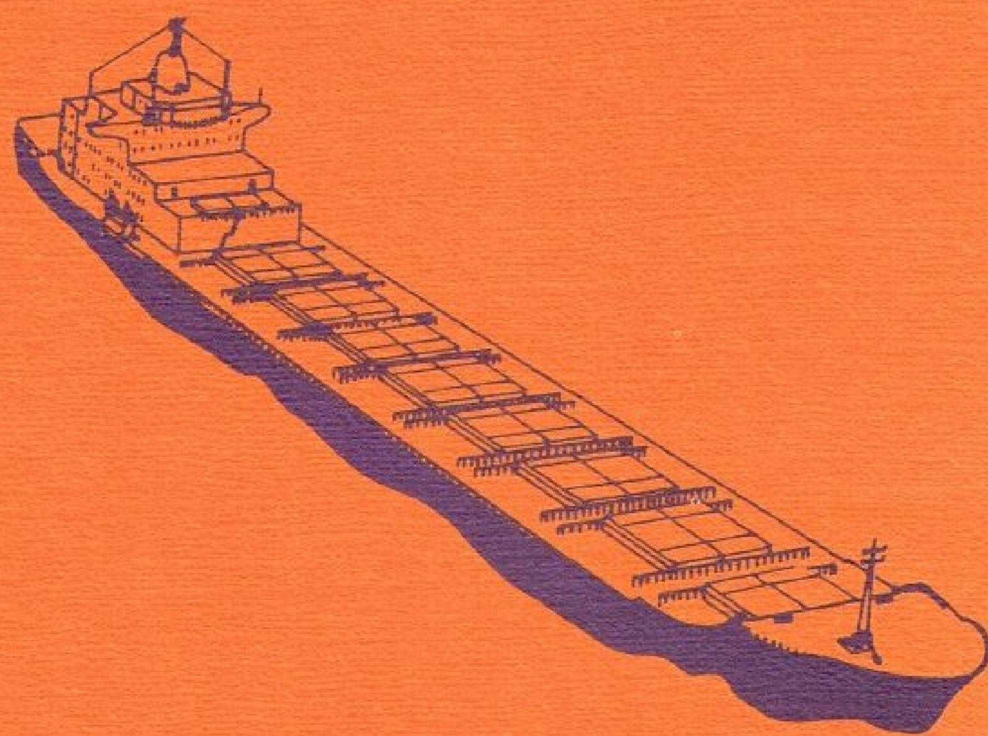
Australian Symposium on

SHIP TECHNOLOGY

at the University of New South Wales
in Sydney 2–5 November 1981



SEA TRANSPORT TECHNOLOGY 1981

DISCUSSION VOLUME

AUSTRALIAN SYMPOSIUM ON SHIP TECHNOLOGY

SEA TRANSPORT TECHNOLOGY 1981

presented by

THE INSTITUTE OF MARINE ENGINEERS
SYDNEY BRANCH

in conjunction with

THE COMPANY OF MASTER MARINERS
OF AUSTRALIA

THE ROYAL INSTITUTION OF NAVAL ARCHITECTS
AUSTRALIAN DIVISION

and

THE NAVAL ARCHITECTURE SECTION
THE UNIVERSITY OF NEW SOUTH WALES

at the University of New South Wales

November 2-5, 1981

DISCUSSION VOLUME

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P R E F A C E

The Australian Symposium and Exhibition on Sea Transport Technology 1981 was held to publicise the advances currently being made or contemplated in the future to reduce the overall cost structure of sea transport during a time of increasing construction and operating costs.

The symposium was presented by The Institute of Marine Engineers, Sydney Branch, with the collaboration of The Royal Institution of Naval Architects, Australian Division; The Naval Architecture Section of The University of New South Wales and the Company of Master Mariners of Australia.

This volume contains an account of the discussions at the symposium together with copies of four papers distributed at the symposium which, due to circumstances beyond the control of the Symposium Papers Committee, were not received in time for inclusion in the main Volume.

In the preparation of this volume the recorded and written questions submitted to the authors of the papers together with their answers are included and the Committee wish to express their appreciation to the authors for the giving of their time and expertise.

We were indeed most pleased to again have Sir Zelman Cowen, A.K., G.C.M.G., G.C.V.O., K.St.J., Q.C., Governor-General of the Commonwealth of Australia to present the Opening Address which is included herein together with the Speech of Welcome by Professor L. Michael Birt, Vice-Chancellor and Principal, The University of New South Wales.

Included also is the speech given by our Guest of Honour at the Symposium Dinner, Professor Harry Benford, Department of Naval Architecture and Marine Engineering, The University of Michigan, U.S.A.

On behalf of the Papers Committee

K.M. MURRAY

Divisional Secretary
The Institute of Marine Engineers

Sydney
June 1982

ACKNOWLEDGEMENTS

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SPEECH OF WELCOME

BY

PROFESSOR L. MICHAEL BIRT, C.B.E.,

VICE-CHANCELLOR AND PRINCIPAL

THE UNIVERSITY OF NEW SOUTH WALES

MONDAY, 2 NOVEMBER 1981

Your Excellencies, Mr. Chairman, Mr. President, Mr. Federal Master, distinguished guests, ladies and gentlemen:

It is a great pleasure for me to welcome you to this Sixth Symposium on Ship Technology which as you know will consider the theme Sea Transport Technology 1981. The symposium, as the Chairman reminded us, has been organised by the Sydney Branch of the Institute of Marine Engineers, in collaboration with the Sydney Branch of the Company of Master Mariners of Australia, the Royal Institution of Naval Architects (Australian Division), and the Naval Architecture Section of the University of New South Wales.

Today's symposium marks, indeed, the Tenth Anniversary of such an occasion. It is a very special pleasure for me, in these first few weeks of my Vice-Chancellorship, to welcome Their Excellencies to this University. We are delighted that you have once again honoured us with your presence, and that you, Your Excellency, have consented to give the Opening Address. I extend to Your Excellencies the very warmest of welcomes.

The Chairman reminded us the first such session was held in 1971 and was organised by Professor Tom Fink of this University, now the Chief Government Scientist, who apologises for his inability to be present today. And I am also reminded that one of the speakers on that occasion was Professor Benford of Michigan University who, of course, is also an honoured guest here today - a special welcome to him.

Many of you will recall that His Excellency addressed the Ship Technology Symposium in 1979 - a symposium devoted to the consideration of the 200 mile limit. I suppose that the territory was at least partly familiar and that, for example, His Excellency was able to speak about "Industrial Law of the Sea". But on this occasion, as is perhaps almost inevitable in 1981, the symposium addresses a topic which, in its general scope, none of us can feel particularly expert. It deals with the impact of various technological advances in sea transport at the present time, and as we are constantly reminded, the impact of technology on our lives provokes a bewildering variety of responses: we see benefits, we see immense possibilities, we see difficulties - perhaps even disasters - as we contemplate the economic, social, ethical and political consequences of technological advance.

It is perhaps particularly fitting that this topic should be considered in the University of New South Wales. Not only do we have a Naval Architecture group, but the University itself has an especial commitment to teaching and research in, and I quote from the Act establishing the University: *'various branches of technology and science in their application to industry and commerce'*. I have remarked that the impact of technology on almost every aspect of our lives is now a matter of lively concern: the governments, unions, community groups and, of course, universities also. The activities of man, the toolmaker, have a long history stretching right back to the earliest traces of our existence as a species, but the pace of change in technological application and the sophistication of technology, particularly as it begins to exhibit capacities for memory and reprogramming and sensing of environment, are reasons which underlie our sense of mounting social, economic, ethical and political problems. Somehow we must learn and relatively quickly to keep a working balance between our technical skills and behavioural traits which are inherited from a chipped flint ancestory. The conservatism which keeps them there is of course inherent in every living form and the reconciliation of this internal tension in man and human society places, I believe, a special challenge before the universities. They are, dare I say it?, alone perhaps, constantly exploring in depth and with wide-reaching historical and philosophical perspectives the full range of man's experience of, and reaction to, the world he lives in. They have therefore a particularly important part of play in helping society to use and regulate technology effectively and none moreso than this University.

I remarked in passing that our notion of a "proper balance" in such matters shifts, of course, with the passage of time. In the abstract of the opening symposium paper, Mr. Evans refers to the importance of refrigeration for the sea transport of meat from this island continent. That remark reminded me of a very dearly loved Professor of Agriculture under whom I studied in the University of Melbourne. I refer to Sir Samuel Waddam, who had very different ideas about the importance of refrigeration. I can well remember him growling on many occasions that *'refrigeration is the ruination of good meat in this country - if it isn't a bit rotten it isn't worth eating'*. I hate to think what his reaction would be to deep frozen steaks and microwave ovens. Today, however, such considerations, while important, are in the background and not the foreground of our attention, though a number of our titles do remind us of the dependence of sea transport on the new tools of technology. Terms like "microprocessor controls" and "navstar global positioning systems" occur in the list of titles. I trust that all the participants in the proceedings will find that their understanding of both particular and general issues is enhanced by their attendance at this symposium; that you have not only a profitable, but also a very pleasant time while you are with us. And indeed, I have very little doubt that both of these hopes will be fulfilled.

I extend to you all a very warm welcome to the University.

ADDRESS BY

HIS EXCELLENCY THE RIGHT HONOURABLE SIR ZELMAN COWEN,

A.K., G.C.M.G., G.C.V.O., K.St.J., Q.C.,

GOVERNOR-GENERAL OF THE COMMONWEALTH OF AUSTRALIA,

ON THE OCCASION OF THE OPENING OF THE

"SEA TRANSPORT TECHNOLOGY 1981" SYMPOSIUM

AT THE UNIVERSITY OF NEW SOUTH WALES, SYDNEY,

MONDAY, 2 NOVEMBER 1981

Two years ago, almost to the day, I opened the Symposium on Ship Technology sponsored by three of the partners in today's enterprise, The Royal Institution of Naval Architects, The Institute of Marine Engineers (Sydney Branch), and the Naval Architecture Section of The University of New South Wales. That symposium explored the impact of 200 mile economic zones. As a lawyer, I was on more confortable ground with that subject than with other technical matters of ship technology. That symposium and today's are part of a series which go back to 1973, and which have been designed to advance knowledge and discussion of issues which emerge as technical and other advances and problems arise in various areas of the shipping industry. The subject of the 1973 symposium was Australian Built Ships; in 1975 it was Small Ships, in 1977, Ship Management. On this occasion it is Sea Transport Technology.

It takes place, as did the 1979 symposium, in the University of New South Wales. It is a familiar venue for me, and on this occasion I come to it for the first time since my friend Professor Michael Birt has assumed the Vice-Chancellorship. I am pleased to see him here today, and I wish him well in his new office.

On this occasion, too, the Company of Master Mariners of Australia joins the three earlier partners in sponsoring the symposium. I hold the august office of Master of the Company of Master Mariners. That I do so bears testimony to the words of Lord Melbourne spoken in another context: *'Let's have no damn nonsense about merit'*. It comes to me by virtue of my Office as Governor-General. The history goes like this: when the Company was established in 1938, the Governor of Queensland held this office; it then passed to another State Governor. Then it came to Sir William McKell, and since then successive Governors-General have borne the heavy responsibility. It appears that as long as I can sign my name on a certificate, I satisfy the requirements of the office; it is a literacy rather than a technical qualification. And may I tell you that the first Governor-General Master, Sir William McKell, attained the great age of ninety a few weeks ago, and it was my pleasure to speak to him on that day. To come back to the role of the Company, it has an obvious concern with the substance of this symposium: it is a federal body with state branches, and it is concerned to promote the efficiency of the Australian maritime services generally, and to facilitate communication to government and other bodies on behalf of its members.

Australia is an island continent and a trading nation; it depends heavily on sea transport for the carriage of imports and exports. Many of its major manufacturing sites are located on or near the coast; this gives a significance to domestic sea transport, though it is the case that only a small proportion of this total tonnage is carried by sea. Overall, sea transport is of great significance to Australia, and so it is that the problems of the industry and its efficiency are matters of great concern. Last year, 1980, the Victorian Branch of the Institute of Marine Engineers held a symposium on Ships for the Eighties: Designing For Fuel Economy, which highlighted a major concern of the industry and the nation. Since 1973, the escalation of fuel prices has posed great problems. That year marked the end of an era in which crude oil was freely available at required quantities at low prices. Since mid-1974, marine fuel prices at Sydney have increased from US$75 per tonne to US$235 per tonne in September 1981. This is a 300% increase; in real terms (on a C.P.I. basis), an increase of 190%. The increases have been especially steep in recent years. A large container ship requiring up to one hundred tonnes of marine fuel oil a day while steaming at sea has a bill of around $24,000 a day for fuel at present prices. Added to this, there has been the problem of increased uncertainty of supply. All of this has directed attention to ways and means of increasing the efficiency of the use of liquid fuel, and also of using alternative fuels. So the Victorian symposium last year looked at a variety of energy sources and also at propulsion plants, sub-systems and hull designs, surface finishes and ship operating techniques. The Institute of Marine Engineers, the Company of Master Mariners and the other partners associated with this symposium also established a task force early in 1979 to initiate, promote, and publish studies and encourage research on the technological and economic aspects of the maritime industry, and part of this strategy was the holding of a symposium late in 1981.

The symposium committee has invited a body of informed speakers to explore recent developments in sea transport designed to promote efficient energy usage. It invites consideration of the energy efficiency of sea transport as compared with other relevant forms of transport. Consideration of the problems has technical and commercial aspects. Technical aspects cover a consequence of rising fuel prices; technical innovations have to be measured in their commercial applications and implications. For example: a recent paper on coal burning ships points out that rapidly rising oil prices have inevitably encouraged ship owners to look at alternative fuels, and of these coal is the cheapest. Since the era when coal was commonly in use as a fuel at sea, both ship-types and tonnages have changed dramatically to meet the demands of modern commerce, and any new coal burning machinery must prove itself compatible with these trends. In addition, the introduction of oil-burning propulsion systems and, latterly, of sophisticated and reliable automation systems which enable ships' machinery to be operated for at least part of each day unmanned, has resulted in a steady reduction in manning levels. This process is still going on, and it can be confidently predicted that coal, in spite of its competitive price compared to oil, will never successfully return to sea unless it is capable of fuelling the very large ships now used while being operated by crews of similar numbers to those now employed. While these are not necessarily limiting factors, ship designers will need to respond to them comprehensively.

I have seen a recent note from the Bureau of Industry Economics that coal fired bulk carriers are due to be introduced in 1982 for carrying alumina on the Weipa-Gladstone run. This will see the reintroduction on the Australian coast of vessels using this type of fuel. The engine technology is new; the ships will use Queensland coal. I understand, however, that the general introduction of coal-fired vessels is not envisaged in the near future; there are hurdles which include the present lack of coal bunkering facilities at major ports.

So far as ship size is concerned, I understand that the first response to increases in operating costs was to increase vessel size, particularly for bulk carriers. Yet, in looking at technical and commercial interrelations, it was seen that savings in haul costs (port to port) which were achieved by using larger vessels were traded off against increased loading and unloading costs once in port. It is also pointed out that capacity utilization problems can arise with very large vessels; there may be insufficient cargo available to use the ship fully, and this can be a problem with very large container ships. In this context I note the development of multi-purpose vessels capable of handling bulk products (dry or liquid) and unitised cargo (containers, pallets and other forms of unit loads). This recent development is seen as a means of ensuring reasonable load factors on all legs of a voyage. A well-known fleet of vessels of these types is that operated by the A.B.C. Line which has a long term contract to carry mineral sands from Western Australia to the gulf ports of the United States of America. I understand that these ships are also designed to carry containers, allowing them to complement their bulk cargo, particularly on legs where they would otherwise be sailing in ballast.

I have seen a recent statement from Australian industry economic sources which analyses new ships on order, from which it appears that large increases in the average size of ships, in particular bulk and container ships, will not occur in the near future.

I was interested to see in the papers for this symposium a consideration of tug and barge transport. The author, and other writers on this subject, point to the implications of the use of tugs to transport barges around the Australian coast. There are said to be fuel, crew and capital cost savings which can be achieved, compared with a traditional general cargo or roll-on, roll-off ship. The point is made, however, that there is maritime union opposition on grounds of safety and reduced manning. This is a factor of significance: the potential for change in the interests of cost efficiency is profoundly affected by industrial considerations: there is a great need to achieve relationships with the maritime unions to ensure regularity and to avoid costly hold ups. Technical solutions do not, of themselves, solve the problems of the industry.

Then there are questions which lie beyond my technical competence: questions which go to instrumentation and hull improvement, which involve improved steering and navigation systems which will ensure minimum port-to-port distances, hull paints designed to minimise skin friction and thereby reduce fuel consumption.

All of this, I am sure, is not a very impressive performance from the Master of the Company of Master Mariners. As sponsors of this symposium, they have full liberty to disown me. I am pleased, however, that you have asked me to participate. Your industry and your professions are faced with great challenges, and the solutions to the many problems: technical, commercial, in industrial relations, are of great importance.

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* *Exhibition and Films Sub Committee*

\# *Papers Sub Committee*

INDEX

Page

CONTENTS A

Opening Speeches

Professor L. Michael Birt, C.B.E.
Vice-Chancellor and Principal
The University of New South Wales ... v

Sir Zelman Cowen, A.K., G.C.M.G., G.C.V.O., K.St.J., Q.C.
Governor-General of the Commonwealth of Australia ... vii

CONTENTS B

Symposium Committee ... xi

Index ... xiii

Index of Contributors ... xx

CONTENTS C

Additional Papers*

Session 1.3 *TIGER LINE CONCEPT*
W.J. Hood, Consultant Naval Architect ... 1

Session 1.6 *COMMERCIAL ASPECTS OF SHIPPING*
J.C. Jenkins, Overseas Containers Australia Pty. Ltd., Sydney ... 15

Session 2.6 *FUEL MANAGEMENT AND FUEL ECONOMY*
T. Amundsen, Det norske Veritas, Sydney ... 21

Session 2.12 *ADVANCES IN MICROPROCESSOR CONTROLS FOR OPTIMISATION OF INDUSTRIAL PROCESSES AND THEIR APPLICATION TO SHIP MANAGEMENT*
R.M. Sproge, Honeywell Pty. Ltd. ... 43

* Editor's Note: Due to circumstances outside the control of the Symposium Papers Committee, these papers were not received in time for inclusion in the Main Volume.

Page

CONTENTS D

Symposium Discussion and Replies

SESSION 1.A CHAIRMAN *Captain J. Dodwell*
MANAGER *K.M. Murray*

Paper 1.1 Rear Admiral W.J. Rourke, RAN
SHIPS, SHIPBUILDING AND NATIONAL DEFENCE

Contributors

Griffiths, G.R., Rear Admiral, RAN (Rtd.)	1.1.1	53
Ellis, W.F.	1.1.2	
Coates, B.P.	1.1.3	54
Jeremy, J.C.	1.1.4	
Pearson, A., Captain	1.1.5	
Author's Replies		55
Summing Up By The Chairman	1.1.6	57
Written Contribution Received After Symposium		
Bateman, W.S.G., Captain, RAN	1.1.7	58
Author's Reply		59

Paper 1.2 P.W. Naughton
COMBINATION CARRIERS - ECONOMIC AND COMMERCIAL ASPECTS

Contributors

Bendall, D.	1.2.1	61
Griffiths, G.	1.2.2	
Benford, H., Professor	1.2.3	62
Wood, G.J.	1.2.4	
Davies, J.I.	1.2.5	64
Russell, L.C.	1.2.6	
McMahon, R.F.	1.2.7	
Ying, C.	1.2.8	65
Dodds, B.	1.2.9	
Hawke, R.G.	1.2.10	
Author's Replies		65
Summing Up By The Chairman	1.2.11	68

Paper 1.3 W.J. Hood
THE TIGER LINE CONCEPT

Contributors

Doctors, L.J., Dr.	1.3.1	69
Waters, W.	1.3.2	
Wheatstone, S.E.	1.3.3	70
Author's Replies		71

Page

SESSION 1.B CHAIRMAN K.W. Limbrick
MANAGER L.J. Prandolini

Paper 1.4 H.D.M. Jones
NEW ZEALAND COASTAL AND OVERSEAS SHIPPING IN THE 1980'S

Contributors

Goulden, M.J.	1.4.1	73
Ritchie, G.	1.4.2	75
Lorimer, R.T.	1.4.3	76
Waters, W.	1.4.4	
Ying, C.	1.4.5	77
Perkins, R.J.	1.4.6	
Author's Replies		78

Paper 1.5 R.J. Perkins
COASTAL SHIPPING - HOW COMPETITIVE?

Contributors

Fitzgibbon, C.H.	1.5.1	83
Campbell, G.	1.5.2	
Keen, P.D.	1.5.3	
Springhall, C.C., Captain	1.5.4	84
Russell, L.C.	1.5.5	
Benford, H., Professor	1.5.6	
Bateman, S. Captain, RAN	1.5.7	
Hawke, R.G.	1.5.8	85
Griffiths, G.	1.5.9	
Author's Replies		85

Paper 1.6 J.C. Jenkins
COMMERCIAL ASPECTS OF SHIPPING

Contributors

Bendall, D.	1.6.1	97
Spiers, J.	1.6.2	
Coates, B.P.	1.6.3	
Waters, W.	1.6.4	98
Author's Replies		99

SESSION 1.C CHAIRMAN J.C. Jeremy
MANAGER A.G. Mitchell

Paper 1.7 N.K. Aggarwal
ECONOMIC BENEFITS OF AUSTRALIAN SHIPPING AN INPUT-OUTPUT ANALYSIS

Contributors

Bendall, H., Mrs.	1.7.1	101
Renwick, C., Professor	1.7.2	102
McMahon, R.F.	1.7.3	
Author's Replies		103

			Page
Paper 1.8	G.J. Wood *OCEAN DRY BULK CARGO SHIPPING IN THE EIGHTIES AND NINETIES*		
	Contributors		
	Coates, B.P.	1.8.1	105
	Sampson, J.F., Captain	1.8.2	109
	Hood, W.J.	1.8.3	111
	Aggarwal, N.K.	1.8.4	
	Author's Replies		112
Paper 1.9	J.M. Wallace *PORT DEVELOPMENT IN N.S.W. IN THE EIGHTIES*		
	Contributors		
	Duthie, W., Captain	1.9.1	115
	Ritchie, J.B., Dr.	1.9.2	
	Author's Replies		116
SESSION 2.A	*CHAIRMAN Captain H. Vanderwel* *MANAGER Captain A. Pearson*		
Paper 2.1	C. Archer *DEVELOPMENTS IN THE SEARCH FOR INCREASED EFFICIENCY OF MARINE MACHINERY* *Editor's Note: This paper was not subject to questions as it quoted factual information.*		
Paper 2.2	W.F. Ellis *GAS FIRED COASTAL BULK CARRIERS*		
	Contributors		
	Drabol, A.A.	2.2.1	119
	Gallois, J.	2.2.2	120
	Kobayashi, O.	2.2.3	121
	Bews, D.C.	2.2.4	
	Tait, A.R.L.	2.2.5	
	Salisbury, P.R.	2.2.6	
	Vanderwel, H., Captain	2.2.7	122
	Roberts, R.H.	2.2.8	
	Author's Replies		123
Paper 2.3	H. Benford and R.M. Scher *AUSTRALIAN BULK CARRIER DESIGN AND OPERATIONS IN AN ERA OF HIGH FUEL COSTS*		
	Contributors		
	Salisbury, P.R.	2.3.1	127
	Waters, W.	2.3.2	
	Bendall, H., Mrs.	2.3.3	128
	Hawke, R.G.	2.3.4	
	Pal, P.K.	2.3.5	129
	Doctors, L.J., Dr.	2.3.6	
	Renshaw, P.	2.3.7	
	Clarke, E.S.	2.3.8	
	Author's Replies		129

			Page
SESSION 2.B	CHAIRMAN R.G. Hawke MANAGER D.A. Gillies		
Paper 2.4	R.F. McMahon *WASTE HEAT UTILISATION*		
	Contributors		
	Edwards, G.	2.4.1	133
	Gallois, J.	2.4.2	135
	Klass, V.E.	2.4.3	
	Author's Replies		136
Paper 2.5	D.B. Brown *USE OF COAL/OIL MIXTURES AS POSSIBLE FUEL FOR STEAM POWERED VESSELS*		
	Contributors		
	Baddams, H.W.	2.5.1	139
	Durie, R.A.	2.5.2	
	Beggs, G.C.	2.5.3	140
	Cowper, N.T.	2.5.4	141
	Kobayashi, O.	2.5.5	
	Alt, J.	2.5.6	142
	Author's Replies		142
	Summing Up By The Chairman	2.5.7	145
Paper 2.6	T. Amundsen *FUEL MANAGEMENT AND FUEL ECONOMY*		
	Contributors		
	Griffiths, G.	2.6.1	147
	Aggarwal, N.K.	2.6.2	149
	Smith, K.B.	2.6.3	
	McMahon, R.F.	2.6.4	
	Oxley, M.	2.6.5	150
	Author's Replies		150
SESSION 2.C	CHAIRMAN G. Griffiths MANAGER K.M. Murray		
Paper 2.7	R.S. Grono *CAN SAILING SHIPS BE ECONOMIC?*		

Editor's Note: This paper was presented by Captain A. Pearson, Company of Master Mariners on behalf of the Author who was absent overseas. As a result there was no discussion nor written questions.

			Page
Paper 2.8	O. Kobayashi *THE FIRST COMMERCIAL MOTOR SHIP WITH SAILS*		
	Contributors		
	Murray, K.M.	2.8.1	153
	Fitchett, K.T.	2.8.2	
	Taylor, F., Dr.	2.8.3	
	Clarke, E.S.	2.8.4	
	Hood, W.J.	2.8.5	154
	Pearson, A., Captain	2.8.6	
	Kirby, G.M.	2.8.7	
	Payne, A.	2.8.8	155
	Author's Replies		156
Paper 2.9	W. Bolitho *TUG AND BARGE TRANSPORTATION IN AUSTRALIA*		
	Contributors		
	Campbell, C.R.	2.9.1	159
	Perkins, R.J.	2.9.2	160
	Benford, H., Professor	2.9.3	161
	Pike, D.	2.9.4	
	Renshaw, P.	2.9.5	162
	Author's Replies		162
Paper 2.10	J.T. O'Toole and G.R. Owen *NAVSTAR GLOBAL POSITIONING SYSTEM AND ITS EFFECT ON NAVIGATION IN THE EIGHTIES*		
	Contributors		
	Flaherty, C.I., Captain	2.10.1	165
	Brace, J., Captain	2.10.2	
	Westwater, B., Captain	2.10.3	166
	Author's Replies		166
SESSION 2.D	CHAIRMAN W.F. Ellis MANAGER R.C. Morgan		
Paper 2.11	R.W. Ware *STOLKRAFT - HIGH SPEED AERO-HYDRODYNAMIC HULL*		
	Contributors		
	Grant, D., Captain	2.11.1	169
	Tait, A.R.L.	2.11.2	
	Edmonds, P.A.	2.11.3	
	Halliday, R.F.	2.11.4	
	Doctors, L.J., Dr.	2.11.5	171
	Author's Replies		173

Page

Paper 2.12 R.M. Sproge
ADVANCES IN MICROPROCESSOR CONTROLS FOR OPTIMISATION IN INDUSTRIAL PROCESSES AND THEIR APPLICATION TO SHIP MANAGEMENT

Contributors

Simpson, F. 2.12.1 175
Edwards, G. 2.12.2
Smith, A.B. 2.12.3 178

Author's Replies 178

Paper 2.13 G. Edwards, N. Holgerson and Captain A. Irons
MONITORING SHIP SYSTEMS FOR OPTIMUM EFFICIENCY AND SAFETY

Contributors

Griffiths, G. 2.13.1 183
Tait, A.R.L. 2.13.2

Author's Replies 185

Exhibition and Films 189

Location Map 190

Symposium Dinner 193

Symposium Dinner Address

Professor H. Benford
University of Michigan 195

List of Registrants and Guests 203

INDEX OF CONTRIBUTORS

			Page
A	Aggarwal, N.K.	1.8.4	111
		2.6.2	149
	Alt, J.	2.5.6	142
B	Baddams, H.W.	2.5.1	139
	Bateman, S., Captain, RAN	1.5.7	84
	Bateman, W.S.G., Captain, RAN	1.1.7	58
	Beggs, G.C.	2.5.3	140
	Bendall, D.	1.2.1	61
		1.6.1	97
	Bendall, H., Mrs.	1.7.1	101
		2.3.3	128
	Benford, H., Professor	1.2.3	62
		1.5.6	84
		2.9.3	161
	Bews, D.C.	2.2.4	121
	Brace, J., Captain	2.10.2	165
C	Campbell, C.R.	2.9.1	159
	Campbell, G.	1.5.2	83
	Clarke, E.S.	2.3.8	129
		2.8.4	153
	Coates, B.P.	1.1.3	54
		1.6.3	97
		1.8.1	105
	Cowper, N.T.	2.5.4	141
D	Davies, J.I.	1.2.5	64
	Doctors, L.J., Dr.	1.3.1	69
		2.3.6	129
		2.11.5	171
	Dodds, B.	1.2.9.	65
	Drabol, A.A.	2.2.1	119
	Durie, R.A.	2.5.2	139
	Duthie, W., Captain	1.9.1	115
E	Edmonds, P.A.	2.11.3	169
	Edwards, G.	2.4.1	133
		2.12.2	175
	Ellis, W.F.	1.1.2	53
F	Fitchett, K.T.	2.8.2	153
	Fitzgibbon, C.H.	1.5.1	83
	Flaherty, C.I., Captain	2.10.1	165
G	Gallois, J.	2.2.2	120
		2.4.2	135
	Goulden, M.J.	1.4.1	73
	Grant, D., Captain	2.11.1	169
	Griffiths, G., Rear Admiral, RAN (Rtd.)	1.1.1	53
	Griffiths, G.	1.2.2	61
		1.5.9	85
		2.6.1	147
		2.13.1	183
H	Halliday, R.F.	2.11.4	169
	Hawke, R.G.	1.2.10	65
		1.5.8	85
		2.3.4	128
	Hood, W.J.	1.8.3	111
		2.8.5	154

			Page
J	Jeremy, J.C.	1.1.4	54
K	Keen, P.D.	1.5.3	83
	Kirby, G.M.	2.8.7	154
	Klass, V.E.	2.4.3	135
	Kobayashi, O.	2.2.3	121
		2.5.5	141
L	Lorrimer, R.T.	1.4.3	76
M	McMahon, R.F.	1.2.7	64
		1.7.3	102
		2.6.4	149
	Murray, K.M.	2.8.1	153
O	Oxley, M.	2.6.5	150
P	Pal, P.K.	2.3.5	129
	Payne, A.	2.8.8	155
	Pearson, A., Captain	1.1.5	54
		2.8.6	154
	Perkins, R.J.	1.4.6	77
		2.9.2	160
	Pike, D.	2.9.4	161
R	Renshaw, P.	2.3.7	129
		2.9.5	162
	Renwick, C., Professor	1.7.2	102
	Ritchie, G.	1.4.2	75
	Ritchie, J.B., Dr.	1.9.2	115
	Roberts, R.H.	2.2.8	122
	Russell, L.C.	1.2.6	64
		1.5.5	84
S	Salisbury, P.R.	2.2.6	121
		2.3.1	127
	Sampson, J.F., Captain	1.8.2	109
	Simpson, F.	2.12.1	175
	Smith, A.B.	2.12.3	178
	Smith, K.B.	2.6.3	149
	Spiers, J.	1.6.2	97
	Springhall, C.C., Captain	1.5.4	84
T	Tait, A.R.L.	2.2.5	121
		2.11.2	169
		2.13.2	183
	Taylor, F., Dr.	2.8.3	153
V	Vanderwel, H., Captain	2.2.7	122
W	Waters, W.	1.3.2	69
		1.4.4	76
		1.6.4	98
		2.3.2	127
	Westwater, B., Captain	2.10.3	166
	Wheatstone, S.E.	1.3.3	70
	Wood, G.J.	1.2.4	62
Y	Ying, C.	1.2.8	65
		1.4.5	77

THE TIGER LINE CONCEPT

by

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SUMMARY

Because its efforts to import freight carrying aircraft into Australia were continually frustrated by Government action, a major road freight company decided to investigate the possibility of providing a fast shipping service between mainland Australia and Tasmania as an alternative to air transport.

This paper describes the concept and the developement of it. The ship and its route between terminals on each side of Bass Strait were viewed as a link in the transport company's line haul, with that company owning and operating all units including terminals, cranes, containers and trucks.

Extensive model testing was carried out to ensure that satisfactory service reliability could be achieved in the Bass Strait environment.

The proposed service created great interest and some controversy, particularly in respect of the manning arrangements and the locations of the terminals.

The service has not been instituted for political and industrial reasons but in technological terms it could have been considerably successful.

1. INTRODUCTION

Until a few years ago, there were very few items which were classified as prohibited imports into Australia. Included in these were drugs of addiction, certain pornographic materials and freight aircraft having all-up-weights above 12,000 pounds. The IPEC Transport Group had been applying to the Commonwealth Government for some 14 years for permission to import aircraft to fly freight across Bass Strait. Governments of the day, of whatever political persuasion, steadfastly refused permission on the basis of defending the 2 airline agreement. The existing air freight capacity was, however, inadequate across the Strait.

The author suggested to IPEC that a fast ship able to cross Bass Strait in 8 to 9 hours would enable that company to provide the same speed of service avaliable from the very limited air freight capability i.e. freight collected by one of the Company's vehicles from around the suburbs of Melbourne by 5 p.m. would be delivered to an address in the suburbs of Hobart by noon the next day. The company commissioned a technical and financial feasibility study of the concept.

The study examined 2 types of vessels both having the same basic dimensions as follows:-

LOA	64.3 metres
LBP	56.0 metres
Beam	11.0 metres
Depth	4.0 metres
Draft loaded	3.0 metres
Deadweight	160.0 tonnes

The service speed required was 25 knots in normal Bass Strait weather. The estimated power requirement was 8500 BHP.

One of these vessels was arranged to carry 20 foot ISO containers on deck in one layer. The other vessel was arranged as a trailer ship, able to load 10 x 40 foot pantechnicons on deck via a stern ramp. In style, these vessels were very much like simple oil rig supply vessels as shown in Fig. 1.

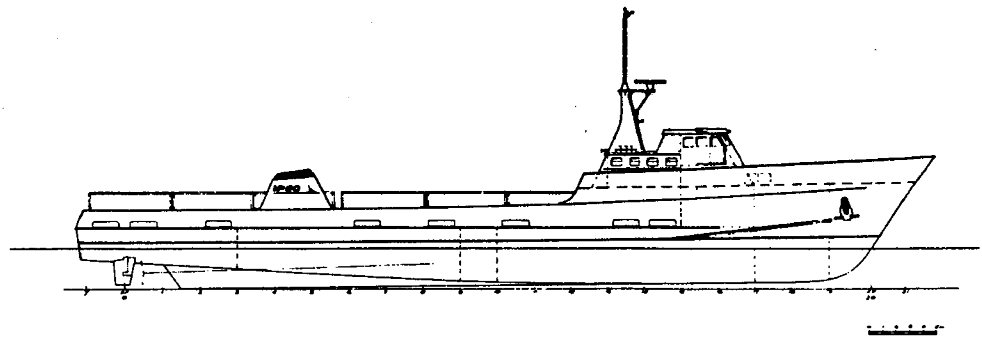
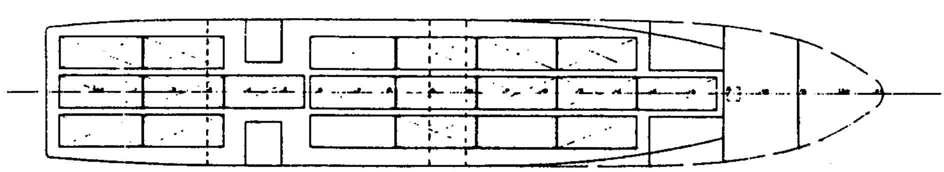


FIG. 1



The financial analysis showed that there was little to choose between the 2 types as far as the freight rate was concerned. The required freight rate was, however, some 65 percent of that required for an airfreight operation.

At this stage of development of the concept, the vessels were intended to carry only that freight which the company generated itself during its normal door-to-door road freight business. The crossing of Bass Strait was seen simply as part of the "line-haul"

Encouraged by the favourable freight rate, IPEC decided to develope the idea and to test market the proposed service.

2. BASS STRAIT WEATHER

Vital to the concept was the need for service reliability. The round trip time required was to be not more than 24 hours including cargo loading and unloading operations. A one way crossing time of 8 to 9 hours was therefore necessary.

At an early stage in the investigations, it was decided to operate from a terminal to be established in Westernport Bay on the Northern side of the Strait. The Southern terminal was to be established in one of the 3 major ports in Northern Tasmania, - Launceston, Devonport or Burnie. Depending on the final choice from these 3 and the location in Westernport, the one way voyage distance would be 180 to 195 nautical miles and the ship's speed would therefore need to be in the 23 to 25 knots range.

The ability of a relatively small vessel to maintain this high speed in what are said to be frequently rough waters required evaluation. Fortunately, a great deal of useful information about Bass Strait was available (1). This although theoretically derived, was believed to provide an adequate basis for evaluation, particularly as advice received from engineers employed on the design and installation of the platforms in the Eastern end of the Strait indicated that the method of deriving the sea state information tended to overestimate the population of a very large waves (significant height greater than 5.0 metres), based on measurements made of actual waves on completed platforms.

A desk study indicated that the vessels should be able to maintain the required speed for an adequately reliable service to be achieved but up to 3 round voyages per year (less than 1% of scheduled voyages) would need to be cancelled because the reduced speeds safely attainable on these voyages would preclude the 24 hour round voyage requirement being met. Having regard to the fact that the Bass Strait crossing was only part of the line haul, it was concluded better to cancel voyages than to delay excessively the remainder of the elements of that line haul.

A substantial proportion of the larger waves along the track connecting Westernport to the mid - North coast of Tasmania is generated by winds in the Southern Ocean. These waves travel in a North Easterly direction. It was to be expected, therefore, that the ships would experience seas on the starboard bow when Southbound to Tasmania and Port quartering seas when Northbound. The speeds of these waves are in the range of operating speeds for the ships and the possibility of steering difficulties and perhaps even broaching could not be neglected on Northbound voyages.

Southbound, in head seas and bow quartering seas, large vertical accelerations seemed certain to occur, potentially leading to extreme crew discomfort and ship and cargo damage.

An outline of a model testing program was, therefore, developed. Examination of the information given in Ref. 1 suggested that the rough water testing should be carried out in a number of scaled sea states, the largest having a significant height of 3.66 metres and a period of 11.0 seconds.

3. CONCEPT DEVELOPMENT

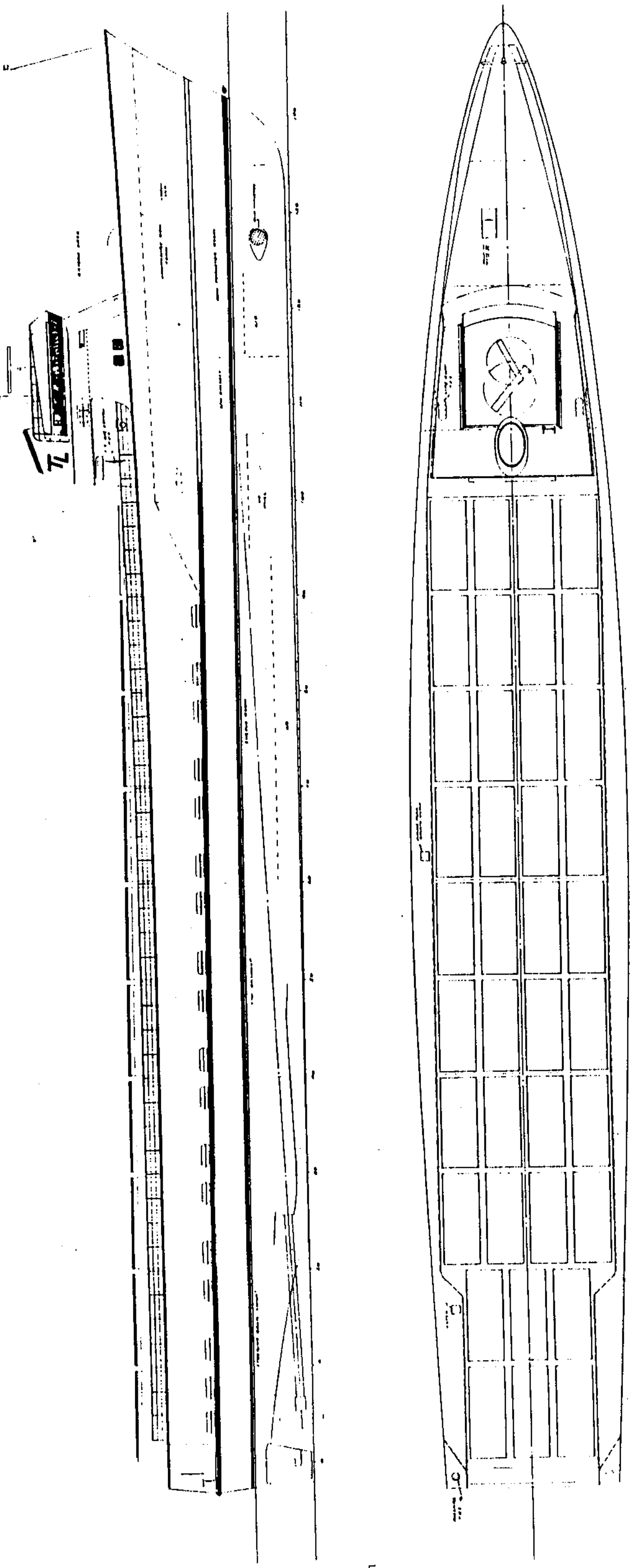
The owners came to believe that the service would generate more cargo than originally estimated. The design was accordingly developed in a number of stages, with ship dimensions increasing to the point where the GRT was approaching 1600 and the very real possibility of the need to carry a radio operator had to be faced. Further increases of size and consequently container capacity therefore ceased, the final design having the following dimensions.

L.A.	99.0 metres
LBP	92.0 metres
Beam	14.9 metres
Depth	6.7 metres
Draft loaded	3.8 metres
Deadweight	975.0 tonnes
Number of Containers	74

Fig. 2 shows the outline general arrangement. The vessel still retains the ORSV type of arrangement with wheelhouse and funnel structure forward above a raised forecastle but with containers stacked two high above deck.

Because of the relatively high speed requirement, a hull form very much like a patrol frigate but with increased beam (for stability and stowage reasons) was developed. (see Fig. 3) This hull shape was reproduced in model form at the Netherlands Ship Model Basin and a series of resistance and propulsion tests were undertaken. A number of minor modifications to the hull were required, notably in the forefoot area. A wedge of about 7 degrees included angle was added to the bottom just forward of the transom, this having the effect of reducing the power required by about 10%. Stream flow tests in the vicinity of the bow thruster tunnel forward and in the bilge keel area were performed as were wake surveys and shaft bracket alignment studies. Fig. 4 shows the horsepower-to-speed relationship in the fully loaded trials condition.

FIG.2



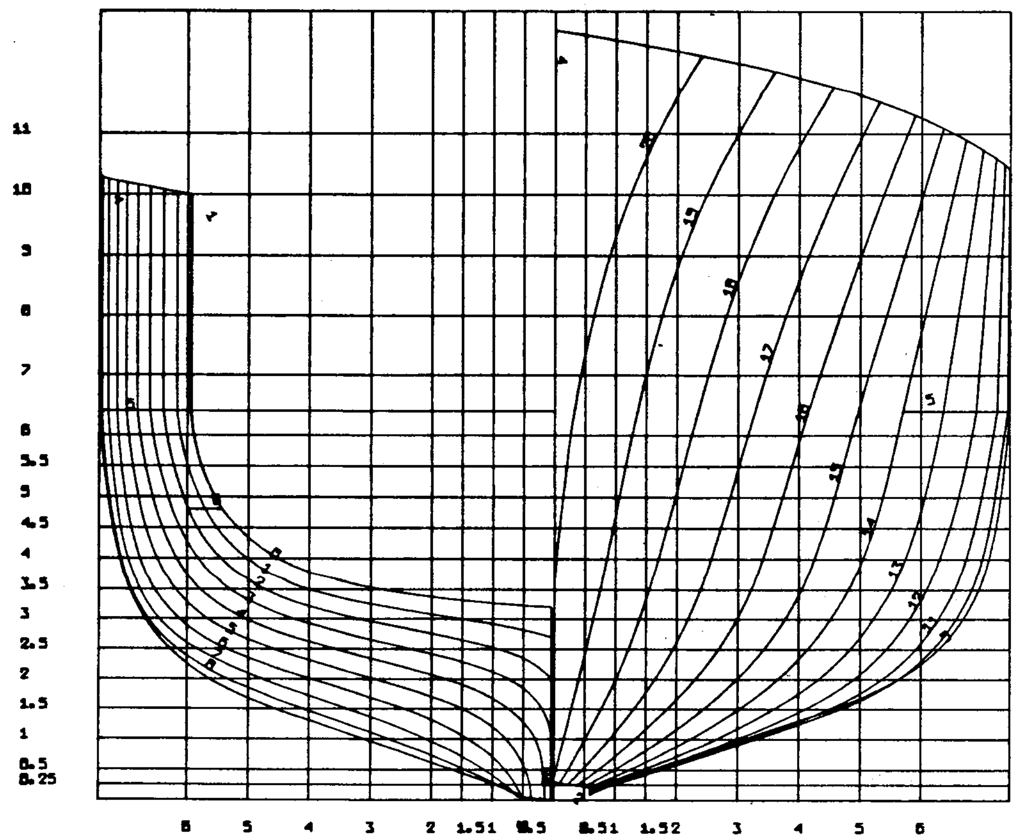


Fig. 3

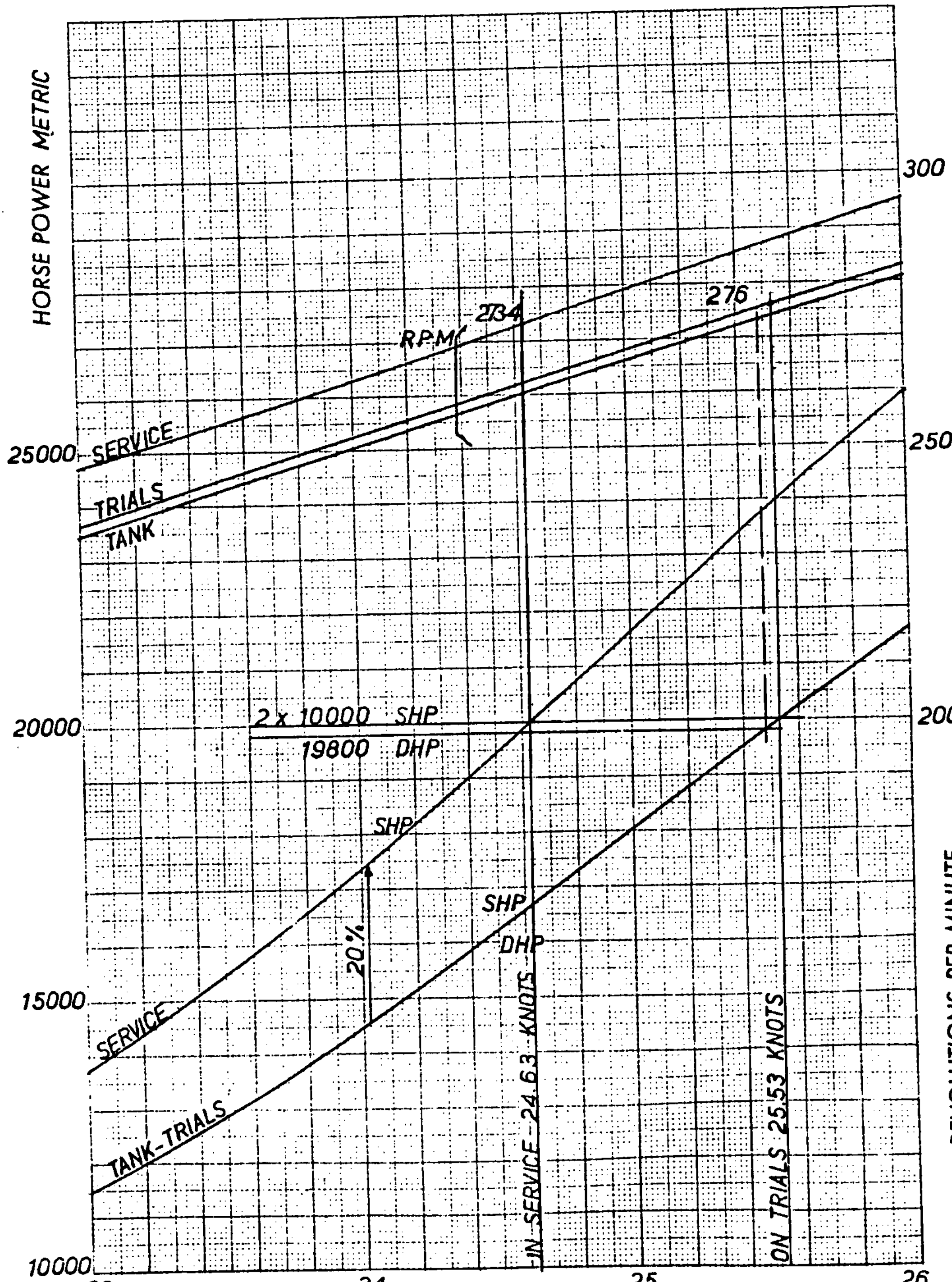
SHIP MODEL 5365 PREDICTION

PROPELLER MODEL 4155 R+L P0.7/D =1.265

TANK VALUES ARE BASED ON RESULTS OF PROPULSION TEST No 36323

DRAFT 4.00 m

FIG. 4



4. SEAKEEPING TRIALS

When the final hull form had been fixed as a result of the trials in 3. above, another model at a scale of 1 to 15 approximately was constructed from wood. This model was self propelled and fitted with active rudders and steering gear. After it had been used for a series of bow, bow quartering and beam seas experiments in scale seaways, it was fitted with additional instrumentation including radio control and automatic pilot to enable a series of broaching experiments to be undertaken. Not a great deal is known about the phenomenon of broaching and even less about appropriate model testing methods. It was decided that the model should be tested without any restraint at all by the towing carriage which would merely follow the model and receive information from and transmit steering instructions to the model by radio. Very large deviations from the desired course and substantial velocity surges were to be expected. A very wide model tank was, therefore, selected. Control of the towing carriage speed was very difficult and considerable effort was expended in development of the model testing technique. Velocity surges of as much as 25% of the steady speed were experienced. Fig. 5 shows a broaching/no broaching envelope developed from these tests.

