technological change while landings and catch per man figures increase very significantly. Adopting this approach to technology there is no doubt, as Spoehr notes for the Philippines that "the national catch of small scale fishermen could be harvested at considerably lower economic costs." He goes on to point out that this would be at the survival cost of vast numbers of small fishing communities.[10]

The answer to this problem lies in the adoption of more socially aware methods of evaluating fishing technology. Devoraj argues, in the case of the Indian Ocean, for attempts at a more holistic approach combining biological, economic, social and political components.[11] Emmerson makes much the same point when he refers to seeking "a many dimensional optimum rather than a single variable maximum." The latter may be the maximum economic yield (MEY) or maximum sustainable yield (MSY); the former goal is the maximum optimum yield (MOY), which is "the greatest benefit that can be obtained from fishing after biological, social, economic and political considerations have been taken into account."[12] MOY is even more difficult to quantify in practice than MEY and MSY. It requires a community based approach involving the human as well as the natural ecology.

The advent of the Exclusive Economic Zone (EEZ) has been seen as the solution to some of these social problems by allowing planned access on a spatially differentiated and quota basis to small-scale village, deepwater urban, and foreign fishermen. But this does not, as may be seen in South East Asia, remove the dangers from the small-scale fishermen. All vessels may be fishing the same stock at different stages in their growth in different areas of access, and market price competition and loans and grants competition favors the medium- and large-scale enterprises. Attacks on bigger vessels by small-scale fishermen have been reported from several places over these issues.

In general a progressive approach to fisheries involves the introduction of "appropriate technology" which meshes with indigenous technology and ways of life, and the development of alternative non fishing occupations in coastal areas to absorb excess and displaced fishermen.

In the face of technological change, the problems of fishermen are not unlike those of port workers and are akin to the problems arising from the erosion of the traditional role of island based trading vessels. But the impact of technical change can be even greater in the more monolithic social environments of remote coastal and outer island fishing

villages in LDCs. These impacts require even greater understanding of the society and human problems involved.

Conclusions

This lecture has concentrated on the negative effects of modern technological change in three maritime sectors. The negative emphasis was made despite the fact that historically technological change has been a major positive factor in economic growth. In the present period the rates of technological change are faster than ever before and the geographical diffusion of technology can be relatively immediate. Positive benefits may ultimately flow to economies as a whole, but the early and visible effects of new technology in ports, shipping and fisheries in some countries has been sectoral unemployment and social blight.

For poorer countries with rapidly growing populations the problem is compounded. Not only is new technology labor shedding, but it is also—in its initial stages—a consumer of scarce capital, a force for organizational change, and a demander of new specialized skills. Furthermore, most of the hardware is often imported while most of the industrial multiplier effect is exported. Yet the irony is that while unemployment results from the introduction of advanced technology, unemployment may also result, in a competitive situation, if new technology is not adopted. In the ports sector in particular there is now little choice if a port is to participate in international transport networks.

Technology is not, of course, quite so deterministic. It is a matter of policy as to how governments and organizations respond in terms of employment, compensation, retraining, job creation and the adaption and meshing of new technology in relation to specific environments. Unfortunately, technological changes with enormous capabilities for social upheaval have been introduced in ports, shipping and fisheries without adequate consultation, research and retraining. Technological assessment does not usually figure in maritime policies, nor are the wider employment effects always taken into account in the provision of maritime training facilities.

The need in most countries is for policies which apply criteria wider than simply operational efficiency and rates of return in the adoption of new technology. The evidence from a limited number of countries and enterprises, where this kind of policy has been applied, is that more advantages accrue in terms of job satisfaction, community viability and political stability when the technological factor is sub optimized in the interest of the human element.

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The McKernan Lectures

This lecture series was created to honor the memory of Donald L. McKernan, who died in Beijing, May 9, 1979, while participating in a U.S. trade delegation. Professor McKernan's last job was that of director of the Institute for Marine Studies, University of Washington. Before that, he had several distinguished careers—as fishery scientist, fisheries administrator, director of the Bureau of Commercial Fisheries, and special assistant to the Secretary of State for fisheries and wildlife in the U.S. Department of State.

Professor McKernan's interests encompassed the entire range of marine policy studies, and this lecture series, as reflected by the following titles, has been designed to incorporate the same breadth of interests.

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U.S. Foreign Policy and International Regimes
by Joseph S. Nye

From Cooperation to Conflict
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by Bernard H. Oxman

Mission Impossible?
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by Bruce Harlow

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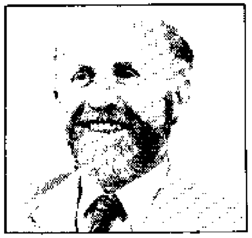

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