The conclusions reached from these seakeeping trials were

a) in head seas, the desired voyage times could be achieved in sea states up to the limits of the tests.

b) the pitching motions were occassionally excessive resulting in accelerations in the wheelhouse close to the limit for personnel exposed to them for 8 hours. Bottom slamming forward could be expected at the same time and an occassional "wetness event" (towing tank jargon for green water over the bow).

c) accelerations anywhere in the cargo stack would never approach 1.0 g and the possibility of damage was, therefore, remote.

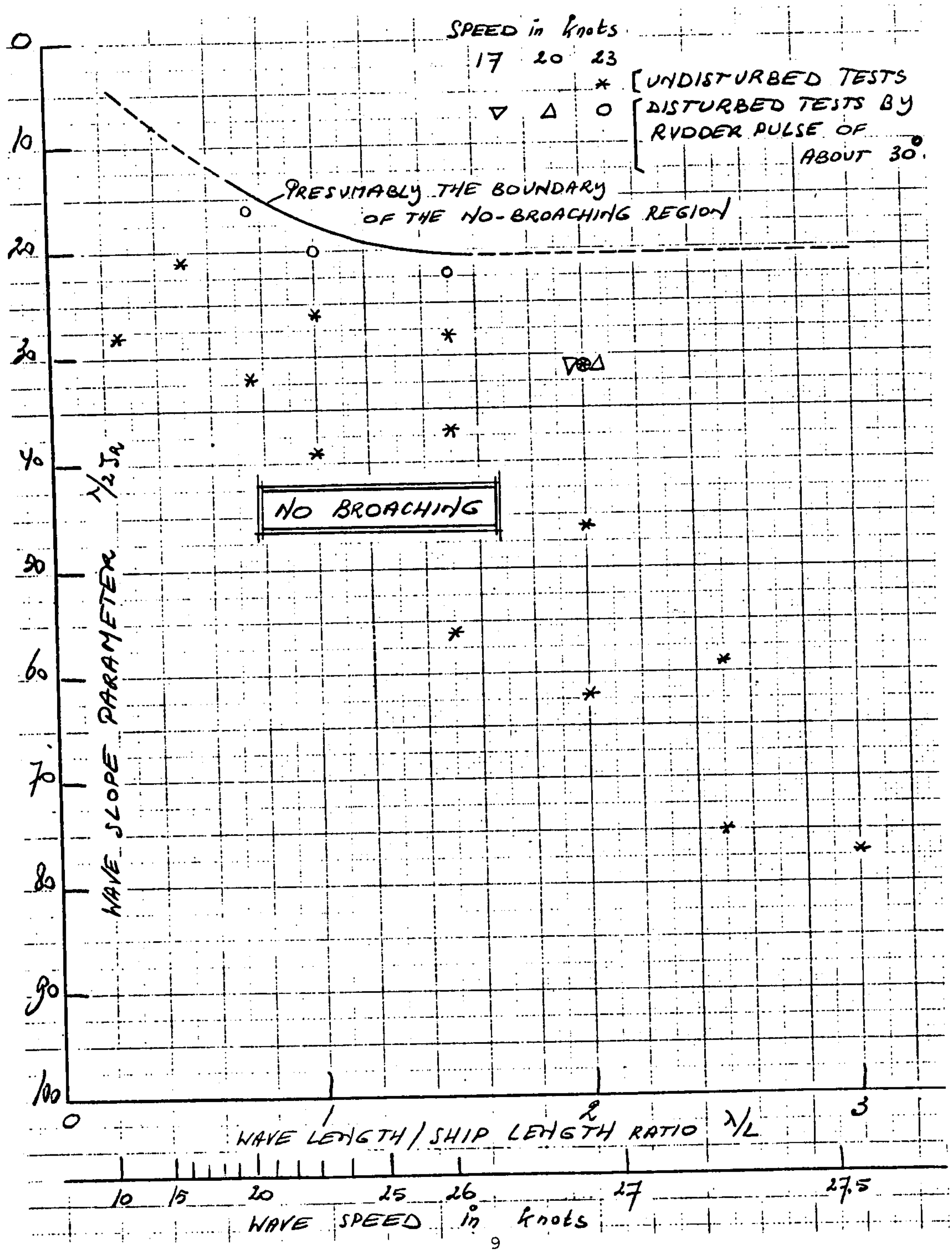
d) in following seas, serious directional stability problems were unlikely to occur and broaching, never.

BROACHING TESTS

FAST CONTAINERSHIP

TEST REVIEW

FIG. 5



5. TERMINAL SITES AND DESIGN

A number of sites were identified in Westernport Bay and preliminary engineering studies for wharves and container handling cranes were prepared. A decision had been made by IPEC that containers were more versatile than wheeled pantechnicons and in any case there was some doubt about the pantechnicon bodies, tyres and suspensions being capable of withstanding the ship motions.

Discussions with the 3 major port authorities in Northern Tasmania resulted in a decision to use Devonport as the Southern terminal site. An existing wharf was allocated in that port and design studies for modifications to it and installaltion of cranes were undertaken.

The container handling cranes were purpose designed for the berths and the ships and were capable of much shorter cycle times than the normal very large cranes seen at the usual container berths. By providing 2 cranes at each berth it was possible to reduce the loading and unloading times to such an extent that the ship's speed could be reduced and the voyage time increased. The reduction in speed was sufficient to permit a reduction in installed propulsive power of 50% - from 20,000 to 10,000 BHP.

6. MANNING AND AUTOMATION

Two factors were the main influence on deciding the manning level for the proposed ships.

a) There is nothing lacking in the available technology which would prevent the ships from safely operating the entire route including berthing operations without any crew at all.

b) The relatively short time required for a one-way voyage.

The first of these raised howls of rage in some quarters. Some minds capable of comprehending, indeed admiring, the technology which had demonstrated the capability to send space craft on voyages through hundreds of millions of miles with pin-point accuracy after years of voyage time, could not conceive of simple adaptations of this sort of technology to a ship operating on a route just a few hundred miles long and for 8 or 9 hours. There was never any intention, of course, to reduce the manning to zero. The concept did, however, set the scene for an examination of the functions of all ship operating personnel.

The second of these factors drew attention to the crewing arrangements of inter-continental, commercial aircraft, where highly trained small crews oversee the performance for a flight which might require up to about 12 hours to complete after which it will be replaced by a similar crew, fresh from a rest period.

The efforts of the design team lead to the conclusion that a crew totalling 5 only would be adequate safely to navigate the ship on a one way crossing of Bass Strait. This crew was to consist of the master, 2 navigating officers and 2 engineer officers. All crew members were to be located in the wheelhouse at carefully designed work stations with all navigating and machinery control equipment and functions coming readily to eye and hand. Those normal sea going functions of ships' crews other than those performed by the officers given above were either not required for the operation in question or were automated, including the berthing and unberthing. Automatic mooring arrangements were to be provided on the ships and their dedicated berths.

Current leave entitlements for members of the Australian sea-going unions are approaching 1 day's leave for each day's service. In order to allow for leave and the crew change requirement at the end of each one way voyage, up to 5 crews would be necessary for each ship.

7. RELIABILITY AND SAFETY

Because it is not possible to develope a concept such as this without a great deal of discussion with government and semi-government authorities, unions and private organisations and individuals who may be effected by it, it was not long before a large amount of informed and un-informed comment evolved. There were those who said that the ships would be unsafe and a danger to other vessels. There were those who wanted to become involved in the commercial decision making by the owners. There were those who were concerned about the environment of Westernport Bay which is a politically sensitive region of Victoria.

The reliability of complex machines (ships, aircraft, computers and so on) can, these days, be predicted. It was decided therefore, to undertake a reliability analysis of the ship design, including all critical components specified and a safety analysis of the voyages across Bass Strait. This work was commissioned from det Norske Veritas, the chosen classification society. Classification society records relating to machinery and structural faults and breakdowns are essential imputs to such an analysis. Additional inputs included weather data,tank testing reports and ship movement statistics in Bass Strait.

It is well known that the average ship has a high degree of redundancy of vital components built into it. For example, there is always more than one way of pumping the engine room bilges or in the event of failure of the main steering gear there is another available even though this may be suitable for hand operation only at reduced ship speed.

The reliability and safety analysis predicted, to give one example, that the possibility of a complete loss of main propulsive power was about once in 18 years of operation. This was considered to be satisfactory although it must be admitted that one cannot predict at what stage one enters the 18 year cycle. A number of recommendations of relatively simple nature, one relating to gear box stand-by lubrication arrangements, were adopted.

Perhaps the most interesting aspect of this type of analysis is in exposing what might be called "soft spots" in what might appear to be thoroughly reliable equipment. As an example, the radar equipment specified consisted of 2 transmitter/receivers, 2 displays and 2 antennae. An inter-switch allowed either transmitter/receiver to work with either display and either antennae. Each of these 6 major items was shown to have adequate reliability when properly installed but the weakness in the whole system was one of the least complex and cheapest components, namely the inter-switch.

The great value of this reliability and safety analysis lies in providing the ability to give proper answers based on sound engineering principles to those conservatives who ask "What happens if such and such stops?". The cost of the analysis was found to be quite reasonable and it may be recommended to any ship designer. It is just as likely to expose an element of over-design as it is a "soft spot".

8. STRUCTURE AND MACHINERY ARRANGEMENTS

Having regard to the characteristics of the commodities to be carried in the containers, the average mass of each including the container had been set at 12.5 tonnes giving a cargo deadweight of 925 tonnes. Budget masses were then set for structure, machinery and outfit as well as the remaining components (fuel, water, crew and effects) of the deadweight. There was obviously no profit in continuously transporting excess fuel backwards and forwards across the Strait. Although the fuel tank capacity was considerable, fueling installations were to be provided at each terminal and nomore fuel than for 3 round voyages was to be carried. The masses of fresh water, crew and effects were obviously fairly small.

A detailed structural design was carried out using the facilities of DNV in Oslo, Norway. This resulted in a light and elegant structural arrangement, partly transversely and partly longitudinally framed which provided a saving of 50 tonnes of steel mass as compared to the budget. This was fortunate as further promotion of the service was resulting in heavier and heavier commodities being offered for transport.

The structure required fairly substantial stiffening in the forefoot and in the bridge front. The bridge front windows were to be double-glazed. Large quantities of water in the wheelhouse would have played havoc with the electronic equipment installed there.

A pressure transducer was to be installed in the forefoot area to provide an alarm in the wheelhouse indicating that a reduction in speed was necessary.

The high bulwarks, of a box-type structure, were considered as part of the main hull girder. They also protection for the containers and support for the container cell - guide structure.

The selection of the main propulsion engine was made fairly simple because there were only 2 or 3 types having the required power, low weight and low fuel consumption that were essential. A further restraint was the low headroom in the engine room which was entirely below the deck supporting the container stack. There could be no casing or skylight through the deck.

The engines selected were manufactured by MTU in Southern Germany. They were of the 1163 Series, having vee form and 20 cylinders. The maximum continuous rating for commercial application of this engine is 5000 HP. Two engines were required, each coupled to a controllable pitch propeller via a reduction gearbox and flexible coupling.

The engine room was also to contain 2 diesel-driven alternators plus the usual pumps and auxiliaries. An emergency generator was to be installed in a separate space within the forecastle while a bow transverse thruster of 3 tonnes thrust, driven by a diesel engine was specified.

The steering gear was to provide for tandem operation of the twin rudders while in the normal operational mode and for independent operation while manoeuvring. With a control system combining the functions of the rudders, propellers, bow thruster and engines, the ships would be able to inch ahead or astern, to move bow or stern to Port or Starboard or to combine any of these movements under the control of "joy-stick" type levers mounted on the bridge wings.

9. SERVICE IMPLEMENTATION

The concept appeared to be soundly based. Nimmo[2] had recommended a fast service across Bass Strait with a round voyage time of 24 hours. Detailed design and cost estimates had shown satisfactory reliability adequate safety and good profitability at ruling freight rates. Tenders were therefore called for the construction of 2 ships, for the necessary containers, cranes, wharves and additional trucks for the road transport sections of the line haul. The total capital cost at 1978 prices was of the order of $40 million.

The company's aspirations may have, to this stage, been treated with a certain lack of seriousness by its potential competitors although the concept had been well publicised. Furthermore, committees appointed by the Governments of both Victoria and Tasmania had investigated the concept in some depth and had reported favourably.

A public meeting held in Hobart had, however, soundly condemned the idea. The opposition came from almost all quarters including seagoing unions, waterfront unions (Hobart branches), freight forwarders and existing shipping companies. IPEC decided at that stage to delay the project, in spite of a large investment in investigations and promotion.

10. CONCLUSIONS

The Tiger Line concept attracted much interest in Australia and overseas. There are a number of sea transport routes of similar distance where a small, fast vessel providing a service having a round trip time of 24 hours appears to be attractive particularly where valuable commodities are involved.

The technical problems relating to service reliability and low manning levels can be solved and, at ruling freight rates, the service is financially viable.

This type of shipping service may, however, never be seen in operation. The most important reason for this in the case of Tiger Line is the very high consumption of expensive fuel. All forms of marine transport are looking for ways of reducing the cost of fuel by such means as slow steaming, coal firing and the use of wind power. The cost of the fuel for one round trip of a Tiger Line type vessel of less than 1000 DWT is very roughly equal to the daily cost of heavy fuel for a much larger, slower vessel transporting 50 times that deadweight.

At the time, the main reason for delaying of the project was opposition from maritime unions and potential competitors which resulted in some official support of the concept being withdrawn. The need for better shipping services to Tasmania continues to exist and the Tiger Line idea may be revived. The passage of time may assist in reduction of the opposition to the concept of manning and propulsion engines capable of running on heavy and cheaper fuels may be developed.

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THE COMMERCIAL ASPECTS OF SHIPPING

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Shipping is an industry.

The commercial aspects of providing a shipping service are those that apply in any industry. They cover the provision of a required service, or product, to a standard which meets the requirements of those using the service; at a price which enables those using the service to carry on business; enables those involved in the industry to provide sufficient return to attract funds; and creates worthwhile employment for those in and associated with the industry.

There is no fundamental change in this definition, whether the industry is run by private enterprise, seeking its investment from privately funded sources, or whether it is run by government, where the investment is obtained, through taxes, from the common wealth of the people.

The return sought by private enterprise will certainly be that which enables the industry to sensibly obtain funds and to create a track record of performance and return which enables that process to be continued in terms of replacing equipment and fixed assets. This may arise for reasons of age or of advancing technology. It must also maintain the standards of those employed in the industry.

In an equal for equal situation governments would have the same objectives and desires irrespective of their political persuasions, but together with additional requirements where the surrounding circumstances are such that a straight financial return cannot be made. The most obvious example here is the provision of services to remote areas, whether by land or by sea. There are several ways of ensuring that these services are supplied.

- One is by government being involved in the overall provision of the services on a fairly wide scale, in such a way that the bulk of the service can support those operations that are not self-standing - that is profitable operations cross-subsidising unprofitable ones, but both government operated.

- Another is by government simply providing the services in the particular areas concerned, for the benefit of the society that requires them, but on behalf of all tax payers.

- A third is by subsidising an operation undertaken by private enterprise either through a direct government subsidy, or by private enterprise developing a tariff which accepts an obligation to trade development despite non-commercial returns.

It is interesting to note that the last two have a different effect on the distribution of the burden of providing those services rendered to areas that cannot support themselves. In the first instance the burden is distributed across all tax payers in the community, in the second the burden is distributed across all those in the community who specifically require the service.

Conference shipping is organised along lines of the second instance. Services are provided which, taken in isolation, would not be commercial - covering outlying ports and areas, pricing to meet the needs of low value products and contributing to the development of port facilities through direct investment.

The shipping industry requires heavy investment in equipment both afloat and ashore, whether it is handling general cargo or bulk commodities, dry or liquid. The cost of a container ship, and the containers that go with it, is in excess of $50 million. The return on that outlay has to be such that the initial investment can be attracted, such that those employed in the operation of the ship can be properly remunerated, and such that money is available for the replacement of assets when this is required, remembering that this cost will be greater than the first investment. All this has to be done at a price which will attract business.

Australia survives by trade, and shipping is a vital part of trade. A functional and efficient relationship between trade and shipping is essential to the welfare of Australia and all those who live in Australia. It follows that it can be argued that, in Australia, shipping is more a part of trading responsibilities and objectives than straight-out transport ones.

Australia is a richly endowed nation. The standard of living which we now enjoy, and, more importantly, that which we pass onto our children, is dependent on the commercial decisions and attitudes which we, throughout the community, now take.

Australia's wealth is realised through trade. Gone are the days when any community could afford to regard itself as self-sufficient, requiring no support from elsewhere. The pace of life, the advance of technology, the demands which individuals place on that technology for their own benefit and welfare and the increasing dependence of each and every individual on the community around him makes any doctrine of self-sufficiency an anachronism bordering on the ludicrous.

Australia has to face the harsh reality of a highly competitive consumer orientated world. The international considerations, whether they involve developed or less developed countries, East and West, or the recently termed North-South dialogue, do create pressures and responsibilities which impinge directly on the commercial aspects of the operation.

The welfare of those involved with an industry, be it shipping or any other, is directly related to productivity. A factor from which we cannot resile is that, in a commercially competitive situation, an industry can generally remunerate well those involved in it whilst still offering an attractive service, provided productivity is maintained. What it cannot survive is lack of productivity or lack of certainty and confidence in the standard and regularity of its services. In international trade the importance of this is absolute.

Each link in the total chain is completely dependent on all the other links. International trade will not take place if the goods are not provided to an acceptable standard, are not moved in an acceptable period and do not flow in a continuous chain, in such a way that people have commercial faith in the operation. Whilst this applies equally to general cargo and bulk shipping, it is most easily discernable in the latter.

The demands of modern society are such that the movement of commodities in high volume and as a continuous flow are fundamental precepts of the survival of the industries concerned and the welfare of the communities being served. Disruption to this flow can cause widespread hurt. This facet has become so predominently important that in many instances a rather less satisfactory commodity, with an assured delivery pattern, may well come to be preferred and out-bid its competitors.

This underlines that one of the most important commercial aspects of both trade and shipping is that of the relationship and goodwill between all those, whether individuals or organisations, involved in the operation of the industry. The prosperity of Australa is directly related to the goodwill of our trading partners. The goodwill of our trading partners is directly related to our standards of performance and dependability - that is straight-out commercial reliability - and the degree to which our ability to perform, or our disinterest in performing, helps or hinders these trading partners in achieving their own goals and looking after their own people.

Much of this seminar is involved with highly technical aspects, largely beyond my ken. But I guess that it is proper to make some comment on the commercial aspects of age and obsolescence. Technology is advancing at a compounding rate as each decade goes by and the problems of making the commercial decisions resulting from the availability of that technology become more complex. Commercially the future becomes more, rather than less, obscure. Bluntly, the technocrats themselves are no better at these decisions than any one else involved in them. The changing emphasis and wealth of nations puts added burdens on that decision-making process. For many years business interests, whether private enterprise or government, were at least able to survive, if not with the greatest degree of credit, by making investment decisions that were very largely repetitive of those that had been made before. Replacement decisions generally resulted from something being worn out rather than questions of comparative efficiency.

This no longer applies. The lead time associated with making large investments in the transport industry is such that one may be forced to consider technological advances of which one has no experience, or may result in further advances taking place after the decisions have been made, but before the investment becomes a reality.

Investments made now may reach the end of their commercially useful life well before the end of their anticipated normal working life, because of either advances in technology or a change in the price structure of some element essential to the operation.

When this occurs during the life of an asset there is only one calculation and decision that can be made, assuming a desire to continue in business. That is an assessment of whichever provides the lesser of two costs for an ongoing period; modernisation or replacement of the asset, or continuing with the existing one as it is for a period.

Because of increasing fuel prices the move from steam turbine to diesel at sea is an example of this situation. The cost of fuel itself has become a commercial consideration not only in sea transport but in international trade generally. The international trader has to weigh the cost and speed of the service offered him against the money cost of being in possession of the goods during their transit. The increase in oil prices after the second oil shock (the first one was $5 a barrel to $11 a barrel and the second one was $13 a barrel to $34) was such that slower transit may well be cheaper for the ultimate user.

Whilst on energy resources it is worth noting the point that, in an increasingly resource scarce world of high energy costs, the inter-relationship between different modes of transport and the infrastructures required to sustain the operation of these modes becomes increasingly important. Australian trade is supported not only by shipping but also by a variety of other services. These need to be related, need to act in concert, need to understand the requirements of trade, and all require investment policies which recognise these considerations in terms of both priorities and timing.

Because of the size of the investment, the transport operator, whether by air or sea, seeks some assurance that his position in the market-place will be of value for a sufficient period to enable him to convince himself and others of the surety of the investment. Historically throughout many years those investing in ships have sought to protect their interests by joining the services of the various operators, rationalising them to meet the requirements which the trade seeks and thus providing the stability and guarantee of service required to enable the trade to survive and grow.

Conferences have been an international shipping concept for about 100 years, and history has shown many examples where, without the concept of that unity of purpose and rationalisation of service, trade has suffered from such eratic performance that it has been impossible for many to survive. In every instance the type of service offered is the result of a meeting between the demands of international trade and the cost of the services being sought. In particular in Australia in liner shipping this has resulted in the provision of continuous and regular services, whether the country is benefiting from a bountiful season or suffering from drought; services which provide an inherent flexibility that can meet trading contingencies; services that offer the same rates throughout the whole of the continent and for all ports historically served. It is on this broad backbone that Australia has become one of the more important trading nations of the world.

An argument frequently raised about the investment in overseas shipping is the propriety of nations shipping their own cargoes. In this area there are two important aspects.

The first is that you cannot be both buyer and seller, you cannot fix the freight rates for export services and import services, and you cannot totally be the controller of a movement in either direction let alone both. In international trade the denial of the rights of the buyer ultimately leads to denying the likelihood of trading. This does not mean that any nation, and indeed particularly Australia, should not desire to be a maritime nation. It is proper that it should, provided the return received matches that available from competing opportunities. In achieving this objective it is equally proper that it is recognised that its maritime aspirations are not developed in isolation; it is vital that they are designed to further the trading strength and welfare of the nation. This Australia is capable of doing. By that definition it should be achieved competitively and commercially. Again, Australia is capable of doing this.

The second is that there are arguments that to move the maximum amount of a nation's goods in its own ships strengthens the nation's economy and benefits its inhabitants. These arguments may be valid, but are not the only ones. The concept should be supported, but must be viewed in a multi-national relationship. Importing countries who have excessive constrictions placed on the movement of the goods they buy overseas are likely, in the long run, to seek to redress this perceived imbalance through controls of their own. Again there needs to be a meeting of the ways.

Setting aside employment which is clearly understood, an argument can be made that there is little difference in the benefits to a community as to whether its export goods are moved by its own ships or those of another flag. Freight earnings are not export earnings, nor do they, as shipping is a service industry, represent the true value of services sold to another country. Whichever way round you do it, some large proportion of the freight earnings are spent by the operator of the service in countries other than the nationality of that operator or the flag of the ship.

Once again this argues for a meeting of the ways and an understanding of the desire of all nationalities.

In assessing the commercial aspects of shipping and the requirements of those who earn their living associated with ships, whether ashore or at sea, it is important to underline the danger that exists in making decisions based only on the business criteria and living environment recently experienced. It is not only the most common, but also the worst mistake, in assessing commercial opportunity to assume that the business and community environment is a firm and static base. Every time one raises this point in day to day work everybody acknowledges the changing economic, industrial and technological circumstances of their own and other communities. It is easy to see that they speak with concern and awareness. Yet the very next decision made will automatically be based on a contradiction of all these statements.

What we have to face is that the world as we have recently experienced it is not going to continue. The background against which we have to make our individual and commercial judgements on international trade and international shipping are not those which we have enjoyed for many years. If we are not prepared to recognise this, then the penalty for that head-in-the-sand attitude will be the effect on the well-being of ourselves, and, more importantly, on that of our children who follow us. It would be a mistake for which they will not thank us.

FUEL ECONOMY & FUEL MANAGEMENT

by

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Australia

The fact that fuelcost in seatransport now approaches 50% of the total operating cost is hardly news to anybody involved in shipping, and lately we have seen shipdesigners, shipbuilders and shipowners making attempts to reduce the effect of this escalating fuel cost. But fuel economy is a rather complex matter and for the owner to take the correct decision with regard to all the conditions effecting fuel economy is not a simple task. Keywords in this respect are: Payload capacity - optimal speed (loaded and in ballast) -hullform - draft limitation - trim - type of propulsion machinery - auxiliary machinery - propeller efficiency - operation procedures - maintenance - fuel quality - performance measurements - crew motivation and training.

In order to sort out the problem of fuel economy a systematic approach is required otherwise only subsystems may be evaluated and the optimal solution not achieved.

One case which may indicate possible savings in fuel costs and you may have read about it in the shipping press, is the 6500 m^3 LPG carrier, built in 1981. This carrier is more than 30% more economical on operational cost than the comparable vessel built in 1979. Needless to say saving of this order can improve project viability considerably.

When analysing fuel economy in seatransport, it is fairly common to concentrate on the propulsion machinery as the main problem because more than half of the fuel energy input is lost in the process of producing torque on the propellershaft. But if most of our efforts to improve fuel economy are restricted to the propulsion machinery we may lose out on the considerable saving potential there is in reducing the actual thrust required to push the vessel through the water, and in improving propeller efficiency. The thrust required is first and foremost related to the speed at which the vessel is to operate. To find the so-called "optimal speed" is far from an easy task due to the problems of predicting future charter-rates and fuel costs. The following example may illustrate the variations we may have to consider.

A bulkcarrier of 60 000 dwt should have steamed at a speed of 15.5 knots in 1972 to "break even" at the charter-rate and fuel cost at that time. In June 1973 the speed should have been 16 knots, in December 1977 as low as around 12 knots and in 1980 13.5 knots.

This example shows clearly that it is almost impossible to make a 100% correct decision at the design stage, but it shows just as clearly that future movements in charter-rates and fuel costs must be considered and a consequence analysis carried out.

First when the desirable speed is set, the hullform can be discussed. Again we are up against a complex matter as speed is not the only relevant parameter with regard to the hullform. The type of cargo to be carried is also an important consideration as well as draft limitations in the harbours the vessel will use. Again some predictions will be necessary. The construction cost is also a relevant parameter for the hullform as it is in general more costly to build a long ship than a shorter ship with increased beam.

Further refinements like bulbs fore and aft, cut-away ship sides, skegs, surface roughness etc. may be classified as detailed work but never the less of utmost importance.

When the ship's speed and hullform is determined the required thrust can be calculated and the matter of propeller efficiency dealt with. Nozzle, number of blades etc. must be considered at this stage which brings us further into the type of propulsion machinery to select. It may be merited at this stage to pause and do a brief check on what consequences our decisions related to fuel economy so far may have on other important operational considerations. Two such matters which come quickly to mind are maintenance and reliability aspects, and possible harmful vibrations.

The above mentioned evaluations may be said to belong to the exercise of the preliminary design. Matters related to fuel economy which will have to be dealt with render the detailed design and production of the final specification are firstly an analysis of the consumption of fuel energy for the whole machinery plant onboard, that is propulsion machinery as well as auxiliary machinery. Many examples can be referred to which have resulted in considerable savings when the fuel consumption has been analysed and modification and adjustment carried out.

In the detail design-work the production of a comprehensive trialprogram should also be included. Extra trials in addition to the conventional ones are necessary in order to verify the level of fuel economy achieved and also to get accurate reference data for later performance evaluation. To be able to operate the vessel to the optimum of the philosophy and the criteria laid down in the design, it is essential to know the characteristic of speed as function of: load, trim, waves, rudder use etc. When such information is available it is possible to work out procedures and instructions for the operation of the vessel. It is worth while knowing that "overspeeding" of 5% may increase the fuel consumption 10%. With regard to displacement it should be noted that the amount of ballast onboard may have a market effect on hull resistance but due regard must be taken to the submersion of the propeller and of course the safety of the vessel in adverse weather condition. The trim has also an effect on fuel economy. Reaction to trim variation depends on type of vessel, in general the response to trim is largest for light loadlines. Trim by the stern will normally increase the resistance at low speed, but will reduce the resistance at high speed. There are, however, exceptions and the bulbform may influence the resistance considerably. Undesirable rudder movement is another loss worth while looking at as it may represent a loss of the magnitude of 2-3%. The rudder movement has a breaking effect and an undesirable rudder use will increase the sailing distance.

The autopilot may cause such undesirable rudder movement. The autopilot should be able to limit the rudder movement to about plus/minus 1.5% (about 0.3% energy loss) in calm weather, if not, one should consider investing in a new one able to work with these limits.

These conditions are all related to the required thrust. In order to produce the most cost-efficient thrust, reference data are also needed for the machinery performance and some extra investment in equipment for condition monitoring is desirable. However, to produce "super" fuel cost efficient torque and thrust by improving the thermodynamic efficiency of the machinery may have an adverse effect on reliability and maintenance cost. On the other side machinery which suffer from lack of maintenance and adjustment is far from fuel economical hence conditions and performance must be monitored closely. Again a systematic consequence analysis may be applicable in order to have an optimal operation.

The whole discussion on fuel economy is triggered off by the increase in fuel cost. To counteract the effect of high fuel cost, search for low cost fuel is a common approach. We have seen coalfiring being reintroduced to shipping and we have indeed seen lower grade diesel oil used for ship's machinery. Such low grade diesel oil may be bought for a reduced price but such low grade fuel may create problems which result in dramatic adverse effects on the economical operation of the vessel. Offhire and heavy maintenance cost can often make low cost fuel very expensive to use.

In order to prevent these adverse effects detailed information about the quality of the fuel is required. Based upon such information actions may be taken in time and harmful conditions prevented. Special fuel quality testing program are now introduced and frequently used. The purpose of such program is to make it possible to use low grade diesel fuel without the risk of abnormal wear and breakdowns of machinery.

The basis for good fuel economy may have been laid down in the design and the specification of the vessel and further in the operational procedures worked out, but the end result is very much dependent of the motivation and skill of the operators onboard, hence there is a lot of merit in some investment in education of the crew in fuel economy and fuel management. Motivation is not always simple to bring about. It has among other things a very personal side. However, it has often been proven that the man who knows how and gets feedback on results of his efforts will be most motivated.

Most of the statements given so far in this paper may be related to new ship projects and hopefully the reader will realize that a considerable improvement in fuel economy may be possible by a systematic approach to the various conditions that effect fuel economy.

However, good results can also be achieved on ships in service if same approach is applied. For ships in service there may not be as many variables. But experience has certainly shown that a systematic evaluation of conditions, which are relevant to fuel economy and can be changed by rather limited action, can give very good return.

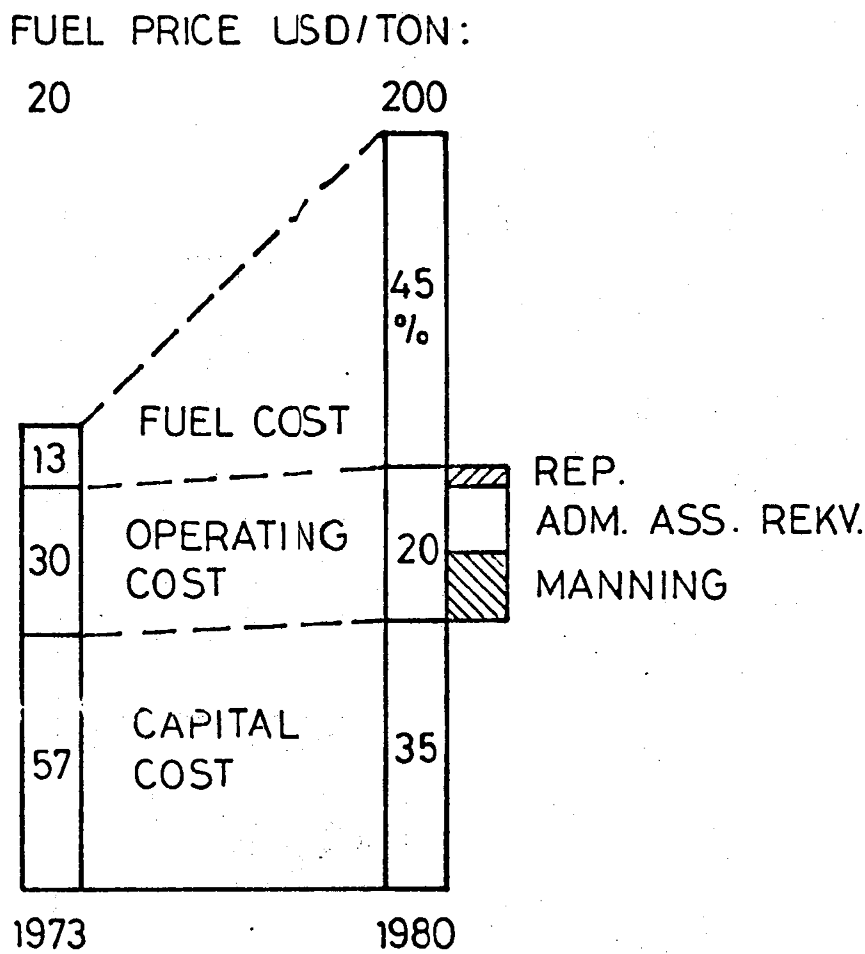
When dealing with fuel economy in seatransport it is quite apparent that a total systematic evaluation is required and the framework for such is market conditions and feasibility studies. Needless to say computers may play an important role in such evaluation and computer programs are today developed for this use.

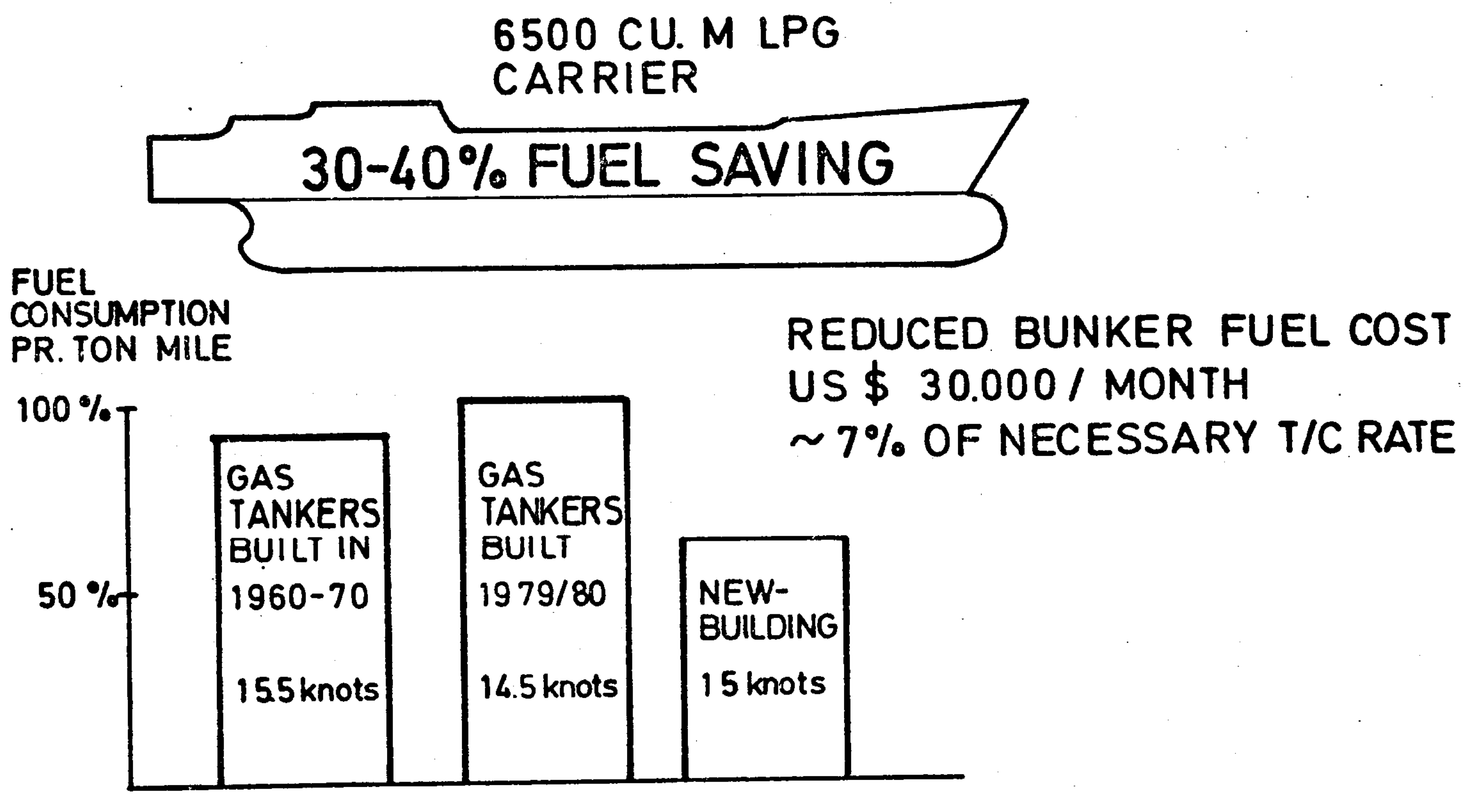
Prognoses and trends, transport-analysis, consequence analysis, parameter studies, operation procedures and control; are all disiplines which have to be covered. It can not be expected that a prospective shipbuilder has got the background and knowledge required to arrive at the overall best solution of the shipowner, consequently the owner will have to take the initiative himself and be actively involved in these studies. As the scope of the task of solving the problem of fuel economy is very wide it is justified to classify it a management task. Many shipping companies have realized this and appointed a manager for fuel economy, in some cases for a particular project only, in other cases for a long-term arrangement which is to cover the ships from the design stage to the time the ship in question is found obsolete.

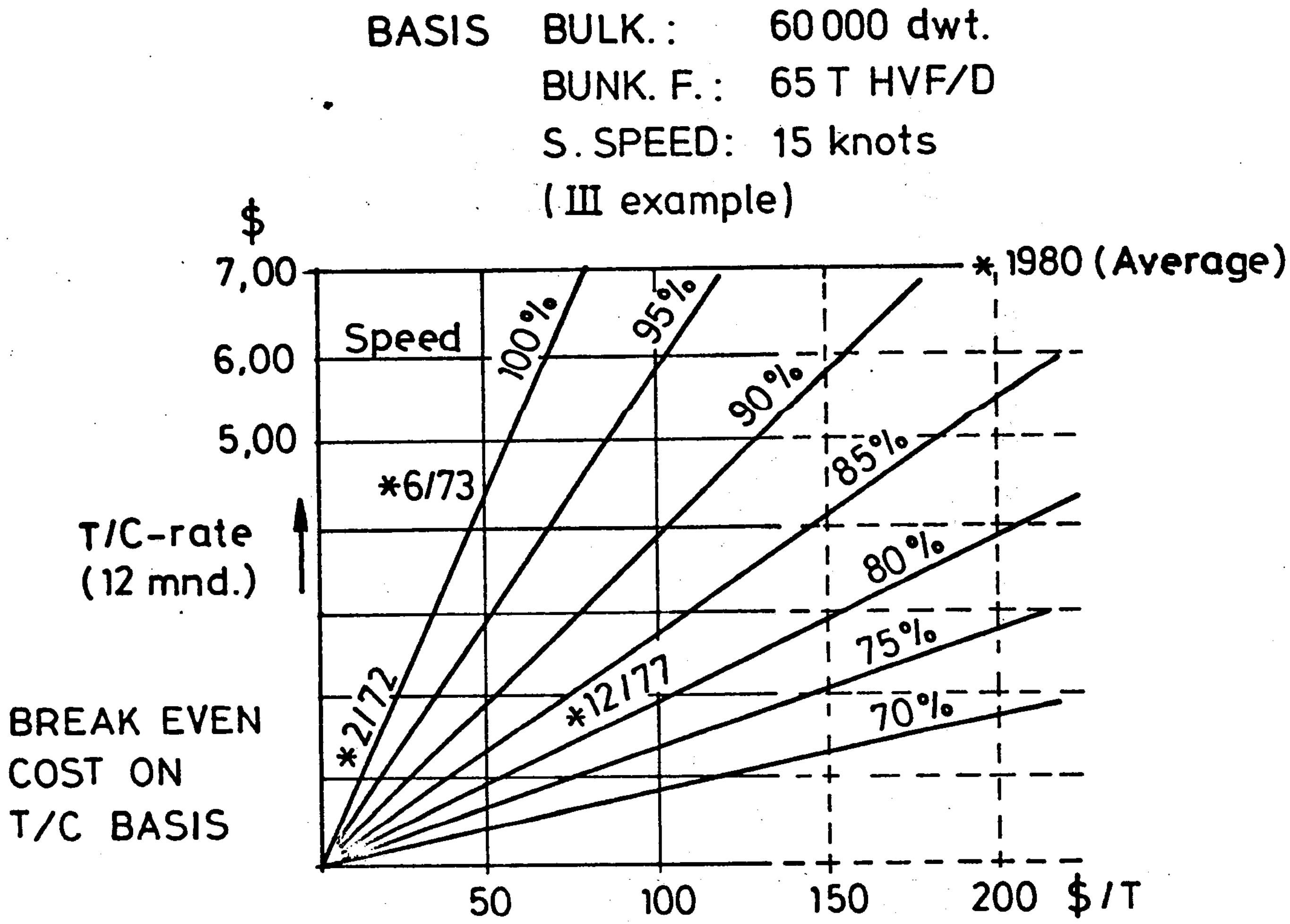
Fuel cost is a dominating factor in today's operational cost of seatransport, crew cost is another. Future fuel economical ships may be technically advanced which will require highly skilled crew. Maybe high crew cost related to highly skilled personnel is well within sound economy in ship operation if your ship is ahead of it's competitor in fuel economy?

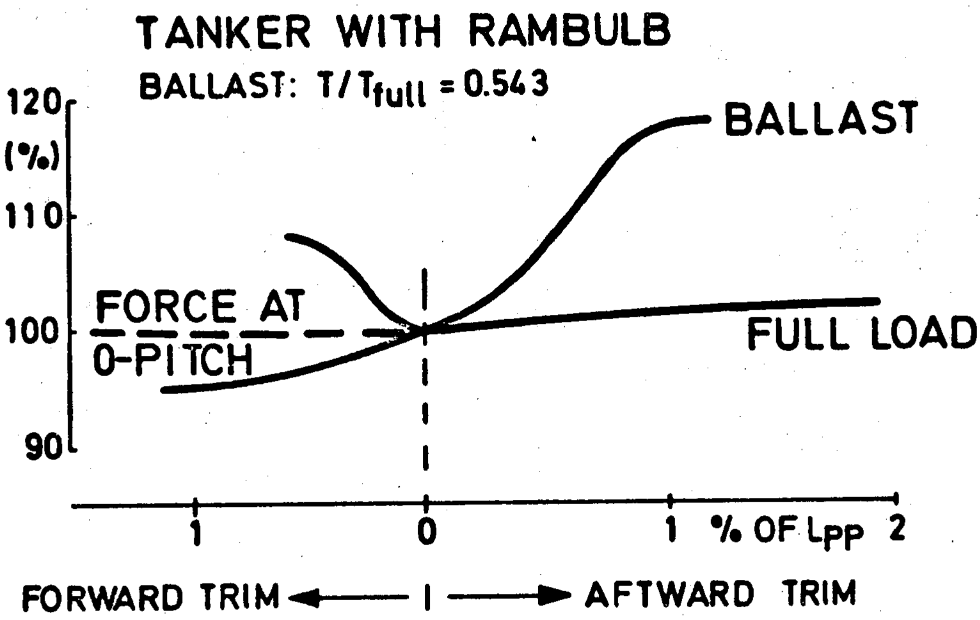
IMPACT OF INCREASES FUEL COST

EXAMPLE: 80000 TDW BULK CARRIER



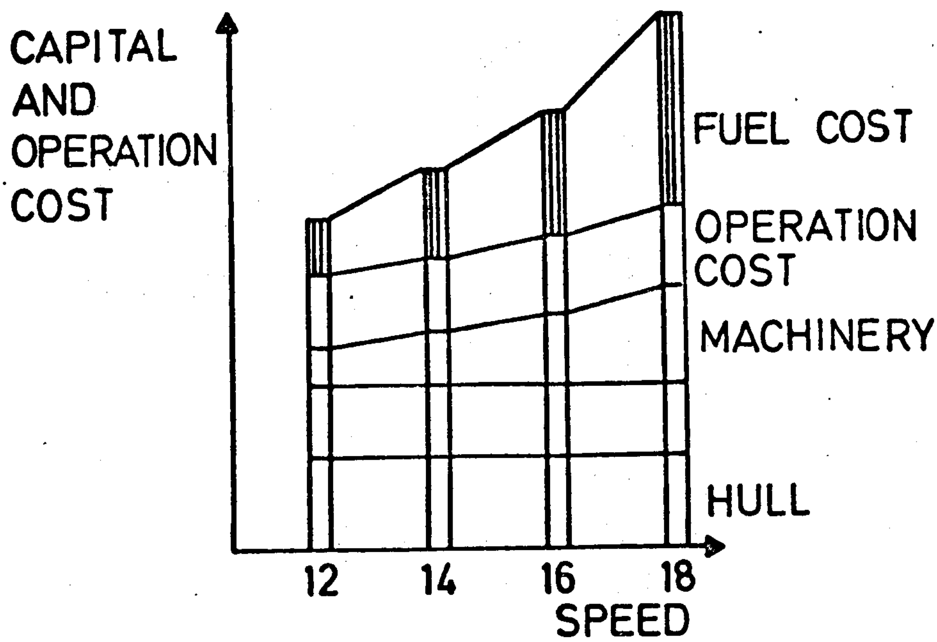

6500 CU. M LPG
CARRIER
30-40% FUEL SAVING
FUEL
CONSUMPTION
PR. TON MILE
100 %
50 %
GAS
TANKERS
BUILT IN
1960-70
15.5 knots
GAS
TANKERS
BUILT
1979/80
14.5 knots
NEW-
BUILDING
15 knots
REDUCED BUNKER FUEL COST
US $ 30.000 / MONTH
~ 7% OF NECESSARY T/C RATE


BASIS
BULK.: 60 000 dwt.
BUNK. F.: 65 T HVF/D
S. SPEED: 15 knots
(III example)
$
7,00
6,00
5,00
Speed
100 %
95 %
90 %
85 %
80 %
75 %
70 %
*6/73
*2/72
*12/77
* 1980 (Average)
T/C-rate
(12 mnd.)
BREAK EVEN
COST ON
T/C BASIS
50
100
150
200
$/T



REQUIRED PROPULSION FORCE AS A FUNCTION OF TRIM

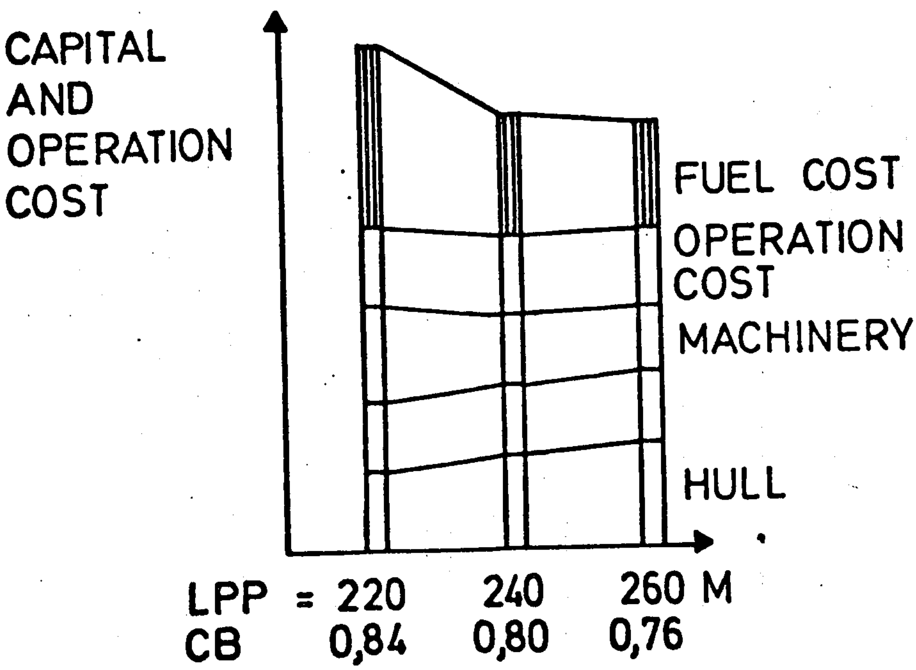
SPEED VARIATIONS
LPP = 240 M
CB = 0,80



REL. CAPITAL- AND OPERATION COST FOR A 100 000 M DISPL. TANKER

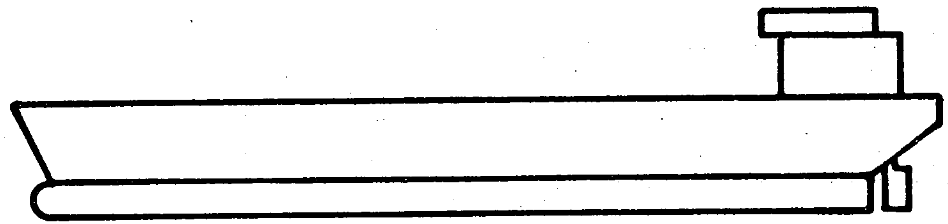
VARIATION OF MAIN DIMENSIONS

V = 16 knots



REL. CAPITAL- AND OPERATION COST

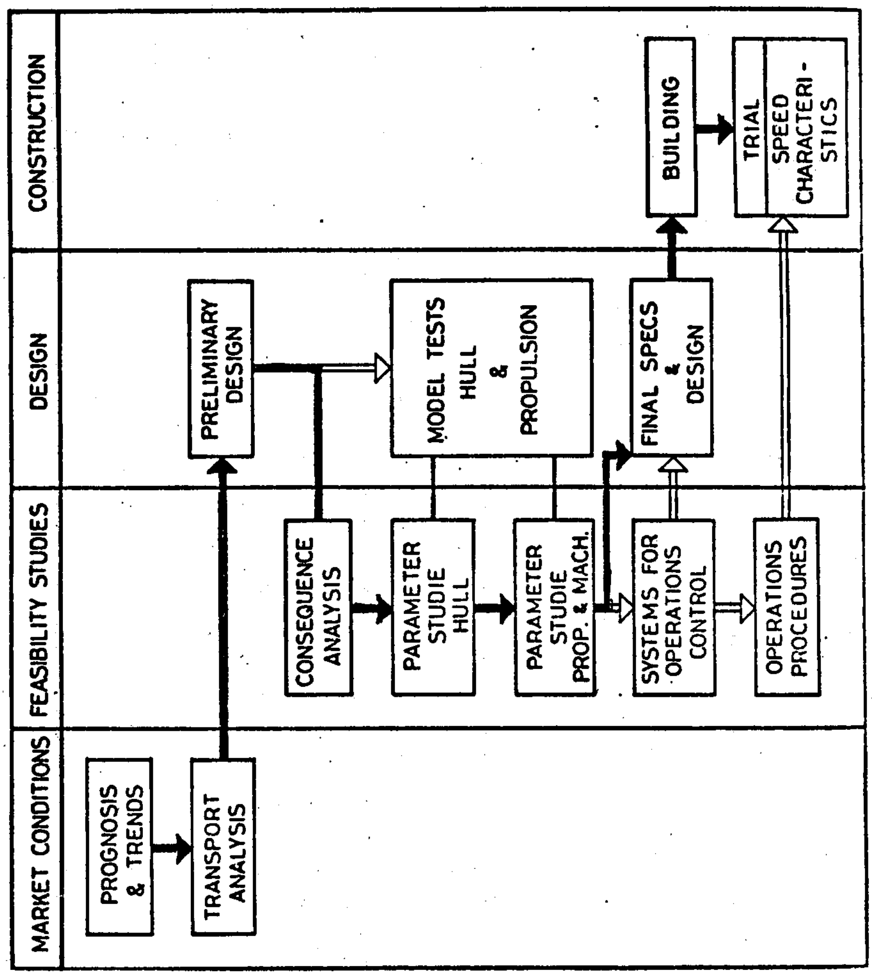
FOR A 100 000 M DISPL. TANKER



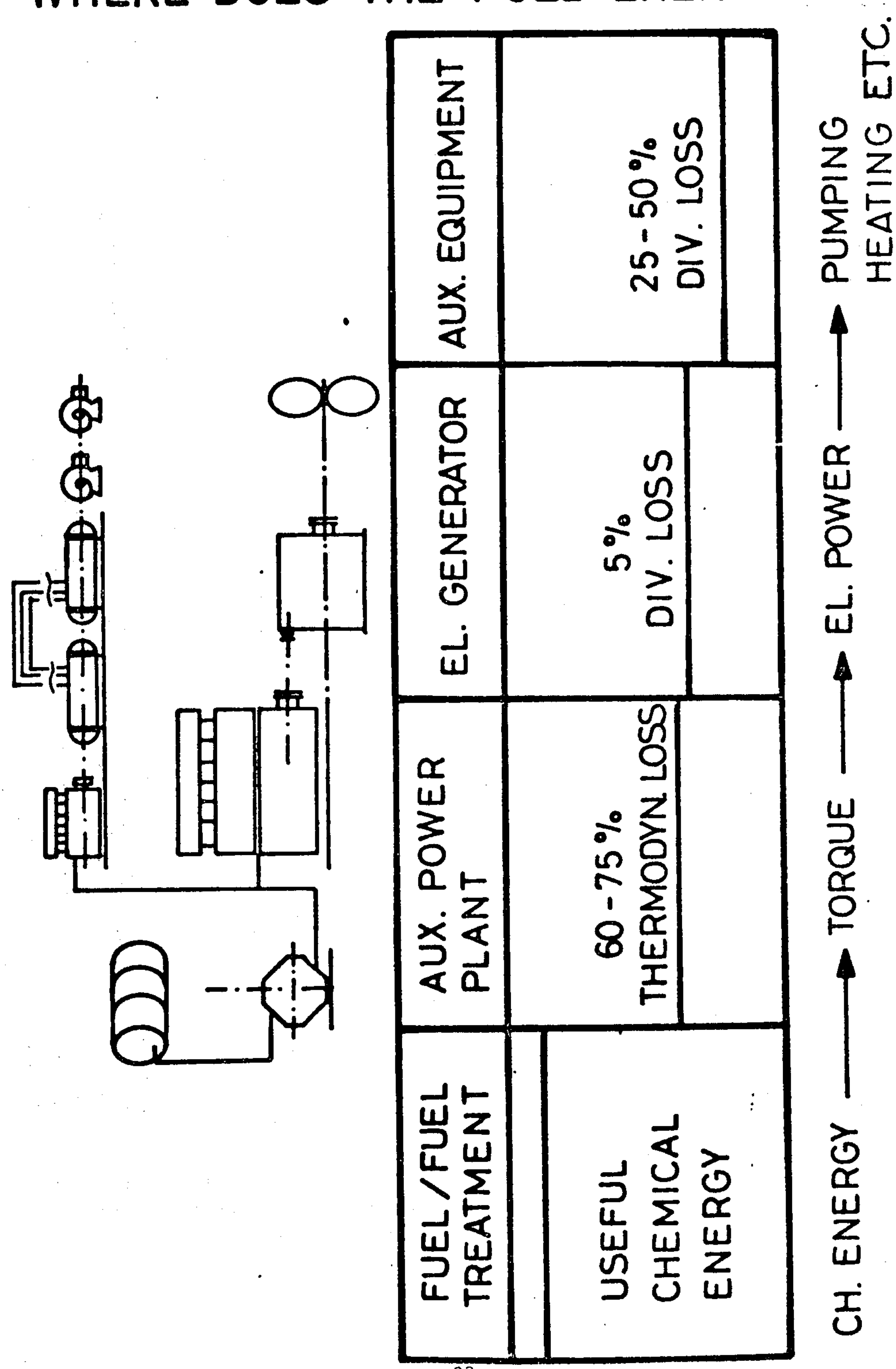
HULL RESISTANCE	DIMENTIONS & LINES	LOAD CONDITIONS SURFACE — " —	NAVIGATION STEERING
POTENTIAL SPEED	0-30% LOSS	0-20% LOSS	0-10% LOSS

← RESISTANCE → SPEED → SPEED → DISTANCE

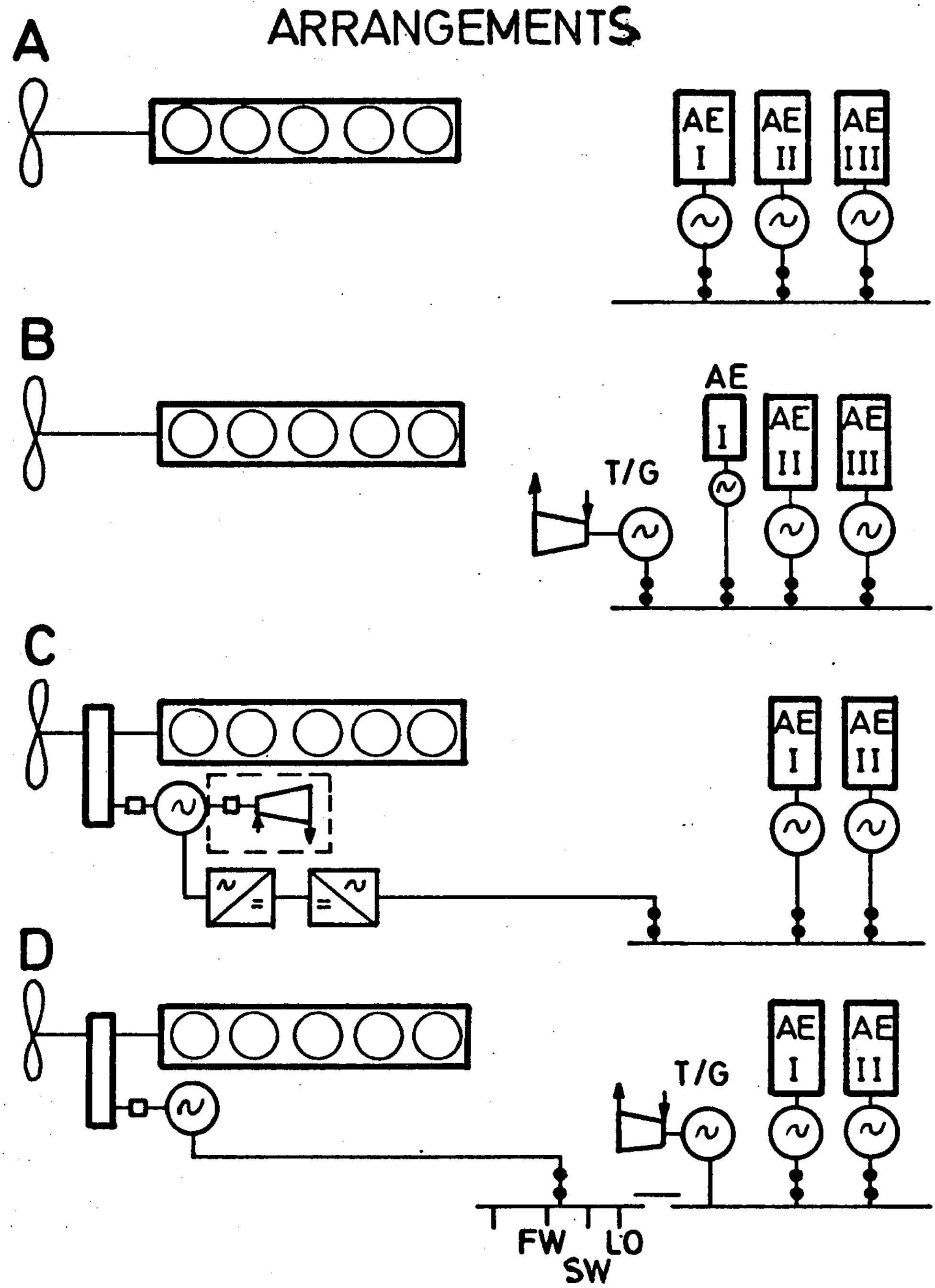
FUEL ECONOMY – NEW BUILDINGS

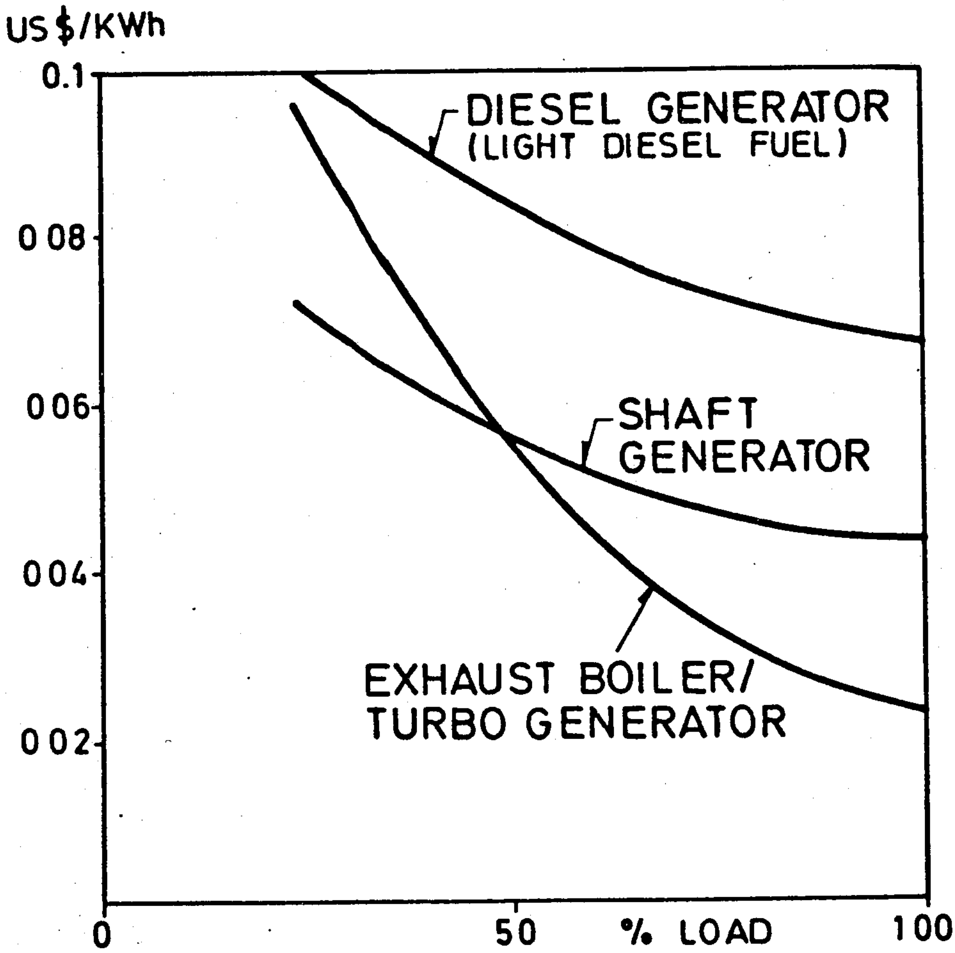


WHERE DOES THE FUEL ENERGY GO



AUXILIARY POWER SUPPLY ARRANGEMENTS

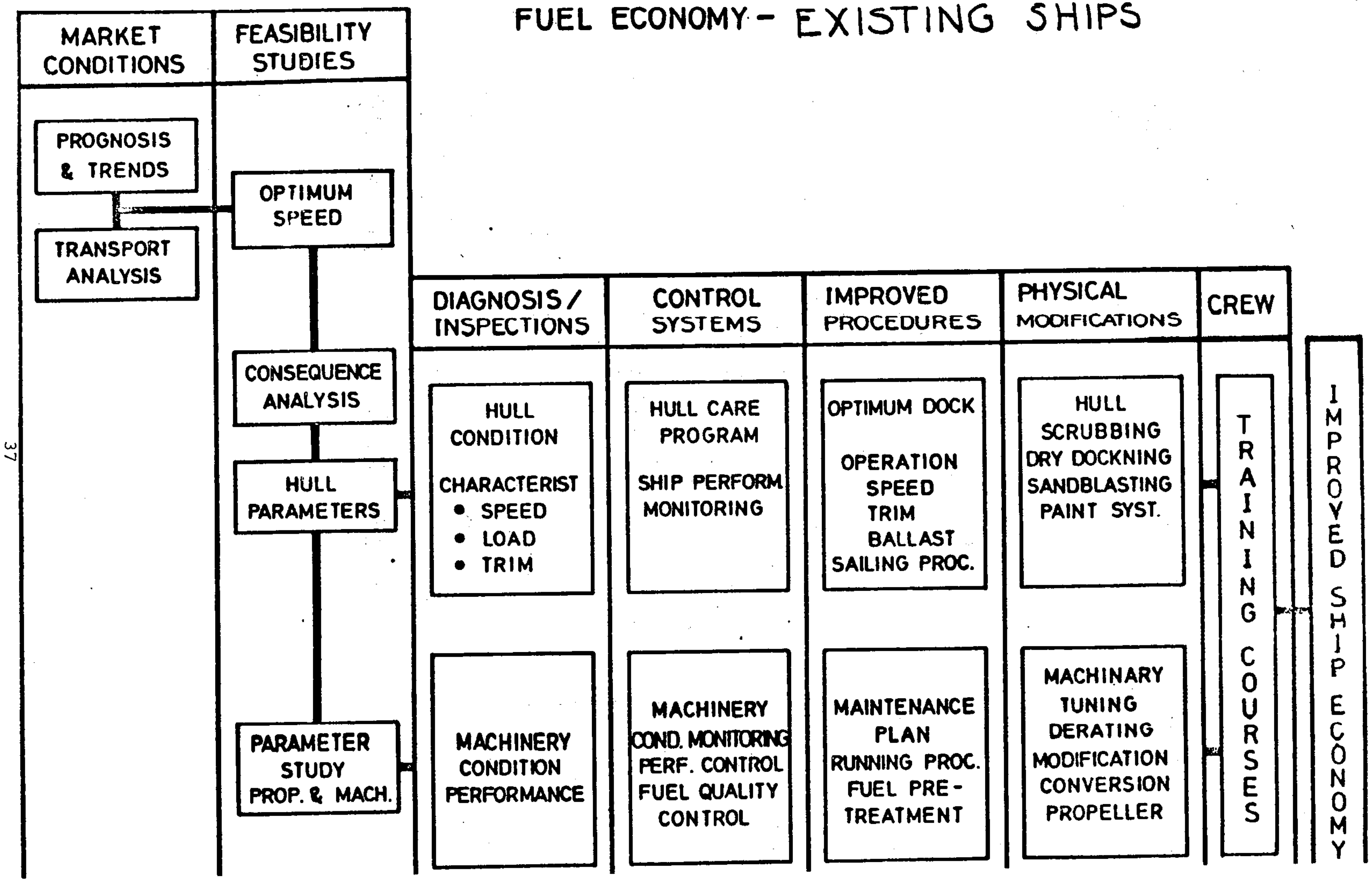




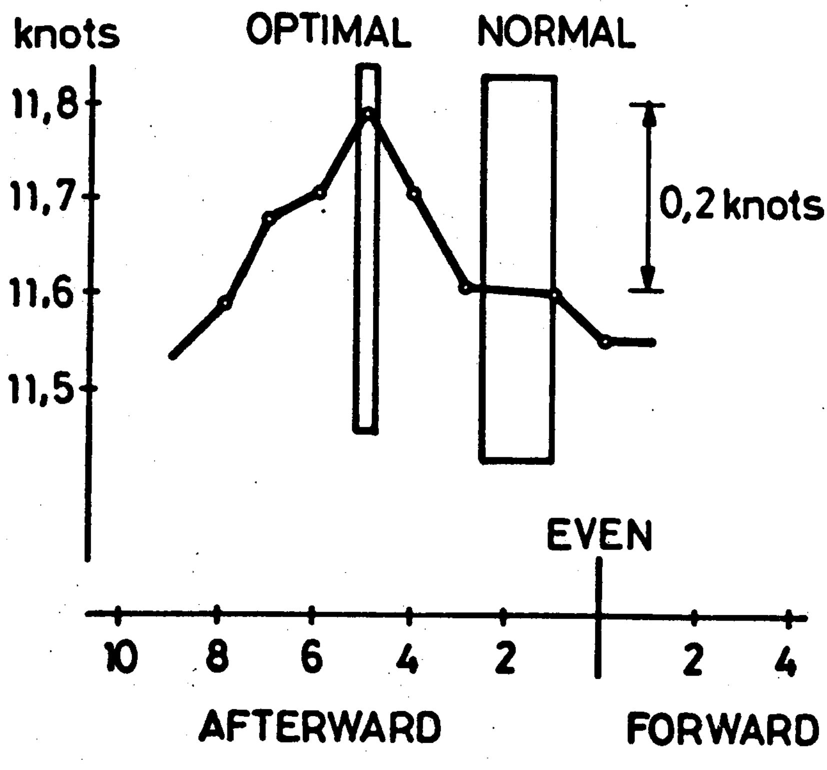
COMPARATIVE COST OF EL. POWER FROM ALT SOURCES (CAPITAL AND MAINTENANCE COST INCL.)

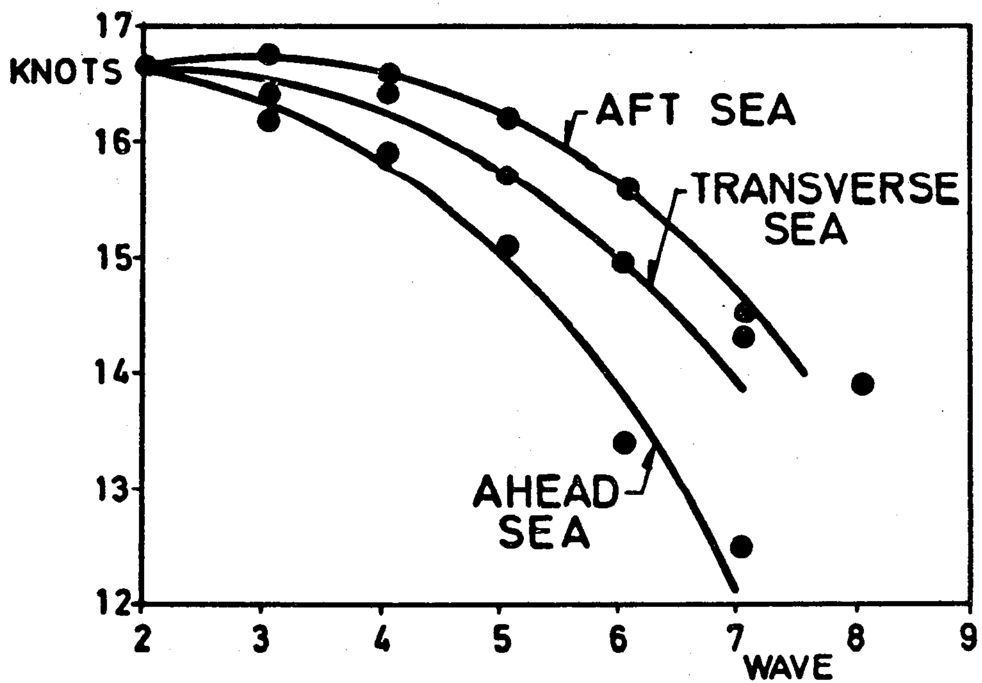
ALTERNATIVE	SAVING/ YEAR US $	PRESENT VALUE US $	COMMENTS
1. AE ON BLENDED FUEL	64.200	531 000	
2. SHAFT GEN. CONST. SPEED	88.200	729.000	RESTR. OPERATING
3. SHAFT GEN.+ INVERTOR	83.400	689.400	
4. T.GEN.360 KW	151.600	1.250.000	T.GEN. POWER LOAD DEPENDANT
5. T.GEN. 280 KW SHAFT GEN.130KW	147.200	1.216.800	SPEED RANGE RESTR. TO 70-80%

FUEL ECONOMY - EXISTING SHIPS

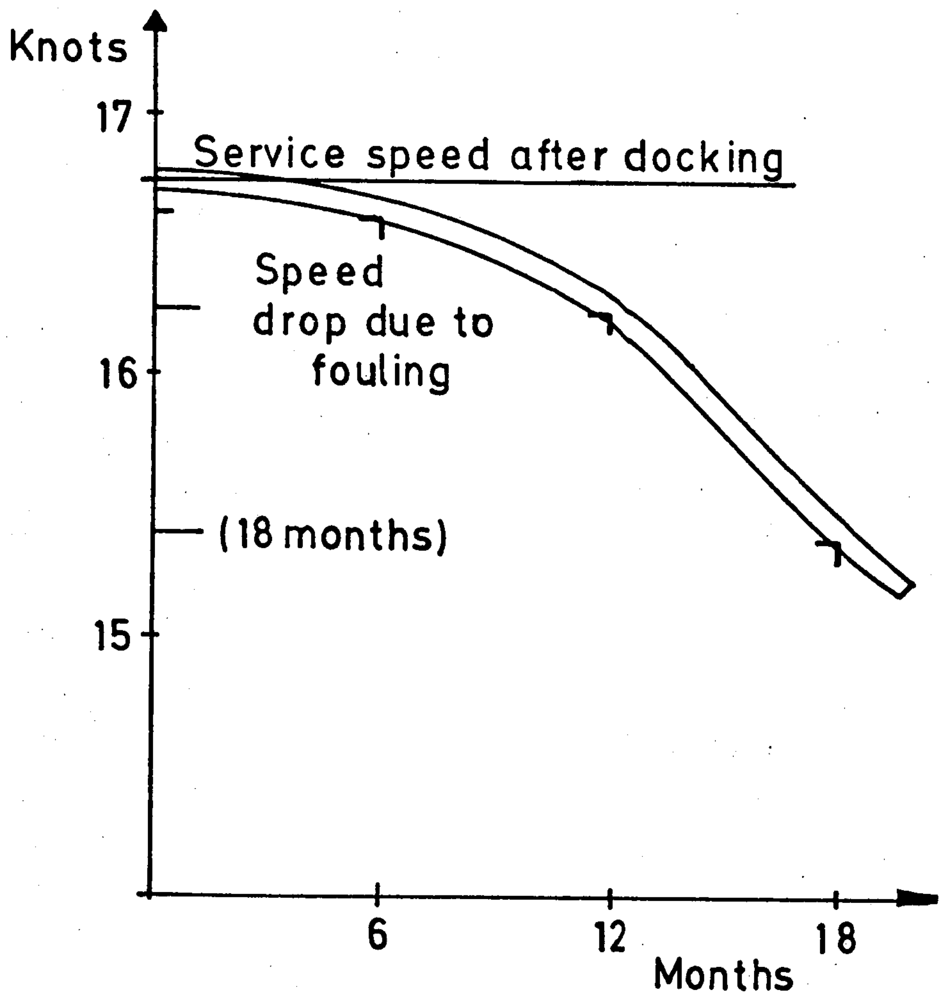


INFLUENCE OF TRIM ON SHIP SPEED
MEASURED ON 120 000 TDW. TANKER

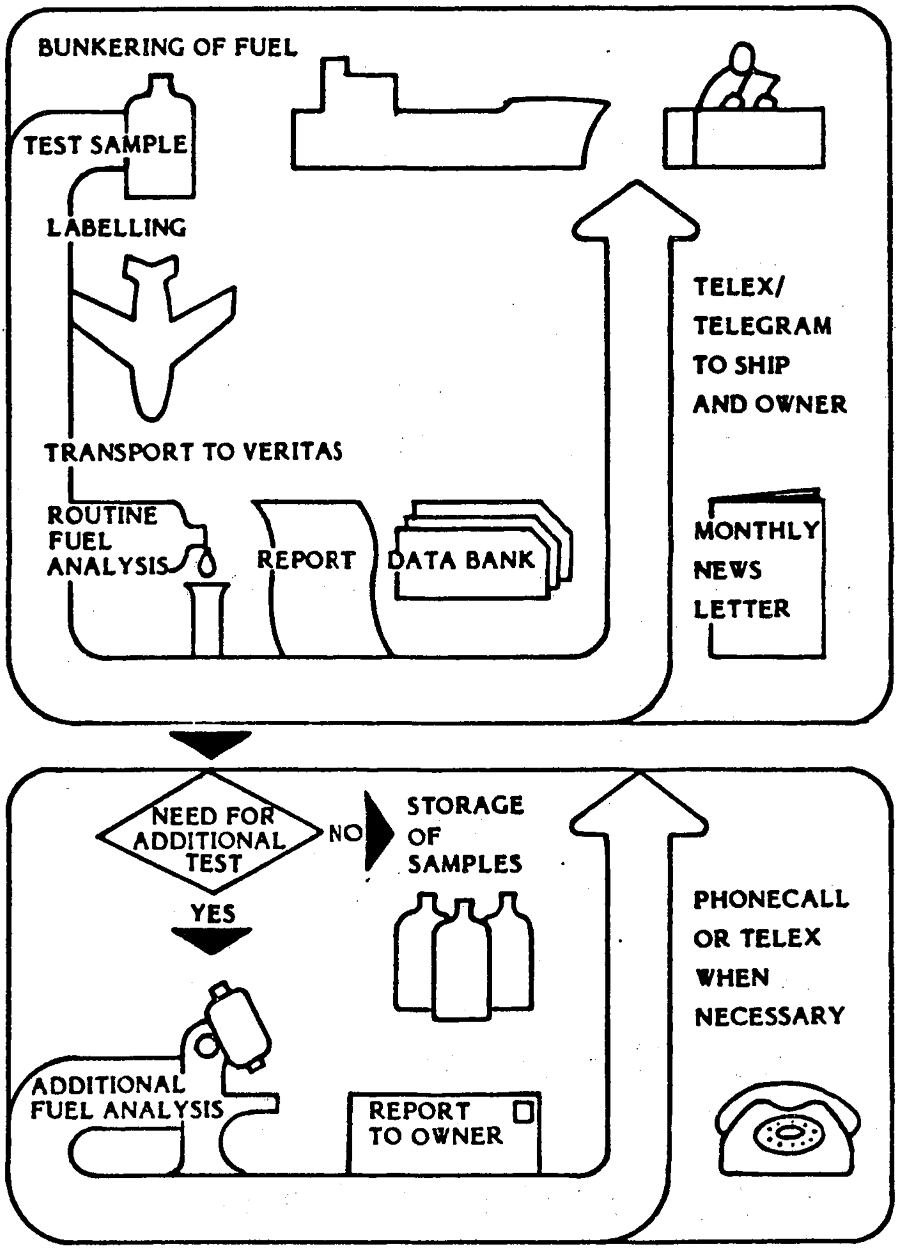




MEASURED SPEED AS FUNCTION OF WAVE HEIGHT, 86.700 TDW TANKER


Knots
17
16
15
Service speed after docking
Speed
drop due to
fouling
(18 months)
6
12
18
Months

VERITAS FUEL QUALITY TESTING PROGRAMME



PROCEDURE FOR ON BOARD MEASUREMENT

1. DECISION.
2. AVAILABILITY/LIMITATIONS.
3. MEASUREMENT METHOD
   * Trim
   * Speed
   * RPM/Torque
   * Engine Parameters
   * Fuel Consumption
   * Other.
4. MEASUREMENT CONDITIONS
   * Load/Trim
   * Speed
   * Engine Loadings
   * External Conditions.
5. MEASUREMENTS/REPORTS.
6. CORRECTIONS.
7. COMPLEMENTARY MEASUREM./VERIFICATION?
8. EVALUATE INSTRUCTIONS.

ADVANCES IN MICROPROCESSOR CONTROLS FOR OPTIMISATION OF INDUSTRIAL PROCESSES AND THEIR APPLICATION TO SHIP MANAGEMENT

BY

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Senior Projects Engineer
Honeywell Pty Ltd

SUMMARY

With marine and offshore applications of its latest range of digital microprocessor based industrial control equipment, Australia's largest instrumentation company is poised to offer the marine market an integrated range of field proven hardware and control instrumentation, developed during the last decade, against a background of spiralling energy costs.

Of particular importance to the marine field is the adaptation of powerful industrial energy optimization software packages to provide for the first time, distributed control, with a total ship management centre.

1. OPTIMISATION OF PROCESSES

Economic pressures for maximum product at minimum cost has led to development of digital electronic instrumentation which offers enhanced opportunities for optimisation of energy costs, and which allows available human resources to be used more effectively.

This instrumentation is based on microprocessor technology and the principle of distributed control.

The purpose of this paper is to illustrate the optimisation features which one particular range of such instrumentation offers and shows how it may be put to use in the marine environment.

In the following sections, a distributed processor control system for marine application will be described. The system will be based upon the TDC 2000 (Total Distributed Control), a control system developed by the Process Control Division of Honeywell Incorporated (U.S.). The system was introduced in Shoreside Industry approximately 7 years ago and has since enjoyed widespread acceptance and success. It serves as the basis for the data acquisition and control systems now being supplied to the marine industry by Honeywell.

Distributed Control System Major Elements and Their Function

The Data Hiway

The Data Hiway is a redundant pair of coaxial cables along which bit serial, time multiplexed data flows between the system elements.

Each cable has an independent electronic interface with each Hiway device for complete redundancy. Access to the Hiway and the designation of which of the two cables is in use is controlled by the Hiway Traffic Director (HTD). This device, the hub of the data communications network, is a card file which is normally located in the central control room. It, too, is fully redundant. The HTD can support three Hiway branches, each of which may be up to 5,000 feet long.

The Operator Station

Centralised display and operator control is provided by operator stations consisting of a 19-inch colour CRT, a specially designed keyboard, and a tape cassette handler. Each operator station also contains its microprocessor, Hiway interface, and power supply. Each station may also have a printer or strip chart recorder output. For example in a recent ship automation system two operator stations with printer data Logger and an eight-channel strip chart recorder are used.

This arrangement is shown in Figure 1. Each station is completely independent and can perform all display and operator control functions by itself. Multiple units are provided not only for redundancy, but for simultaneous display of different information.

The following displays and controls are available to the operator at the operator station:

Overview Display - The display in Figure 2 is designed to present the information normally available to an operator looking across a room at a bank of conventional central control panels. It gives a simultaneous overview of up to 288 critical parameters, arranged into groups which correspond to the equipment or subsystems being monitored.

Group Display - The display in Figure 3 is designed to represent the close inspection by the operator of an individual control panel on a conventional console. Analog values are represented by bar graphs, as well as numerically, and digitals are indicated by coloured, labelled "annunciator lamps", depicted on the screen. The operator may raise or lower analog alarm limits, target values, and set points. Similarly, he may activate digital commands with keys on the keyboard which mimic the displayed push buttons.

Detailed Display - This display is designed to show, and allow modification of, the basic configuration data concerning a point. Changes affecting operation of a remote device are automatically passed to the appropriate unit by the operator station, over the Data Hiway.

Trend Display - This display shows a paragraph of historical trend information for any point selected from a controller with trend memory option.

Alarm Summary Display - Normally, one operator station is assigned by the operator as the alarm display. The alarm summary display provides a chronological list of all active alarms in the system, together with their time of occurrence. As alarms occur, a horn is sounded and the alarm message is added at the top of the list. Unacknowledged alarms are identified by flashing characters next to the message. As alarms clear, they are removed from the list. A record of all alarm occurrences with time and date is generated on the printer.

Alarm Group Display - At any time, the alarm status of all points within 1 of 36 alarm groups can be examined on any operator station. In the station doing alarm scanning, the light corresponding to the alarm group in question flashes when a new alarm is detected. After acknowledgement, this light will stay on until the alarm clears or is manually disabled.

Other Displays - The operator station provides several other important, but less often used displays, such as Data Hiway and device status, operator station assignments, etc.

Printer - An interface board in the operator station transmits information to a printer for printing alarms, logging, trending, and screen copying.

The operator station is also used to make the initial entry of the system configuration parameters. When configuration entry is complete, this information is saved on cassette tape cartridges for later system restoration. This is required because the solid-state memories used in the operator stations and the remote units will lose their content if power is interrupted.

The operator stations are ruggedised for the offshore application by adding some internal stiffeners and vibration isolators. Also, air conditioning of the central control room is recommended to control temperature and humidity. This corresponds closely to the amount of protection necessary for the centralised computer control system.

The Controller

Controllers are microprocessor-based devices capable of receiving and transmitting 4-20mA analog signals. In the example system for engine room automation, two controllers are utilised for functions such as thermostatic control valves and boiler control loops.

The following is a general description of TDC 2000 Controller.

- Inputs from process: Sixteen 4 to 20mA or 1 to 5Vdc signals.
- Outputs to valves: Eight 4 to 20mA signals
- Computational capability: Eight computational slots configurable to provide control algorithms and strategies such as:
  - One, Two or Three Mode controllers, with or without cascade or ratio.

- Computer back-up stations - computer-manual, computer-manual-automation, or supervisory set point stations.

- Auxiliary functions, such as:
  Multiplication/Division
  Square Root Extraction
  Addition/Subtraction
  Lead/Lag, Override, High or Low signal selection
  Hi/Lo Process Variable or deviation alarming

- Independently perform up to 8 loops of control.

- Configured locally or from a remote location via the communication system.

- Data entry panel is a locally mounted controller interface satisfying operational, engineering and maintenance needs. It can be either a portable plug-in device or panel-mounted.

  Provides digital display showing process variable and certain selected variables in either percent or engineering units. Dedicated pushbuttons are used to call up a particular loop for display.

  Normal operating adjustments such as mode, set point, output, ratio, and bias are made by pushbutton but are protected from unauthorised changes by a keylock.

  It also displays basic controller diagnostic codes.

<u>Process Interface Unit</u>

The Process Interface Unit (PIU) is a remote device for interface to the machinery for both analog and digital input/output signals. The configuration of each PIU is controlled by the selection of input/output (I/O) cards and the addition of card files. The range of signals handled includes 4 to 20mA, high and low-level analog voltage inputs, RTDs, thermocouples, pulse counters, contact closures, and TTL, 24-Vdc or 48-Vdc digital levels. Optical isolation, relay isolation, fuse protection and filtering are provided in the conditioning circuits depending on the particular type of signal. The PIU's provide the terminal strips for interconnection of wiring to the sensors and actuators.

The microprocessor in each PIU continuously scans its inputs, rescales analog inputs to engineering units, checks for alarms and stores the current and past values in memory. It executes analog or digital output commands received from the operator station. The PIU continually executes selfchecking diagnostics and sets a status word which is read and reported at the operator station. In cases of trouble, this error detection scheme can isolate the fault to an individual PIU card.

The standard PIU's are modified for marine use as follows. First they are repackaged into drip-proof enclosures. Then, additional dc power supplies are provided to isolate digital circuits and to provide redundancy.

Alarm Summary Display - Normally, one operator station is assigned by the operator as the alarm display. The alarm summary display provides a chronological list of all active alarms in the system, together with their time of occurrence. As alarms occur, a horn is sounded and the alarm message is added at the top of the list. Unacknowledged alarms are identified by flashing characters next to the message. As alarms clear, they are removed from the list. A record of all alarm occurrences with time and date is generated on the printer.

Alarm Group Display - At any time, the alarm status of all points within 1 of 36 alarm groups can be examined on any operator station. In the station doing alarm scanning, the light corresponding to the alarm group in question flashes when a new alarm is detected. After acknowledgement, this light will stay on until the alarm clears or is manually disabled.

Other Displays - The operator station provides several other important, but less often used displays, such as Data Hiway and device status, operator station assignments, etc.

Printer - An interface board in the operator station transmits information to a printer for printing alarms, logging, trending, and screen copying.

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The standard PIU's are modified for marine use as follows. First they are repackaged into drip-proof enclosures. Then, additional dc power supplies are provided to isolate digital circuits and to provide redundancy.

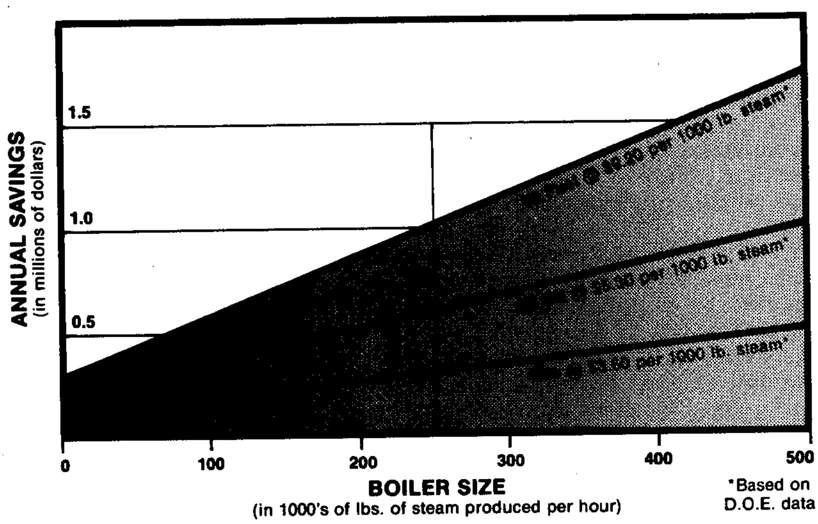
2. ENERGY CONSIDERATIONS

With fuel costs rising and EPA regulations tightening, efficiency has taken on a new meaning. Today, boiler efficiency must be measured by the boiler's ability to squeeze a maximum amount of energy out of every fuel dollar spent, while complying with increasingly restrictive emission control standards.

Many industrial process boilers today run inefficiently by any definition; they waste fuel, labour, and generating capacity. The cause of this waste lies most often in their old inadequate, unreliable control systems. These systems require frequent tuning adjustments. They do not easily accommodate varying BTU content fuels or changing steam demand conditions.

The key to consistently efficent steam generation is a reliable automated combustion control system. It must provide accurate, repeatable and responsive control, and adapt simply and economically to changing plant needs.

At current fuel prices, even a slight improvement in boiler efficiency leads to substantial savings. As the chart below demonstrates, a 5% efficiency improvement in a boiler producing 250,000 pounds of steam per hour translates into a $300,000 to $1,000,000 savings per year, depending upon fuel used.



In plants where TDC 2000 process control system have been applied to boilers, users report up to 20% improvement in boiler efficiency, with payback most often achieved in less than a year.

TDC 2000 improves operating efficiency through:

Greater Precision and Repeatability

Unlike analog devices, TDC 2000 is not subject to drift. When process performance depends on delicately balanced operating parameters, even a slight imbalance in one of these values could cause a major decrease in operating efficiency and fuel economy. A fuel-air ratio deviation of even 0.5% could cost several million BTU's/year, and cause increased gaseous and particulate emissions.

Improved Reliability

In conventional control systems, a controller malfunction goes unnoticed until the process upsets. It may even shut down the boiler. TDC 2000 with its built-in self-diagnostics, pinpoints a controller malfunction as it occurs, and identifies the nature and location of the problem. Circuit card replacement is quick and easy, and overall boiler efficiency is not affected.

Increased Adaptability

With traditional control systems, a change in operating conditions often calls for a complete overhaul. With TDC 2000, you simply re-configure system loops to implement a wide variety of control strategies. And you can expand TDC 2000 easily to accommodate additional boilers, new fuels, and new equipment.

An example of this adaptability lies with boilers operating with oxygen trim on liquid fuel combustion control systems.

As liquid fuel costs escalate, many owners are looking seriously at coal conversion. With coals need for greater excess air the ability of an oxygen trim combustion control system to cope with coal can be marginal.

With a TDC 2000 equipped boiler, changing the combustion control system from oxygen trim to opacity trim at the time of a fuel conversion to coal, may be achieved by a series of simple pushbutton keystrokes with no changes in wiring, field instrumentation or control actuators (subject, of course, to the boiler having been fully equipped with a comprehensive range of field instrumentation in the first place).

3. USE OF COMPUTERS

With the use of microprocessor based electronic control systems comes the ability for easy interface to a host computer.

This facility arises from the fact that all microprocessors operate on a digital basis, including both those in TDC 2000 components and those in computers. Thus, by designing the Basic TDC 2000 microprocessor to operate using computer compatible communication protocols, and by providing (as part of the standard range modular options), a General Purpose Computer Interface, the addition of a computer can be easily accomplished.

Particular TDC 2000 computer applications that are already at sea can be found in semi submersibles serving offshore developments. In these cases Hewlett Packard computers have been linked with the TDC 2000 system to provide optimisation control for machinery plant and services. Such systems have an enhanced ability to undertake very complex control strategies such as those needed for Automatic Station Keeping (or Dynamic Positioning) and drilling parameters as well as the ability to provide a greater range of management level historical records concerned with such aspects as vessel efficiency, reliability, and endurance.

Other applications may be found in some of the latest container vessels, where Honeywell Level Six Computers have been linked into the Data Hiway to achieve not only Main Propulsion control monitoring and alarm functions, but also monitoring and calculations associated with loading, ballasting, and temperature control of the refrigerated containers.

Another vessel type believed to be particularly suited to the application of a TDC 2000 computer system, is the LNG tanker. Such a system could contribute significant economies to any suitably equipped vessel, by allowing reliable automatic optimisation of such things as the use of boil off gas, refrigeration controls, main propulsion, ballasting, power generation, and hotel services.

4. CONCLUSION

There is little doubt that digital electronic technology and the employment of microprocessors is now well established in industry ashore.

Continued use of such equipment will inevitably lead to broader applications of this technology at sea.

The Honeywell TDC 2000 system is already well established and proven in arduous service ashore and offers outstanding ability to minimise operational costs to marine operators.

References: Offshore System Management with Digital Technology
by
G. Soghomonian
Honeywell Pty Limited

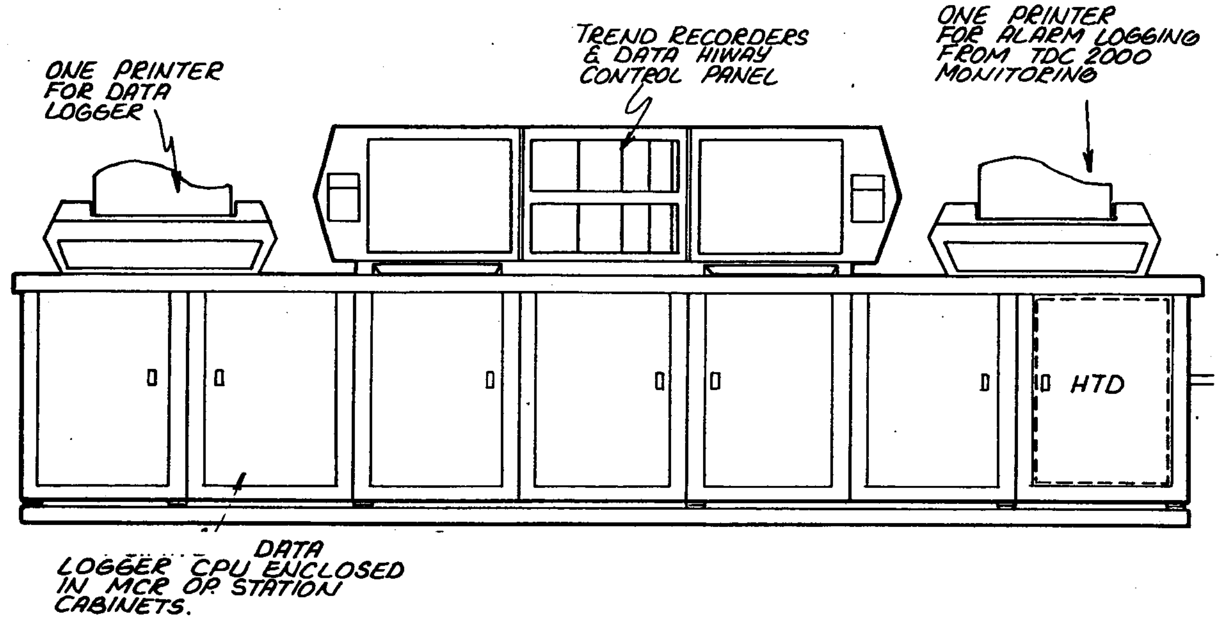


FIGURE 1 - TYPICAL OPERATING CENTRE

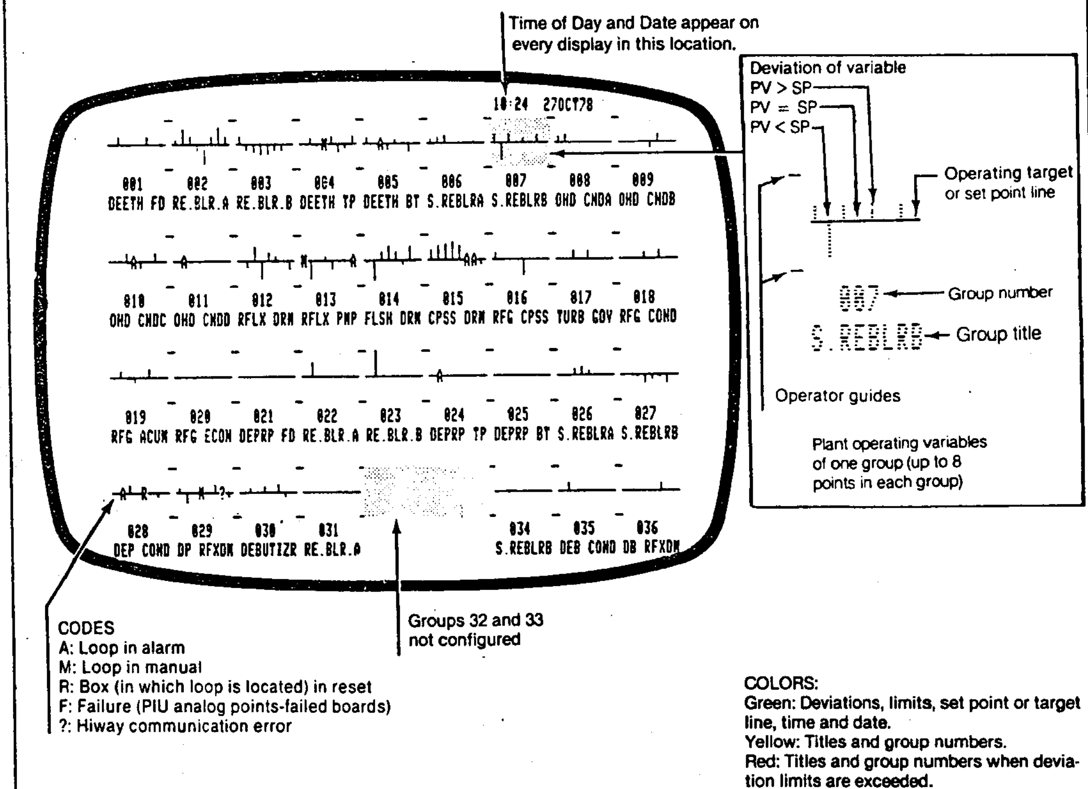
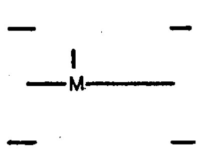


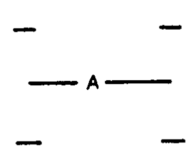
Figure 2 – Overview Display

Manual Conditions



When a tag is placed in manual, either by the Basic Operator Station, DEP, or the Analog Display; an M appears at the tag's position on the base line. Significant deviations above or below the M are also shown.

Alarm Conditions



If an alarm condition is reached, the bar graph disappears and is replaced by an "A". At all stages of deviation, the operator can see which loops are controlled properly and which are upset, and whether or not a deviation is a problem to the plant-wide process or a temporary local upset instead. NOTE: Alarm conditions for the Basic Controller Lead/Lag algorithm are not reported in the Overview, Group, or Detail Display.

Digital Points

If digital points are included in any of the 36 groups (288 points) they do not show deviation, but do show alarm conditions as configured.

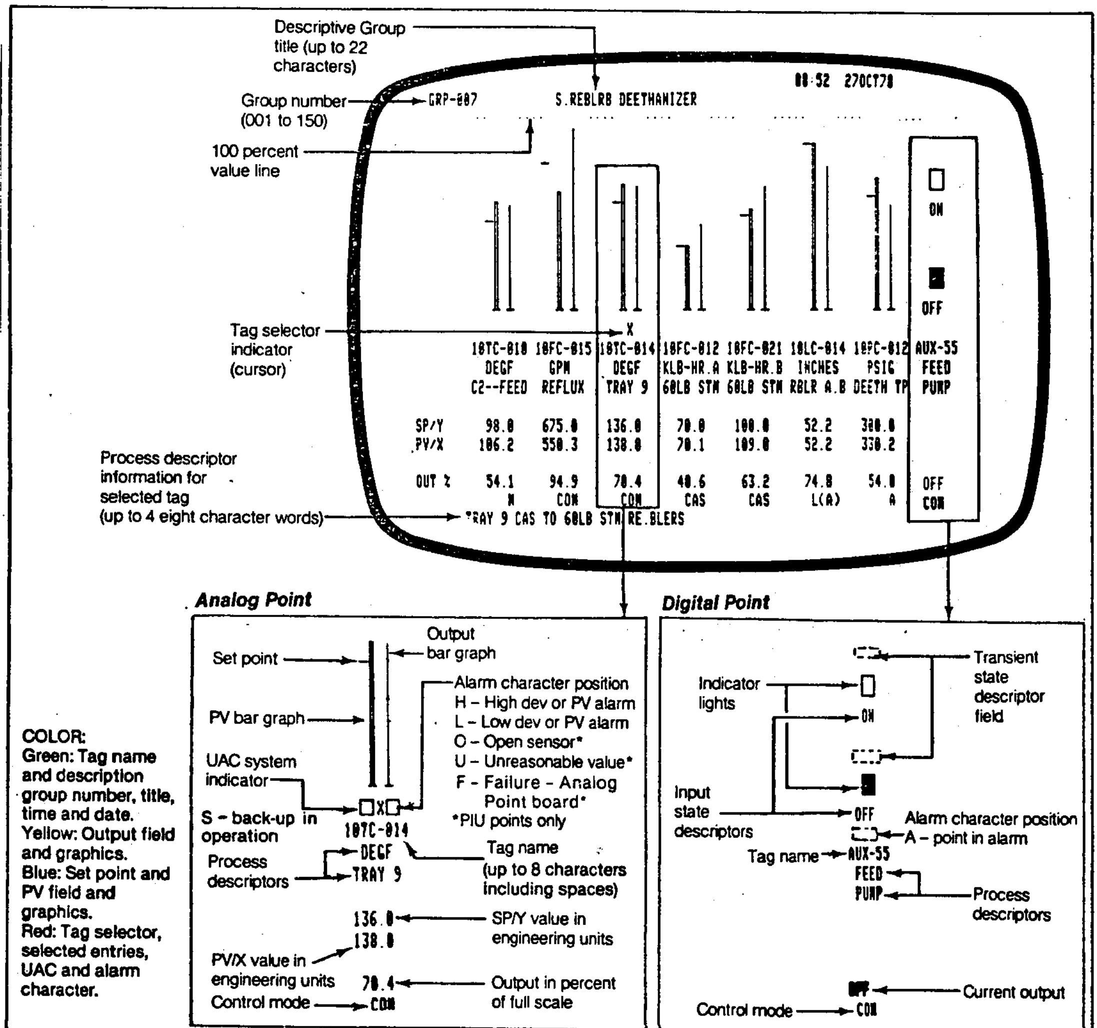


Figure 3 - Group Display

SESSION 1.A CHAIRMAN CAPTAIN J. DODWELL

Paper 1.1 SHIPS, SHIPBUILDING & NATIONAL DEFENCE

by

Rear Admiral W.J. Rourke, RAN

DISCUSSION AND WRITTEN QUESTIONS

1.1.1 *Rear Admiral Guy R. Griffiths, RAN (Rtd)*

I agree with the general thrust of the Admiral's paper and the emphasis placed on the need for this island nation to become more self-reliant in providing Australian flag carriers to transport a greater percentage of our vital trade. The Admiral is not allowed to express an opinion on whether our current and projected naval forces are adequate to protect this key aspect of our livelihood and economic development - I believe the naval forces are not adequate.

There is an important point on the use of naval forces which has not been brought out, and that is their value as a deterrent to avoid conflict, and to spread friendly influence as an integral part of government policy. The avoidance of conflict under conditions favourable to Australia is surely more important than solving a problem by conflict. In either case your naval forces have to be tactically significant in the environment in which they are deployed.

Do you see any current or projected developments in marine technology being applied to naval ships to decrease fuel consumption without lowering their tactical capability? Observing the distances over which our naval forces could be deployed in goodwill, deterrent, or conflict roles, and the relatively short range of existing and projected naval ships, where does nuclear propulsion fit into the Australian naval scene in the future?

1.1.2 *Mr. W.F. Ellis, W.F. Ellis and Associates*

Rear Admiral Rourke is to be congratulated on a very good description of the broad scenario of this subject and the major relationships between the shipping and shipbuilding industries and defence.

Over the past decade most of our major shipyards have been dismantled and when the amount of subsidy which was poured into these yards over the previous twenty years is considered, it must be questioned whether such subsidy was justified, particularly from the defence viewpoint.

The system of supporting the shipping and shipbuilding industries together with an inter-related defence application in the USA seems to be a workable or though by no means perfect arrangement.

Expenditure of some defence funds on Australian merchant ships to enable them to play a more effective role in a defence situation has been done to a very limited extent in the past. Some items which come to mind are the strengthening of tank tops and decks for heavy army support equipment on Ro-Ro ships, installing additional horse power for increased speed in a defence logistic situation and provision of additional equipment where necessary to enable a ready conversion to a defence role without impairing greatly the normal commercial function of the ship. Does the Author see any expansion of this particular approach to improving our defence capability?

1.1.3 Mr. B. Coates, Hammersley Iron Pty. Ltd.

Mr. Chairman, I would like to comment and question something the Admiral referred, relating to the making of a sailor. Has the Navy revived or is thinking of reviving the practice whereby naval personnel are seconded, maybe for short passages, on merchant ships? Some years ago we used to do this with tankers and the idea was to promote better understanding of the communication purposes and anticipation of convoy work should there be an outbreak of hostilities. I feel this could be achieved not only through the Australian flag vessels but also through any British registered ship.

1.1.4 Mr. J.C. Jeremy, Vickers Cockatoo Dockyard

Admiral Rourke and I think on the same wavelength about the aims of our shipbuilding programme and what can be achieved. I believe we're a long way from having a self-sustaining shipbuilding capacity to support the Navy, but I hope that we can achieve it in the years to come. There is one aspect on which I would like to seek your views. You made the comment that the mine hunter programme will provide a basis for ongoing production of these ships in time of war. I would agree wholeheartedly, but there is one aspect which concerns me, not only with the mine hunter but with any other ship: and that is the weapons system. The lead time for weapons systems today is growing longer and longer, particularly as the consumption in various countries around the world gets more and more ambitious. Moreover the source of these weapons systems is predominantly, particularly for the mine hunters, Western Europe. If we were to have a major conflict which perhaps involved the Soviet Union, I have read it is possible that Western Europe could be in a very serious situation within the first seven days of such a conflict. This would immediately mean that our sources of supply are likely to be cut off. Have you any suggestions as to how we might overcome that situation in the event of a major conflict?

1.1.5 Captain A. Pearson, Company of Master Mariners

I see no argument with the views expressed in the paper which sets out the existing situation clearly, indeed I believe they would be echoed by the great majority of those involved in the allied industries of shipping and shipbuilding.

However, bearing in mind the situation in which the United Kingdom was placed on the outbreak of war in 1939 when it had to initiate a crash programme of naval (especially escort corvettes) and merchant building (the Empire ships) and also bearing in mind the limited building facilities existing in Australia, I ask the following questions:

(a) Could Australia initiate a rapid shipbuilding programme for naval vessels especially escort vessels?

(b) If so, does any such plan exist?

(c) Initiate any plan to replace merchant ship losses in the event of conflict?

(d) If not, does the Admiral know of any plans to rapidly upgrade the present extremely limited building and repair facilities in the event of conflict?

I realise that these questions might bear upon defence policy, but they are obvious in the light of this well presented paper.

AUTHOR'S REPLIES

Admiral Griffiths seeks comment on developments in marine technology that may reduce fuel consumption, and on the prospects for nuclear power in the Australian Navy. First I would emphasise that sea transport is already by far the most energy efficient means of moving heavy loads and that as the price of fuel goes up, so does the comparative advantage of sea transport. Additionally, I have confidence in the ability of technology to find a way around the high price of any particular factor in the economic calculus. Others in this Symposium will talk of coal firing and the use of the solar power of sail. Furthermore, designers of heat engines will be on their mettle around the world, and so too will be the hydrodynamicists and the underwater paint technologists, who pursue ever decreasing hull resistance. I can assure Admiral Griffiths that life-time fuel costs are carefully considered in our ship selection processes.

Nuclear power becomes comparatively more attractive as the price of fossil fuels increases, and increasing reactor core life is reducing the significance of some aspects of support. Nevertheless, I believe there is a high entry fee to be paid to become competent in nuclear engineering matters, and I maintain the view that the Australian Navy cannot afford the costs of blazing the trail, but should keep close on the heels of any local nuclear industry development.

Admiral Griffiths believes our current and projected naval forces are not adequate to protect our vital trade. I share this view, but doubt whether we could ever expect to maintain or plan to acquire a peacetime force that would be adequate for war. I share also his view that naval forces have a substantial value in deterrence of conflict, a value made apparent by widespread deployment of our forces throughout our region.

Mr. Ellis suggests defence funds might be selectively applied so that merchant ships might be more readily converted to defence roles. I agree that this may be useful, and should be considered, together with planning for conversions in advance of need. At present I see little opportunity to expand the approach unless there is some expansion of commercial building, except perhaps that it may prove useful to examine the commercial trawler/minesweeper conversion, and encourage the construction of ships adaptable to the maritime role.

Mr. Coates, I can only partly answer your question. Yes, we do to a certain extent, and I think we're probably anxious to expand. We do have quite a problem at the moment in regard to a large intake of young officers particularly, and limited billets for them to get some of their initial sea experience. So I think both from the initial training levels and with more experienced officers we would like to pursue this more. I think we'd always like to hear from shipowners, operators, who can propose anything to us of this nature. The particular requirement for the training side has really arisen from the fact that we seem to be concentrating more and more on smaller ships, ships that are very limited in their crew space aboard. Therefore we can't normally put a lot of people on for training. So that is something I think we could pursue more than we do at the moment. I think we've gained value from it in the past and should be doing it again.

In reply to *Mr. Jeremy*, of course, if the major conflict is extremely short, you've really got to fight the conflict with the forces you've got at the moment, and that is why it's a very important reason for making sure, in this long lead time game that it is for naval war vessels, that you maintain an adequate number of them even when the horizon looks fairly clear. So it's an important thing never to let that number diminish below certain levels. But if it is a longer conflict? Even in that volatile part of the world in the Middle East, the most recent conflict there between Iraq and Iran, although it had a sudden start, have shown that some of these conflicts do have the habit of going on and on. And I do believe that our shipbuilding capability and the ability to put weapons into the ships will never be entirely self sufficient and I do believe we will be able to bring in by air and I certainly hope by sea, some of the things we need. But we need to lessen our dependence, particularly on the larger volume, heavier items, and more crucial items that we require in larger quantity. We have in Australia under development at the moment a highly capable and effective sonar system, the *Mulloka* sonar. It is being developed by our own defence scientists and it's being produced by EMI Australia and there are some parts of it still being made overseas in the United States. But the idea is that we are going to bring that technology back and we are going to have the entire sonar made here in this country. And that is the sort of thing we need to do. In the particular case of the mine hunter, we were faced with a problem of a field that we considered very important, with some urgency to resolve it; a field where all the solutions seemed unduly expensive and we tried to produce a lower cost solution ourselves, and a need to get the programme off the ground quickly. So in the first place, apart from the local construction of the hull and some general hardware, all the specialist hardware is being imported. But we will be having a very close look at that programme and seeing progressively what more we can do. Certainly between the prototype and the production phases we will be saying,"can anybody take up these things under licence" or "can anybody build something which is an equivalent". For example, we are already on to some equipment, like the non-magnetic cranes, saying, "can people now come along and make us proposals". So the aim is not only to be able to build the ships here, but to be able to build their major components. One area where we have no longer a capacity, that disturbs me, is our ability to produce ship propulsion machinery. Perhaps in some ways gas turbines are more transportable around the world, and we can bring them in and put them in ships, but I still think that we need to support and encourage our diesel engine capacity, for example, to be able to get a greater national capability to build engines in this country.

The insufficiency of our peacetime naval forces to meet the demands of war brings me to *Captain Pearson's* questions on the ability to expand our force in time of need. I believe this to be a vital issue and I thank Captain Pearson for calling attention to it.

The Navy has currently several programmes that are indigenous programmes, especially planned not only to serve our current defence needs, but to provide a capacity for expansion in time of war. First our patrol boat programme where a series of high quality vessels are being produced in Cairns over a period of several years. This is giving us a national capability that could be spread to numerous shipyards in Australia in time of need.

We have similar plans for the new class of minehunter catamaran. Two prototypes are to be built; then a production run of at least four more; and then the proven and established plans are to be held in readiness for a substantial local construction programme in time of need. In formulating each of these programmes, there has been some discussion as to the relative benefits of proceeding with one builder for each class, or sharing the task. My personal view is that as our total volume makes continuity difficult, it is better to work to get an efficient programme with one builder than to divide the task in two. I believe the national capacity to build efficiently is best established through the series production the single builder can achieve.

I hope that in the future we can institute a further programme for coastal escorts. Again I would see a fairly modest peacetime order providing a substantially increased capacity for rapid expansion in time of need. I hope it might prove practicable in the context of such a programme or series of programmes to return to Admiral Henderson's ideal, so that all the requisites of a ship of war: radar, sonar, guns and machinery, can be built in this country. I believe that provided we continue to pursue efficiency that the objective is attainable, and would be a significant contribution to our national security.

1.1.6 Summing Up By The Chairman

I'd like to say thank you very much Rear Admiral W.J. Rourke for your paper. It has been very interesting. I think we will have found here, from many points of view, that it comes through as obvious that the merchant navy and the Royal Australian Navy need very much to co-operate with each other. This factor was borne out in the last term of major hostilities in World War II and I think it would be more valid in today's scene than perhaps it was then, particularly with the increasing technology. I was very interested to hear that there are plans to develop our shipbuilding and ship repair, preplanning, for any future needs.

Editor's Note:

Since preparing the foregoing questions and answers, Rear Admiral W.J. Rourke, RAN has just recently received a letter from Captain W.S.G. Bateman on the subject weight and volume of Australia's seaborne trade.

1.1.7 *Captain W.S.G. Bateman, RAN, The University of New South Wales, Royal Military College, Duntroon*

I am sure you will not mind if I pointed out a small inaccuracy in your paper delivered at the Ship Technology Symposium last year. It occurs on Page 8 of the published papers in the sentence: *The total volume of exports is ... only about one-third of our volume of imports.*

The two quantities cannot be compared in this way since overseas cargo is recorded either in terms of units of weight or measurement depending on the basis on which freight is charged. The statistics for cargo recorded in tonnes are shown separately from cargo recorded in cubic metres and the separate totals are neither additive (unlike quantities) nor referring to the same cargo. The source for these comments is the explanatory notes to the ABS publication, *Overseas Shipping* annual.

The *Australian Year Book* appears to create a trap by showing annual overseas cargoes, loaded and discharged, with weight and volume side by side for each but without noting that different goods are involved (i.e. they are not alternative measures of the same set of goods).

Something seemed wrong when I heard your paper at the Symposium but I did not research it until I saw it republished in the last *Sea Trader*. It has also come up as part of my current study. The attached table showing current trends and relevant relationships may be of interest.

AUSTRALIA'S SEABORNE TRADE

1967-68/1978-79 By Value (Constant 1974-75 Prices)

Weight and Volume

	Incoming			Outgoing		
	Imports[1] $ mill	Cargo Discharged[3]		Exports[2] $ mill	Cargo Loaded[3]	
		'000 tonnes	'000 cubic m		'000 tonnes	'000 cubic m
1967-68	5,734	28,013	5,316	5,518	42,000	2,386
1978-69	6,038	29,767	5,918	5,801	55,835	2,331
1969-70	6,552	28,654	5,844	6,933	78,082	2,410
1970-71	6,823	21,754	5,742	7,572	101,819	2,959
1971-72	6,318	19,505	5,865	8,308	108,047	3,161
1972-73	6,624	20,167	6,084	8,775	132,363	3,555
1973-74	7,879	23,055	7,641	7,901	150,471	3,071
1974-75	7,961	21,893	8,029	8,541	164,866	2,926
1975-76	7,326	19,718	7,170	8,847	156,133	2,488
1976-77	8,185	20,554	7,775	9,718	164,899	2,219
1977-78	7,709	21,712	5,269	9,835	164,464	2,236
1978-79	8,615	21,884	6,753	9,829	165,094	2,210

Notes:
1 - includes imports carried by air - approximately 5% of total imports by value in 1978-79.
2 - includes exports carried by air.
3 - cargo discharged and loaded is recorded either in terms of units of weight or measurement depending on the basis on which freight is charged. Unlike quantities are involved and the separate totals for weight and measurement cannot be added.

Sources:
ABS, *Overseas Shipping Cargo,* annually until 1975, various issues.
ABS, *Overseas Shipping,* 1977-78 and 1978-79.
ABS, *Exports and Imports of Merchandise at Constant Prices,* quarterly.
ABS, *Overseas Trade, Part 2: Comparative and Summary Tables,* annually.

AUTHOR'S REPLY

I am indebted to *Captain Bateman* for pointing out to me that statistics for imports and exports are recorded either in tonnes or in cubic capacity and there is no ready way of aggregating them. The figures for 1978-79 for imports aggregated 21.8 million tonnes and 6.7 million cubic metres and were valued at $8.6 million, while exports totalled 165 million tonnes and 2.2 million cubic metres and were valued at $9.8 million. The total volume of exports is apparently considerably greater than the total volume of imports.

Paper 1.2 COMBINATION CARRIERS ECONOMIC AND COMMERCIAL ASPECTS

by

P.W. Naughton,
T.N.T. Resident Director - Shipping

DISCUSSION AND WRITTEN QUESTIONS

1.2.1 Mr. D. Bendall, Australian Shippers' Council

I am pleased to learn that the Union Steam Ship Company is considering introducing two self-sustaining combination vessels to rationalise vacant space in the trans-Tasman trade.

One assumes there would be savings in freight costs and the question is: have you been able to quantify the savings in costs by rationalising the service, and will those savings be passed on to shippers by reducing rates?

I like your remarks about the Trade Practices Act. I agree with them entirely. As far as your incentives to shipowners is concerned, I don't think I could accept that you've got to have subsidised shipping. I think that any shipping that we're talking about here today, particularly in the competitive situation, your arguments for competition would agree that let's have commercial shipping by all means in our trade, Australian flag shipping by all means commercially, but no subsidies. On the subject of the Shippers' Council itself, we'd love to talk to you, who don't you come in?

I have a question: Mr. Rosenfeld seems to prefer the idea of containers in cellular ships. When the new ships come on are they to be cellular? There are obviously advantages for containers in cells. Is there provision for dry and refrigerated containers? I just wondered when the Union Company was going to wake up to containers in cells and the advantages in that type of carrying. I'd love to see containers in that trade.

1.2.2 Mr. G. Griffiths, Australian National Line

Listening to Mr. Naughton talking about the ABC - combination ships, the bulk carrier on the one hand and carrying containers. I'd like to indicate that it's very much a non-conference situation which he has been describing. Perhaps he can tell us what sort of a total service can the ABC line give to the Australian shippers generally? We in the Australian National Line running in conference have to meet the requirements of a total shipping system and it is our experience in regard to ABC and independents that they tend to cream off the high paying cargo. They do not tend to support and help to subsidise the low paying cargo. This is a vital characteristic and I would like to know just what ABC intends to do in that category.

1.2.3 Professor H. Benford, University of Michigan

Too few of our technical society papers give us an insight into the functional requirements that underlie our ship designs. Mr. Naughton's paper is a welcome exception. His statement of the potential commerce in various commodities is clearly presented. He goes on from there to outline several variations on a design concept for a ship suitable for cargo carried in containers or in bulk. The combination carriers that he shows seem admirably designed to overcome the imbalance inherent in Australian overseas trade.

Ship design invariably demands compromises. That is true even in cases where only one cargo is intended. In cases like those proposed the number and degree of compromises must be enormous. The ideal container ship and the ideal bulk carrier are two widely differing beasts. The former is relatively small, relatively fast and relatively fine-lined. The latter is large, slow and full-bodied. Of these three important differences, the matter of size would seem the most difficult to bring into line. The solution in the case of the ABC Containerline was to find a commerce in bulk cargo (mineral sand) in which the demand was such that ships of modest size would be appropriate.

Another solution would be to resurrect the idea (mentioned in the paper) of carrying containers on the deck of what would be primarily a bulk carrier or tanker of great deadweight. Such a ship, sized for a virtually unlimited supply of bulk cargo, could carry on its deck enough containers to fill a containership of normal size. These boxes would of course be empty when the holds were filled with bulk cargo and loaded for the return trip. The question of stability would be crucial, but the relative lightness of the container cargoes would allow easy ballasting.

As a point of clarification I would ask Mr. Naughton for details on the extent of modifications within the holds. For example, was it necessary to install vertical guide rails for each stack of containers?

I appreciate this opportunity to take part in what I am sure will be a series of stimulating discussions of a valuable paper.

1.2.4 Mr. G.J. Wood, Star Shipping (Aust.) Pty. Ltd.

The author has comprehensively promoted the Combined Carriers of ABC and Union Steamship Company, but leaves open to question some critical assertions and anomalies. The main commercial theme of this paper appears to be the claimed competitive advantages of ABC tonnage relative to Conference vessels.

Why do ABC not publish a full range of independent tariffs rather than merely discount Conference tariffs, which gives the impression of 'creaming off' Conference cargo and not giving shippers the benefit of cost integrity?

Is a single operator with a limited number of gearless economy ships restricted in capacity and committed to both bulk and container shippers really able to offer the advantages and options Mr. Naughton claims relative to the large fleet of Conference Ro-Ro, cellular and intermediate vessels and the bast network of back-up facilities which the Conference members have developed over many years?

In endeavouring to be constructive we must acknowledge that as both container and bulk carriers the ABC vessels perform well and no doubt provide satisfactory service to those shippers not in need of the total liner facilities and sophisticated tonnage of Conference. My own company, Star Shipping, and various other groups have on several occasions with Combined Carriers failed to compete with Conference not by virtue of freight rates, but rather due to inability to convince shippers that their demands for tight scheduling, fast transit and delivery times with multi-port calls, etc. could be met over a protracted period. Servicing wool sales is a classic example.

From an operational viewpoint, Mr. Naughton oversimplifies trading patterns and the so-called problem of imbalance. It is misleading to state that imports are mainly general cargo and exports predominantly bulk in justifying the versatility of Combined Carriers.

Despite the advent of containers the Conference have by rationalizing their services managed to reasonably balance inwards and outwards cargoes, although I understand ABC's incursion has given them some headaches in this regard.

Similarly in the bulk trades it is only the larger vessels hauling coal, iron ore and bauxite that regularly have to make long ballast passages. The handy sized bulk carriers, into which category ABC vessels fall, find a lot of regular employment both inwards and outwards in this part of the world. My company during the past sixteen years have achieved well balanced trading to the extent that only three vessels have ever had to ballast into or out of Australia.

The ABC vessels are only ideally suited to certain cargoes, not all cargoes as the paper suggests. As bulk carriers their role, particularly the new generation of ABC ships, is limited by the fitting of cellguides in one third of the cubic capacity and by the fact that they are being traded gearless. These ships can only satisfactorily lift full bulk deadweight cargoes of heavy commodities such as mineral sands and concentrates and are restricted with the main bulk commodities traded such as grain, alumina, sugar, fertilizers and coal account high stowage factor and the requirement of many charterers that vessels have cranes. I would also suggest that container fittings such as pots on tanktops, must be a liability when trimming out bulk cargo with grabs and bulldozers.

In terms of container cargo the ABC vessels have lower speed performance, less refrigerated capacity, can only handle integral units (reefer), and obviously suffer to some extent by being gearless, whereas the Conference, whilst fielding some gearless ships, have also Ro-Ro, Lo-Lo , barge ships and gantry craned vessels.

In summary, Mr. Naughton must recognise that his vessels are not the answer to the prayers of many bulk and container shippers but do provide a useful complementary and alternative service for some.

Competition is healthy, the Conferences do strive to monopolize general cargo trades and enjoy Government support because of ANL, which provides great leverage for Conference to substantiate its claims for higher freight rates with bodies such as Shippers' Council due to ANL's high cost structure. I wish ABC well.

Only brief comment is warranted regarding the section covering Union Steam Ship Company.

The trans-Tasman trade is totally protected and whilst giving credit to USS Co. of NZ for their long record of technical innovation and extremely sophisticated ships, it must not be overlooked that freight rates on this run are reported to be the highest per ton mile in the world.

The so-called problems of Ro-Ro vessels returning from Australia with empty space and bulk ships ballasting to Australia ex New Zealand referred to by Mr. Naughton are created by the protection of local shipping. If foreign flag operators were permitted to trade freely on the trans-Tasman runs freight rates would be reduced dramatically and imbalances would disappear overnight together with the necessity for such high cost new tonnage of the type described which are neither good bulk carriers nor container ships in my view.

1.2.5 *Mr. J.I. Davies, Seabridge Australia Pty. Ltd.*

We wholeheartedly agree with the comment on Page 2: *Therefore it is paramount to Australia that the service available, by whoever provides the tonnage, is efficient for the purpose, with the required speed, regular and at the lowest cost commensurate with the service needed.* The full concept of efficiency, far broader than above, is made by the rationalised conference services, generally giving a mix of ships and, more importantly to the client, and Australia's export endeavour, common pan-Australian freight rates. Also there is a wide range of ports in Australia to a wide range of ports in the overseas area concerned and, importantly again, catering for the total range of shippers and all classes of cargo from the lowest paying freight to the highest.

Does the ABC Line really provide this type of service?

Would Mr. Naughton be good enough to elaborate on ABC plans for the return of northbound refrigerated containers?

It seems on examining routing through Europe thence Australia and turnaround figures given, that each will need 200 days at least which calls for a total requirement of between 2700 and 3000 pieces of equipment and indicates a high financial servicing burden. This bears relation also to the statement on Page 7 that the first and second generation vessels will have 75 reefer containers on deck, yet on Page 8 an average of 100 reefer boxes is referred to. Clarification would be welcomed also on this important aspect for better understanding of the paper's conclusions.

1.2.6 *Mr. L.C. Russell, Australia to Europe Shipping Conference*

On the basis of a quote from the paper: *The Company is convinced that multi-purpose ships operating in conjunction with their Ro-Ro vessels offers the best solution .... provides the greatest flexibility of action to meet changing trading patterns.* Would not Mr. Naughton agree that a Conference like AESC with a wide range of ship types, cellular container, Ro-Ro's and modern conventional vessels provide the necessary commitment to Australian Trade Development and Facilitation? Is it true that two large Ro-Ro vessels operated by the Union Steam Ship Co. have gas turbine engines which are very expensive in terms of the costs for bunkers?

1.2.7 *Mr. R.F. McMahon, Australian National Line*

Firstly, Mr. Naughton is to be congratulated on his presentation on the concept of the combination carrier and its commercial impact. He illustrates his points with the ABC Line which through freight discounting maximises the carriage of the cream of the high value freight offering on each sector of the service in competition with the Conference lines.

Can Mr. Naughton explain how low value freight and empty containers can be shipped to required destinations around the world?

Should such commodities be abandoned in Australia as unprofitable cargoes or left for the rest of the community to worry about and subsidise?

1.2.8 *Mr. C. Ying, New South Wales Institute of Technology*

Mr. Naughton has indicated some criticism of the Australian Shipper's Council in their negotiations with the Conferences. This may be due to a lack of 'muscle' in the legislation. Would you favour the ASC being granted rate settling powers (or being permitted to run a freight booking centre) or, going the other way, would you recommend the abolition of Part X of the Trade Practices Act 1974 so that the anti-competitive provisions of the Act would then apply to the Conferences?

1.2.9 *Mr. B. Dodds, Australian National Line*

In relation to Mr. Naughton's paper I would be interested to know of a complete voyage schedule of these vessels. Please advise numbers of ports visited, type of cargo handled; time in each port in addition to sea times? Has ABC been able to maintain advised schedules?

1.2.10 *Mr. R.G. Hawke, B.H.P. Co. Ltd.*

Does Mr. Naughton expect the proposed Australian Flag Combination Carrier to have a crew of 25 as for a Belgian Flag Ship?

Has there been consultation with the Australian Maritime Unions? The question also applies to the Union Steam Ship Company vessels.

AUTHOR'S REPLIES

In reply to *Mr. Bendall's* questions: as indicated it is a proposal only to introduce such vessels by the Union Company into the trans-Tasman service. Whilst research into the economics of trading patterns has taken place the concept is still subject to approval and with building time still some way off. Consequently it is too early to accurately quantify savings as such. However, you will be aware of and appreciate that any replacement of old tonnage by new buildings imposes an immediate additional capital component which must be serviced. A dditionally operating and cargo handling costs will unfortunately continue to escalate. Realistically new construction is best considered as a means of lessening the impact level of future freight increases in comparison to continued use of older tonnage and operating methods.

For reefer containers? Yes, there would be when you want a lot of them. If you can carry them on deck, say 100 or 150, there is no problem. But when you want 700, yes, you've got to do something about it.

Cellular? Yes, three hatches. Because of the large reefer capacity; they're put in because of the reefers.

Once you put the cell guides in you can put dry or reefer. But they were put in for the reefers.

The Union Company are doing their studies now and I did mention the type of ship that they are seriously contemplating which has certain advantages. But that could be another subject. There are a lot of containers in the trade now and one of the reasons that the new ships are being discussed at the moment is to provide for the ever-increasing amount of 20 foot units in the trade.

In answer to *Mr. Griffiths* questions: it's a pity that time prevents answers to the questions that were written because it is all answered there. The ABC Line is giving the same service or in most respects the same service as the Conference lines do by calling at Fremantle, Melbourne and Sydney, and if cargo permits with the reefer capacity especially for the east coast, north America, calls will be made in Brisbane. In fact, calls have been made anywhere there is enough cargo. Otherwise you centralize it in exactly the same way as anybody else does. The meat cargo from the north-west of Western Australia we would centralize to Fremantle and I see nothing really different. So far as the freight rates are concerned and the freight schedule, they are the conference rates, less a discount. Conference service and conditions are applicable to the overwhelming number of shippers. (I can't think of anyone wanting to ship cargo from somewhere and he can't ship it on these ships.) So, I don't see that there is any real difference between the service provided currently by the Conference lines and this particular independent line. ABC Line extend carriage to the full range of commodities exported and imported all at discounted rates and it's simply not true that the high rated cargo is creamed to the disadvantage of lower category cargo.

In reply to *Professor Benford*, it is not necessary to install any vertical guide rails in the holds for stacking containers. Basically the configuration of 9 across and 6 high is simply block stacked and secured by the use of removable stacking fittings on tank tops and between each tier. No lashings in holds but used with on deck carriage.

In the two first generation vessels removable container support benches were necessary to square off small sections of the holds to cover the flare in Nos. 1 and 7 to facilitate stacking. These proved in practice awkward to handle, consequently in second generation permanent frames were fitted in No. 7 hold.

In answer to the question from *Mr. Wood* I advise that from inception ABC in their Australian/Europe service have used as a basis for freighting current conference tariff and conditions, less a realistic discount against the appropriate category. It would be relatively simple to issue an independent tariff and conditions, however, over a very long period importers and exporters have become used to the conference tariff in their trading calculations and to a greater or lesser degree understand it in relation to their particular commodity. It is logical therefore that when dealing with the same clients and products for carriage that the least confusion and clearer rate comparison can be made by simply comparing like with like.

Over their 3 years of operation ABC as responsible carriers have not simply creamed off top rating cargo, but have carried the full range of products offered at discounted rates. It is interesting to note that conference in many cases have made greater freight concessions on lower rated cargoes than on the so-called cream.

The number of operators in a trade is immaterial in the context of service. It is the number and type of ships used and frequency of sailings available. With 8 vessels in the trade in 1982 and probably 10 by 1983 ABC will be by far the largest operator. In fact conference owners appear to be reducing their tonnage.

No suggestion has been made nor any intended that the combination vessel should supplant the pure general cargo container ships whether they be lift on/off or ro-ro. On the contrary one of the main arguments in the paper is that they should be used in conjunction with the greyhounds, i.e. shippers having the option to use and pay for the service at a price they can afford.

In any assessment of national trading patterns and tonnages one must to some extent generalise when using total import/export figures, but basically Australia does import general and export bulk cargoes. Consequently Star Shipping must be congratulated on their ability over the years to reduce ballast voyages to the extent stated.

Again no claim is intended that ABC type vessels are ideally suited for carriage of all bulk cargoes. However, they certainly can economically carry a wide range of dry commodities in the so-called lighter cargoes, e.g. alumina, coal, etc. With combination liftings, i.e. containers and bulk, full deadweight or maximum allowance draft can be achieved with a very wide range of cargoes.

The 2 third generation vessels have been specifically designed with 9 holds, i.e. 6 open and 3 fitted with cell guides, on the basis that if required full bulk liftings can be carried in the open holds.

The stacking pots on tank tops are removable and when not in use plugs are inserted in the position holes, thus leaving the tank top clear for loading/discharging bulk. Decks have been strengthened during building to take cranes if required. To date this has not been necessary.

Whilst it is true that the trans-Tasman trade to a large extent is protected, not be legislation but by labour attitudes on both sides,it is of course quite open to those wishing to invest and trade under these conditions to do so. In fact this has been done and there is quite strong competition currently in the trade. Whilst rates are higher than in some trades, it must be viewed in the context of the high operating costs, both in manning and cargo handling at all stages of voyages in both Australia and New Zealand. Carriers in other trades face this cost factor probably only once. The rates are simply not the highest per ton mile in the world.

Replying to *Mr. Davies:* I advise that in the particular trades catered for by the Line, ABC basically do provide a similar service to conference operators over the full range of cargoes offering, but at discounted rates of freight.

With the introduction into service in 1982 of the third generation vessels with their greatly increased reefer capacity, it is quite correct that this will require the provision of a large number of reefer units being either company owned or leased, hired as necessary.

The first and second generation vessels were built for carriage of 75 reefer boxes. However, to meet consistent demand additional points have been added giving liftings up to 150 per ship. Thus the indicated average of 100.

In reply to *Mr. Russell*: it is not intended to infer in any way that the members of this conference are not providing a commitment to service the Australian Trade and its development. This they are doing but to put it simply with the wrong type ships for at least a percentage of the cargoes. Use of combination vessels can reduce operating costs reflected in rate reductions.

In answer to Mr. Russell's second question: yes.

Mr. McMahon: as explained previously ABC Line does not discriminate between commodities but offers a service to the full range of cargoes. It is not a 'creaming' operation. In practice substantial freight discounts have been offered to commodity shippers of low rated cargo. In truth the community has much more to worry about and subsidies in conference arrangements than independents.

You raise a very interesting subject *Mr. Ying*. Rightly or wrongly over many years it is clear that successive Federal Governments have as a matter of policy favoured the continuation of the conference system (closed, as compared to the USA, open). This resulted in the incorporation of part X of the 1974 Trade Practices Act, which, for practical purposes, excluded them from the competitive provisions. As Government policy this was considered acceptable.

However, my remarks were directed in respect of proposed amendments of the 1974 Act. These are seen to be discriminatory against independent operators and users of conference. Surely responsible legislation should have as its objective the protection of the weak and not the succouring of the strong.

In reply to *Mr. Dodds*, the typical voyage schedule is as set out on Page 8 of the paper, with an additional call on most voyages at Geraldton to load sand. Fleet sailing schedules are updated fortnightly and widely distributed.

Where practical schedules are being basically maintained. However, like all operators, programmes are inevitably subject to change if vessels encounter unavoidable port delays through strikes, congestion, etc. particularly in Australia.

Replying to *Mr. Hawke*. There is no valid reason why an Australian Flag Ship of similar design and specification should require higher manning than a Belgian Flag. Prior consultation with Australian Maritime Unions is of course essential to the introduction of such a vessel.

The Union Company vessels are New Zealand manned.

1.2.11 Summing Up By The Chairman

I can, maybe, envisage a change in the thinking that might come over the Conference lines and I suppose it could be said that there is really nothing that I know which can prevent ABC competing in the shipping services; and we get right back to the concept of competition. I'd like you to join with me in thanking Mr. Naughton for his paper.

Paper 1.3 THE TIGER LINE CONCEPT

by

W.J. Hood,
W.J. Hood and Associates

DISCUSSION AND WRITTEN QUESTIONS

1.3.1 Dr. L.J. Doctors, The University of New South Wales

I would like to ask a question about Figure 5 which summarises the broaching tests on the container ship. Could you supply more details about these tests, particularly in regard to the way they were conducted, and the results taken? What is the meaning of the symbol J_R in the wave-slope parameter? Why does the speed of the craft appear to be unimportant in determining the onset of broaching?

Secondly, there appears to be an inconsistency in the axis denoting the wave speed. According to my calculations, the wave number is given by

$$k = 2\pi/\lambda = g/c^2$$

where λ is the wave length, g is the acceleration of gravity, and c is the wave speed. This gives us

$$\lambda/L = 2\pi c^2/Lg$$

where L is the ship length. If we substitute for g and L (presumably the LBP of 92.0 m) and express c in knots, we obtain

$$\lambda/L = 0.001844\ c_{kt}^2$$

Selecting, say, $c_{kt} = 23.2$ kt gives $\lambda/L = 0.995$, which agrees closely with the value of 1.0 given. However, taking $c_{kt} = 27.55$ produces $\lambda/L = 1.4$, and not the value 3.0 on the axis.

1.3.2 Mr. W. Waters, Union Steam Ship Co. of New Zealand Ltd.

The paper shows clearly what can be done and should be done by the shipowner or his consultants before the design leaves the drawing board.

The study refers to two types of 'fast feeder vessel' of the same speed and dimensions. It would have been enhanced by a Benford type economic analysis of at least two other types, say cellular container ship and a conventional 'self-sustaining' cargo vessel.

In the same way, the Det norske Veritas reliability and safety analysis also uses the sea state data to forecast seaworthiness and would carry more weight with the owner's superintendents and master mariners if, at a moderate extra cost, the data for an existing ship known to those gentlemen were put through the same series of 'desk studies'. There is then a 'feel of the boots' conversion factor which would allow the mariner to relate both sets of figures to his own personal experience in the existing ship.

I would like your comment on the effect of the large vertical accelerations and velocity surges on the cargo lashings, particularly the trailer ship version. Was the Det norske Veritas method applied? (Classification Notes, Note No. 32.2).

Obviously cargo securing would be a major time factor in port and a cost factor in terms of the additional crew required. To what extent did this aspect influence the financial analysis?

The IPEC project appears to have the normal reception meted out to anything new. Would the economic analysis already mentioned above show that jobs were not likely to be lost if additional staff ashore are taken into account? Is it possible that shipowners are placing too much emphasis on the savings to be made from reduced manning and not enough emphasis placed on a determination to provide a minimum manning consistent with safety requirements?

It would be interesting to see either a 'pie-chart' or percentage breakdown of costs showing crew costs, fuel costs and cargo terminal costs.

Would you please give more detail of the propeller, shafting, gear box, flexible coupling system. The optimum propeller in present day economic terms and basic propeller theory is the largest practical diameter and the slowest practical rpm. What kind of torsional and transmission problems does this create when linked to a high rpm lightweight engine with 20 cylinders? Diesel-electric transmission is ruled out but would a hydraulic coupling be a better proposition?

Would a 'crash stop' test create other gearing problems?

Did the structural analysis examine the effect of high frequency vibration originating in the main engines on the accommodation and navigational equipment on the bridge?

1.3.3 Mr. S.E. Wheatstone, Bureau of Transport Economics

I congratulate you on such a good paper. The ideas expressed are the types needed to stimulate and to bring about changes in general cargo shipping. There are three questions I wish to raise.

The comparison between the fuel costs of the IPEC Tiger (1000 dwt) and a 50,000 tonne ship is most amusing but uninteresting. Certainly a 50,000 tonner would rarely be used on such a short route as the Bass Strait trade. A more useful comparison would have been between the Tiger and say the MV Melbourne Trader.

The Melbourne Trader at 5132 tonnes dwt has a complement of 33 and a maximum installed power of 8830 kw (11835 BHp) with a service speed of 18.4 kts. The Trader's load factor range at present is 0.4 to 0.8 with corresponding fuel consumption figures of 46 cargo tonne km/litre (46920 tonne km/tonne FO) to 76 cargo tonne km/litre (77520 tonne km/tonne FO).

Given these fuel consumption/productivity figures, I would like you to compare the fuel and crew productivity of the Tiger with this typical Bass Strait ship.

Towards the end of your paper, you note the negative response of the maritime unions, shipowners and freight forwarders. The two Tiger ships proposed could carry up to 525,000 tonnes of cargo per year each way meaning they had the potential to capture some 40% of the Tasmanian general cargo trade (approximately 1.3 m tonnes south bound in 1979-80). To make such changes to the supply of shipping and the services provided, along with the reduced manning levels proposed and the likely redistribution of waterfront labour, surely one must expect fierce opposition.

Do you not feel IPEC should have expected opposition from these quarters and taken all necessary steps to counter it? If not, why not, and if so, what actions in hindsight should they have taken?

The other major stopper at present to the Tiger project you noted was fuel costs. Could the author discuss the effects of costs of fuel on such a project, considering the savings made on fixed costs through high utilisation?

Editors Note:

Due to circumstances beyond the control of the Papers Committee we regret to advise that the Author has not up until the time the Discussion Volume went to press been able to provide the answers to the foregoing questions.

SESSION 1.B CHAIRMAN MR. K.W. LIMBRICK

Paper 1.4 NEW ZEALAND COASTAL AND OVERSEAS SHIPPING IN THE 1980's

by

H.D.M. Jones,

Director, Marine Division, Ministry of Transport N.Z.

DISCUSSION AND WRITTEN QUESTIONS

1.4.1 *Mr. M.J. Goulden, Marlborough Harbour Board, New Zealand*

General: The transport industry in New Zealand is particularly subject to continual and major change. With the consciousness existing of the hitherto almost complete dependence on fuel oils for a range of uses, including the sea transport industry, we are now seeing a rapid diversification which will involve a much greater use of coal in industry and possibly as a fuel for the ships serving that industry.

New Zealand is one of the most remote countries in the world, and, with its economy based principally on agriculture, it is almost totally dependent on sea transportation as a supply line to its trading partners.

New Zealand's nearest trading partner is Australia, some 1300 miles away, but many of its markets are thousands of miles distant. The sea transport industry, as it effects New Zealand, therefore, is one of crucial importance, and one in which we will see a developing consciousness of the need to bring about greater economies of scale in the years ahead.

The opportunity to be associated with this Symposium is appreciated, and the organisers are commended on the choice of subject matters to be considered.

My comments on the paper by Mr. Jones will use the same headings as used in the text of the paper, and this will be followed by a question.

New Zealand Coastal Shipping: The change in the composition of the New Zealand shipping fleet, particularly that part of it involved in home trade, has been greatly influenced by the evolution of the Cook Strait Ro-Ro service which plies between Wellington and the southern tip of the North Island, and Picton, in the north of the South Island.

The efficiency of this service combined with improved management of the associated main trunk rail network inland, resulting from modernisation of equipment, and the use of large capacity freight trains, has been successful in reducing costs to a level below that of traditional coastal shipping. This change had a very significant effect with the development of facilities at the Port of Picton in the Marlborough Sounds.

It may seem obvious that greater economies of scale will result if the use of the main trunk rail system is maximised, and also this use is related to the best deep water harbour facilities available in New Zealand.

Question: Is it considered that the consolidation of internal freight on the main trunk rail system and hence the Inter-Island Ro-Ro system will continue, or is it considered that we will see a resurgence of coastal shipping trade carrying general cargo both between secondary ports and the four cellular container ports in use at the present time?

The Next Decade: You will forgive me I am sure for appearing to dwell on a matter which obviously has direct importance to our organisation. We recognise the national interest and of course the importance of the main trunk rail system and the Ro-Ro system which forms part of it.

Of interest to us are the plans, as referred to in the paper, that have been made to replace two of the four rail ferries by one larger but similar ferry. The justification for moving to larger ferries is to provide for an expected increase in freight, and also to benefit from the economies of scale inherent in the use of larger vessels.

It is interesting to note that the trend towards larger vessels is worldwide, but in order to take full advantage of this trend, it will be necessary to provide additional deep water ports.

In New Zealand, the provision of deep water berths by dredging at many of the existing ports, will be very expensive, and the scope for constructing new deep water ports in New Zealand is therefore limited.

Adjacent to the Port of Picton, is Shakespeare Bay, which is intended to be developed as a new deep water port. As well as natural advantages, Port Shakespeare is close to present rail and road distribution networks, and of course the South Island ferry link and has the potential to be developed at low cost to accommodate facilities for large bulk carriers up to 200,000 tonnes dwt capacity. Although port facilities do not presently exist, it is hoped to commence construction by the mid-1980's, at the latest, to handle timber exports estimated to be in excess of 1.3 million tonnes per annum that will be produced in the Marlborough province during the next decade.

The author appears to see little future in the tug and barge concept for coastal shipping. With larger capacity bulk carriers being demanded on economic grounds, there may, in the future, be problems in conveying high volume export commodities such as coal, other mineral exports and timber products, from areas where deep water ports cannot be constructed economically.

In this context, the use of tug and barge to transport commodities to areas where deep water ports can be constructed, appears to be both sensible and necessary. The alternatives of either constructing deep water berths at great expense of constructing specialised off-shore mooring dolphins, with associated loading equipment, has the distinct disadvantage of being too inflexible in a world where trading patterns are constantly changing. The tug and barge concept has a much lower capital input, and in any event, is much more flexible in its uses.

It is also observed that the trend is for the new larger general cargo carriers to be purpose built, with their own specialised loading equipment. This may lead in the future to more direct exporting from secondary ports. In particular, the introduction of combination type vessels will mean that the ability will exist to carry general cargo and containers loaded by either the ship's own cranes or through facilities such as quarter stern loading ramps. This, it is seen, will provide further economies. The use of such vessels may result in greater utilisation, in terms of vessels undertaking fewer voyages in ballast, a problem which is noted in the paper.

As stated before, the New Zealand general cargo coastal trade is dominated by the Cook Strait Ro-Ro service, and with the present technology available it provides the cheapest method of transporting railway rolling stock across the 94 km of water separating the North and South Islands. However, when compared with pulling rolling stock on railway track for the same distance, the cost per tonne is much higher, due in the main to much higher ship capital cost and manning levels.

It is suggested in New Zealand that Ro-Ro ship similar to the Cook Strait ferries be introduced on other longer coastal runs carrying general cargo and railway rolling stock between Wellington and Lyttelton.

There would appear to be little economic justification for the use of these vessels for this purpose over this longer distance, when rail locomotives would be able to convey the same quantum of freight over land at a significantly lower cost.

Question: Can such a concept be justified either under socio or pure economic considerations?

Conclusion: I concur with the author's general assessment that the decade of the '80's will be one of consolidation and planning for increases in trade that are going to take place during the 1980's.

New Zealand has large reserves of coal and a substantial potential for the export of timber, as well as other commodities. From reported trends, we believe it likely that much larger ships will be used in the conveyance of bulk materials, and that we will see the introduction of larger specialised bulk carriers and general cargo carriers with self-loading facilities. I totally agree with Mr. Jones, and commend him on his final paragraph in which he expresses his view that the '80's will be a period during which planning, research and development will be of paramount importance.

Finally, may I congratulate Mr. Jones on so precisely stating the case in so far as the New Zealand coastal and overseas shipping in the '80's is concerned.

1.4.2 Mr. G. Ritchie, The Shipping Corporation of New Zealand Ltd.

I would like to compliment Mr. Jones on his concise appraisal of the New Zealand shipping scene. His paper clearly illustrates the present situation, the way in which this developed, and the probable outcome for the future.

Aside from the factual information, Mr. Jones expresses the view that New Zealand shipowners must devote considerable resources to the planning and forward thinking of shipping services in the 1990's. He feels that the outcome of such planning may not see any radical designs of ship or of propulsion systems during the 1980's, but that if nothing is done now, we may fall into the trap that we did in the 1960's.

I must endorse Mr. Jones' comments to the extent that we must learn from past mistakes. However, in defence of the industry, I must say that we are all in fact putting considerable effort into forward planning. Indeed the fact that there are two substantial shipping companies in New Zealand both with diverse interests means that any complacency that may previously have existed has disappeared. Could Mr. Jones perhaps indicate whether or not he feels adequate efforts are now being made? If not, in precisely which areas of planning and development does he feel we are deficient?

There are some specific areas of future development in New Zealand's shipping requirements that I would like to ask Mr. Jones' opinion.

Firstly, the New Zealand Government has proposed the development of mineral and energy resources such as coal, iron sands, natural gas with its associated by-products and the expansion of aluminium smelting capacity. These commodities have export potential and given that no New Zealand shipping companies have been active in international bulk shipping does Mr. Jones see an involvement in this area for New Zealand shipping companies and if so to what extent?

Secondly, bearing in mind the aims of this Symposium, does Mr. Jones think government has enough involvement in policy and technical matters or does he feel that perhaps a more direct role might assist in the promotion of New Zealand shipping?

Finally, I would like to thank Mr. Jones for his paper and its timely comments. I hope I have given some reassurance that we can live up to his expectations.

1.4.3 Mr. R.T. Lorimer, Auckland Harbour Board

In referring to the cargo handling interface, the author states it is responsible for much delay, damage, pilferage and unnecessary cost. Can you indicate the order of the costs involved and identify any differences attributable to different modes of cargo handling, e.g. cellular container ships, roll-on/roll-off vessels, which offer significant potential to reduce these costs?

In commenting on the relationship betwee the parties involved in cargo handling, the author calls for improvements, particularly in communication, and the adoption of progressive attitudes. The call for better communication is not new - indeed it is in danger of becoming an industrial platitude, but can you elaborate on your views and adduce evidence as to significant changes in attitudes and corresponding benefits which have followed any such moves?

1.4.4 Mr. W. Waters, Union Steam Ship Co. of New Zealand Ltd.

(The views expressed or implied are personal and not necessarily those of The Union S.S. Co. of N.Z. Ltd.)

The Union Steam Ship Company of N.Z. Ltd. can be criticised in the same paper for having lack of foresight over the Cook Strait ferry exercise in the '50's and for fitting gas turbines to four of their vessels in the '70's. Join the club. Perhaps we are allowed one 'famous last' to add to a long list of 'famous firsts' dating back to 1879.

Having grown up in a (British) railway port the writer can be forgiven for thinking the Cook Strait ferries ought to be part of the N.Z. railway system but the logic of a three-engine railway train regularly carting West Coast coal over a mountain range to Lyttelton to the detriment of coastal shipping escapes him.

The next decade must see a return to sea transport using either offshore moorings and slurrying techniques or an integrated tug/barge system.

Mr. Jones comments on earlier attempts to introduce tugs and barges but the next decade will be influenced by the following factors:

(a) The integrated tug/barge system has been perfected both technically and commercially. Conventional towing is not practical and articulated systems have still to be thoroughly tested in regular service.

(b) For the maritime organisation the dramatic demise of coastal shipping offers a simple choice of jobs on tug/barge units or none at all.

(c) There is no logic in one barge or even only three barges per tug but the same pusher tug can handle dangerous goods, bulk oil, logs (on deck), coal, etc. carried in specialist barges belonging to private businesses or the government and the tugs provided and managed by private enterprise.

(d) It would appear that it is government policy to favour the railway system at the expense of coastal shipping plus a preoccupation with the carriage of dangerous goods by road rather than using coastal barges to avoid roads, rail and population centres.

(e) The declared intention to support the existing shipbuilding facilities in New Zealand requires a healthy order book based on tug, barge, and fishing vessels with the offshore supply vessel used as a utility type.

(f) The existence of two fast gas turbine vessels designed for heavy axle loads seems to have escaped the notice of the logistics sections of the N.Z. Army and Navy, whereas the need for a fleet of shallow draught vessels to bring the country back to its feet after a nationwide disaster seems to have no political appeal.

Mr. Jones is well aware of the writer's personal opinions, as expressed above, but it is hoped he will answer the question: 'To what extent does he agree that such developments can and will receive attention in the next decade?'

1.4.5 Mr. C. Ying, New South Wales Institute of Technology

I notice in the paper you are in favour of increased participation of New Zealand tonnage in the carrying of New Zealand trades. I notice you made a passing reference also to the United Nations 'code of conduct'. Bearing in mind that it seems that the code of conduct for liner conferences may come into force when the EEC decides to put forward its compromise proposals, does New Zealand have a policy toward the UN code of conduct and if so, is it in favour of the code of conduct with its mandatory allocation of cargo tonnage and, of course, would your policy take into consideration the increased capacity that would be necessary to take into account this capacity to ship New Zealand exports and imports?

1.4.6 Mr. R.J. Perkins, Bureau of Transport Economics

The four-fold increase in New Zealand coastal cargo tonnage over the last 20 years is a statistic of interest. The tonne-kilometre task is also considered to be a good indicator of activity. Are figures for tonne-kilometre task available for this period and if so, do they show a similar sized increase?

Comment was made in the paper on the large changes over the last 25 years in the size and number of vessels in the New Zealand coastal shipping fleet. Could you comment on the prospects for coastal trade in terms of major commodities (oil, cement and Ro-Ro traffic), their major routes and ports likely to be used over the next decade? Are there any major new commodities expected to be shipped on the coast over this period? If so, how would the industry (ship operators and port authorities) meet the demands for these new commodities?

Are there any controls over transport operations in New Zealand which influence the competition between road, rail and sea transport? How are these controls exercised and what effect do they have on coastal shipping operations?

AUTHOR'S REPLIES

In reply to *Mr. Goulden's* first question on coastal shipping I have indicated in my paper that I do not think we will see any spectacular increase in the quantity of cargo carried by coastwise ships during the '80's, nor will we see any significant shift of transport mode. In planning for their new rail ferry Railways have predicted a steady but modest growth factor and I think there will be a similar growth in the carriage of bulk commodities such as cement and oil products. I do not think however, that we will see a major resurgence of coastal ships carrying general cargo.

I agree with Mr. Goulden's philosophy concerning the advantages of tugs and barges serving deep water ports. Previous efforts to introduce tugs and barges in New Zealand have been largely unsuccessful. This has been partly because of industrial problems but more particularly because we have not had the quantities of bulk cargoes to enable barge services to operate economically and efficiently. They have all been based on a one tug one barge concept which really isn't the best way to operate tugs and barges. Although I do not discount completely the introduction of tugs and barges into the coastal trade I remain fairly sceptical at this stage. I have suggested in the paper that there may be scope for them on the Tasman with larger barges than we have been accustomed to seeing.

I don't think we will see increases in cargo and ships on the coast. I think there will be a steady but modest growth and this will occur both in the carriage of bulk commodities such as oil and cement, in the rail-ferry services between Wellington and Picton. In fact, in planning for their new ferry, this is precisely the attitude the railways have taken. I don't think that we will see a major resurgence of coastal ships carrying general cargo.

Finally, Mr. Goulden asks whether the introduction of a rail-ferry service between Wellington and Lyttelton could be justified. The feasibility of such a service has been investigated on a number of occasions over the last decade. It is a concept which appears to offer many political attractions as it is election year in New Zealand, but on economic grounds it cannot be justified under present conditions.

In reply to *Mr. Ritchie* who takes issue with my comments on the planning in the past by New Zealand shipping companies, I agree with him that the corporation has probably done more than any other company in this respect and I have made mention of that in the paper. They have certainly become more aware of the need for planning and have devoted a considerable amount of effort to it. However, I think there is a lot more effort needed and I refer particularly to areas in the industrial relations field, manning scales, training which I referred to, and retirement of overage seafarers. We took out some figures recently and there are some ablebodied seamen of 77 years of age manning our ships. Again, Mr. Ritchie askes what should shipping companies be doing? I think they must become more active in the potential export of bulk commodities. He concedes in his comments that so far they haven't taken much interest, and my question is, "well, why not?" They ought to be going out and seeking the business and not waiting for it to appear. There are so many examples in New Zealand of commodities that are being carried by other shipping companies because the companies didn't go out and get their trade. The railways set up a service across Cook Strait because the shipping companies couldn't or wouldn't. N.Z. Forest Products carried their own timber in their own ships across the Tasman because the shipping companies wouldn't or couldn't. And so it goes on.

With respect to Government involvement, obviously it has to occur to some extent in the general economic policies of the country and in certain regulatory and technical functions. But I can't help feeling that in New Zealand the government pays too big a part in the role of running ships. New Zealanders by and large are imbued with the concept of a welfare state, where government can always be relied on to provide subsidies, loans or straight out hand-outs to rectify commercial failure or inefficiency. I think in the long run New Zealand shipping would do a lot better if it could escape the constraints of bureaucracy to a much greater extent that it does now.

In answer to *Mr. Lorimer*, yes, figures do exist and a number of investigations have been carried out in New Zealand into this particular matter. The reports all point to the fact that there is a clear need for concern at the levels both of pilferage and delay, and they point out the need for measures to be taken to combat them; but like most reports they don't come to any conclusions as to what actual costs are involved or exactly what measures are needed to be taken. I have made some enquiries from shipping companies recently and from the Insurance Council, and it is fairly clear that since the advent of containerisation, there has been a significant drop in the number of claims for pillage and damage. So far, fortunately, we haven't had to contend with instances of whole containers and their contents being pillaged or stolen, but we certinaly have too many instances of container loads being damaged due to poor packing, and also to delays in the unpacking of LCL boxes at wharf depots. I think there is considerable scope for investigation into the relative costs associated with the damage of containers and cargoes as between container ships, Ro-Ro ships and conventional ships. I think the results of such investigations would be most illuminating.

Mr. Lorimer asks for an example of better communication and takes the view that there is a sort of platitude but nobody does anything about it. As one example of better communication I would instance the initiative taken by the New Zealand committee of ICHCA which in February 1980 organised a seminar on the handling of hazardous goods. Now, as a result of that seminar and the meaningful communication between modes that stemmed from it there has been a tremendous impetus given to the introduction of common rules for the multi-modal transport and handling of dangerous goods in New Zealand. The benefits of such developments obviously do not require elaboration.

Mr. Waters invites me to comment on the extent to which the use of tugs and barges or off-shore loading of slurried cargoes will receive attention during the next decade. He also lists a number of factors which in his opinion will influence New Zealand shipping in the 1980's.

In my reply to Mr. Goulden I have already indicated the causes of lack of development in tug and barge coastal traffic in New Zealand and I do not think there is any inherent technical problem which has inhibited the operation of such systems whether they be pusher, integrated or whatever.

The maritime organisations do not, as suggested by Mr. Waters, face a simple choice of jobs on tugs/barges or no jobs at all. On the contrary, despite the so-called demise of coastal shipping, coastwise cargo has increased four-fold in the last 20 years and the number of job opportunities for New Zealand seamen in coastal and foreign-going ships is nearly as great now as it was 20 years ago and is increasing.

I am not aware of any stated government policy to favour Railways at the expense of coastal shipping, nor of a pre-occupation with carrying dangerous goods by road rather than by sea. Competition between rail, road and sea transport modes has always been fairly fierce and each mode has from time to time adopted various devices to attract cargo at the expense of its competitor. There is no doubt that for Ro-Ro cargoes between North and South Island the ownership of the Cook Strait ferries has given New Zealand Railways a tremendous advantage over its competitors - an advantage which was offered to, but declined, by the long established ship owners.

I agree with Mr. Waters that the continuation of a shipbuilding industry in New Zealand requires a healthy orderbook and, in fact, government has recently introduced a bounty scheme to encourage the placing of orders for new ships in New Zealand yards.

I must, however, disagree with Mr. Waters' final comment. I am sure the New Zealand Defence Department is well aware, not only of the existence of, but of the logistic potential of, all New Zealand commercial ships including the two gas turbine ships he mentions. As for the fleet of shallow draft ships referred to, unless they can be usefully employed whilst awaiting the nationwide disaster predicted by Mr. Waters, there is no political or economic justification for them.

Off-shore moorings and the use of slurry techniques are well understood and used in New Zealand, but the main problem, as with the use of tugs and barges, lies in the fact that only relatively small quantities of cargoes are involved. Establishing facilities for off-shore loading of large vessels is not economic unless an adequate financial return can be obtained. The reason for railing trial shipments of coal from the West Coast to Lyttelton, which so bewilders Mr. Waters, may be illogical but at present it is cheaper than shipping it.

In conclusion I reiterate my scepticism as to the likelihood of extensive tug/barge operations being established in New Zealand coastal waters during the 1980's, but I do certainly envisage that considerable attention will be paid to the possibilities of off-shore loading facilities being developed for certain bulk cargoes.

In answer to *Mr. Ying*, I can only speak from the government's point of view - obviously the shipowners will have one view, the maritime unions will have one view. So far as government is concerned, we take a fairly pragmatic view at the moment. The 40/40/20 concept sounds all right on paper, but I think we are realistic enough to appreciate that it is not going to come into force as far as New Zealand is concerned for a long time. We just could not provide ships or men to meet a 40/40/20 distribution of cargo.

In reply to *Mr. Perkins* on tonne-kilometre figures, I am sorry but I have been unable to locate any data for coastal cargo tonnage.

The prospects for coastal trade in the '80's will obviously depend to some extent on the state of the country's economy but, as I've indicated in my reply to Mr. Goulden, I think there will continue to be a substantial trade in the coastwise carriage of oil products although, as mentioned in my paper, the construction of pipelines could have some effect.

I am confident that bulk cement will continue to be a major coastal trade in the '80's as will Ro-Ro traffic between Wellington and Picton but in both commodities the growth will be a steady, modest one, not a spectacular one.

I foresee a continuation and possibly some limited expansion of the Ro-Ro trade between Auckland and the South Island and the dry cargo trade between Onehunga and the South Island. This latter route appears to be particularly suitable for carrying a mixture of containers, break-bulk cargo, and dangerous goods to ports such as Nelson and Timaru.

There is obviously a potential for the coastwise carriage of LPG and indeed a suitable vessel has recently been ordered by the Shipping Corporation.

As mentioned in my paper the past record of New Zealand shipowners, particularly in the coastal trade, has not been particularly progressive and whilst I am sure shipping companies will react in terms of *being asked* by producers to carry their products I have little faith in those shipowners going out and looking for cargoes on their own initiative.

Port authorities on the other hand appear to be much more enterprising and are more likely to take positive steps to seek out prospective cargo carriers and provide facilities for them if they possibly can.

There are no statutory controls over sea transportation in New Zealand coastal waters, other than those of safety, manning, etc.

Road and rail transport on the other hand have controls placed on freight charges and in respect of road haulage there is a limitation of 150 km for the carriage of a wide range of goods particularly bulk goods.

Shipowners have claimed that New Zealand Railways by undercutting shipping rates on their rail network and rail-ferry ships have killed or at least severely affected coastal shipping. NZR of course deny this and attribute the decline in coastal shipment of many commodities to inefficiency, high wage rates for seamen, high cargo handling costs and delays in moving goods from port to port. I have no doubt that there is some truth in both sides of the argument.

Paper 1.5 COASTAL SHIPPING - HOW COMPETITIVE?

by

R.J. Perkins,
Bureau of Transport Economics

DISCUSSION AND WRITTEN QUESTIONS

1.5.1 Mr. C.H. Fitzgibbon, Waterside Workers' Federation

If one can place reliance on the cost statistics provided by the BTE, in particular the alleged percentage of costs related to stevedoring (which is doubtful), how could opening up coastal trade to overseas shipping improve competitiveness since one presumes the stevedoring cost, bunker charges, etc. will be the same, unless what is being relied upon is the use of cheaper crews and levels of shipbuilding and financing subsidies provided by overseas governments and not provided by Australia?

Additionally, how can any degree of competitiveness be determined unless like is considered with like and the competitiveness of coastal shipping is measured by at least one other factor, the degree of support subsidy it obtains from government compared with rail and road? Specifically: Federal and State government direct subsidies to rail to meet capital costs, freight and passenger deficit operations and road grants, etc. for the Road Transport Industry. (See *Bland Report Victorian Transport*.)

1.5.2 Mr. G. Campbell, Amalgamated Metal Workers' and Shipwrights' Union

On reading the paper, it appears to me to have a serious deficiency in that it does not address itself to the question of hidden or open subsidies which apply to both rail and road transport, but simply treats the comparison of the three modes of transport on the basis that each operate on an equal footing. It is well known in the transport industry that there are substantial hidden subsidies applicable to freight costs particularly on freight carried by rail or road and any paper produced that ignores that aspect is really a meaningless exercise.

1.5.3 Mr. P.D. Keen, Bulkships Limited

As clearly shown in Table 5 land based costs as a percentage of total costs vary widely. The major portion of land based costs are of a fixed nature (i.e. capital investment in terminal facilities and permanent labour), thus markedly sensitive to change in volume. Does the author have a feeling as to what level total shipping costs may need to fall to be competitive in the general cargo area if this is:

(a) practical,

and (b) desirable?

Following on from the question as to whether or not it is desirable for coastal shipping to be competitive, could the author comment on the total cost to the community of the various general freight services? The analysis is based on rates offered whereas we are all aware, for instance, of the massive deficit under which the railway system operates.

1.5.4 Mr. C.C. Springall, Port Phillip Sea Pilots

You state in your paper that: *coastal shipping of general cargo goods is not competitive with road or rail.* Wouldn't you consider that the heavy government subsidy enjoyed by our railways is the reason they are able to effectively compete with the present Ro-Ro vessels of the ANL trading between mainland ports, i.e. Melbourne/Fremantle?

1.5.5 Mr. L.C. Russell, Australia to Europe Shipping Conference

Referring to Table 3 in your paper, was there any reason why the number of working days lost during the whole of 1979 was divided by the number of workers in the industry, as at June 1979 instead of the number of workers involved during the whole of 1979? If the latter method is used, the days lost per number employed in water transport would be very similar to rail; therefore similar in reliability!

Secondly, is there any reason why coastal shipping should be treated any differently from any other domestic industry such as steel-making in Australia, in terms of the materials employed in the industry?

1.5.6 Professor H. Benford, University of Michigan

Are the 'ship costs' presented in Table 5, costs faced by the owner or the shipper?

1.5.7 Captain S. Bateman, RAN

I have concern about the paper's firm conclusion that: *coastal shipping of general goods is not competitive with road or rail.* I wonder how sensitive this conclusion is to relatively minor changes, say in ship terminal technology?

Table 4 suggests that sea freight rates are significantly lower over the longer routes (e.g. Melbourne, Sydney, Brisbane to Perth) than those for road and rail. The source for these rates is given as 'industry sources' but Table 2 shows that the present coastal non-bulk and combined carrier fleet consists mainly of specialised vessels optimised for particular trades. Would the competitive situation of coastal shipping be assessed differently if freight rates in Table 4 included those for a 'theoretical' ship designed the long distance East-West route?

There also appears to be a possibility that the paper is comparing 'oranges and lemons' in that present costs for road and rail, in which modes there have been strong incentives through competition in recent years to minimise costs, are being compared with costs for sea transport where there has not been the same incentive. Very complex changes have occurred in all three modes during the last 10 years or so and perhaps if these were analysed, there would be grounds for believing that whilst coastal shipping may have been non-competitive, it may now be becoming more competitive. There are also, of course, other reasons for moving some interstate freight back to sea, e.g. road congestion costs. Trends in cost/freight rates may be more illuminating and useful for planning than the cost differences at one particular point in time.

How sensitive would the paper be to some technological change in shipping? Specifically, referring to the 1000 container ship, contained in Table 5, if that was built back into Table 4, how would the indicative freight rates look then? The theoretical, efficient ships should be considered rather than the ship which seems to have been considered in Table 4, which I notice is from industry sources.

1.5.8 *Mr. R.G. Hawke, B.H.P. Co. Ltd.*

Given the clear conclusions reached as to the competitive advantages which road and rail modes enjoy over sea transport for the domestic movement of non-bulk cargoes in Australia, do you think the transport industry could be better served by concentrating on means to further improve the efficiency of road and rail transport rather than trying to overcome the problems which disadvantage the sea mode for non-bulk cargoes?

1.5.9 *Mr. G. Griffiths, Australian National Line*

On Page 43 of your Summary you refer to the fact, as you put it, that to improve competitiveness of coastal cargo movements means must be found to reduce the overall level of loading and unloading costs, and to improve the perception of the industry's reliability. After the Second World War we did have quite an effective coastal general cargo trade, but in the early '50's it just about lost out completely to road and rail. The only way that it even got back into the picture was to change the loading and unloading operations in order to reduce costs, and this is how shipping companies eventually got into the Ro-Ro operation which is very popular and in fact, the main method of carrying cargo in this part of the hemisphere. Have you got anything specifically in mind in regard to how shipping companies can change again?

AUTHOR'S REPLIES

A number of questions have been submitted to me (*Messrs. Fitzgibbon, Campbell, Springall and Keen*) on the topic of transport 'subsidies'. In general, they imply that both road and rail transport receive assistance (through the funding of infrastructure, meeting of deficits, etc.) over and above that offered to the sea transport sector, which (if it is the case) provides these sectors with a net financial advantage. It is also implied that these 'subsidies' should be of an equivalent level in all modes, otherwise competitive forces will be distorted.

Returning to my paper, I think it is worth repeating that competition arises, *when the purchaser of a service is faced with a choice between two or more operators.*

In general, coastal general cargo shipping only faces competition (according to the definition I have adopted) from long distance road and rail operators. The 'subsidies' received by rail operators to meet their deficits mainly arise from urban transport and LCL operations and not from the provision of long haul services. Grimwood and Stanley[1] have investigated this question and found that long haul rail covers its avoidable costs. If this is the case, it would appear that 'subsidies' offered to rail operators have little or no significant impact on the provision of long haul services, and hence few implications for competition between sea and rail services.

Long distance road transport 'subsidies' refer to the provision and maintenance of roads out of public funds, with little direct contribution from users. This is particularly important in the maintenance of roads where road damage is believed to be roughly proportional to the fourth power of the axle load. As road pricing (through fuel taxes) does not properly reflect the avoidable costs associated with road use by heavy (long distance) vehicles there may be some distortion of mode choice, particularly between road and rail modes.

These mode choice distortions are not confined solely to the road and rail sectors. As was pointed out in the paper, inefficiency can arise where entry barriers exist. I believe that one of the reasons why coastal general cargo shipping is in decline is the lack of coastal shipping 'competition' (my definition), which robs the industry of any incentive to innovate. For this reason it may prove worthwhile to examine ways of increasing competition within the industry.

In reply to *Mr. Fitzgibbon*; the question of the accuracy of the BTE coastal shipping cost structure estimates (shown in Table 5) has been raised. It is always difficult to estimate costs in a system as complex as shipping, and many assumptions have to be made, some of which are mentioned in the paper. However, if Mr. Fitzgibbon has any more precise or accurate figures I would be pleased to see them.

The Bureau is currently undertaking a study of the coastal shipping industry including cost structures for a number of services. This work is presently in a draft form. I therefore welcome any discussion which may lead to an improvement of our present estimates.

A second question queries the relevance of opening the coastal trade to overseas shipping, as a means of improving the competitiveness of the coastal shipping industry. Obviously such a move would have very little effect, (at least in the short term) on land based costs, and I certainly did not suggest otherwise in my paper. Access by overseas shipping was simply mentioned as *one* possible way of stimulating change or innovation in the coastal trade. Competition is usually seen as the most effective force for innovation and it is difficult to see real competition developing without some significant outside impetus.

I am not *advocating* entrance of overseas shipping, and I recognise that such a move could present practical difficulties and might prove totally disasterous. However, it seems to me that all such options should be examined in detail so that the likely impacts can be predicted. Most of the discussion of such issues at present seems to be very light on actual analysis.

For example, the calculation of subsidies accruing to long haul rail services, which may be competing with coastal shipping services are complicated

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1. *Grimwood, P.R., Stanley, J.K., Rail Freight in Australia: Some Cost Recovery Issues, ATAC, 1981, forthcoming.*

by internal subsidisation between these services, which are generally believed to be profitable, and less profitable rail activities such as passenger services. The few calculations made to date, some of which we have made, indicate that little or no subsidy is extended to the sectors of the rail industry which directly competes with the coastal shipping industry. Also, I would be surprised if a detailed examination of the shipping industry showed it to be completely free of subsidies even if they are fairly indirect in nature.

In reply to *Mr. Keen*; land based costs as a percentage of total costs vary according to the ship type and route examined. Across ship types and routes the land based costs do vary widely, as is shown in Table 5.

In order that general cargo shipping become 'competitive' (using my definition of competition) it is not sufficient that shipping costs only should fall. I believe that there needs to be greater competition (in terms of competing operators) within the industry to provide a necessary incentive for greater technical efficiency. This in turn may reflect on the major mode choice factors such as reliability, frequency and freight rates, thereby improving the industry's position relative to the other competing modes.

In a specific answer to *Mr. Springall*, I assume he is referring to the ASP service which operated between the eastern states and Fremantle. I think there certainly was a case there where the railways may have used (let's say) some muscle or their financial backing, to compete with ASP. I know that Gallagher, in his paper on Western Australia Container Shipping, gave some background on that and also put the hypothesis that possibly they might have deliberately set out to end the service. These sort of questions are always extremely difficult to answer although it might be shown that the long haul rail is generally competitive if you have a fairly solid structure such as the state railway backing your particular service, then you are always open to those sort of accusations. All I can say is that we have not looked at it in detail. I wouldn't doubt that there is a possibility of that sort of thing happenging.

In reply to *Mr. Russell*, as my paper stated: *although it is claimed that there are perceived differences in reliability, however this is defined, it is very difficult to precisely define both the concept of reliability and what it means to different shippers.*

In other words, any partial performance measure of the type used in the paper is only useful as one measure or indicator of performance. I am not interested in measuring reliability *per se*, as I believe that to be a fruitless task, but am concerned about the general *perception* of reliability, particularly between the major modes. I suggest that the perception of general cargo shipping is one of low reliability compared with other modes.

You are suggesting that the number of working days lost divided by the number of workers involved as opposed to the number of workers employed. It could be a valid measure. I place not a great deal of store on that table by the way, and I suggest that in the paper. I think that any partial measurements might go a long way towards proving a particular point. If I wanted to set out to prove that the coastal shipping industry or the shipping industry was unreliable I might want to use these figures. I am not interested in doing that - I'm interested in sitting back and being objective: I'm looking for particular measures. I take your particular point, it might be just as useful. I'll certainly recalculate the numbers on your suggestion and include them in the discussion volume which is to follow this Symposium. I might make a comment on the thing too.

In answer to the second part of your question, an economist would say no. Decision makes who are responsible for weighing economic as well as political, secotral, institutional and other factors may have a different reply.

In reply to *Professor Benford*, the ship costs presented in Table 5 are those faced by the shipowner in providing a door-to-door (terminal to terminal for bulk) service. They consist of two costs:

(a) direct costs

(b) charges levied by other organisations.

Direct costs are those costs involved in a normal shipping operation. It includes the cost of capital, fuel, labour, stores, maintenance and administration.

Levied charges are the charges levied by other organisations in providing a service. No attempt has been made to determine the true costs involved in providing this service by the provider. Charges included are for port and canal dues, light and pollution dues, stevedoring, land transport and container cleaning.

Replying to *Captain Bateman*, I pointed out in Table 4 that freight rates are only one aspect of modal choice. There was no vessel, or road or rail combination intended or implied with Table 4. These are actual freight rates collected and quoted by various organisations and it probably doesn't take much imagination to see where all of them come from. In fact, I have given the sources for the road freight forwarders and the rail which all stem from BTE published sources. I have had to adjust them slightly to bring them up to the December quarter, 1980. As for Table 5, the non-typical ships. I take your point. These are not the only ones that we've examined; we have a whole range of ships that were considered. We have gone to some pains to look at an enormous matrix of various combinations of ships by Froude Number, etc. We do have a naval architect who is working with us and he has put an enormous amount of time into the examination. I am probably as much to blame as anyone for the ships we have chosen. I did not use them to emphasise any of my points, they just happen to be the ones that were suggested. As to the sensitivity of the results. I don't think that this particular percentage structure changed greatly. I was not particularly interested in this paper in looking at the bulk shipping services. I did include a bulk ship in Table 5 (it's the only mention of a bulk ship in the paper). I'm afraid I haven't done any background and so I don't really feel qualified to answer. But, to my knowledge, I don't think the results are particularly sensitive. I think we might have to do more work on the subject.

Minor technological changes are not going to help shipping, major changes may. Institutional changes though will definitely help shipping. I am not saying institutional meaning government, but rather all institutions including the shipping and terminal companies, labour organisations and governments combined.

There is no doubt that shipping has cheaper line haul costs. The problem is primarily in the terminal and land transport areas where a large portion of the costs are involved, particularly short haul. In Table 1 freight rates and terminal costs are compared. In terms of cost, shipping is priced out of the market.

In terms of the effect of price, I refer you to the recent Transport Outlook Conference where Mr. W. Egan[2] said: *Recently a study was undertaken to assess the likely diversion of traffic from road to rail in the event of a worsening energy crisis. It was found that even under quite severe shortage conditions (with associated fuel price rises) it would require the introduction of new regulations to achieve any significant diversion. It does appear that, for a variety of reasons, customers will continue to patronise a road service in preference to a significantly cheaper rail service. It is apparent that a customer's choice of mode is not a simple matter of choosing that with the lowest price tag, but is a complex balance of pros and cons.*

Although Mr. Egan does not refer to sea directly, the important thing to note is that price is not the only determination of mode.

Other determinants of competitiveness are reliability, service frequency and delivery time. Shipping has a bad reliability reputation, service frequency compared to road and rail is poor, and delivery time is long.

At present, to provide a dedicated service from east to west, you would employ 2 to 3 ships at most. To survive these ships would at best provide a nine to ten day line haul service, organised primarily for frequent quick services. In terms of existing times on door to door services, rail and road have an advantage, taking four to six days. The frequency of service is the killer for shipping. Unfortunately shipping thrives under economies to scale (big is beautiful) which makes large infrequent services attractive. To get frequent services, small expensive ships would be required, or the combining of coastal and overseas cargoes. At present the conference lines are servicing the east and west ports every one to two days.

In Tables 2 and 3, indices for real domestic freight rates and non-bulk freight movements are listed. In terms of freight rates, shipping rates have increased by 180% over the last 6 years, while road and rail have roughly stayed the same. But in terms of non-bulk cargo moved, shipping has held its own.

This shows that despite freight increases, shipping has held its market. This is not surprising when it is noted that the captive Tasmanian trade makes up a large proportion of the total. Shipping, in terms of price alone, is not becoming more competitive but less competitive.

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2. *Egan, W.P., Domestic Freight Transport, Market Segment Papers, Transport Outlook Conference 1981, Bureau of Transport Economics, AGPS, Canberra, 1981.*

TABLE 1

Freight Rates[a] and Terminal Charges - Sydney/Melbourne Route

Mode	Melbourne to Sydney	Sydney to Melbourne	Terminal Charges (including port dues)
Sea[b]	422	422	300-400
Road[c]	392-557	316-375	60 -120
Rail - Race[d]	333	287	60 -120
- O/S Container[e]	346	194	60 -120
Forwarder[d]	439	392	60 -120

(a) In $A/TEU at December Quarter 1980, calculated from forwarders freight rates (BTE 1981) and adjusted using real domestic freight rate indices from DOTA (1981).
(b) Terminal to terminal, rates include wharfage and wharf handling charges but not pick up and delivery.
(c) Road rates are terminal to terminal and door to door. Higher rates are door to door.
(d) Door to door.
(e) Terminal to terminal.

Sources: Paper Table 4; BTE 1981; DOTA 1981.

TABLE 2

Real Domestic Freight Rate Index††

Mode	Sea	Road	Rail
1975	100	100	100
1976	123	94	104
1977	150	88	99
1978	168	86	95
1979	170	85	92
1980	175	85	91
1981	180	91	96

†† June Quarter 1975 = 100. Data is for June Quarters.

Source: DOTA.

TABLE 3

Non-Bulk Freight Moved Index**

Mode	Sea	Road	Rail
1972	100	100	100
1973	114	101	110
1974	114	104	110
1975	106	97	100
1976	112	100	110
1977	103	97	100
1978	103	95	98
1979	109	101	100
1980	102	101	95
1981#	104	108	100

** June Quarter 1972 = 100. Data is for June Quarters.
# March Quarter 1981.

Source: DOTA.

References: Department of Transport, Australia, Transport Indicators June Quarter 1981, AGPS, Canberra, 1981.

Bureau of Transport Economics, Tasmanian Freight Equalisation Scheme A 'Landbridge' Approach to Estimation of Subsidy Rates, AGPS, Canberra, 1981.

In reply to *Mr. Hawke*: when examining non-bulk transport it is important to remember the primary task is to move the goods from A to B. Not to move the goods by any particular mode from A to B.

The major problem area in transport at present is the terminal interchange area. Road, rail and sea transport are all affected to varying degrees. Rail and sea more so since road transport is often able to by-pass or short circuit terminals.

In this era of high interest rates and expected high rates of return on capital, inventory costs have become increasingly important to the consignor. The terminal is the area where most time is lost. Therefore not only do terminals have high running costs they also have high hidden costs. The terminals are the prime areas where time losses and costs can be reduced. Any improvement here will have an effect on the whole transport scene and will benefit all modes.

Technological changes are not likely to make major changes to terminals in the near future. In any event the benefits of technical innovation is tightly constrained by institutional factors so that investment is curtailed. The most important potential improvement in costs is likely to be through different methods of operating, managing and staffing terminals. This is not a problem confined to any one mode.

Acknowledging *Mr. Griffiths'* comments: obviously I don't. The thesis is, of course, that competition is a sort of thing which spurs innovation - the Ro-Ro concept of handling and container concept of handling cargo were extremely important innovations. ANL and other Australian corporations are obviously justly proud of the role they played in pioneering that field. I am not fully informed but I might add we looked at these cost structures with the idea to try to possibly put the debate into perspective. Let's try to obtain a value for such things like fuel costs, loading and unloading and how does it effect the ultimate consumer? I feel we are doing that. Unfortunately, we are not a bureau of ship design or ship innovations, so I'm afraid that I'm not able to provide practical suggestions.

1.5.10 Editor's Note

On the question of energy consumption which several of the questioners raised, the Officer-in-Charge of the Planning Techniques Section has referred me to a publication prepared by Mr. Quarterman of the Bureau of Transport Economics, titled *Freight Transport Energy Consumption*, and in particular to the section entitled "Route Circuity and Feeder Services", Page 52, as well as Figures 5.1, 5.2 and 5.5 and Table 5.3

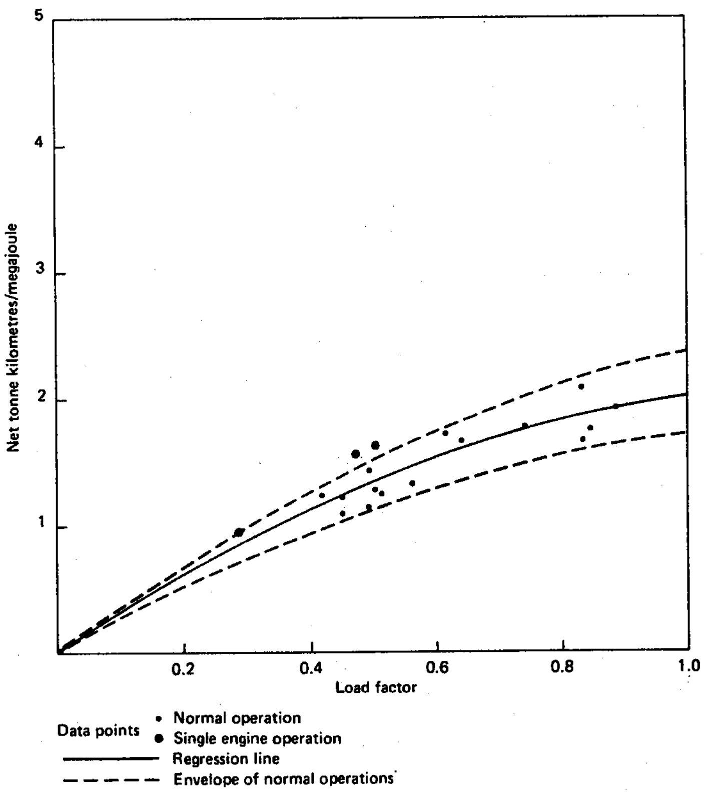
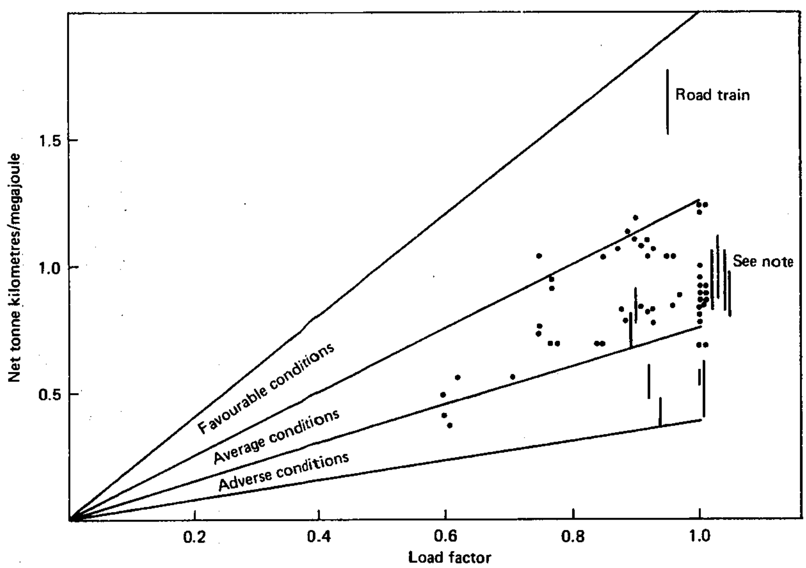


FIGURE 5.1
SEA FREIGHT ENERGY EFFICIENCY DIAGRAM FOR M.V. MELBOURNE TRADER



- Average value specified
| Range of values specified

NOTE: The large number of data points occurring at load factor = 1.0 have been separated laterally for clarity.

FIGURE 5.2
ROAD FREIGHT ENERGY EFFICIENCY DIAGRAM

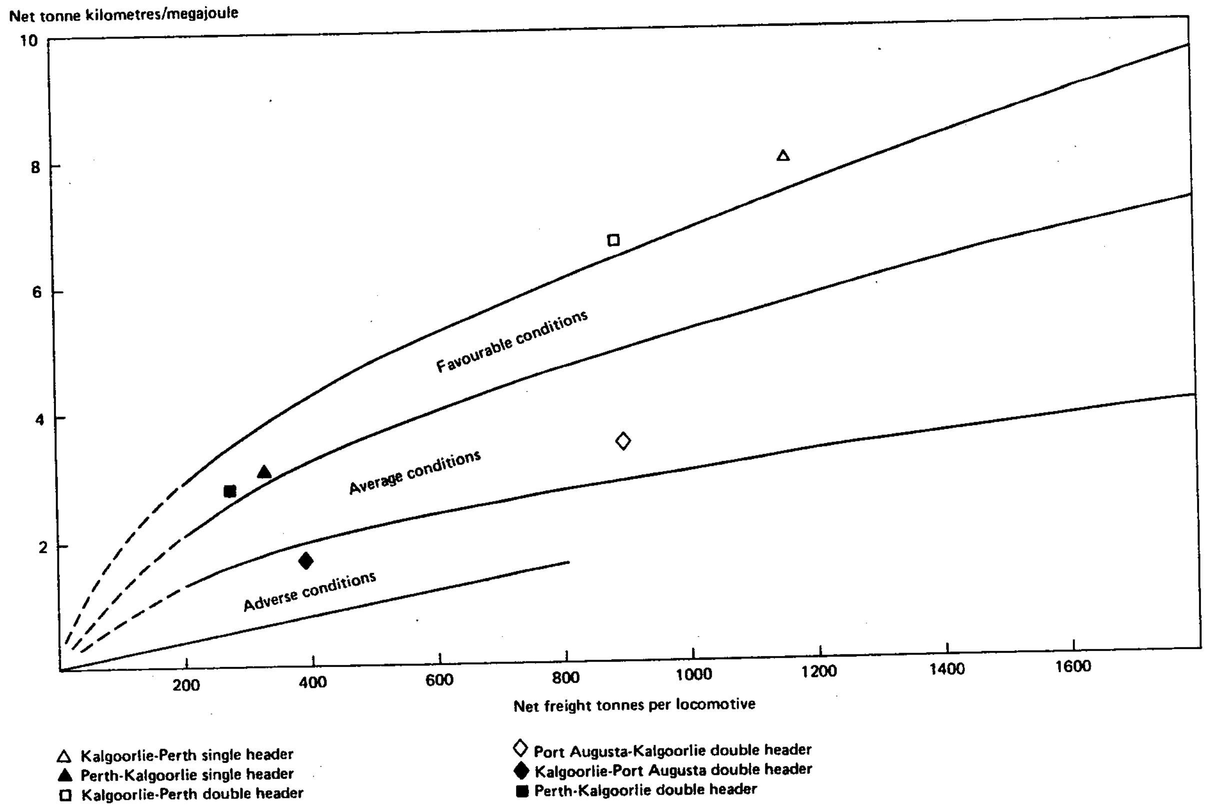


FIGURE 5.5
RAIL FREIGHT NET ENERGY EFFICIENCY DIAGRAM

ROUTE CIRCUITY AND FEEDER SERVICES

One of the main features of contrast between the freight modes is that in transporting a consignment from origin to destination, the use of the sea mode will always involve the use of feeder services at either end of the linehaul, rail will usually involve the use of such services, and road will frequently (but not always) avoid their use. In making an intermodal comparison of energy use it is essential that this aspect should be examined, and it is convenient to deal with this at the same time as the effect of variations in linehaul distances, or route circuity, between modes.

The number of possible combinations of origin and destination is immense, and the number of ways in which linehaul and feeder services may be combined is therefore also immense. If in addition the possible variation in shunting fuel consumption is considered it becomes clear that to attempt to make a generalised comparison between the modes based on a single parameter such as distance would be both inappropriate and futile. A tabular approach which can be applied on a case by case basis is more suitable, and some examples follow.

In Table 5.3 parameters have been selected to represent a situation in which a consignment is sent from the Melbourne area to the Sydney area. The actual pick up and delivery points are assumed to be 50 kilometres from docks and rail depot in a direction involving backtracking along the linehaul route. In terms of actual places this would be from somewhere near Wallan on the Hume Highway north of Melbourne, to Camden. It is assumed that road transport would be able to perform a direct door to door service with the linehaul vehicle, and the actual road distance is therefore 100 km less than the terminal to terminal distance of 893 km. Rail and sea modes each involve 50 km feeder service at each end, and their terminal to terminal linehaul distances are 963 km and 1100 km respectively. This is the type of situation which gives road an advantage over rail or sea. The linehaul energy efficiency is estimated (by reference to Figures 5.1, 5.2 and 5.5) to be 0.8 t-km/MJ for road, 2.8 t-km/MJ for rail and 1.8 t-km/MJ for sea. Additionally it is assumed that for rail there is a shunting requirement of 13 MJ/t at both Melbourne and Sydney and a further 2 MJ/t at each of three intermediate stations (making a total of 32 MJ/t) and that the road feeder service operates with an energy efficiency of 0.4 t-km/MJ. Using these values, Table 5.3 can be completed and for this particular operation it is found that road transport would consume 991 MJ/t, rail 626 MJ/t and sea 874 MJ/t, the last two being inclusive of the necessary road feeder service.

Paper 1.6 COMMERCIAL ASPECTS OF SHIPPING

by

J. Jenkins,

Deputy Managing Director
Overseas Containers Australia Pty. Ltd.

DISCUSSION AND WRITTEN QUESTIONS

1.6.1 Mr. D. Bendall, The Australian Shippers' Council

I read the paper diligently and noticed with some amusement that the single reference to competition in this 'commercial' paper relates to exporters. I suppose that this is understandable in view of the shipowner's tendency to minimise competition through the penal clauses in the Shipper Agreements which exporters must sign.

Your point about Australia having to face the harsh reality of a highly competitive consumer orientated world is well made. Do you believe that Conferences can continue to insulate themselves from the harsh reality of competitive conditions and, if not, what will your company do to cope with competition from non-Conference services and trans-shipment services?

Referring specifically to Conferences, I note the historical reference to continuous and regular services. I also note in your second paragraph that it is a mistake *to assume that the business and community environment is a firm and static base*. I have read elsewhere that the Conference system is under pressure and indeed there have been cases recently of Conferences collapsing.

Would the author agree that Conferences must become more competitive than in recent history and does he believe they have a future?

1.6.2 Mr. J. Spiers, Shipping Reporter, The Australian

Are the peculiar problems of the shipping industry which you mention - with their wider implications - adequately appreciated by business and the public at large? Do you believe that the shipping industry tries hard enough to promote even a basic level of accurate knowledge of the many difficulties with which it must contend?

1.6.3 Mr. B.P. Coates, Hammersley Iron Pty. Ltd.

I take your point about the trade being inherently vital in the shipping context rather than transportation. I do not think that is really appreciated. After all, the ships will follow the cargoes, the cargoes to sales and sales to markets. Now, marketing, of course, is knowing a market and how to reach it. The one point I have issue with is that the ultimate responsibility is with the shipper or the producer. If he doesn't sell he doesn't survive and we know that in the iron ore industry very well at the moment. We cannot afford the luxury of Conference wrangling and outside competitors, so we do it ourselves. I suggest to you that the Conferences are falling foul of what I would term the prostitute's phallacy, which has basically been the same old thing over and over again for the same amount of money in real terms. I am sure that is rather dull. Now, where is the innovation? Since Sir John McEwan dropped the box on us some years ago there has been nothing much. The reason you have the *Rosie Maru* and those sort of ships coming into the picture is that there is a need. I suggest that there is a warning note, not in competition or freight rates, but because the shipper is moving into the shipping arena. It is a source of amazement to me.

Now, for example, and I know this is oversimplification, but the principles will of course stand up. In your paper you talk about a container vessel of $50 million. That's about the price you pay today for a 180,000 tonne sophisticated bulk carrier. The handling facilities are comparable and probably cost more for the development of an iron ore port, and so where is the difference? The difference is in the freight rate. We get our very low commodity over there for something like a twelfth of the freight rate that you people charge. Now, I know you have got stevedoring and all these things, but the difference is accepted. I suggest that the industry is getting a bit insular, tanker trades, tri-bulk, liner trade. I think the Conference ought to be between the trades. Now, we have these big ships, for example, going to Dampier (people could apply this to coal probably to a lesser extent), high density cargoes. You can load in every alternative hold - the space is there, the liner service is there - and the ships are efficient and one ought to get together to maximise the assets. I do not think a serious study has been done on this sort of thing. I'll leave the thought with you.

1.6.4 Mr. W. Waters, Union Steam Ship Co. of New Zealand Ltd.

Mr. Jenkins' willingness to present a paper on a commercial subject to a technical audience has prompted the writer to stray beyond his normal sphere of activity to ask Mr. Jenkins to express his views on the relative merits of a 'conference' formed with the government lines as in the case of QUANGOS (involving SCONZ and ANZ) and one formed with one or more of the privately owned Australasian shipowners.

As a New Zealand taxpayer the writer is very conscious of the fact that SCONZ came into being to be able to provide some competition into the UK/NZ run but has finished up drawing its container cargo from the common pool.

On the third page of the paper the author comments that the engineer has been no more successful at reaching the right conclusion than any one else. This raises two questions:

1. When should the technical team be brought into the planning team?

2. Quoting Professor F.P.S. Lu*: *The fact is that it is easier for engineers to master the fundamental concepts of economic decision-making and to apply them to engineering projects than for non-engineers, proficient in the techniques of economic analysis, to acquire the necessary technical background.* Professor Benford's paper† to this Symposium must add support to Professor Lu's statement. Would the author like to express his view on the need for a combined team of economists and technocrats from the very outset of a project?

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* From the Introduction to his book *Economic Decision-Making for Engineers and Managers.*

† Professor H. Benford and R.M. Scher.

AUTHOR'S REPLIES

Referring to *Mr. Bendall's* questions and taking them quickly in order, I believe it is wrong to refer to clauses in the Shipper's Agreement as being penal. The agreements are contractual agreements and any contractual agreement has requirements on both sides. The agreements are that a certain quantity or total quantity of cargo will be shipped by the Conference and that as a result the Conference will provide a regular service to support the requirements of those shippers. A regular service irrespective of whether those shippers are having a good year or a bad year. It was stated that Shipper's Agreements must be signed by exporters. They don't have to, that was made quite plain this morning.

I would argue that Conferences have not insulated themselves from the harsh reality of competitive conditions. I would argue that the rates quoted by Conferences are competitive rates. They are rates which provide a service for the small shipper, the big shipper and from the main ports and outlying areas. The rates provide a through service competitively. Conferences have been under pressure and I guess in a business sense it would be quite wrong for me to say that is in any way a bad thing. I think any organisation which operates under pressure is likely to operate better and operate more efficiently than one that isn't. I do believe Conferences will continue, or something like a Conference. You can have all sorts of Conferences. It is the only form of international sea transport which can provide the type of guarantees which major trading nations require.

Do I think they will become more competitive in the future? I think they are getting pretty competitive right now.

In reply to *Mr. Spiers*: I guess the short answer to your question is no. I do not think they do a very good job. I think that if they are all the things which I have just professed then they should be capable of doing a much better job than they are doing at present. I think, incidentally, that the job is worth doing better. I guess, it is always a little bit difficult for bodies that are joined together to handle this sort of situation compared with single-minded identities or industries. I know from my own experience in working in and with shipping Conferences that they are always rather sensitive of not wishing to get outside the fairly close paths which they normally regard themselves as treading. By and large, I think you are absolutely right. They do not do a terribly good job and should do a lot better.

I appreciate *Mr. Coates'* comments. Obviously there is a big disparity between the cost of moving commodities like iron ore, coal, bauxite and general cargo. I think I would dispute whether that disparity is out of proportion because the concepts are in fact totally different. The only thing that is common is making something which will float on water for moving the various types of cargoes. The fact that all ships have a bow at one end and an engine at the other (well, some people don't even put the engine at the other) does not bring any similarity in the commercial areas that have to be dealt with. I really do think that it is one thing in your instance, for you to become directly involved in shipping, because of the very close connection which exists between a fairly limited area for sourcing and loading your cargo.

I take your point entirely. A very high cost shoreside infrastructure and limited destination areas. I am not saying it does not go to all parts of the world, but the distribution at the other end is very limited. Large quantities, large rates of loading and a very long term assessed future in the development of the mine, or whatever it is. I think there is a great difference to that of providing liner services. One of the things that liner services have to look at and look at fairly carefully (oddly enough we spent a fairly long time on this not long ago) is ensuring that we do provide a service for the very small shipper. We went through the number of LCL shippers in 1969 who are now FCL shippers. I would suggest that those LCL shippers could not have become FCL shippers if they had not been able to avail themselves of some limited volume service.

I refer to the questions posed by *Mr. Waters* and advise:

1. This is really a bit out of the area of my personal knowledge, and I am aware that there are quite particular aspects of the Trans-Tasman trade. I would suspect that the short answer is, as indeed it is in all operations, rationalisation in terms of the optimum use of a costly asset (ship), though recognising that there are frequently a variety of circumstances which circumscribe the operator's ability to freely achieve his objectives.

2. Because of the rate of advancing technology it is more and more difficult for *anyone* to make the correct decision irrespective of their backgrounds, be it financial or technical. For all it is a problem that, whilst the rate of technological change increases so rapidly, the length of time of commitment to a project and the write-off period for the investments is not decreasing. I would think that for a major project of any kind, involving a large technical content, to have any chance of coming up with the right decisions, a combined team including both sides, right from the beginning, is absolutely essential. I believe that this sort of team process is absolutely vital, and is much more likely to achieve success than any argument of educational mastery in either direction.

SESSION 1.C CHAIRMAN MR. J.C. JEREMY

Paper 1.7 ECONOMIC BENEFITS OF AUSTRALIAN SHIPPING AN INPUT-OUTPUT ANALYSIS

by

N.K. Aggarwal,
Department of Transport Australia

DISCUSSION AND WRITTEN QUESTIONS

1.7.1 *Mrs. H. Bendall, The University of New South Wales*

In view of the importance of the issue of Australian flag participation in overseas trade, it is a pity that input-output analysis proved so inadequate. The author in his conclusion sets out the relevant central issues and then points out that these considerations are not readily incorporated into an input-output analysis! (Page 67).

In hindsight, how would he suggest attacking the problem now?

The paper points out in Section 8, Paragraph 2 (Page 66) that freight charges of cargoes carried on foreign ships are not included. It would appear that the total stevedoring costs have been applied to something less than 20% of ships or whatever share Australian flag vessels have of the liner trades. Is this correct?

In Section 8, Paragraph 3 (Page 66) - *65% of final demand for water transport is for overseas trade.* This figure I take it comes from the 'export' category in Table 5. Does 'exports' in this sense include as well the stevedoring service for imports on foreign ships which are generally charged to non-residents so that the service is exported?

Should not the local demand of 32% of the total demand for water transport read 35%? (Section 6, Paragraph 4 (Page 64)).

I note in your conclusions on Page 66 - *The multiplier effect for water transport was found to be greater than the average multiplier effect.* Is this statement referring to the multiplier effect in Table 3 or the labour multiplier in Table 6? In both cases, the water transport multiplier is less than the average of all the sectors.

In the paper you explain that it was not possible to segregate the water transport category into its various components. When I checked the ABS (1976) employment figures, I found that 44% of water transport employment was involved in stevedoring operations and only 32% of labour was actually employed in ocean,coastal and inland water transport. Therefore, the highly labour intensive figure for water transport should not have been a *surprising result* (Section 8, Paragraph 2). Would you agree?

In reference to my previous comments on Section 8, Paragraph 3 (Page 66), I am only asking for clarification. I was actually more confused when you provided further explanation. You have 65% of the final demand for water transport as overseas trade. Did that come from the export category in Table 5?

Do exports in this sense include as well stevedoring service for imports on foreign ships that are generally charged to non-residents and therefore in that sense we have got a service that is exported? Otherwise, I could not come to grips with what was happening with the foreign going ships. Is that true?

1.7.2 Professor C. Renwick, The Hunter Valley Research Foundation

Mr. Aggarwal has used traditional input-output to assess the employment impact of water transport for the Australian economy. Input-output is now quite an old technique for deriving employment, income and industry output multipliers although it still represents a very powerful tool for analysis despite some severe limiting assumptions some of which have been mentioned in the paper.

The following comments, of a methodological nature, I believe are relevant for this paper.

1) I am not convinced by the statement on Page 2 which states that the input and output relationships of the Australian shipping industry have ... *not significantly altered since 1974-75* ... the date of the latest Australian input-output tables. Perusal of the transactions table for 1974-75 shows fuel to be a significant input. With significant changes in the price of oil since this time the relative importance of this input in the 'production function' of the water transport sector would most likely have increased relative to other inputs. This could easily have been assessed by undertaking sensitivity tests, with this input, to the final multiplier results.

2) The paper states a Type I employment multiplier of 1.6, however no mention is made of Type II multipliers (including the induced component) or income and output multipliers which would have provided greater information on the economic benefits of Australian shipping.

3) The sector 'water transport' includes the following four digit ASIC groups:

5304 Ocean and Inland Water Transport
5305 Stevedoring Services
5306 Services to Water Transport n.e.c.

I think more accurate multiplier results for "overseas shipping' could have been obtained by adjusting the initial transactions table to extract stevedoring services and services to water transport from the rows and columns of the sector used. This could have been done using either published or unpublished data.

These notes are based on experience in input-output analysis over two decades and reflect the position reached by our current work, in the care of Steven Garlick, of the Foundation's staff.

1.7.3 Mr. R.F. McMahon, The Australian National Line

Mr. Aggarwal is to be congratulated on his paper analysing input, output and multiplier effects on the economy of investments in Australian shipping. Can Mr. Aggarwal further comment on ways that his conclusions can be applied to advantage by the industry?

AUTHOR'S REPLIES

In reply to *Mrs. Bendall*, there is adequate data available from the Australian Bureau of Statistics, but it is not available publicly because they have confidential constraints. If that constraint is removed then it is possible to determine the impact of overseas shipping only, but I do not think we should be talking of only overseas shipping. If our own coastal shipping is efficient, or the efficiency is improved, then the extension into overseas trades would be automatic and that is why I have tried to consider the economic benefits of the entire shipping industry rather than just the overseas shipping.

I wish this figure was correct because at the present time I understand it is somewhere close to 9%. Yes, the input-output tables used the entire output of the stevedoring services and in that respect we are considering the shipping industry so therefore that assumption is correct.

As suggested in the penultimate paragraph of the conclusions, data segregated into statistical components of water transport can be incorporated into the analysis to obtain the comparative parameters for Australian flag overseas shipping, coastal shipping, stevedoring services and 'services to water transport nec'. This analysis would provide an insight into the impact of individual components of water transport.

When we look at the entire shipping industry the answer is no. Even if you are talking about the stevedoring industry today particularly when considering all the container terminals, it is a capital intensive industry and of course the ships themselves are capital intensive and I would not want to intentionally use any other data with or in conjunction with these input-output tables because that would not make the statistics consistent and I do not want to be accused of that very common saying about manipulating statistics. I have to be cautious in the application of the statistics that I used for the analysis and that is the reason the data on the stevedoring industry and operation of overseas ships is unavailable publicly and can only be guessed; therefore I decided to be cautious and not use this data.

In reference to expenditures of non-resident transport operators, in Australian ports, the input to water transport includes expenditures on port charges, stevedoring, commission paid to Australian agents, providing repairs and servicing and such expenditures.

It all depends upon who pays for the stevedoring services on imports. If those services are paid for by the overseas companies, then that expenditure is lumped in along with the exports. So it is just a matter of who pays which is one of the reasons why the export figures is really low. Because the export freight component is very low that is one of the drawbacks to the statistical system, but I think in a way it does reflect correctly. Because we are talking about the Australian economy and the effect on the Australian economy, if the activity was overseas it should not be included in the Australian economy.

'Exports' of water transport include

(a) freight and other earnings of Australian transport operators from exports, in accordance with the normal convention concerning calculation of balance of payments on imports and exports.

(b) freight paid on imports to overseas transport operators.

Stevedoring charges for imports are included in local consumption or to relevant industry sectors if traceable.

The figure of 32% quoted in the paper is correct. The difference of 3% is the consumption by capital expenditure (Table 5, 25 ÷ 831%).

The computer program calculated the multiplier effect to 6 decimal places (in addition to exponentials). Considering the averages in these calculations, the statement is correct.

The statement in the paper is based on the capital intensive nature of ships, tugs and other watercraft, container terminals, port developments and maintenance, stevedoring equipment, etc. Due to lack of reliable co-relationship of output and requirements of capital per unit labour in the various components of water transport, conclusion from statistics quoted in the question could be unreliable.

Acknowledging *Professor Renwick's* questions, the main objective of the paper was to quantify the relevance of Australian shipping industry to the rest of the economy and to *estimate* the multiplier effect of diverting the national resources to shipping (where the fiscal incentives are not currently provided) from other sectors, e.g. mining or agriculture (where the incentives are currently provided).

I accept the comments made without hesitation, that more accurate results could have been obtained with further analysis.

Referring to the impact of oil price changes, this has affected the production function of all industry sectors, to a varying degree. I intend to do further analysis using the next set of input-output tables, which I understand are due to be published shortly.

Segregated components of water transport were not analysed for lack of suitable data.

In answer to *Mr. McMahon*: A significant expansion of the Australian shipping industry would require a re-allocation of national resources, involving assessment of competing demands by various industry sectors for limited resources. This requires an objective inter-industry comparison. The paper has attempted to provide this comparison, in particular the comparison of water transport with mining, where the fiscal incentives have been provided.

The input-output analysis is a powerful analytical tool. It can be used for analysis of national, social or commercial systems, and for inter-industry and intra-industry comparisons. The analysis depends upon the validity of the assumptions particularly on the stability of the input-output coefficients, which can be improved by estimating the functional relationships over a number of years using actual operating data. In addition, through the expansion of the system to include input claimants (or profit centres) individually and the use of a dynamic model which handles capital formation, the input-output technique can be used for financial analysis and planning.

The input-output technique can be used by the management to predict the impact of a change in the normal level of operation, analyse the flows into and out of specified areas or investigate the changes in operating levels and conditions. Such a framework, if common (or similar) in all firms, also provides a uniform procedure for aggregating firms data and thus is a method of consistently establishing an inter-firm analysis of an industry or an inter-industry analysis for the economy.

Paper 1.8 OCEAN DRY BULK CARGO SHIPPING IN THE EIGHTIES AND NINETIES

by

G.J. Wood,
Director, Star Shipping Australia Pty. Ltd.

DISCUSSION AND WRITTEN QUESTIONS

1.8.1 Mr. B. Coates, Hamersley Iron Pty. Ltd.

I would like to preface my remarks by complimenting Geoffrey Wood on presenting such a wide ranging paper. My comments are intended to state another viewpoint, and as a stimulus to further discussion.

It is always hard to achieve statistical concensus, but as a matter of interest Fearnley's Oslo say that the latest figures indicate that dry bulk cargoes as a percentage of total world seaborne trade (expressed as freight tonnes) was 32% in 1980.

Whilst admitting that it is extremely difficult to forecast seaborne trade as far ahead as the year 2000, longer term crude steel production which is reasonably predictable will continue to govern the seaborne movement of iron ore and coking coal.

The significant indications are that iron ore and coal are likely to account for approximately half of the world seaborne movement of dry bulk cargoes:

Coal and Iron Ore as Percentage of World Seaborne Movement of Dry Bulk

	1970	1980	1985	2000
Coal	17	16	19	24
Iron Ore	41	28	26	24
	59	44	45	48

Much will depend upon the ultimate price differential between coal and oil, but present indications are that steaming coal as an alternative to oil for power generation will also make a significant impact, in particular as a consequence of changes in supply sourcing emerging from new trade patterns through port development and utilisation of larger vessels, e.g. Panamax vessels from Hampton Roads to Brazil changing to 200,000 dwt. carriers from Roberts Bank and Australia to Brazil.

The statement relating to the large scale ordering of dry bulk tonnage by frustrated tanker operators, which in turn could cause a glut of dry bulk carriers is unrealistic. Following the prolonged shipping depression between

1974 and 1979, the attitude of financial institutions together with the philosophy of those shipowners who survived that crisis have all but eliminated the speculative shipowner. In essence it is true to say that, certainly larger vessels, are not built today without cargo guarantees in one form or another, and a timecharter is not in itself to most banks satisfactory evidence of assured long term revenues.

Scrapping: Whilst agreeing that any boost in demand for steel will raise demolition prices, this does not mean that increased scrapping will follow because the freight market will also respond and owners will be less interested in scrapping vessels than in the money making end of the market through sale and purchase. Tankers and obsolete ships will be scrapped regardless of demolition policies.

International Industry Structure: *The virtual total demise of traditional flags from the open freight market.*

What is to be understood by the open freight market today, bearing in mind that about half of the world's dry bulk cargoes comprise iron ore and coal shipped mainly under special arrangements to minimise and stabilise ocean freight costs?

Reliability and performance are inherent in the substantial long term chartering arrangements essential to sustain the capital servicing of costly new buildings. Homogeneous crews, first class owners, and reputable national flags are fast becoming a prerequisite for bankers and charterers alike. Flags of convenience are in apparent disarray for industrial, political and safety reasons.

The Japanese are in a special position since they dominate the world seaborne movement of dry bulk cargoes and trade their vessels internationally.

The various heavily subsidised Japanese government shipbuilding programmes reserved for Japanese owners against cargo guarantees designed to reinstate Japanese merchant marine competitivity has achieved its purpose, and are now being phased out along with the Japanese shipbuilding depression cartel.

This is likely to provide potential for secure employment of new traditional flag vessels under 'tie-in' arrangements.

Shipbuilding preferences relate to financial incentives and cargo support, and there are a number of influences emerging which are likely to encourage Western ship builders in securing their share of shipbuilding during the next period of economic resurgence. For example, there is the development of such ports as Hunterston, Fos, Gijon, Dunkirk and Wilhelmshaven to meet increased raw materials import requirements also the projected dry bulk shipping trade imbalance indicating a shortage of vessels in the Pacific in the size range 150-200,000 dwt. to carry these cargoes to the Atlantic. Opportunities will therefore exist to test the capability of British and Continental shipyards to build these larger vessels encouraged by forward looking incentives, e.g. UK government and the Danish bond schemes in particular, and the weakening of the pound sterling against the yen could be strong contributing factors.

The shift of national flags to flags of convenience is not mainly due to reduction in crew costs but rather to reduce the burden of taxation in the owner's country of domicile. Crew costs, whilst important, are not the major reason. This is particularly so if crewing is reduced, with the attendant need for more highly qualified crews; cheaper 'convenience' crews are presently unable to provide the standard required for highly skilled, low complement, general purpose crews dealing with a complexity of sophisticated machinery and electronic controls.

Japanese/European crews may be relatively expensive but on a crew for crew basis the difference is not a real consideration, particularly when one considers the value of the asset to be protected. The rate of insurance premiums is another important factor.

Australian operators may differ with the view taken in the paper that Australian ships are withdrawn from service for lengthy lay ups and costly shore maintenance (because of Australian crews); also the suggestion of consistent disruption of overseas trading by Australian registered vessels, would appear to be at variance with the facts.

With respect I would question these observations by the author. What are the facts to support these views in the bulk trades?

Cost Effective Employment - 'Horses for Courses': The Panamax vessel may no longer be the outstanding vessel as stated in the paper. There are specific developments for large vessels, and it is now practice for 150,000 dwt. vessels to part load in Hampton Roads and later top off in Richards Bay for Japan, with the result that the trade is only partly limited by the Panama Canal.

Major coal terminals which will come on stream during the '80's will cater for vessels almost exclusively in the 100,000 dwt. plus size range, and steaming coal is the likely major growth commodity in the '80's.

One interesting development is the expansion of the Tubarao (Brazil) terminal to accommodate 200,000 dwt. coal cargoes from Australian and Canadian ports as an alternative to existing Panamax tonnage from Hampton Roads. Nevertheless about 60% of total dwt tonnage on order (September 1981) is in vessels below 70,000 dwt. (30% in the 50-70,000 dwt. range).

With regard to bauxite, shipments are already made in Panamax vessels with 60-65,000 tonnes being the preferred cargo size, and future cargo sizes are likely to increase slightly. The present preferred cargo size for the more valuable alumina cargo is about 35,000 tonnes.

Financing New Buildings: This of course is a complex subject with frequently changing circumstances, rules and regulations from country to country and affects different shipowners in different ways (i.e. exchange rates, source and magnitude of finance required by individual owners, etc.). Subsidies in particular have taken the form of *ad hoc* measures in many instances and with banks again interested in ship financing there is a wide range of finance packages available to the enterprising shipowner/charterer of substance and good standing.

It may be more appropriate to view shipping as an investment opportunity in the '80's and '90's rather than addressing ourselves to a shorter term depressed market, and if one is to accept the present trade forecast predictions, shipping from an investment point of view must have some attractions.

Over the last few years the shipping industry has become conditioned to a climate of gloom and depression and it is so easy to forget the halcyon days when shipping was an industry of considerable prosperity. If one accepts the more optimistic trade projections for the next two decades, shipping should once again become a profitable investment without the need of mostly politically inspired subsidies. To keep shipping 'at home' and to prevent vessels going off shore, governments of Western developed nations must give shipping its due recognition and encourage the profitable growth of national fleets by ensuring that the shipowner has access to fair and reasonable tax considerations.

The Crawford Report: In an earlier section, the growing desire to see national flag carriers from producing countries being used to transport raw materials was mentioned. In Australia this view is shared by both the producers and the Australian Government. The Government has recently taken concrete steps to examine the possibility of some fundamental changes to the economics of Australian flag carriers. The report by Sir John Crawford on the Australian shipping industry is now in draft form. As reported in the press, the *Crawford Report* may recommend an increase in depreciation of vessels to 20% per annum, an investment allowance of 20% and the abolition of import duty on vessels. Should these recommendations become law then Australian owned vessels will become more competitive and capture a larger share of Australia's export trades.

Safety: The human element is the greatest contributor to marine casualties. It follows then that a shipowner should give maximum consideration to the standard and competence of his crews. The need for highly trained crews, able to *use* and cope with modern technology would indicate a diminishing trend in the employment of flag of convenience (cheap) crews.

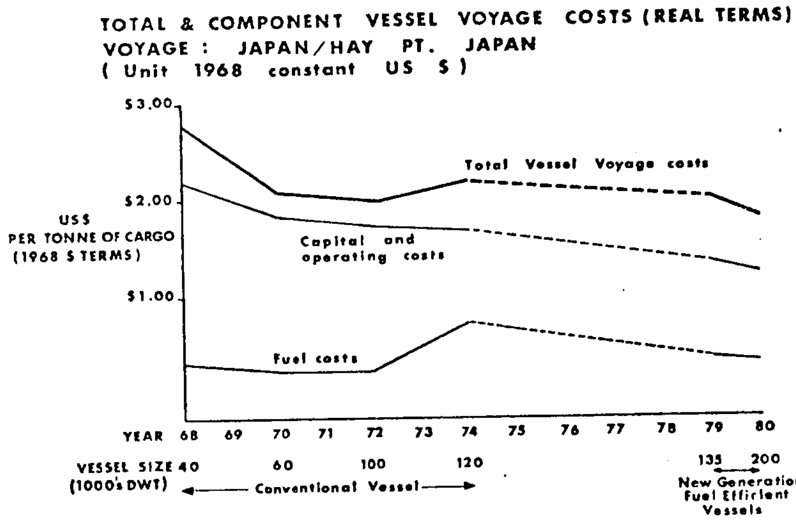
With increasing ship sizes the risk of damage to very costly bulk terminals becomes more acute and port authorities may refuse the berthing of VLBC's unless the vessels have a fully competent and highly trained crew on board, particularly in the case where crews are reduced to around 20 or below. In fact this situation is mandatory at the Port of Dampier - Australia's largest port.

Modern technology, highly qualified crews and a more optimistic outlook for the future may do far more to maintain the presence of traditional national flags in world shipping than any short term economic, political or industrial pressures.

Bunker Fuels - Indicative Voyage Costs: The table below shows the total and component vessel voyage costs in constant terms for the Hay Point/Japan coal trade excluding port costs.

This shows how modern vessels have contained total voyage bunker costs, while ship operating and capital costs have shown a steady decline throughout the period due to increasing vessel size and greatly improved ship construction methods. The 'new generation' vessels also reflect significant reduction in manning levels and in particulat the incorporation of advanced technology, leading to a containment of operating costs in the face of continuing inflation.

However, the introduction of 'new generation' vessels has not been without difficulties, e.g. the Australian iron ore industry has operated throughout this period of rapid change and has had to contend with a mix of



vessel sizes which has not made best use of existing shiploading facilities. Any savings arising from larger 'new generation' vessels servicing Australia must be shared in a way that fully recognises the considerable expenditure on additional handling facilities.

Conclusion: I do not necessarily agree with the third paragraph of the 'Conclusions'.

A completely unregulated system of sea transportation would produce lower apparent costs but higher true costs. Surely it is a question of determining the degree of regulation needed to produce the lowest true cost of sea transportation compatible with the needs of society as a whole?

In today's highly competitive markets the cost of shipping services have a profound influence on commodity marketing strategies. Prosperity in shipping usually goes hand in hand with prosperity in commodity marketing and renewed profitability in shipping would underline a healthy world economy.

The ships have to follow the cargoes, which in turn follow the sales. Forward looking shipowners and charterers alike recognise the growing interdependence between a shipowner and the user and the need to eliminate the inherent conflict of interests between shipowner and charterer. Who would disagree with this?

The common aim is to achieve reliable and stable sea transportation and this objective is more likely to be achieved by an owner who makes full use of technological advances and highly trained crews, than by an owner chasing a 'fast buck' by making use of 'convenient' alternatives which can only undermine long term stability and service.

1.8.2 Captain J.F. Sampson, Electrolytic Zinc Co. of Australasia Ltd.

The basis of Captain Wood's paper is the forecasted enormous increase in the tonnage of world dry bulk trade. This is expected to double in quantity over the last quarter of the century, with the tonne mileage increasing five-fold. It is, perhaps, unfortunate that the author did not quote the source of his base information since this would have enabled more constructive critique.

Without a disaster of unimaginable proportion world population will continue to grow exponentially and thus create a demand resulting in the consumption of more and more raw materials and good. This is, I believe, indisputable and, therefore, world trade will likewise dramatically increase. There is another most important factor which has to be taken into consideration, and this is the accelerating trend for major industries to be established outside of what can be termed the Western industrialised nations.

There are a number of reasons for this, and three of these are:

(1) national aspirations;

(2) differential energy costs;

(3) freight savings.

This rationalisation of secondary production has been gaining momentum over the last 10 years and can be seen most clearly in the aluminium industry, where energy costs form an exceptionally high proportion of the value of the end product. The same trend is evident in other non-ferrous metals; on the one hand there is the stated policy of governments, of which the Canadian Government, both Federal and Provincial, are an example, to have minerals processed at home, and on the other hand the realisation of countries like Japan that the costs of energy and of pollution control make smelting uneconomical.

I question, therefore whether there may be a significant trend to shipping steel rather than iron ore and coal, and aluminium rather than bauxite and alumina which has not been taken into account in Captain Wood's forecasted figures. Similarly I just do not believe that there will be a five-fold increase in the tonne/mileage over the next 2 decades. If tonnage is forecasted to double then surely mileage must more than double in order to achieve a five-fold increase in tonne/mileage.

In fact, the people who really matter, those that pay the transportation bill, whether they be buyers or sellers, are doing their damnedest to reduce that bill by rationalisation. I believe we will see Japan becoming increasingly reliant on Australia as a supplier of iron ore at the expense of Brazil and Brazil strengthening its position in Europe. It will be interesting to see whether the shipowners of the world are prepared to commit themselves to the enormous capital involved on the basis of forecasted figures similar to those in Captain Wood's paper.

As Mrs. Margaret Thatcher said recently: *It's a very brave thing to make a prediction, especially about the future.*

Perhaps Captain Wood could comment on the source and accuracy of his forecasted tonnages.

1.8.3 Mr. W.J. Hood, W.J. Hood and Associates

In the first paragraph of section 3 on cost effective employment, it says that the main work horse in the iron ore trades in the foreseeable future will be the 100-250,000 tonne dwt. bulk carriers supported by Obo and Combination Carriers. You don't mean by that, that new Obo's will be built? You mentioned the possibility of a lot of ships not being scrapped and that we will continue to be using old Obo's.

The question of manning and safety: in the last part of section 5 you mention feeling somewhat nervous about very large ships operating with very small crews and perhaps by background, I saw not so very long ago a very large Japanese bulk carrier, about 192,000 dwt. with a crew of 18 one of whom was a doctor - he doesn't do anything else but look after the health needs of the crew. The most critical operation on the whole ship in terms of the number of people available seem to be mooring, but the ship seemed to be very well run and well maintained. All the ratings were general purpose hands who have been specially trained to work anywhere on deck, in the engine room, and some of the officers were to some extent general purpose as well. Do you really believe that a ship with a crew with that kind of training is such a serious risk as you seem to suggest in your paper? Wouldn't you believe if better training, somewhat on the Japanese style, was given to Australian seafarers, that we might see a gradual reduction in manning on Australian ships with increases in safety?

1.8.4 Mr. N.K. Aggarwal, Department of Transport Australia

You state that Australia is served by the most economic shipping services at the present time in the overseas bulk trades. Just studying the structure of what is referred to as the cream of the overseas bulk trade - iron ore and coal - something like 75-80% of the ships are either Japanese registered or Japanese beneficially owned even though they may be under a flag of convenience. Would you please comment on the fact that do we know what freight charges are paid by the Japanese steel mills to the Japanese ships and are those similar rates offered by the same companies to the overseas operators who are willing to enter the trade? You suggested that it is a biased market. If it is a biased market, how do we say that it is a competitive market? If the buyers can pick and choose whom they want, how can complications be removed which in the end result would not be in their interests anyway?

When you say that we really don't know the freight rate paid by the Japanese to the Japanese companies and if the bulk of the trade is carried by Japanese ships, whether they are owned or controlled or a flag of convenience or beneficially owned by the Japanese, I am just wondering what justification we have to assume that Australia is the most economic. I suggest to you that we just don't know how much freight is being charged by the Japanese in that particular trade because it doesn't really matter to us, but it could well be that if we did know what freight rates are being paid by the Japanese companies to their own ships, we'd probably have a measure of internal class or pricing anyway. We would find it could well be that the Australian ships would need to compete, but I still have my doubts whether it is a buyer's market where they can compete - they can't get in.

AUTHOR'S REPLIES

Mr. Coates questions my figure of 25% as a total of world trade represented by dry bulk cargo, and quotes a higher proportion of 32%. He may be nearer the mark, but it is merely academic. My figures are averaged from various statistical sources which indicate that it is difficult for any two researchers to come up with closely related tonnages. The forecasted increases in dry bulk cargo volumes are all indicative and the assessments are similar to those that Mr. Coates has made. It would also seem that coal will be king, but as Mr. Coates points out the degree of substitution of oil by coal in power generation will be the key to ultimate volumes. Irrespective of whether coal or iron ore predominate, big bulk carriers will feature in these trades.

I would like to dispute, with respect, Mr. Coates' assertion that the speculative shipowner has all but been eliminated. My own experience in discussions with various owners' representatives clearly establishes the contrary and in my view as long as there are ships operating in a competitive market situation there will be speculative shipowners. The comments in my paper regarding scrapping would appear to have been taken out of context. My main theme is that by virtue of regulation many tankers over age and non profitable, will go to the breaker's yard rather than be upgraded and this is related to the comments in my paper concerning segregated ballast and tank washing systems, etc. due to international regulation. Scrap prices have almost been halved in the last 2 years and despite the freight market being depressed owners will only resort to scrapping ships as a last resort; rather they are being sold as I have said previously, to Greece, China, Singapore and other cheap flag operators.

Mr. Coates then queries my prediction that we may see the demise of traditional flag owners in the open freight market in the period under review and goes on to claim that FOC are in apparent disarray. The freight price on voyage basis per tonne or time charter rates will govern who succeeds in operating the ships. Now, whilst there may be a basis for asserting that certain national crews are better performers than others, we still must keep in mind the fact that economic reality decrees that for most bulk cargoes the fundamental consideration has always been, and will continue to be, price. Most charterers readily accept whatever suitable ship is nominated to them by the broker regardless of flag. Admittedly, at present there may be Australian charterers who are worried about FOC bans, but their reaction is not to refuse those FOC ships, but to impose the risk factor of delay upon the owner or operator. According to H.P. Drury and FIRS statistics that is 'Fair play'. FOC registrations are increasing which would not seem to indicate that these registries are in disarray. Contrary to Mr. Coates' views, owners do claim that the shift of interest to FOC operation is due to crew costs and whilst taxation is an important factor, it is generally secondary to crew costs. It is also wrong to claim that FOC crews are unable to provide the standards required. They do, although, of course, as with all ships, there are exceptions. We also have low standard traditional flag ships regularly seen on this coast.

On the subject of Australian ships again, Mr. Coates admirably champions the cause and I honestly hope that he is right. Howard Smith have certainly taken a very strong initiative with their recent entry into the coal trade and I can only hope that they will succeed.

Both Mr. Coates and Mr. Sampson raised the question of large bulk carriers topping up coal cargoes at Richards Bay and in the gulf area of the USA after part loading at restricted draft ports in the USA. This is in opposition to my claims that the Panamax and slightly larger size will be the main work horse of bulk trading which was partly supported by my contention that for a long time to come American ports will not be handling the very large work horses of the iron ore and coal trades, and I think that this has been recently substantiated by the Panama Canal Authority who have admitted to gross inadequacy to handle the traffic that is being generated or to increase the draft restrictions currently limiting the size of the ships transitting the Canal.

Panamax and slightly larger size ships of course will be operating across a wide section of the bulk trades and have great flexibility. But the instancing of these relatively small proportions of large bulk carriers topping off from barges in the USA Gulf or Richards Bay, I don't think is really relevant to world trade statistics when we consider them and the tremendous volumes of coal moved from the US eastern seaboard.

Mr. Sampson questions my predicted five-fold increase in tonne/ mileages. This prediction in actual fact is a figure again given by H.P. Drury and Dr. James Lisnyk in a recent symposium given in America both claimed on the basis of increased size cargoes being hauled over much longer voyages. As Mr. Sampson observes there will undoubtedly be an increasing trend towards processing of raw materials wherever it is economically most advantageous. But despite this the large scale movement of the basic bulk commodities/cargoes, such as coal, iron ore, grain, fertilizer, bauxite, alumina, concentrates, sugar, etc. are forecast by all the experts to increase tremendously in the period under review.

The comments on my paper by Messrs. Coates and Sampson are certainly appreciated.

In reply to *Mr. Hood*: the Obo carrier is still being built today and I feel (and the facts are as outlined by various forecasters) that there will continue to be a demand for these type vessels - predominantly for employment in the dry bulk cargo trades as opposed to the oil trades

In the first part of your question - my own company are like most other European owners aiming for crew reductions and I do myself feel that 18 is adequate - it would be a bare minimum - I would prefer to see a few more, because as I point out in my paper, it's not under normal operating conditions where the inadequacies of these small crews becomes manifest, it is in an emergency situation when can happen with the tremendous risk factors involved with the size of ship to which you refer. I would, personally, as a ship operator, prefer to see possibly a crew of 24 or 25 which I would consider as minimum manning.

The second part of your question: I think the Australian maritime unions today are happily becoming aware of the fact that if they are not prepared to be flexible on manning that the prospects for them to be involved in the major bulk trades of the world are extremely limited. The dispute on the *Iron Hunter* in Japan recently, where a large ship was held for 3 months over one cook or pantryman, was certainly not indicative of this trend. But I think that the union executives are generally becoming more appreciative of the fact that if they are going to enter into any sort of bulk trading they have to reduce manning.

In reply to *Mr. Aggarwal*, on the first part of your question regarding freight rates for the large, predominantly Japanese, trade - although I question your percentage, I think that there would be a very large proportion of flag of convenience ships, maybe controlled by Japanese, perhaps I misunderstood you. But, freight rates on that trade are not generally known to the shipping industry because many of these trades are operating under long term contracts but there are, of course, many market fixtures which the contracts of freight would cover. A large percentage of the iron ore moving to Japan, but as in most of those major bulk trades there is always a certain proportion which is taken up by the market so that the importers can take advantage of the volatile nature of the freight market. In other words, at certain times they will have to face a market which is slightly above their contract rate, and at other times they will face a market which is below the contract rate and they will profit by this. So, they and most other major bulk handlers or importers will always tend to cover a proportion of their trade by contract and leave a proportion to the fortunes of the market.

I was merely quoting this because as I said prior to that, the Australian exporter in the main has to sell FOB - it's a buyer's market so the buyer can dictate the terms of purchase; if he doesn't like the terms he can go elsewhere. And with very few exceptions in the major bulk trades I think it is all sold FOB. There are a few exceptions such as Coal and Allied, but by virtue of the fact that the buyer buying FOB (because it's a buyer's market) they can dictate the terms.

All Japanese buyers don't overcommit and in the longer term they tend to review their contract rates relative to the market. They are not going to come across with a blanket rate to a shipowner for 5-10 years in this day and age; there are very few charterers or owners who would go in for that sort of an arrangement because of the unforeseeable cost escalations, currency adjustment factors, and these sort of things. But I just feel by virtue of the fact that a proportion of that cargo being quoted in the open market and similar trades are (from Australia to other overseas destinations) quoting the overseas market, it's not difficult to evaluate what is being paid.

Paper 1.9 PORT DEVELOPMENT IN N.S.W. IN THE EIGHTIES

by

J.M. Wallace,
President, Maritime Services Board of New South Wales

DISCUSSION AND WRITTEN QUESTIONS

1.9.1 *Captain W. Duthie, Five Star Shipping & Agency Co. Pty. Ltd.*

In a paper which covers most aspects of port development, there is no mention of discussion or involvement with trade union or industrial organizations.

Both internally and externally, the Maritime Services Board has, for some time, been plagued with industrial disputes through alleged lack of consultation or communication.

What steps are now proposed by the Board to alleviate this situation?

There is continuing criticism of the Board in regard to its environmental responsibilities, particularly in Botany Bay.

The environment is briefly touched on in the paper, but could Mr. Wallace outline any proposals currently being progressed in regard to fire and pollution prevention in the main ports?

In the Policy Section (e) reference is made to decentralisation. Could this be expanded with reference to any proposals in the north of the state?

It is understood that offers are continually being made to have some export cargo diverted to Brisbane, and it is believed those efforts will now accelerate with the introduction of the BATL Terminal at Fisherman Island, and also the recently announced proposal to introduce bulk handling in the Port of Brisbane.

What consideration has been given, at this stage, to the bunkering of coal-fired vessels should such facilities be required in NSW?

1.9.2 *Dr. J.B. Ritchie, NSW Combined Colliery Proprietors Association*

The paper highlights with great clarity the parameters which need to be taken into account in attempting to meet the future port requirements for NSW. As stated, these parameters are often in conflict. With the high degree of uncertainty surrounding the future, planning is no easy task. This task is made even more difficult because of the long lead times which are necessary between the decision to proceed on a project and its completion. The Board is to be congratulated on its achievement to date in meeting the needs of the coal industry.

The coal industry, in order to continue to grow and utilise increased port capacity, must remain competitive in world markets. The factors affecting competitiveness include the cost of loading and the cost of sea transport. These two costs represent a very significant component of total industry costs. An increase of even $1 per tonne in these costs can represent the difference between success and failure in the market place.

The dilemna facing the industry is whether to agree or not to the deepening of the harbour at Newcastle. This deepening must be paid for predominantly by the coal industry. Recovery of the capital cost can be achieved by increasing the cost per tonne to load all coal through Newcastle, even though the majority of coal will not be shipped in the lower cost, larger vessels for which the port is being deepened. Alternatively, recovery of the capital cost can be achieved by applying a higher cost per tonne of coal shipped only in the larger vessels which may remove their cost advantage. Other difficulties facing the industry include the higher cost of transport from the western coalfields to Newcastle in the event that the western coalfields wanted to take advantage of the larger ships and not be discriminated against with respect to the northern shippers. In fact, in NSW deeper may not be better.

In addition there are political factors which make the handling of very large ships most important, not only to the community but also in the market place.

Could Mr. Wallace comment on the balance as he sees it between the issues raised above?

AUTHOR'S REPLIES

In reply to *Captain Duthie* who indicated in his questions that in his view the Board has been plagued both internally and externally with industrial disputes through alleged lack of consultation or communication.

Whilst accepting that the ports of this State have during the past twelve months been affected by the general industrial unrest in the industry, usually completely external to the Board's area of control, I would disagree with the statement that we have been plagued by internal disputes.

In this regard during the 1980-81 financial year our employees lost 3.5 days or about 1.4% of the manhours worked. Whilst this is not necessarily a good record if one compares it with the waterfront industry generally, it is excellent because in the September 1979 quarter the comparable figures were: Sydney 15%, Brisbane 9.8% and Melbourne 7.7%. In the March 1980 quarter the figures were: Sydney 4.6%, Brisbane 1.9% and Melbourne 8.5%.

Captain Duthie also touches on the criticism the Board originally had in relation to environmental issues in its development of Port Botany and seeks information on aspects of fire protection and pollution control.

On the question of fire protection in NSW ports generally this has been the subject of a working group comprising representatives of the Board, the NSW Labour Council and the Board of Fire Commissioners. The working group has completed its recommendations which are now under consideration by government.

In relation to pollution control our greatest difficulties in Botany Bay have been associated with the inability to boom a vessel at the AOR multi-buoy tanker terminal in the middle of the Bay. As mentioned in the paper we are building a new crude berth within sheltered Port Botany and the long-shore nature of this berth will enable it to be adequately boomed and so significantly minimising oil spill problems.

Dr. Ritchie poses the question for the funding of further deepening of Newcastle Harbour, from 15.2 m to 18.2 m.

The question is basically whether the capital cost should be recovered from vessels of current size, which would not need the extra depth or whether to recover the cost only from larger vessels when the further harbour deepening is completed. The second part of the question asks whether western collieries are being discriminated against in having to pay the higher rail cost to use a deeper port at Newcastle.

As most people are aware the current harbour deepening project is being paid for by contribution from the coal industry and BHP as a $1.00 per tonne levy on cargoes of existing sized vessels. It is not uncommon for funding of new projects to be by way of profits or levies accrued on use of existing facilities. Where this is not the case, as would happen if Dr. Ritchie's suggestion is followed, the project is financed completely on borrowed funds and the industry is then required to pay the interest and capital repayments. It is my view that in the present financial climate it would seem doubtful if the project would go ahead if it were necessary to borrow the money to complete the work and then charge a levy after the completion.

A second point, is that whenever the project is paid for, it will be the same industry in general that is funding the work. Many present shippers, when the extra depth is available will move from the smaller vessels into larger ones and therefore the question only becomes one of when they pay for the facility.

The smaller vessels, i.e. up to 120,000 dwt, will also benefit from a further deepening in that they would be able to move on low tides as well as high tides while at 15.2 m depth they would require a high tide to leave fully loaded.

The second part of the question regarding western coalfields shipping through Newcastle does not really appear to be a question for the Board to answer as it involves a multitude of issues outside the Board's influence.

SESSION 2.A CHAIRMAN CAPTAIN H. VANDERWEL

Paper 2.2 GAS FIRED COASTAL BULK CARRIERS

by

W.F. Ellis,
W.F. Ellis and Associates Pty. Ltd.

DISCUSSION AND WRITTEN QUESTIONS

2.2.1 *Mr. Aage Arnold Drabol, B & W Diesel Australia Pty. Ltd.*

Would you please advise me on the following:

(1) What is the actual gas consumption?

(2) What is the price for gas?

(3) How would the actual running cost be compared to traditional two-stroke low speed engines?

Example:

Chosen engine: Fuji Dual fuel engine
2X6LG32X 1650 BHP - 3300 BHP
2 gearboxes + 2 propeller shafts

B & W engine: 5L35GBE 2900 BHP 2150 KW weight 58 tons
or 6L35GBE 3500 BHP 260 KW weight 66 tons
Mcr 200 P max 120 bar
Fuel consumption 129 g/BHPh or 175 g/KWh

Consumption: 5L35GBE 2900 BHP - 0.374 t/h or 8.975 t/24 hours
6L35GBE 3500 BHP - 0.452 t/h or 10.848 t/24 hours
Fuel price (according to DCN 16/10/81)
Fuel 380 cst Sydney/Melbourne $208.00
5L35GBE $1866.80/24 hours
6L35GBE $2256.38/24 hours

Editors Note:

Burmeister and Wain have produced a paper, *Choice of Propulsion Plant for LNG Carriers*. It is suggested for those interested that they contact B & W Diesel Australia Pty. Ltd., Sydney.

2.2.2 Mr. J. Gallois, CGE Alsthom International

Congratulations to Mr. Ellis for his very interesting paper mentioning an original solution for the propulsion of a coastal bulk carrier.

I advise that Fuji is one of the Pielstick Licensees, for PA engines, and their original Fuji dual fuel engine is using some of the technology of SEMT-Pielstick dual fuel engines when fed with natural gas. But, there is another solution which may be cheaper for a country such as Australia, where there is ample coal and by using low calorific value gas coming from a coal gasifier.

It would be quite interesting to have Mr. Ellis' ideas about that possibility and as an example, at the present point of technology, it is possible for a coal gasifier, fed with coal of 6820 kcal/kg (7.93 kWh/kg) to produce a gas which gives an average analysis of the following percent per volume:

H_2	- 15.8	Cn Hm	- 0.3
CO	- 29.7	CO_2	- 3.4
CH_4	- 2.8	N_2	- 48

which means:	Octane index	120
	LHV [1848 kWh/m^3 (n)]	1589 $kcal/m^3$ (n)
	pv comburivore	1.450 m^3/m^3
	sp mass	1.077 kg/m^3 (n)

The efficiency of such a production in heat available in cold and clean gas to produce useful power (auxiliaries deducted) on the heat available in the burned coal is 0.78.

SEMT is now able to offer two types of engines burning such a gas:

	The PA4-200 GP rated in this case at	100 kW/cyl	at 1500 rpm
or		80	at 1200 rpm
	The PC2-5 LCV rated at	393 kW/cyl	at 500 rpm

Both of them are running according to dual fuel process which means that they are burning for firing 7% of the energy input at full load in liquid fuel. For the PC engine, this liquid fuel could be a blended fuel up to 175 cSt (mm^2/s).

The requested power of 3300 hp (around 2400 kW) could be covered by two PA4 engines of 16 cylinders running at 1200 rpm or one six PC2-5 running at 500 rpm. The fuel specific consumption of both of them is very similar which means that, at full load it represents:

1680 kcal/ch h of which pilot injection

118 leaving around 1 cubic metre of gas per hph.

In coal according to the given efficiency and calorific value, it is:

0.294 kg/hph (0.4 kg/kWh) and

12 kg/hph (16 kg/kWh) of liquid fuel.

On the total: 941 kg/h of coal and 37.5 kg of liquid fuel.

At 85% load 331 kW/cyl for the PC2-5 LCV, we have in specific:

0.300 kg/hph of coal (0.410 kg/kWh) and

14 g/hph (20 g/kWh) of liquid fuel.

Per hour:

37.5 kg of liquid fuel, and

814 kg of coal.

The overall efficiency of such an operation is power on the engine shaft on thermal flow at gasifier inlet:

At full load 29.8%

At 85% 29.3%

On larger installations, up to 14,000 kW, the overall efficiency can be a little improved, but in this case, heat recovery allows also to make steam on board for electricity.

2.2.3 *Mr. O. Kobayashi, Japan Trade Centre*

What will be the temperature of the fuel gas while being stored and at the inlet to the engine?

2.2.4 *Mr. D.C. Bews, Port of Melbourne Authority*

Our vessels have got even less distance to travel than the *Accolade* and I am quite interested in your gas propulsion. You have given us some generic figures for the reasons to go to gas rather than any other fuel. However, there seems to be a fairly high initial cost with fitting the gas system. Do you have any whole of life costing projections for the vessel with the gas propulsion, dual fuel propulsion?

2.2.5 *Mr. A.R.L. Tait, Bureau Veritas*

I would like to know why you put the gas bottles behind the collision bulkhead? With long connecting pipeline at risk along the deck, would it not perhaps have been better to have had the bottles just forward of the engine room? Was it a trim situation or was it a question of the safe area?

2.2.6 *Mr. P.R. Salisbury, TNT Ltd.*

I congratulate Mr. Ellis on his originality both with the propulsion system and the method of loading/discharging. He also mentions the possible use of gas producers to utilise coal fuel in ships and suggests this would not only be more economically desirable than burning coal under boilers but also more efficient. This prompts the following questions:

(1) What is the efficiency rate of converting coal to gas in terms of available BTU's as compared with burning directly under a boiler?

(2) Does the gas producer leave significant volumes of coke or just ash? If the former, has this a residual value for selling on disposal ashore?

(3) Some information on cubic capacity taken up by the gas producer and uptakes as compared with a boiler would be of interest.

In the case of *Accolade II* was the position of storage of gas cylinders dictated by trim conditions or does safety demand that the bulk storage is remote from the engine room?

This ship of course is on a very short run but does the author see potential for this system in general coastwise work or would that always involve a gas producer system?

Lastly, like many others who have studied the Kvaerner Cargo Scraper System, I wonder what will be the life or damage rate of the scrapers which it is understood are like the rest of the moving parts made from ordinary mild steel.

2.2.7 *Captain H. Vanderwel , Company of Master Mariners*

In a follow up on Mr. Tait's question, would you please tell us why you used high pressure cylinders for the storage of the gas?

2.2.8 *Mr. R.H. Roberts, Sulzer Australia Pty. Ltd.*

Once again we have to thank Mr. Ellis for a very interesting paper. As we have come to expect from him he has not only described an interesting ship but has given us something to think about for the future.

The proposal to utilise coal in a gas producer to drive reciprocating engines for ship propulsion is novel and warrants further study. Perhaps this study should include the possibility of using the waste gases from the gas producer in a gas turbine driving an auxiliary generator.

Based on the author's stated prices for the heating value of various fuels it would appear that whenever natural gas is available at the ports serviced by the ship there could be a definite case to consider dual fuel engines. It would be necessary to have a shore based high pressure gas system in each port or the compressor plant could easily be part of the ship's own machinery.

As members will be aware a large LNG carrier is fitted with a Sulzer slow speed dual fuel engine operating on boil-off gas. Part of the technology required to implement the author's proposals is therefore already well establshed.

On a two stroke slow speed dual fuel engine it was found that the output of the engine using 5% pilot fuel oil was 70% of the output that could be obtained from the same bore engine operating purely on fuel oil. With 35% pilot fuel the engine has the same output as a pure diesel engine.

This suggests that on a ship fitted with CP propellers the propulsion system could be designed to use this potential higher engine power to increase the ship's speed if service conditions require it at any time. Alternatively, even with a fixed propeller the sea margin power of the engine could be reduced and additional pilot fuel could be introduced as and when required to avoid engine overload. This latter proposal would have the advantage of reducing the higher cost of the dual fuel engine compared with the normal diesel engine.

The author mentions that the engines on the *Accolade II* have a reduced output when operating on gas. Has he investigated the possible advantages of using higher percentage of pilot fuel as suggested above?

AUTHOR'S REPLIES

In reply to *Mr. Aage Arnold Drabol*: this ship in question has a very low L/B ratio of 4.56 and there is a requirement for the ship to berth without tug assistance and without the sophistication of a bow thruster. The designers therefore considered it prudent to have two widely spaced propellers to assist in manoeuvring. Had it been a ship of conventional hull form economics would undoubtedly have dictated the installation of a single slow speed engine.

The fuel consumption of the installed engines is confirmed by the engine builders to be:

	Diesel Operation	Dual Fuel Operation
At 3/4 load	165 gr/BHP/Hr	1800 Kcal/BHP/Hr
At 4/4 load	165 gr/BHP/Hr	1753 Kcal/BHP/Hr
(Diesel fuel:	10,200 Kcal/kg	Gas: 8365 Kcal/Nm^3)

After allowing for the cost of compressing the gas and 7% pilot fuel of gas oil the overall fuel operating cost in the gas mode at 3/4 load is approximately 35% of the cost of operating in the diesel mode.

The details submitted by *Mr. Gallois* of performance for the PA4 and PC2 engines when used in conjunction with a coal gasifier are most interesting and helpful and endorse the remarks made in the paper concerning this type of propulsion.

A rough calculation based on the performance figures for the PC2 engine indicate that an installation of gasifiers and 2-8PC2-5LCV engines powering a 15 kt 15000 dwt bulk carrier on typical Australian coastal service would result in fuel savings equivalent to $566,000 per annum compared to the diesel engine burning heavy fuel.

The maintenance costs of the gas fired engine are less than the heavy fuel burning engine but little is known of the maintenance costs of gasifiers in the marine environment. This together with the increased capital cost and the natural conservatism of shipowners will probably inhibit the adoption of this system of propulsion unless the price differential between oil and coal increases significantly.

A very real advantage of the system, which is difficult to quantify, is the ability to use either coal or oil in the case of industrial action interrupting supplies of one or the other.

In answer to *Mr. Kobayashi's* question: the storage of natural gas at high pressure was preferred in this case in order to contain the gas bunker volumetric requirements within reasonable limits. Penalties are incurred in that power is required to compress the gas and in this instance no attempt has been made to recover the pressure energy during expansion to the usable pressure.

The temperature drop during expansion through the reducing valves is very substantial and owing to the various indeterminent heat gains no precise data is available for the gas temperature after expansion. Precautions have been taken by fitting hot water/gas heat exchangers before the reducing valves and before entry to the main engines.

The maximum temperature of gas leaving the shore compressor will be 50°C. With heat losses in pipe lines and storage bottles it is anticipated the stored gas temperature prior to departure from Adelaide will not exceed 36°C on most occasions. The gas will be heated to 60°C before the reducing valves and again heated to 20°C before the engine gas control valve.

Subsequent experience in service may prove that the primary heating is not necessary.

Replying to *Mr. Bews*: we certainly did in the case of this little vessel. But bearing in mind that the price of gas seems to vary dramatically from port to port. I don't know what you would have to pay for your gas in Melbourne, but in Adelaide, after allowing for the increased cost of the gas equipment and amortising that over the normal period together with the normal operation of the vessel, the overall fuel savings per annum were in excess of a quarter of a million dollars.

In reply to *Mr. Tait*: I think like all things in ship design, it was a bit of a compromise. (Mr. Salisbury asked this same question.) There was no specific reason for the gas bottles to be right forward; they could have been adjacent to the engine room, provided there was a coffer dam around the compartment. But in this case the design was being advanced at the same time as we were investigating the use of gas - the gas decision being a fairly late one - and with natural layout of the ship it seemed to be a logical place to physically locate the gas bottles. Not for any practical reasons other than the fact there was plenty of room up forward.

As technical manager of a successful and enterprising shipping company *Mr. Salisbury* has asked some searching questions from the shipowner's point of view.

To my knowledge no published data exists concerning the overall efficiency of a propulsion system utilizing waste heat recovery from the internal combustion engine(s) to generate steam for use in producing gas fuel from coal. If the engine is capable of burning hot gas from which the tar has not been removed an acceptable overall thermal efficiency for the propulsion plant is assured.

For a coal gas producer the following is a typical heat balance when making hot uncleaned gas and the alternative cold clean gas:

	Percent
Input:	
Heating value in fuel	97.6
Sensible heat in steam	2.4
	100.0
Output:	
Heating value in cold gas	74.3
Sensible heat in gas	12.1
Heating value in tar	5.1
Sensible heat in tar	0.2
Heat loss in tar, dust, etc.	2.2
Heat loss in cooling water	0.3
Heat loss in carbon in ash	0.4
Heat loss in water vapour	1.9
Heat loss in radiation	3.5
	100.0
Cold efficiency based on gross heating value of cold gas	76.1
Hot efficiency based on useful heat in gas and tar	93.9

There appears to be a variety of designs of coal gas producers available which perhaps indicates insufficient past demand to fully research and optimise for performance and manufacture. As a rough guide mechanical producers are generally 2.5 m or more in diameter gasifying 1.5 to 5 tonnes per hour. The height to diameter ratio is about 1.6:1. Should clean gas be required the gas cooling and clean up equipment would be such that the overall size of the gas producer plant would be somewhat similar to the equivalent capacity boiler with all appurtenances.

In reply to the question concerning the location of the gas storage in *Accolade II* the decision to place the storage bottles forward was taken after considering several factors including:

(1) Safety

(2) Available space

(3) Desirability of stowing the gas bottles vertical to facilitate purging and draining

(4) Close proximity to the bunkering position

Although safety was a prime consideration in all decisions in relation to the gas equipment the actual storage bottles could be located anywhere provided a coffer dam was provided around the gas storage compartment. In the case of *Accolade II* the forward stowage suited the rectangular hold configuration and the bunkering position. This location does have the disadvantage of remoteness from the accommodation for engineers carrying out operational checks on the reducing valves, gas scrubber and high pressure gas heater, all of which are located in the gas compartment.

With regard to potential use of compressed natural gas for propulsion the cubic and deadweight penalty of gas storage will be such as to limit application to short voyages. Harbour tugs, ferries, dredgers, and fishing boats operating from sources where gas is competitively priced could enjoy substantial savings in fuel and maintenance costs by using dual fuel or spark ignition gas engines.

For long voyage ships operating from coal ports the dual fuel engine installation with a coal gas producer may prove most beneficial when the economics of the trade dictate a return voyage on oil fuel.

With regard to the wear rates on the Kvaerner cargo scrapers time alone may tell. However the limestone cargo in this instance is of comparatively small sizing and experience on the existing unloading equipment would indicate that it is not highly abrasive. The scraper blades are easily replaced and longer wearing materials could be substituted if a problem of this nature should arise.

In reply to *Captain Vanderwell*, I advise that we did initially look at tanks and this is described briefly in the paper. If you reduce the pressure - I think it was about 600 psi we were looking at for storing the gas - we ended up with 4 very large tanks which completely filled the deck of the vessel and this did not seem to be too practical. So we then did an overall feasibility study of the price for high pressure cylinders and how they could be stowed which ended up as a cost effective business fitting a high pressure storage system.

In thanking *Mr. Roberts* for his complimentary remarks it is fitting that he is also thanked for his thoughts which extend the concept of dual fuel operation to further areas.

The high efficiency of the combined gas producer/dual fuel engine installation is due to the complete utilisation of the gases produced. Unfortunately, the hot exit gases from a coal gas producer would contain tar and fine ash. If means could be devised to filter out the ash and burn the hot tar containing gas in a dual fuel engine the overall efficiency would be very high and would further being enhanced if the gas producer jacket cooling water were utilised as feed water to the exhaust gas boiler operating on exhaust from the diesel engine. Steam produced would be used in the gas producer and elsewhere as required.

Mr. Roberts' remarks concerning the ability to obtain full power output from a dual fuel engine with only 35% pilot fuel are very pertinent indeed and should be noted by engineers associated with further installations of this type. The owners of *Accolade II* will no doubt bear this in mind when studying the in-service performance of this ship.

Paper 2.3 AUSTRALIAN BULK CARRIER DESIGN AND OPERATIONS IN AN ERA OF HIGH FUEL COSTS

by

H. Benford and R.M. Scher,
University of Michigan

DISCUSSION AND WRITTEN QUESTIONS

2.3.1 Mr. P.R. Salisbury, TNT Ltd.

A first reaction from reading yet another of Professor Benford's lucid and interesting papers is that much of the effort that has gone in the past to optimization of hull forms and tank testing has been misapplied. If the same effort had gone into reducing turn round time or crew numbers it would have had a much greater effect on the RFR.

Mention is made of the use of copper nickle alloys for combating both corrosion and fouling. It is believed this material is also available as a clad form of mild steel (rolled on hot and bonded). Have the authors any knowledge of this material and have they heard of any ships which have actually been coated with these alloys?

Although included on Page 125 (Volume 1) as a possible option the authors appear not to place stress on economies resulting from fitting a controllable pitch propeller. Considering that bulk carriers make a high percentage of their voyage in ballast at reduced draft the gain in always optimizing efficiency should be considerable. Could it be that this is more apparent with diesel engines and the authors experience with primarily American steam turbine vessels leads to less emphasis on this point?

2.3.2 Mr. W. Waters, Union Steam Ship Co. of New Zealand Ltd.

Some years ago an economic study of lifesaving equipment quoted a figure assumed in the calculation for the life of a seaman. If we allow for inflation and the present rate of exchange we could apply this figure to a current exercise. But surely that is not the purpose of the type of economic study pioneered by Professor Benford?

Can the authors explain how best to relate safety standards and human life to such studies? For instance, a separate economic study may show a saving of fuel by installing satellite navigation equipment but to what extent is the probability of collision increased as all vessels crowd on to that 'most economic' route?

It was good to see the reference to barnacles for two reasons. It is always fairly easy to find a cheaper paint. The cost of paint shows clearly on the ledgers. So does the cost of fuel. But the barnacles are underwater and the progressive loss of speed not always so carefully monitored. Often those most vocal about savings in fuel costs are also pressing the fleet managers for an extended docking period even when the presence of fouling is obvious.

Taking all types of commercial cargo ships into consideration can the authors suggest the best parameters to use to monitor the loss of speed due to fouling against docking interval?

Reference is made to a ship performing better by the head than on level keel. A family of twin screw passenger ships with fine after lines and full bossings were directionally unstable on a level keel but behaved normally when trimmed by the stern. If this suggests poor initial design would the authors agree the same argument applies to 'jumbo-ising' which offers no universal guarantee of reduced fuel bills, especially as the slower service speeds now accepted make the 'frictional' component the predominant factor in the total resistance.

2.3.3 *Mrs. Helen Bendall, The University of New South Wales*

The authors have listed various strategies for cost savings in an era of rising fuel prices. I am surprised that this compendium did not include and indeed highlight coal-fired propulsion, especially as the authors were analysing Australian design and operations. Could you please explain why?

In the conclusion (on Page 123) would you please explain the statement that port turnaround time varies inversely with route distance?

In referring to the cast study on Page 118, I am aware that Americans have only recently discovered the marine diesel but I am surprised that you should choose an engine turning at 225 rpm. This speed would hardly be suitable for Panamax or larger vessels. Would you agree?

2.3.4 *Mr. R.G. Hawke, The Broken Hill Proprietary Co. Ltd.*

I would be pleased if the authors would anwser the following questions:

1) Owing to draft restricted harbours and the air draft of unloading equipment the *Iron Whyalla* would be the largest ship we can build if the ratios of beam to draft of 3 and length to depth of 12.5 are maintained. What would be your comments on shallow draft hull forms suggested in *Characteristics of Bulk Carriers for Restricted Draft Services*, SNAME, 1974, and the twin stern hull form suggested by some Japanese yards?

2) Re propellers: change out for slow speed steaming, have you any indication at what level a ship would be able to pay for its new propeller, e.g. a percentage reduction in power?

3) We are interested in retrofitting propeller ducts but cannot find enough saving to cover the expense. We have not investigated reaction fins as yet.

   Would you consider that the result of your investigation would have changed if you had assumed that a duct was to be fitted as original equipment, e.g. could the Cb of the after body have been fuller?

2.3.5 Mr. P.K. Pal, The University of New South Wales

You state in Appendix 1 (Page 137, No. 8) that *revenue and operating costs remain constant.* In real life I think this will not remain constant and I would like to hear your comments.

2.3.6 Dr. L.J. Doctors, The University of New South Wales

It occurred to me when you mentioned very low ship speeds like 12 knots if you have to contend with a current in the water then the time for the round trip will be increased because if you have, say, a 4 knot current, then you'd be doing 16 knots one way and 8 the other and the round trip would be increased and therefore your total efficiency would be reduced. Is that actually important or not? Have you seen any studies made on the effect of currents?

2.3.7 Mr. P. Renshaw, Department of Transport

I was a bit surprised by the effect of the extended port time. I would have thought that the effect of delay would be that your fixed annual costs would be spread over a smaller tonnage and that the result might be that you should increase the speed. Is this wrong or is this delay effect only applicable to a delay built into the system by a cargo-handling restraint. If the delay was due to unexpected factors would it give a different result?

2.3.8 Mr. E.S. Clarke,

I have an ill developed question regarding ballast return voyages. Surely one of the significant aspects of the voyage is the long ballast return. Did you assume (you didn't take any varying ballast draft conditions) the same ballast return speed as the loaded speed? Can you comment please and has this any effect?

AUTHORS' REPLIES

In the first instance, *Mr. Salisbury* makes a comment which I accept without reservation. With respect to copper-nickel alloy cladding over ordinary mild steel this is indeed available and has been tried. The paper by *Schorsch et al* cited in the references can be consulted for details.*

We fully agree that controllable pitch propellers are appropriate in most bulk carriers. We assumed they would be used in our case study ship.

With respect to the comments and questions from *Mr. Waters*: the present value (with suitable discounting) of one's future income is a valid, albeit crude and unfeeling, measure of one's worth to society. As such it is a useful tool in seeking to find the optimal degree of investment in shipboard safety

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* *Editor's Note:* See Page 127, Vol. 1 . A very important potential is ahead of us in the use of copper-nickel alloys.

features. That, however, is a design consideration outside the purview of the present study. In our view, there are no perceptible differences in the safety levels of our various fuel-saving proposals. The same navigation system that encourages ships to crowd together can also be used to warn them of impending collision.

There are many factors to consider when settling the question of when to dry dock a ship. None of them, including speed loss, is easy to measure except in crude, macro-performance terms. All we can suggest to shipowners is to keep abreast of currently available instrumentation and encourage their further development. Offsetting the evasiveness of this reply is the realisation that one can depart rather widely from the exact optimal docking schedule with only negligible effects on the overall economics.

Mr. Waters implies correctly that jumboising a ship can only add to its annual fuel bill. What he perhaps overlooks is that jumboising will add in even greater measure to the ship's annual transport capacity. If the cargo is there to fill the ship, few measures are better calculated to reduce the fuel burned per ton of cargo delivered.

In reply to *Mrs. Bendall*, I thank her for raising the subject of coal fired propulsion. Our failure to mention this form of propulsion serves as a good example of the ever-present danger of forgetting to mention the obvious. We concur that a reversion to coal power is likely to come about, and appreciate having this omission called to our attention.

Our conclusion (on Page 123, item (e)) regarding port turnaround time is poorly expressed. It would be less ambiguously stated thus: *Port turnaround time has a major influence on transport economics, and the degree of that influence varies inversely with route distance.* Let me explain this further. Mr. Ellis told us about a ship that was making a very short voyage - about 4 hours. Now, if that ship had a 48 hour turnaround time in each port that would ruin its economy. But ships coming from the Persian Gulf that spend, say 48 hours in port, would not effect their economy. This is what I'm trying to convey, that port turnaround varies inversely with distance.

Regarding engine speed, we should make clear that we envision gearing between engine and propeller. We propose a 33 ft diameter wheel turning, in each case, at an optimized speed.

Acknowledging *Mr. Hawke's* comments and questions, let me simply point out that what may be true today would I hope in the future with proper planning and political persuasion on your part bring about a change, because it is important to move towards bigger ships especially with your highly paid labour content.

We recognise that our case study ship is bigger than any now found in Australian waters, but considering the economic and energy-saving imperatives of ship size, we trust that Australian ships will attain those dimensions within the foreseeable future. We understand that Botany Bay will already accommodate ships with drafts as great as that proposed. In any event our conclusions should remain valid regardless of size

With respect to your comments on shallow draft hull forms as published in SNAME, 1974, I have not had time to review that paper (I remember reading it), and I have a general impression that it is a good paper. If we are fighting restricted drafts we must always move in the direction of trying to find out how extreme we can have the beam/draft ratio and length/beam ratio. As far as the twin stern hull form suggested by the Japanese concerned, I am a little hazy on the subject. Let me simply say that there are, as most of you know, important advantages of single screw propulsion. You get a better propulsive efficiency and it is cheaper to build the ship and probably cheaper to operate. On the other hand, there are disadvantages which would be turned into advantages for the other hull form suggested. With single screw and shallow draft you are limited in how much horsepower can be put in to the ship. Also, if you have an extremely wide shallow ship with single screw you may have considerable trouble with vibrations because of poor flow of water to the propeller and by placing the propellers farther out can help you to eliminate that problem. The shallow draft and twin stern hull form referred to are less efficient than more normal forms. They may nevertheless be appropriate in certain trades where traffic is too light to justify extensive dredging.

There is no simple answer as to the level of power reduction that would justify a new propeller. Factors such as remaining life of the ship, tax structure, and type of propulsion plant complicate the analysis. Each case would have to be studied on its own merits.

Adding a duct might allow some modest increase in block coefficient, but our method of analysis is not sophisticated enough to handle that complication.

The question of *Mr. Pal* raises the subject of inflation. We are talking about these costs remaining constant in real terms. We assume that as the dollar inflates the shipowner will be free to increase his rates to his customers and given that assumption, the optimum ship remains the same. Now, if he is foolish enough to sign a long term contract at a fixed rate he is in trouble. But we assume that he is free to raise his rates. What I have stated may be a little untrue because I do not know the Australian tax system, however, in the United States the government does not admit that inflation is having an impact on its depreciation allocations so in effect we have a slightly higher tax than the official tax rate. It may be different here. We are talking about dollars that have been corrected for inflation so we say that they are a constant.

Answering *Dr. Doctors*: I guess your point is that if the ship has to operate against the current and then with the current that the average speed is going to be less than you had anticipated because you're spending more time fighting the current. In fact, if the current was the same speed as your ship you would never make a round trip. No, we did not consider that aspect, but let me defend myself by saying that we assumed a 24 hours delay. Our programme was not that sophisticated. It was an imaginary voyage. It could have been worked in if somebody had wished and I invite you to do so. Certainly it would be worth examination and it would not be difficult to learn how to avoid those currents when they're against you.

The change in the technical characteristics, *Mr. Renshaw*, is minor. Actually, if you look at the tables in the back that show the more complete information, you will see that there is some slight difference, but we are in an area of what is called flat laxity - there is very little change in optimum characteristics. The impact on the technical characteristics is small but you will notice that there is a 9% change in the economic cost of transport. So port time delays of any sort, whether it is because of queuing, fog or whatever, are an important economic factor.

Mr. Renshaw also asked a question, in higher speed ships does it become less important? The answer is, so. You put more money into machinery and when that ship is sitting tied up in ports the capital costs are continuing worse than they do in a slow speed ship. So the high speed ship suffers more from port delays.

In reply to *Mr. Clarke's* question, we assumed a slightly higher speed in ballast. If you look in the appendix you will find that we allow 8.5% increase in the ballast speed.

SESSION 2.B CHAIRMAN MR. R.G. HAWKE

Paper 2.4 WASTE HEAT UTILISATION

by

R.F. McMahon,
Australian National Line

DISCUSSION AND WRITTEN QUESTIONS

2.4.1 Mr. G. Edwards, Sydney Technical College

I congratulate Mr. McMahon on his well researched paper on the subject. The ever increasing cost of propelling ships must ultimately force owners and builders to expend large amounts of capital to maintain reasonable voyage speeds whilst endeavouring to reduce fuel consumption rates.

I am sure neither the OPEC countries nor Western shipping nations realised at the time, that the massive increase in bunker costs, actually made us look very carefully, not at how much fuel we were using, but how much we were wasting.

In trying to be constructive I have stayed in line with the headings shown in the paper.

More Efficient Engines:

(i) In the case of longer stroke engines it would appear that savings are twofold:

(a) carrying piston pressure for a slightly longer time, higher average pressures.

(b) basically slowing down the engine thus increasing the propeller propulsive efficiency. It would appear however, that there would have to be some type of tradeoff in respect to power available for turbo-charging.

(ii) There has been much discussion on the subject of 2 stage turbo-charging. I believe the only people who have taken any direct action is Mitsubishi on their slow speed UE engine. We appear to have just about reached the limit of single staging which is a compromise and this is evident by the ready tendency to stall or surge.

MAN is looking at variable incidence nozzle guide vanes on the gas wheel to get that little extra from single staging.

In the case of the UE engine the ducting and mounting is somewhat complex. The MAN modification of variable nozzle guide vanes requires special bearings, seals, and actuators with their subsequent maintenance problems.

What I cannot determine is why the marine engineer does not take a leaf out of the aircraft engine manufacturer's book and fit a 2 stage axial compressor with variable inlet guide vanes. This avoids any additional wheels, coolers and ducts.

(iii) Variable injection timing has its penalty in higher bearing loads, and we are not really out of the woods entirely with top end bearings especially if we reduce revolutions and associated inertia loadings.

More Efficient Auxiliaries:

(1) I can still recall the engine driven pumps on older Doxford and British Polar Engines. They were quite effective and with the exception of power the main engine was the prime mover for everything.

(2) This would appear to require some type of positive displacement pump or the fitting of sophisticated speed regulating gear on the electrical side so that speed is governed by pump demand.

(3) This again is an area where a constant speed drive can be utilised. The constant frequency gear used on aircraft engines could possibly be an answer. Of course with a CPP the pitch can always be trimmed to maintain frequency.

More Efficient Hulls: I cannot help but feel that the tradeoff will be cargo vs. hull shape, with the former taking precedence.

Waste Heat Economisers: I have had some experience with respect to recovery of steel balls for economiser cleaning at 'Yallourn' power station. I have no information regarding their use at sea.

Thermal fluids would appear to overcome the problems of corrosion in the systems.

Steam Turbines: The pass in process is well proven and is tied back to the high pressure inlet valve. As pass in quantity increased the high pressure valve closes off and vice versa.

I cannot help but think if there is justification in returning to lower powered ships. We cannot justify a large propulsion plant just in case we need it or for it to produce waste heat for other purposes. The less initial fuel we burn the better off we are environmentally. The other point of course is that the complexity of these combined plants may require another change in certification.

Absorption Refrigeration Plant: I seem to recall that the *Queen Mary* had some form of refrigeration plant using the steam ejector principle which could supplement the absorption heat source by using waste steam. However, the problem here seems twofold:

(1) Where do we get heat when the main engine is shut down?

(2) With one closed down we have to carry a duplicate plant to take over (capital expenditure).

Passive Energy Conservation:

Use of Shading: Have we forgotten the designs of older ships before the advent of air conditioning? Their open verandah decks and breezeway designs could certainly be incorporated into modern vessels other than tankers.

Points to Consider: The comments regarding turbo-charger mass flow indicate a move to aero practice where cooling of the working fluid is not carried out. However, I feel that an in-depth study must be carried out to determine if we will suffer additional problems due to:

(1) Lubrication breakdown

(2) Variable injection timing

(3) Possible vanadium problems due to higher exhaust temperatures. In this case we should measure metal instead of exhaust gas temperatures.

The utilisation of outside air for turbo-charger suction is not new, however I cannot comment on the improvement in efficiency. I am sure it would tend to negate any possible detrimental effects due to the lack of casing cooling. However, sodium ingestion would have to be watched.

The justification of absorption plant on a one percent saving would, I feel, be skating on rather thin ice.

The Union Steam Ship Company Motor Ships always used generator waste heat for:

(1) Domestic heating

(2) Warming main engines (*Wanaka*, built 1938).

Conclusion: As we are already slowing down voyage speeds perhaps the old Doxford design of 9000 tons at 9 knots on 9 tons per day is worth another look.

2.4.2 Mr. J. Gallois, CGE Alsthom International

Mr. McMahon is to be congratulated for his paper and I would like to draw his attention that four stroke engines have approximately 60% more heat recovery capabilities than two stroke slow speed engines.

SEMT is currently considering two additional possibilities:

(1) The use of high pressure water (up to 100 bars) and with suitable flashes and expansions, recover about 12% of the service power.

(2) With the use of organic fluid recover the same amount of power.

Do you think that this method would be possible on board ship?

2.4.3 Mr. V.E. Klass, The Broken Hill Proprietary Co. Ltd.

I have read the paper but do not note any new technology - everything can be carried out now provided that the shipowner specifies his requirements and is also prepared to pay the cost. There is, however, a question: on what parameters do you base the comment of a further 3% saving in fuel consumption with regard to navigation as all the things proposed are now in use on most modern vessels?

AUTHOR'S REPLIES

Mr. Edwards is thanked for his comprehensive and thought provoking appraisal. He has reminded us that we should not forget our past experience and further appraisals the solutions by engineers of past eras. Probably the best way to reply to Mr. Edwards is to add a few more salient points worth mentioning.

Total Ship Economy Package:

The major Japanese shipbuilders are now offering total ship economy packages exploiting the best available energy saving devices for the size and power of the vessel.

The package may include:

- Computerised selection of hull form and service speed
- Specific fuel consumption below 130 g/bhph
- Low speed propeller (say 50 rpm)
- Reduction gearing via flexible coupling
- High performance mixed pressure turbo generator
- Dual pressure exhaust gas economisers
- Shaft generator - no need for diesel generator at sea
- Scoop system for condenser cooling - low power consumption
- Direct outboard suction for main engine turbo-chargers
- Electronic control of main engine and cp propeller
- Reaction fin
- Energy saving auto pilot steering system
- Self polishing anti fouling
- On board computer for trim and ballast optimisation calculations
- One grade of fuel for main engines and generators (up to 380 cst or more)
- Air coolers circulated by thermal fluid in first stage (to avoid air coolers becoming pressure vessel)
- Wide use of high tensile steel for light weight
- Optional absorption refrigeration plant
- Optional Freon turbine generator plant
- Possile use of solar energy systems
- Possible development of auxiliary sailing rig

Sail: A recent US Maritime Administration report claims that up to 20% fuel savings are possible with auxiliary sail; others claim that there is room for further savings in shipboard maintenance and fuel management.

Payback Period: The following conclusions emerged from a recent study by Professor Ing Gallin of Delft University of Technology:

(1) The life cost of fuel should be considered at the design stage.

(2) The annual fuel cost of a marine propulsion is estimated to be in the region of 85-90% of the capital investment in main engines, shaft, bearings and propeller.

(3) Every alternative for fuel reduction is recommended to be analysed. Reductions in capital cost at the expense of efficiency is usually bad economics.

(4) Low propeller rpm is very profitable. The internal rate of return on money invested to reduce propeller rpm is very high.

(5) Pay back period for 2 stroke and reduction gears costing an extra \$0.5 - \$1.0 million is 2-4 years.

(6) Pay back period for 4 stroke is less than 1 year.

(7) Present worth values of capital investment corrected for fuel savings in 15 years is 0.2-0.5 that of investment for standard propulsion.

Waste Heat Recovery:

The following findings emerged from another study by Professor A.J. Morton of the University of Manchester:

(1) It is a cardinal economic error to use high grade heat (360°C after turbocharger) for low grade duties (75°C) such as ships heating. High grade heat should be kept for power recovery. Recovery up to 13% power is possible for power production.

(2) $\frac{\text{Recovered Power}}{\text{Main Engine Power}}$ = up to 0.136 Dual Pressure/Steam Cycle

or up to 0.157 Organic Fluid/R11 Cycle

Further point: Individual percentage savings are not arithmetically addable otherwise we could save more than 100%.

I thank *Mr. Gallois* for his kind remarks and I believe that his proposal is technically possible. However, the concept would appear to be too radical an advance for the average ship operator at the present time.

Marine engineers are familiar with and have considerable experience with steam plants.

I believe that advances in steam plant including the development of high pressure flash plant as proposed by Mr. Gallois will gain fairly rapid acceptance in the industry. However, although organic fluid plants offer further potential gains in efficiency the writer believes that they will be slow to gain acceptance.

This is because of marine engineers unfamiliarity and lack of experience with organic fluids. Basic conservative attitudes within the maritime industry will probably inhibit risking capital investment in organic fluid plants until the techniques and new equipment are thoroughly proved and debugged by the manufacturers.

In reply to *Mr. Klass*: the paper surveys some modern energy saving equipment now in production and mentions some aspects with further development potential.

Parameters for a 3% saving in fuel consumption with regard to navigation are:

(a) With the most recent Decca Racal Autopilot for example the manufacturers claim a 2% improvement in fuel economy by minimising the number of rudder movements to steer a correct course.

Extensive analysis by Decca has shown that there are two types of causes for course deviations:

(1) Course deviations caused by sea wind and swell.

(2) Course deviations caused by ship characteristics (trim, draught, list).

The new equipment is claimed to differentiate between deviations caused by weather and deviations caused by ship characteristics.

Decca claim that if the ship is allowed to yaw naturally, the correct course is made still good over a period of time with fewer rudder movements, thus minimising the drag which follows frequent rudder movements.

Satellite navigation provides all weather accurate positioning of the vessel permitting the captain to accurately navigate the optimum course between two points and thus save fuel.

Specially programmed on board mini-computers can also aid the master in optimising the ballast and trim condition of the vessel and help him to quickly check the stability.

Thus the master can now take better advantage of carrying minimum ballast in favourable conditions and optimising trim to save fuel.

In conjunction with optimising speed and routing for weather, tides and currents advantages the fuel saving possible with navigation economics is estimated to be of the order of 3%.

Paper 2.5 USE OF COAL/OIL MIXTURES AS POSSIBLE FUEL FOR STEAM POWERED VESSELS

by

D.B. Brown,
The Broken Hill Proprietary Company

DISCUSSION AND WRITTEN QUESTIONS

2.5.1 *Mr. H.W. Baddams, Shell Oil Co. of Australia Ltd.*

In section 8 of the paper a statement is made that: *The technologies of selective agglomeration, COM preparation and COM firing are new but most technical problems appear to be solved.*

Despite this (because the economics of converting ships are unattractive) only if some national demand gives emphasis to the need for its introduction, is a full scale operation likely.

Australia quite definitely has, by comparison, far more coal resources than oil and in any emergency situation, the proposal set forth in this paper must be of national importance. Surely some attempt should be made by the shipping industry to approach the National Energy Research Development and Demonstration Council for funds to finance a full scale trial.

As a comparison such funds have already been made available for several solar energy demonstration projects which like COM firing are not economic but are considered worth the cost in the national interest to prove what can be achieved if an emergency ever makes it a necessity.

Would Mr. Brown please comment on the approaches, if any, made by his company for assistance.

2.5.2 *Mr. R.A. Durie, R.W. Miller & Co. Pty. Ltd.*

Mr. Brown's interesting paper provides a timely review of many of the factors involved in using coal/oil mixtures as a fuel in marine applications. I agree with Mr. Brown's conclusion that such a fuel is unlikely to become acceptable for use in the existing vessels designed for oil firing due to technical problems and the costs involved in making the necessary conversion of plant to cope. I also agree that it is unlikely that ships will be built specifically to operate on coal/oil mixtures since a considerable component of oil is still involved and it makes more sense to go to direct coal firing as is already happening.

With regard to the technical aspects, could Mr. Brown answer the following questions?

(a) Reference has been made in the paper to the preparation of low ash coal using a selective agglomeration process and the subsequent mixing of the agglomerates with oil to form a coal/oil mixture.

In attempts to obtain stable dispersions in the oil it will be necessary to disintegrate the agglomerates during the mixing. Does this readily occur?

(b) What grade of oil is considered best for the preparation of coal/oil mixtures? In principle, the heavier the oil, the lower would be the settling rate of the coal.

(c) Re the stability of the coal/oil mixtures, I believe that British Petroleum have developed a technique for conditioning the oil in a way that stabilizes the coal/oil mixture. Can Mr. Brown provide any information on this?

(d) Turning now to the combustion of coal/oil mixtures, Mr. Brown suggests in his paper that slagging problems from the ash in the coal could be avoided by selecting coals with refractory ashes. Even so, depending on the grade of the oil used, there could be ash forming constituents in the oil which can flux the silicates in the coal at least to the extent of causing sintered deposits on the heat transfer services. Has Mr. Brown observed any evidence of this happening during the trials conducted to date?

2.5.3 *Mr. G.C. Beggs, The Australian National Line*

It is suggested that supplies of coal fines for long-term COM operation could come from a coal washery, the fines being extracted from the washing stream. Most COM production processes require precise control of the particle size in order to achieve reasonable consistency and stability of the fuel. How sensitive is the selective agglomeration process to variations in the particle size of the feed material?

In the case of a plant designed for commercial production quantities, what would be the expected residual ash content of the coal after treatment by selective agglomeration, assuming our initial ash content of, say, 20%?

What proportion of the initial ash content will normally be liberated prior to treatment?

In the investigation carried out by Babcock and BHP:

(i) What was the estimated maximum gas velocity in the furnace?

(ii) How frequently would the boiler require shutting down to permit the removal of ash from the furnace?

(iii) To what extent does a 50/50 COM affect the achievable turn-down ratio and the time of response to load changes?

In view of the size range of the agglomerates (1 mm to 3 mm), by what process is it envisaged that improved stability can be achieved?

The author suggests that it is unlikely that COM will be acceptable as a ship's fuel in the immediate future because it is not competitive. In view of the high cost of COM production plant, does he consider that it is likely to become competitive with either liquid fuel or straight coal firing at any time within, say, the next 20 years?

The estimated annual savings in fuel costs do not appear to allow for the cost of financing the modifications required to the ship's boilers, bunkers and fuel handling systems. Can the author give any indication of the order of these modification costs?

How would the cost of a new bulk carrier designed for operation on COM compare with (a) a diesel-driven alternative and (b) a coal-fired alternative, assuming an equal cargo lifting capability in each case?

2.5.4 Mr. N.T. Cowper, Slurry Systems

The author presents an exciting intermediary step in the conversion from use of oil to coal for steam powered vessels. The results of the pilot plant test work are encouraging. The use of a coal/oil agglomeration as an intermediary ash reduction process enhances the potential use of COM by minimizing the problems in boiler conversion. However, there is insufficient cost data presented in the paper to support the negative conclusion on vessel conversion.

The following questions do arise:

(1) If the coal/oil fuel presents a substantial saving of fuels, then what is the basis for rejecting its use?

(2) Are there any serious technical questions on development and does BHP intend to continue development?

(3) What is the cost for infrastructure to prepare the COM?

(4) Does costing for fuel incorporate capital charges for onshore plant or only the raw material (coal/oil) cost?

(5) In the light of reduced cost per tonne of scrap melt experienced at AIS Port Kembla, is a reduction in fuel usage per pound of steam for ships' boiler plant anticipated?

(6) Other researchers report that the stability of a COM mix can be achieved by use of ultrasonics. Did BHP consider this approach in their work?

2.5.5 Mr. O. Kabayashi, Japan Trade Centre

I have heard that the burning of coal is affected by the individual properties of different types of coal. After selective agglomeration, does the coal still retain original characteristics? When used in the coal/oil mixture, do different coals still affect burning and if so, does this require changes to specifications of related equipment?

2.5.6 *Mr. J. Alt, Fuji Engineering*

Would you please advise what experimental work BHP , or indeed any other Australian industry, is doing to improve the s tabilization of COM for the marine industry?

AUTHOR'S REPLIES

I agree with *Mr. Baddams* that Australia quite definitely has by comparison far more coal resources than oil and in an emergency situation the proposal set forth must be of national importance. Surely some attempt should be made by the shipping industry to approach the National Energy Research Development and Demonstration Council for funds to finance a full scale trial. As a comparison, such funds have already been made available for several solar energy demonstrated projects which like COM firing are not economic but are considered worth the cost in the national interests to prove what can be achieved if an emergency ever makes it a necessity.

BHP has approached NERDDC (National Energy Research Development and Demonstration Council) for funds for a stage 1 of a COM demonstration project, but the application has been made for a general project on COM, rather than one specific to the shipping industry.

In reply to *Mr. Durie* I advise the following:

(a) The agglomerates are composed only of coal and waxy fuel oil. If the temperature of the oil with the agglomerates mixed is maintained above 50°C, then the agglomerates disperse rapidly and require no extra grinding or similar step.

(b) The best grade for the agglomerates is the waxy oil to give the agglomerates strength. There are no restrictions on the oil you use to make up the final blended mixture.

(c) In essence the BP process uses ultrafine grinding in an oil heated mill. This is very energy intensive. In conventional COM 80% less than 75 microns. In BP COM 55% less than 10 microns with the fine size ensuring stability because the particles are in Brownian motion. In the pilot study BP carried out, they were looking at working 600 grams of coal grinding for roughly 20 minutes. If we scale this up to the tonnage we are looking at you can see it is going to take a long time and a lot of power.

(d) Trials in Port Kembla open hearth have shown no deposits on any surfaces, in fact the electric precipitator installed is removing fly ash as in a normal coal fired boiler installation. The percentage of ash in oil compared to the percentage of ash in the coal is such that no fluxing between the two takes place.

With respect to the questions from Mr. Beggs:

The selective agglomerative process is sensitive to both feed size distribution and feed slurry density. For operation control, both need to be kept constant. If the feed slurry density remains constant, then decreasing the particle size, causes a surface area increase which requires more oil to form satisfactory agglomerates. If the oil addition rate and particle size distribution remains constant, then fluctuations in the feed slurry density will cause an oil deficient or excess, with consequent drop in agglomerate quality of size and strength.

The selective agglomeration process removes particles from the slurry that have any carbonaceous material at their surface. Thus if coal and mineral matter are liberated in the slurry, then the agglomeration process will produce a good separation of material and a low ash coal in the agglomerate, but if the particles have mineral matter locked in the coal particles then the ash reduction is low. Treating a fine coal slurry with a large quantity of clay material in it produced an ash reduction from 40% in the slurry to 14% in the agglomeration, while agglomerates made from other slurries rich in middlings particles produced an ash reduction of only 2%. The variability of coal prevents any definite statement being made on the likely ash reduction.

With respect to Mr. Beggs' third question:

(i) It is estimated that gas velocities would increase by some 11%, however the anticipated velocity through the second bank of superheater tubes was put at 40 ft/sec. The maximum design for this tube arrangement is in the order of 65 ft/sec.

(ii) At this stage no definite figure can be placed on frequency of shutdown for ash removal but a figure of 10 days steaming would not be too optimistic. Factors such as percentage of ash deposited, volume in furnace floor allowed for ash buildup would assist in extending such shutdowns.

(iii) For all purposes of control whether it be that of turndown, time of response, COM would react in a similar manner to that of conventional oil firing systems.

Although the agglomerates are 1 mm to 3 mm after leaving the agglomeration vessel, they are made up of very fine particles of coal (80% passing 75 microns) and oil. When the 3 mm agglomerates are mixed with oil they break down to produce a COM of very fine coal and oil, indistinguishable from a COM made from mixing coal and oil (except for any ash reduction that may have occurred in the agglomeration stage). The improvement in stability is the comparison between a coal oil mixture stored for a long period and agglomerates stored for the same period and made up into COM shortly before use.

For a possible economic climate for COM to eventuate, the fuel oil rises of past years would need to continue, coupled to this would be the number of vessels built to burn COM, life expectancy of such vessels together with capital outlay necessary. The greater the number of vessels the greater the savings, greater economics. For shore based plants operating on gas, either LNG or LPG, a possible change to oil parity pricing (in the not too distant future) would enhance the chances of COM in this area.

Modification costs required for the COM conversion were in the order of A$1.5 million to which erection and commissioning costs have to be added. Shore based capital costs were in the order of A$2.0 million.

No real costing comparison has been made for a COM fired vessel against the other two alternatives mentioned. However, it is expected that a cost penalty similar to that now applying to second generation coal fired vessels over diesel engined vessels would be placed on by shipbuilders. This penalty as you are no doubt aware, can be as much as 25%.

I acknowledge *Mr. Cowper's* questions and advise that the return on capital investment to establish the shore plant together with conversions required on board the vessel was insufficient (taken over the economic life of the vessel) to make such conversion feasible.

Wet system estimated A$3.5 million
Dry system estimated some A$2.9 million } + erection costs

Possible savings between A$0.4/A$0.9 million
Conversion would take from 4 years to 9 years
to pay for itself

There are no technical drawbacks and BHP is continuing to prove developments and identify applications for other areas.

Mr. Cowper's third question depends upon scale of operations. The open hearth conversion at Port Kembla was some A$1.75 million, for a proposed shore plant and ship conversion would be some A$2.0 million for shore together with A$1.5 million for vessel.

No capital costs have been inbuilt into cost of COM. The cost of COM having only A$10/t to cover preparation, handling, labour, etc.

Open hearth is much simpler system than ship's boiler plant and no predictions could be made.

Ultrasonics provide an alternative way of mixing coal and oil but the philosophy behind the conversion was to keep the coal in the agglomerates mix with oil shortly before combustion, thus eliminating the problems of long term stability.

In reply to *Mr. Kobayashi*: coal retains its original properties, although if the mineral matter is liberated from the coal before the agglomeration stage, then significant ash reductions of the coal in the agglomerates are possible.

Coal properties, such as percentage of volatile matter and particle size, do affect combustion, but this can be incorporated in the fuel specification. There will probably be a need for changes from oil designed equipment to COM designed equipment, but once the COM conversion has taken place then only small changes should be required to burn different coals, provided extreme deviations from the original coal specifications are avoided.

In answer to *Mr. Alt's* question, the only work I know we have done as a company is possibly to send samples to Japan to a certain chemical company to see what they can supply for stabilization. The greater the homogenising of the COM the greater the colloidal the solution, therefore the greater is the settling out time.

2.5.7 *Summing Up By The Chairman:*

I was personally very interested in this project because our people at AIS Port Kembla had reported such good results in their open hearth operation. But, as given in the paper, you can see it is one thing to burn these materials in an open hearth furnace which has a long depth and another thing to try and utilize the same type of material which would give the same sort of flame in a boiler which has been designed originally for straight oil firing.

<u>Paper 2.6</u> <u>FUEL MANAGEMENT AND FUEL ECONOMY</u>

by

T. Amundsen,
Principal Surveyor, Det norske Veritas

DISCUSSION AND WRITTEN QUESTIONS

2.6.1 Mr. G. Griffiths, Australian National Line

Mr. Amundsen is to be congratulated for managing to present a readily identifiable picture of ship design and operational complexities which influence fuel economy.

He rightly points out that optimising for good fuel economy involves numerous exercises for the shipowner, especially in circumstances where there are few if any constraints and he is free to establish the broad parameters of a total system. Unfortunately it is not often that a shipowner finds himself in such an ideal situation as in most projects undertaken compromises have to be made.

Today slow steaming is common practice in many trades and is likely to remain so for some time to come. However, I would like to point out that while high fuel costs have a big bearing on a need to slow steam it is often an overtonnaging situation which exerts the most influence. In other words, we are experiencing today the double edged effect of high fuel costs and too many ships. It should be borne in mind that slow steaming was common practice in pre World War II days when fuel was relatively cheap and that trade growth in post war years produced an under tonnage situation which in turn led to the practice being discontinued. As to why the world is experiencing an overtonnage situation and how long it will last, your guess is as good as mine. Downturn in world trade is clearly a factor, as is also greater national flag participation by hitherto non-maritime countries in line with 40-40-20 UNCTAD agreement.

Shipowners contemplating new tonnage have to face up to an evaluation of design and operational aspects affecting fuel economy, as described by Mr. Amundsen, but before doing so it would be prudent for them to decide whether existing practices in respect to slow steaming are likely to continue. Whatever the outcome of such deliberations they are not likely to reach a decision without having to speculate on possible changes which may or may not take place during the useful life of a ship. Few shipowners today are in a position to approach this particular question with confidence. However, most will agree that at the upper end of the scale the existing generation of high speed container ships which for the most part are presently slow steaming will almost certainly be replaced by slower vessels on account of fuel costs alone.

In regard to ships purposely built for high speed container services the practice of slow steaming in accordance with rearranged schedules for a total service, as for example in the Australian/UK North European container trade where ANL vessels are now steaming at 18.5-19.5 knots as against 22 knots previously required to meet service commitments, is not without technical and operational problems, the nature and extent of which would largely depend on the type of main propulsion machinery installed. In this respect some shipowners would fare better than others. At one end of the scale requiring maximum attention lies the twin screw steam turbine plant and at the other end requiring minimum attention lies the multi-engine medium speed diesel installation associated with a CP propeller. In respect to the former, conversion to diesel may well be the only acceptable solution while in regard to the latter, no action is required because the machinery plant can be operated with one or more engines cut out and the pitch of the CP propeller can be adjusted for optimum performance.

The Australian National Line was indeed fortunate to find itself with an overseas fleet of vehicle deck containerships propelled by multi-engine medium speed plants, a feature which is attributable to ship design and application rather than any thought of slow steaming. However, our participation in the Australia/UK North European service and East North American service, in partnership with a consortia of UK companies resulted in ANL ownership of two steam turbine ships with propulsion machinery plant comprising two Foster Wheeler boilers supplying steam at 64.0 $kg\,cm^2$ to a 32,000 SHP Stal Laval turbine driving a single propeller shaft at 140 rev/min through a combination of APE-Allen epicycle and parallel gearing.

These vessels together with six similar ships owned by our British partners in the service were designed to maintain a 22 knot service between Europe and Australia, or East Coast of North America and Australia. However, the fuel crisis of 1979 coupled with a downturn in container cargo made it necessary to introduce slow steaming at 18.5 knots, which of itself decreased daily bunker consumption from 150 to 120 tonnes.

With little probability of the ships returning to full speed during their remaining period of useful life of around 8-10 years, we examined in conjunction with our ACTA partners ways and means of increasing propulsion plant efficiency at the reduced power, as an alternative to spending a considerable amount of money on conversion to diesel. In conjunction with Stal-Lavel, APE-Allen gearing and SMM propellers we were able to produce a cost effective conversion package involving turbine nozzle adjustment, gear ratio alteration and new slow running propeller which could be retro-fitted in 24 working days and time to coincide with annual drydocking.

Australian Exporter, one of two ANL steamships in the consortia, was the first to undergo conversion at the Bremer Vulkan Shipyards in Germany. The conversion was completed on schedule despite an additional work program including extensive boiler repairs, conversion of ballast tanks to fuel oil tanks and complete blasting of entire hull prior to recoating with self-polishing paint.

A detailed evaluation of the ship's performance in service has yet to be completed, however, it was clearly evident from data obtained during post conversion trials recently conducted in the North Sea that expectations associated with this low capital solution had been realised.

Delegates will no doubt be interested to learn that arising from work undertaken on this vessel to improve fuel economy during the course of the drydocking and conversion period referred to, we appear to have achieved the following savings:

(1) Decrease in fuel consumption due to increase in propulsion efficiency - 8%.

(2) Decreases in fuel consumption due to upgrading of boiler casings and combustion equipment - 3%.

(3) Decrease in fuel consumption due to improvement of underwater hull - 9%.

(4) Decrease in fuel consumption due to installation of profiled bow thruster tunnel grids - 1½%.

From performance data, prior to docking, the vessel was averaging 120 tonnes a day at 18.5 knots at a mean draft of 9 metres.

It is anticipated at a similar speed and draft that the vessel will now consume 96 tonnes per day, giving an annual reduction in fuel costs of just under A$900,000.

ANL is naturally delighted with this result as we will recoup the cost of modification within the first 2 years, based on current fuel prices.

This particular project is one of many undertaken by ANL with regard to fuel conservation. However, as indicated by the broad picture painted by Mr. Amundsen we have a long way to ge before completing an exhaustive study of all the possibilities.

2.6.2 *Mr. N.K. Aggarwal, Department of Transport*

I apologise as my question is not related to fuel economy. I would like to have clarification on the figure you showed on the screen: if I ignore the fuel costs I am left with 55%; out of the 55% you have mentioned 35% is a capital cost which gives me 65% if I ignore the fuel cost. Considering dry bulk trade where the fuel is usually paid for by the charterer, could you please advise what flag ships you have considered in this course analysis and whether these percentages are right after considering the financial concessions available to these ships?

2.6.3 *Mr. K.B. Smith, The Shell Company of Australia Ltd.*

Mr. Amundsen mentions in his paper that special fuel quality testing programs have been introduced. Could he outline the scheme operated by Det norske Veritas and in particular could he indicate how he sees the results from the program being benefically used by shipboard personnel.

2.6.4 *Mr. R.F. McMahon, Australian National Line*

Congratulations to Mr. Amundsen on his fine paper and his recent elevation to Consul General. Mr. Amundsen is always at the forefront in bringing the best available information and accumulated experience at his disposal to the notice of marine engineers and this paper is no exception. I would ask the following questions:

(1) Is there any operational feedback on the 30% more economical LPB carrier and how was the 30% achieved?

(2) Can Det norske Veritas offer any feedback of operational experience to shipowners and designers on the performance of various elements in modern energy saving plants?

(3) Using the computer as a management tool will Det norske Veritas keep statistical records of surveyors' experiences with equipment over a large number of ships and make the results available to individual shipowners?

2.6.5 *Mr. M. Oxley, Shipping Corporation oaf New Zealand*

At the beginning of your paper you make a comparison between an LPG carrier built in 1981 and a similar one built in 1979, and you say that there is a 30% saving in operational costs, but I could not find any information about the differences between the two ships that resulted in these savings. Would you please explain.

AUTHOR'S REPLIES

Mr. Griffiths draws my attention to the alternative of slow steaming and how ANL have succeeded with that method first of all because they have had ships with machinery not requiring extensive modification or investment to redesign some of the machinery for more economic slow steaming.

I don't know whether the ANL had that in mind when they first selected the machinery - very few owners did at that time. However, working on new projects and analysis for such flexibility will certainly have to be carried out today, even on existing vessels and in particular as an alternative to slow steaming, an analysis should certainly be carried out perhaps on the lines I have mentioned.

You will see a lot of similarities between the studies we do on new construction and on existing vessels. You really have to go through this exercise in order to come up with an answer that will stand good for some time and I again refer to the systematic approach. There is no doubt that slow steaming gives good fuel economy, but there are other factors that also make up the cost structure of sea transport. As a matter of fact to find the optimum speed is not a simple task and the graph illustrates this point. This is based on break-even costs and you will note that as the time rates vary your optimum speed is certain to be affected. So a bulk carrier which is designed for 15 knot speed in February 1972 should be run at 13 knots in December 1977. In order to make a prediction for the long term it needs to be made before you make the decision of modifying your ship which could be at the stage where a permanent modification is required. We usually think of an optimum speed as a shipowner. May I suggest we also seek the view of the owner of the cargo,as an extra week for transport can indeed be very costly and he may be quite prepared to pay a higher freight rate in order to reduce the inactive time of the investment he has in the cargo sitting on board. It may be possible to introduce a special service for any special cargoes if the owner feels it is a good business proposition. I would also like to take the opportunity to suggest that Australian exporters could often benefit by being the owner of the cargo somewhat longer than the cargo is loaded on the ship. I am, of course, thinking of cargo shipped by CIF in contrast to FOB. What we have read in the press regarding the Northwest Shelf gas deal with Japan in respect to transport is very interesting.

In reply to *Mr. Aggarwal*: it is a very general statement, but our studies on this have been mainly on Scandanavian ships but we have certainly tried in our studies to indicate the cases where there are special conditions with regard to the capital cost.

Mr. Smith's question relates to the practical action for the personnel on board. The Veritas fuel testing program is to obtain the samples and forward them to our laboratory in Oslo within 3 days. We carry out routine tests and if clear of any problems it is recorded and we inform the owner usually within 5 days and more often than not before they start using the fuel. If there are problems or signs of problems we do additional testing giving them priority in the system. We immediately inform the owner that there are reasons for concern. There are about 200 ships in this scheme at the moment and we send out newsletters from time to time on general information where we draw the attention of those in the scheme to certain problems occurring in certain parts of the world referring to the amount we have tested.

Illustrated in the paper is a typical front page of a newsletter which was for August this year.

Now to what you should do. First of all inform your principals as soon as possible because fuel with impurities outside specifications can create economical and indeed legal conditions after the fuel is used and harm done to the ship's machinery. But let us hope that action can be taken to prevent such conditions and I would suggest the following actions may be applicable with due regard to the type of machinery in question and the amount of impurities evident. For example, if the sulphur has changed from the order of 1.5% to 4% you will have to look at changing the lubricating oil. With regard to a high level of carbon, it is essential to have the fuel injection equipment in excellent mechanical order and well adjusted in order to prevent abnormal wear. In other words, the ship's personnel will have to check the injection valves and also have a look at the pumps when it is known that there is a problem fuel on board. If high carbon content is the case then it is desirable to keep the temperature on the exhaust valves down so it may be decided to run at reduced power whilst burning the fuel. High sodium content will require more frequent washing of the exhaust turbine.

Generally if you have a problem fuel it is worthwhile concentrating on extra treatment on board like centrifuging. By running the purifiers at low speed and with frequent cleaning it would minimise quite surprisingly the number of problems that could otherwise occur.

In answer to *Mr. McMahon's* questions: the two LPG carriers mentioned in the paper turned out to have very different fuel consumptions despite the fact that they were built in the same yard and for the same owner within a period of two years - the last built in 1981 was 30% more fuel efficient than the first one built in 1979, and the alterations were as follows:

(1) Modification of the lines. The last one has very fine lines and the length increased by 5%. We also carried out a special study and modification of the hull shape fore and aft which resulted in a considerable lowering of resistance.

I would also like to mention that the new hull shape gave a very interesting improvement for the ship when running in a seaway.

(2) A reduction in rpm and a larger propeller were introduced which gave a 15% improved propeller efficiency.

(3) Electric power at sea was generated by a shaft driven generator.

(4) Special treatment of the underwater hull was carried out to reduce the skin friction.

It is rather interesting that all this was talked about and implemented within the time span of 2 years and initiated by the owner, not the builder.

Not sufficient to see a trend in reliability at this stage but we do have a computerised record system for breakdown and abnormal wear and in the not too distant future we shall see the trends of this effect on the reliability when special measures are taken to obtain fuel economy. Let me say, we certainly share Mr. McMahon's concern on this matter of a possibility of reducing reliability in our very active exercise these days to obtain super fuel economy. Again, I would like to mention that the interests of ship operators compared with those of the builders would have to be kept in mind. We can see a situation where we have super fuel economy but in the long run may have a costly ship to operate because of the reduced reliability.

In the first part of my reply to Mr. McMahon I have answered Mr. Oxley's question which is on the same subject.

Paper 2.8 THE FIRST COMMERCIAL MOTOR SHIP WITH SAILS 'SHIN AITOKU MARU'

by

O. Kobayashi,
Japan Trade Centre

DISCUSSION AND WRITTEN QUESTIONS

2.8.1 *Mr. K.M. Murray, Institute of Marine Engineers*

Have you had enquiries from any other source for the purchase of a similar type. My reason for the question is that in the South Pacific at the present moment there are five tankers of a similar capacity which are operating with diesel engines, and I suppose you know that in the South Pacific there are prevailing winds - trade winds - which may suit your particular type of craft which could be of some success. I was wondering if you have had any enquiries in that direction?

2.8.2 *Mr. K.T. Fitchett, Lloyds Register of Shipping*

The material for the soft sails is loosely described as canvas. Is this the old-fashioned canvas that we know, or is it a synthetic material? Also, how is it actually attached to the steel frames; is it glued, laced, or is it secured by some other means?

2.8.3 *Dr. F. Taylor, Australian National Line*

I'd like to congratulate you for a very interesting, informative and instructive paper. My question concerns the deck houses and the thing which interests me is that as you considered the wind effect, and looking at the advantages that you would obtain, there appears to be, in the pictures that I've seen, no consideration to any aerodynamic fairing of the deck house. It appears to be an absolutely conventional square deck house and I'm a little surprised and wonder if it was considered, but found that there were no advantages in fairing the structure.

2.8.4 *Mr. E.S. Clarke,*

I would like to join Dr. Taylor in congratulating you on the paper and the excellent film. I hope everyone will see it. If one looks at Figure 7, it seems that the bottom of the sails (i.e. the height of the bottom of the sails) has been determined by the need for good vision forward from the wheel house. The bottom of the sails is exactly in line with the top of the wheel house. I wondered if any thought has been given to lowering the sails in the interests of reducing the sections of the masts to overcome the bending moment at the root of the mast and conning the ship from forward rather than aft. Secondly, as a very amateur one-time Pittwater sailor, I would draw attention to the rather forward position of the forward sail and suggest that it is imposing quite a yawing moment on the ship which therefore would throw in the need for contrary rudder and therefore increase resistance. Could you comment please?

2.8.5 *Mr. W.J. Hood, Consultant*

Would you comment on the feeling that the 15% increase in the capital cost of the ship is possibly not worth the 10% reduction in fuel consumption? Secondly, there has been mention about trade wind sailing and this is something that I have studied considerably in the last few years. Trade winds tend to blow in one direction and most of these shipping routes in the South Pacific tend to be downwind with a favourable wind in one direction and against the wind in the other. What is the extra resistance caused by the folded masts and sails of this particular ship?

2.8.6 *Captain A. Pearson, The Company of Master Mariners*

Is it intended that ships propelled by both motor and sails would sail from port to port by the most direct route or follow the trade wind? Does the association intend further research into pure sailing ships? Is there any practical limit to the size of sail assisted ships?

2.8.7 *Mr. G.M. Kirby, Australian Sail Training Association Ltd.*

I was most interested in the shape of the sails which, when set, can be described as square sails of conventional aerofoil shape, notwithstanding that they are made of metal (assumably aluminium). I assume that the trimming mechanism permits the sails to be set virtually fore-and-aft, but would doubt that the ship could be expected to point as high (i.e. get as much benefit from the sails in adverse wind conditions) as a conventional sailing craft. I would think that there would be a zone of at least 45 degrees, and probably considerably more, on each side of the prevailing wind in which the ship, assuming her heading to be into that zone, would gain no assistance at all from her sails.

This leads me to ask whether the developers of the *Shin Aitoku Maru* project considered or experimented with any alternative methods of harnessing the energy of the wind to marine propulsion?

Early this century a German, Professor Magnus, discovered that the effect of wind on a rapidly rotating body was to drive that body at a right angle to the direction of the wind. In 1924, this discovery was applied by Anton Flettner to the development of the motorship *Buckau*.

Buckau was a small cargo ship, originally schooner rigged, which mounted two circular towers each fifty feet tall, and each powered by a 45 hp electric motor capable of spinning the rotor at 1400 rpm. Steering was assisted by controlling the rotation of the towers. After reasonably encouraging results, further experiments on a larger ship with three great cylinders each sixty feet high achieved good results only under perfect conditions, and the idea was abandoned.

However, I wonder whether the rotor idea may be capable of further development, perhaps with open rotors (rather than closed cylinders) which would trap and be rotated by the wind itself (instead of being rotated by electric motors), thereby themselves generating (instead of using) electric power, which could be fed directly to the ship's propulsion machinery. Theoretically, it would be possible to use the energy of the wind even when the wind was dead foul for the ship's heading.

Problems inherent in the idea are:

(1) the need to carry rotors large enough to generate a worthwhile conversion of wind energy to electric energy, but small enough not to unduly interfere with stability and cargo working;

(2) the need to allocate below deck space to the electricity generating plant as well as to a conventional propulsion unit;

(3) engineering/mechanical problems inherent in simultaneously harnessing electric and conventional power to marine propulsion, particularly with a single screw vessel, and

(4) the need to ensure vessel stability even under adverse conditions, e.g. it may be necessary to 'retract' the rotors (take in sail) with high winds abeam.

The design problems would not seem insuperable. No doubt a more discerning and professional eye than mine will be able to detect other difficulties to be overcome.

In summary, I thoroughly agree that as fossil fuels are depleted, increasing attention will have to be paid to alternative energy sources, particularly inexhaustible sources such as wind energy, for marine propulsion. Nuclear power, at least in the present state of the world economy, is not a viable alternative because it is not competitive in terms of cost. The economics of the situation may change, but at the same time there are obvious emotive overtones associated with nuclear propulsion which tend to inhibit its introduction on a significant scale, at least in the reasonably near future.

The obvious and most readily available alternative for marine use would appear to be wind energy. However, I would suggest that technology will need to effect a significant improvement in the ratio of distance run to wind energy consumed/available. Ideally, a wind ship, given sufficient strength of wind, should be able to travel straight down the rhumb line, regardless of wind direction, instead of having to beat up.

The wind technology of *Shin Aitoku Maru*, notwithstanding that the sails are set and trimmed by computer, remains essentially that which was born when man first hoisted a rag of sail. I would therefore be most interested to know whether the managers of the *Shin Aitoku Maru* project have further research projects in mind and if so, in what direction?

2.8.8 Mr. A. Payne, Consultant

Written question submitted by Mr. Payne requested details on the sails. (*Editor's Note:* This is similar to the question by Mr. K.T. Fitchett. Please refer to the same reply.)

AUTHOR'S REPLIES

In reply to *Mr. Murray*, I am advised that there are three similar ships planned at NKK. They are all approximately the same gross tonnage. One is a tanker which is already in operation and sails will be fitted sometime in the future. The other two are general cargo ships. Aside from these vessels, there have been several enquiries for sail assisted ships received by NKK.

The five tankers that you mentioned might be very suitable for the fitting of sails and I would like to look further into this and inform JAMDA about them.

Both *Messrs Fitchett* and *Payne's* questions are similar so I will make the one reply. The sails are constructed with a fixed central steel frame and attached steel plate joined to moving sections consisting of a steel frame with canvas attached except at the leading edges. The canvas is actually PVC coated polyester, 6 mm thick. As to the construction of the sails, the canvas is attached to small aluminium frames to form sail units which are bolted to steel sail frames. No glue or lace is used. After one year's operation of ship, under wind conditions which frequently surpassed 30 m/s, there have been no reports of problems of chafing such as you have suggested.

At the moment, it seems that the developers are not planning further refinement of the sails but instead they are now investigating ways to decrease the cost of the sails.

As regards the problems of stiffness and stability, the sail area of the *Shin Aitoku Maru* was determined so as to secure certain stability with the given hull form. Stiffness is not a great problem for the *Shin Aitoku Maru* and the difference in stiffness experienced while the sails are stretched or folded is effected only by the moment produced by wind pressure. This does not greatly effect the comfort of the crew. On the contrary, the ship experienced very comfortable conditions with the sails stretched under certain wind direction and wave conditions. As Mr. Payne pointed out, the natural period of the larger vessels is long in comparison with smaller vessels and consequently, does not cause great problems for the *Shin Aitoku Maru*.

Thank you *Dr. Taylor* for your remarks, and I am advised that not much consideration had been given to the shape of the deck houses. However, JAMDA is now investigating ways to reduce aerodynamic resistance generated by superstructures; for example, by introducing a smaller and more streamlined superstructure. I hope this will provide an improvement when constructed in the near future.

I appreciate the remarks of *Mr. Clarke*. In the case of the *Shin Aitoku Maru*, the sails were arranged so the navigating officer had 1.5 degrees upward vision from the wheel house. With the ship's sails trimmed this angle was found to be more than necessary and therefore was decreased to zero in the design of the Company's second sail assisted ship, *Aitoku Maru*.

It may be more desirable for vision to place a wheel house forward on a sail assisted ship but this can cause some disadvantages. For example, accommodation and engine rooms are far apart, a bridge forward in a tanker would introduce some problems from the explosion point of view and would incur extra cost in the remote control system on so on. For these reasons the wheel house was placed aft. However, a 12000 dwt sail assisted cargo vessel being trial-designed at Cockerill Dockyard in Belgium is said to have adopted a forward wheel house with such merits as you have mentioned.

For the second part of the question, I would comment that the centre of fluid pressure exerted on a ship is approximately one-fourth from the foremost point, and the layout of the sails in which the centre of the sail area coincides with this position is most desirable. The layout of the sails on the *Shin Aitoku Maru* is similarly designed. Therefore we don't think the forward sail is positioned too far forward. The angle of contrary rudder can be maintained within 3 degrees and this increases resistance only slightly.

In reply to *Mr. Hood:* Firstly, suppose the sails are fully used and a 10% fuel cost is achieved, the amount of fuel saved will be about 155.4 kl/y in terms of C heavy oil, namely 9.09 million Yen per year. The initial cost of the sails, 60 million Yen can be recovered by a 10% fuel cut in six to seven years.

Of course, the situation will change depending on the change in oil price and also on availability of favourable winds. If we take into consideration that the ship is the first of its type and NKK is investigating ways of reducing costs of sail construction, we can say the cost of sails will be reduced in the near future.

Secondly, I would like to draw attention to Figure 12 which shows that on the *Shin Aitoku Maru* the rigid sails can harness wind energy from a wide range of directions. Even if the wind is unfavourable, if the wind direction is larger than 20°, it will assist the ship's propulsion. Therefore, if we take a slightly zig-zagged course we can take advantage of the wind.

In answer to *Captain Pearson's* first question: a sail assisted motor vessel is intended to sail basically from port to port by the most direct route but depending on the availability of the trade wind on the route and on how soon the cargo must be transported, the route can be diverted to follow the trade wind pattern. In the case of the *Shin Aitoku Maru*, the route is limited to within Japanese coastal and neighbouring seas and in most cases, her route is directly between ports.

With regard to Captain Pearson's second question, it seems that the Association does not intend at this stage to conduct further research into pure sailing ships.

Lastly, as regards the third question, I would like to explain that in determining the size of the sails, we have to consider the safety of the ship and especially the stability.

In a small ship such as the *Shin Aitoku Maru*, GM is small in comparison to larger ships, thus limited in sail size. When sails are applied to larger ships, the limitations mentioned above will be eased but as the sails become larger, for example 50-60 m from sea level to the top of the sails for a 10,000 -35,000 dwt bulk carrier, other limitations arise such as air draft limitations depending on the rivers and ports which the ship enters and the maintenance of such tall sails, etc. Such problems are now being investigated by JAMDA and NKK.

I would like to thank *Mr. Kirby* for providing some interesting information and suggestions for sails and other methods of harnessing wind for marine propulsion. I will transmit this to the developers of the *Shin Aitoku Maru*. It appears that they have no specific plan to further refine the sails at present but they are now investigating the feasibility of applying sails to larger ships and of decreasing the sail manufacturing cost.

Paper 2.9 TUG AND BARGE TRANSPORTATION IN AUSTRALIA

by

W. Bolitho,
Executive Director, The Brambles Group of Companies

DISCUSSION AND WRITTEN QUESTIONS

2.9.1 *Mr. Cecil R. Campbell, The Riverside Coal Transport Co. Pty. Ltd.*

Mr. Bolitho is to be congratulated on a most informative and thought-provoking paper. While he professes to be no scholar, his efforts in the preparation and presentation of this paper have been most scholarly and are deserving of a much wider audience than can be reached at this forum. His subject is of such importance as to be compulsory reading for those people he includes in the self-interested, self-seeking and monopolistic groups in Australian society.

I feel Mr. Bolitho, perhaps, could have given a little more emphasis to the extreme importance of the cost of transportation and its effect on the standard of living of the average Australian.

Our country is vast and sparsely populated. Embargoes placed upon the 'barge-tug' industry denies us the advantages that this most efficient concept could provide for us and greatly influences the cost of our goods, etc.

We are told that 600 semi-trailers leave Sydney for Melbourne and *vice versa* each day, and this type of activity is going on between the major cities of Australia. These cities owe their very existence to the maritime industry which had its 'hay day' during the period between the world wars.

The cost of road maintenance to the community is astronomical and the situation seems incredible when one realises the sea is virtually 'free', maintenance free and the port and light costs are already supported by the very much diminished maritime industry. Sea transport is now a very minor segment of our interstate and intrastate transport system.

Quoting from the paper thus: *If we can convince society at large and the Maritime Unions in particular, that it is safe, efficient, cost effective, fuel efficient and that it will increase employment and should be introduced, then we will have taken a small but valuable step in maintaining and improving our standard of living by reducing costs, reducing energy usage and increasing commerce and trade generally.* I ask Mr. Bolitho what time scale he should expect before 'barge-tug' operations are as commonplace in Australia as they are in most other maritime nations, bearing in mind that acceptance can only be brought about by education. Yet our education system, right through from primary to tertiary levels, extols the virtues of State hand-outs to all facets of society and plays down the complete dependence of such hand-outs on the profit based private enterprise system.

While Mr. Bolitho's suggestions of employment of funds, attractive depreciation and subsidy schemes, energy savings, etc. all go far towards making barging viable, does he feel that our basic education of society does not emphasise enough Australia's complete dependence on private enterprise and a fair return for effort and investment?

I believe Australians should be encouraged to buy shares in public companies and thereby have a very direct interest in the welfare of those companies.

It has been stated that only 4% of Australians have shares in public companies. The practice of double taxation, that is tax on company profits and also tax on dividends, is no doubt the main reason for this. A reduction in these taxes must encourage more direct and local ownership. I feel the average person in Australia is too 'removed' from the company he is working for and ownership, no matter how small, must create a condition of better co-operation which is so lacking in our maritime scene.

It is my firm belief that barging on our coast will not occur until a new enlightened generation of Australia's 'doctors, dentists, public servants, politicians and union members'.

Once again, I thank Mr. Bolitho for his most interesting paper. Perhaps he may comment on my remarks which I hope are not too pessimistic. While holding these views, I also sincerely believe that tugs and barges operating on our coast are inevitable.

2.9.2 Mr. R.J. Perkins, Bureau of Transport Economics

An estimate of door-to-door costs for shipping containers across Bass Strait by Ro-Ro ship and tug and barge are presented in the table below*. The estimates show an overall cost advantage for the tug and barge system for the route and assumptions adopted.

Fuel and crew costs as a proportion of total costs are lower for the assumed tug and barge operation (being 3% for tug and barge compared with 8% for the Ro-Ro operation) but in relative terms would offer only a small saving compared with a typical Ro-Ro operation.

Would the author comment on the cost estimates presented? Does he have any suggestions on ways of reducing load-unloading costs (reflected in stevedoring charges) which account for around 50% of total door-to-door costs?

The author suggests that Australian shipping is presently operating unsatisfactorily due to high manning requirements, resistance to technological advancement and a monopoly position totally sheltered from foreign competition. The last point he suggests has been a principal factor in the decline of the industry. If, as he suggests, the opening of our coast to foreign flag vessels is an unacceptable option, how do we encourage a more competitive shipping industry and therefore presumably a strong future for Australian coastal shipping?

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* This example is hypothetical only. The present Tasmanian trade is insufficient to support the continuous employment of a 500 TEU tug and barge operation. Smaller tug and barge combinations have not been used due to a lack of capital cost information.

Estimated Round Voyage Shipping Costs, Door-To-Door Service: Melbourne - North Tasmania

	Ship Type			
Cost Item	Ro-Ro* 375 TEU		Barge** 500 TEU	
	$'000	%	$'000	%
Ship	54.9	12	35.0	7
Containers	17.3	4	35.3	7
Operating - crew	25.5	5	4.8	1
- other	32.7	7	29.2	5
Fuel	14.1	3	8.4	2
Voyage charges	38.1	8	51.7	10
Stevedoring charges	209.8	45	267.0	50
Land transport	66.0	14	87.9	16
Container cleaning	10.6	2	14.1	3
Total	469.0	100	533.4	100
Cost/TEU/leg	0.782		0.667	

* Assumed speed of 17 knots, time in-port 2.2 days per call with time at-sea of 0.6 days per crossing. Ro-Ro capital cost $14.6 m. Container cost $2.9 m for 675 containers. Load factor 0.8. Loading/ unloading rate 15 TUES per hour.

** Assumed speed 11 knots, time of tug in-port 0.25 days per call with time at-sea of 1.0 days per crossing. Capital cost of tug and 3 barges $18 m. Container cost $11.6 m for 2700 containers. Load factor 0.8. Crew size assumed at 12 man.

Source: BTE estimates, Phillips, P., Speech to Legislative Council on Appropriation Bill, New South Wales Parliament, 12 November 1980.

2.9.3 *Professor H. Benford, University of Michigan*

This is a meeting having to do with fuel saving economy, it is not clear to me how a tug and barge system saves on energy.

2.9.4 *Mr. D. Pike, Pike, Lane and Company*

I remember not so long ago for the installation of the jacket structures in Bass Strait there was a classic tug and barge operation from Newcastle to Barry's Beach. Can you see from that precedent any future hope or perhaps areas of co-operation between the offshore industry and the future tug and barge industry on the coast?

It was probably a break through at the time and was actually a barge with the modules on top, I think one of the Intermack barges was used but I'm not sure which one. As you confirm it was a first and I hope it may have been a break through.

2.9.5 *Mr. P. Renshaw, Department of Transport*

For any transport system to work there must be a market. Which work markets are you examining? There does not seem to be any coastal trades where you are going to have the volume for the sort of operation you showed in the slides for example. It seems to be more potential in Northern Australia and in that case what sort of tug and barge technique would you be contemplating?

AUTHOR'S REPLIES

In reply to *Mr. Campbell*, if you had asked me this question 20 years ago, when I first put forward tug and barge investment proposals in Australia, I would have said 3-5 years, because the benefits are so great in specific areas that a logical and enlightened populus cannot but agree with their introduction in the areas for which they are suited.

20 years later I am again saying 3-5 years, not because of any continuing faith in the existence of a logical enlightened populus, but because I hope that the high cost of fuel will force us to employ the right transport mode for the right task, despite an illogical and unenlightened populus.

I am not at all sure how to answer your second question, perhaps it depends upon your point of view with respect to private versus public enterprise and as I lean towards the former, perhaps my answer should be: no, I don't think so.

I suspect that something over 50% of the ordinary shares in Australia's public companies are owned by Australians through their involvement in superannuation funds, insurance companies and investment trusts. Looked at in this fashion, I would have to think that the 4% figure is too low.

Corporations do not pay tax, they simply collect it on behalf of the Government from those who purchase their goods and services. An estimate of tax is an element of all pricing policies. Any corporation which does not collect tax from its clients in its prices will go bankrupt.

I tend to agree that some measure of tug and barging will occur in time for the reasons already given, but I am by no means certain. Waiting for the enlightened generation will be a long task. I hope that events in and around the hip pocket will bring tugs and barges about much more quickly.

Replying to *Mr. Perkins* who has presented a November 1980 cost estimate for Ro-Ro and barge, I advise that ANL freight on the sea leg across Bass Strait for a TEU is currently, I believe, some $900, of which on northbound cargoes a freight equalisation payment of about $300 is made to the grower.

The BTE's $782 estimate for a Ro-Ro TEU door-to-door inflated at say 15% for 12 months is also around $900, so I guess that the order of magnitude is about right.

I question, however, the proportion of stevedoring costs given that a purpose built vessel with purpose built terminals each end should substantially reduce these.

Work we have done in-house suggests that with purpose built vessels and purpose built terminal costs of $700 per TEU are not impossible as against the ANL's current $900.

One problem is, however, that on northbound TEU's the grower would receive no benefit, all that happens is the taxpayer pays less freight equalisation subsidy so there is a little or no incentive to introduce an improved system.

Container capital costs average out at about $4300 but a large proportion of the Tasmanian trade is fresh fruit and vegetables so I suspect that the box cost is a bit low.

As always however, it is difficult to get an apples with apples comparison, and I guess that the BTE figures were about right in 1980, although too high on stevedoring for purpose built vessels and terminals with permanent labour perhaps working day shifts only.

I am of the belief that a roll trailer operation of the type shown in the slides you have just seen would reduce loading and unloading costs. Further an express overnight service both ways, I believe, would generate as much as 40-50,000 TEU's per year which is enough to support a substantial and purpose built operation.

An efficient roll trailer operation would also considerably draw Hobart cargo through northern Tasmanian ports, thus creating the volume necessary to support an efficient system.

I am not so sure that I would like to see a blanket encouragement of coastal shipping.

Almost always in the past shipping in Australia has been, and largely still is, treated as an exercise in itself unrelated to the door-to-door transport task the shipper requires to be performed.

Encouraging ships built as part of an integrated door-to-door movement, with specific ships built for specific tasks, will certainly help. It is in this area that the future of Australian coastal shipping must lie rather than a 'stand and deliver' tactic using unsuitable vessels to exact what the market will bear type freight rates because there is no opposition from road or rail.

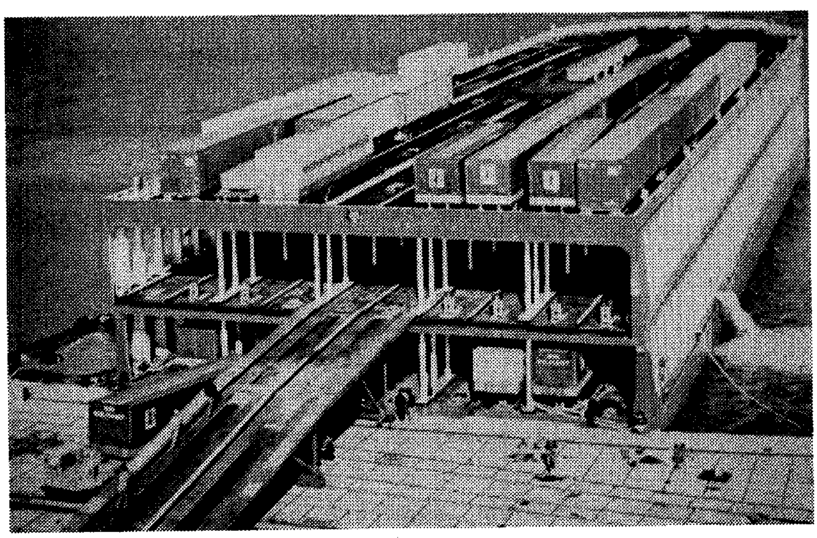
In acknowledging *Professor Benford*: only in the sense that for the same volume of material to be moved it burns less fuel, albeit it does it at a lower speed.

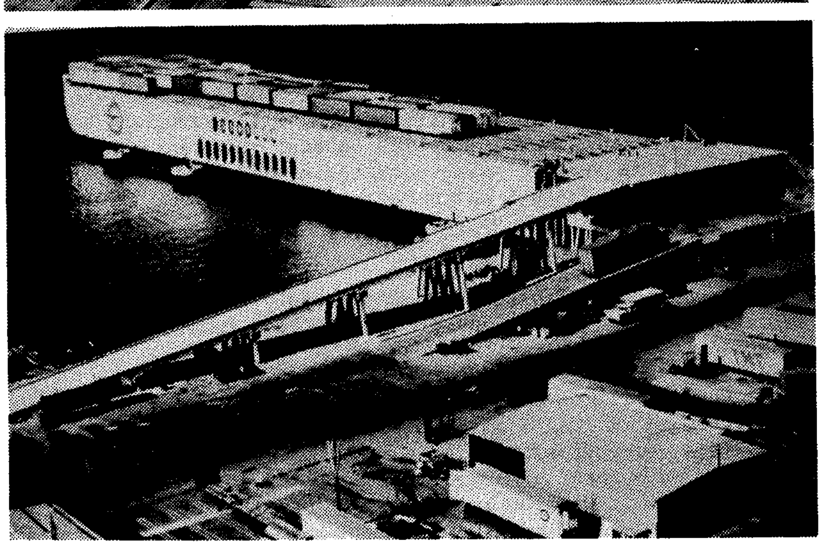
In reply to *Mr. Pike*, only in a very general sense. The particular operation, if I remember rightly, was a wet tow, the modules were in the water, and not on a barge. Certainly the maritime trade unions were consulted and agreed because it was the only feasible means of transport on that occasion - only in a very general sense of proving that there is a degree of co-operation and assistance between transport operators and the maritime trade unions. On the subject of break through I'd like to think so, but really don't believe so. There is a vast difference between a one-off out of guage load and a consistent regular commercial transportation activity.

Replying to *Mr. Renshaw*: On the contrary, I think every Tasmanian would hop up and oppose your comments. I think there is capacity right now for perhaps 50-60,000 TEU's per year across Bass Strait. Coles, for example, are flying ordinary groceries down to Tasmania because the transport costs are so high and the transport systems are so inefficient despite the freight schemes. I think probably if you introduced a decent roll trailer type operation you would not only pick up the fresh fruit and vegetables which are flown from the mainland now, which is the bulk of the trade, but you would also pick up cargo from Hobart as well. I really believe there is a trade and there is sufficient volume.

Editor's Note

Reproduction of the slides shown in connection with a tug/barge operation.





Paper 2.10 NAVSTAR GLOBAL POSITIONING SYSTEM AND ITS EFFECT ON NAVIGATION IN THE EIGHTIES

by

J.T. O'Toole and G.R. Owen,

Marine and Navigation Divisions,
Amalgamated Wireless (Australasia) Ltd.

DISCUSSION AND WRITTEN QUESTIONS

2.10.1 Captain C.I. Flaherty, Master 'Empress of Australia'

SATNAV as we know it today is an excellent aid to navigation, in thick weather, during ocean transit, it is the first reliable system for position fixing and any improvement on this, such as NAVSTAR GPS will be most useful.

It is stated in Section 3 of the paper that the worst case of time between fixes if 5 hours. In practice this worst time is often up to 14 hours owing to bunching of satellites, poor doppler or poor satellite altitude.

I would like to ask Mr. Owen, what provision is being made to train technicians in NAVSTAR, both from the point of view of the manufacturer, agents such as AWA and the operator? Our recent experience with new technology is that the floggers are too far ahead of the fixers!

2.10.2 Captain J. Brace, Sydney Technical College

I would like to congratulate both of the authors for their clear, simple and factual exposition. The papers were presented previously this year at an ordinary meeting of the Company of Master Mariners and were illustrated with audio-visual material. The general tenor of comments following the presentation was highly laudatory, and it was obvious that the papers had been pitched at just the right level. They are most appropriate and timely for the Symposium.

At an International Symposium of Institutes of Navigation held at the University of Sussex, England, in September 1979, Dr. Johnson of Texas Instrument Company, a prime user of equipment supplier for the Department of Defence, suggested a figure of only US$2,000 (1979) as the projected cost of a light aircraft, GPS receiver.

This would seem to be the type of upline technology that many economists have recommended Australian entrepreneurs should engage in. The fast growing leisure activities calling for navigation data, e.g. sailing, flying, bushwalking, etc. offer ready markets for low priced equipment, and it is to be hoped that Australian industry does not leave all of this market to the US and Japanese manufacturers. The figure of $7,000 quoted by Mr. Owen would be for professional equipment to standards laid down by safety regulatory authorities.

The most important feature of the GPS system is that for the first time we have made a major advance towards a marine traffic control system. The automatic data system on board can now be interrogated for navigation information, to be automatically transmitted to a central area computer via a marine communications satellite. The area controller can then relay his instructions to the vessel's Officer-of-the Watch, or directly to the radio receiver interfaced with the automatic pilot.

This has important implications for ship's officer training, and the time is far advanced for regulatory authorities to re-think their training syllabuses, to bring them into line with modern technology.

2.10.3 *Captain B. Westwater, Master Mariner (Seagoing)*

How long do you think it will be before we have pocket calculator satellite navigators on board or on the person?

AUTHOR'S REPLIES

Captain Flaherty has endorsed the Transit satellite navigation system as a reliable aid to navigation and has suggested that any improvement such as the Navstar Global Positioning System will be most useful for shipping in thick weather and during ocean transit. His comment that in worse cases the time between accurate fixes is often up to 14 hours is correct and is due mainly to the bunching of satellites, satellite altitude being too high or too low and is also a function of the ship's latitude. Our estimate of 5 hours between fixes is also acceptable if 'questionable' satellite passes are utilised: that is, satellite passes that have higher or lower elevation angles than is considered optimum.

With reference to the training of technicians for the support of ship board Navstar receivers, it is a little early to commence training at this time. However, it is important to highlight the training aspects now at all levels to ensure that it receives the priority it demands. There are still many people in our industry who place insufficient emphasis on training. They buy equipment at the lowest cost and are subsequently critical of the fact that equipment is unsupported. It is important to realise that the cheapest solution in marine electronics is never the best. Support training is not cheap and those who provide it must charge a little more for their services but bear in mind that those who provide training for their technicians are those who wish to continue to serve the Australian maritime industry.

In terms of Navstar training, AWA will do what we have done in the past. As soon as equipment becomes available and the release of the Navstar system for commercial use is imminent, we will send a senior engineering officer overseas to spend time with the manufacturer of the equipment which we will be marketing and supporting. His training will include all aspects of manufacture, installation and testing of the units to component level. He will also be trained in the Navstar software programs and will return to Australia fully capable of teaching 'users', 'fixers' and 'floggers' of the equipment.

I would like to go on record on behalf of our own company with the statement that our 'fixers' are generally ahead of our 'floggers'. This has been the case with developments in communications, radar and in particular, with satellite navigators and satellite communications equipment. For example, our marine engineering officers have acquired both software and hardware modification and repair capability for satellite navigator receivers manufactured by Tracor and we have provided training in satellite navigator techniques to 'users' including most shipping companies present here today, the RAN, the fishing industry and members of Government organisations. We have also provided training in satellite communications to OTC as well as to our own radio officers and technical staff and, in fact, we are regarded as the main repair centre for Comsat General Marisat terminals in the Pacific. In February 1982 we will be sending an engineer to the United States for training in the new Comsat General INMARSAT satellite communication terminals shortly to be introduced to the marine industry.

I thank *Captain Brace* for his remarks about the paper and appreciate his comments which do not need any reply.

In reply to *Captain Westwater*: I don't think it will ever get to that stage. They are getting pretty small at the moment,as you may be aware, in the order of weight 4 kilograms and overall dimensions roughly 15 mm × 8 mm × approximately 20 mm deep. But you will still need an aerial located at the best practical position in a ship. I do not think we would ever reach the stage of pocket satellite navigators. I did go through the slides rather quickly, but you might have seen or noticed the mock-up of what one manufacturer believes a Navstar receiver will look like and believe me, it's quite small, about the size of a clock radio.

SESSION 2.D CHAIRMAN MR. W.F. ELLIS

Paper 2.11 STOLKRAFT - HIGH SPEED AERO-HYDRODYNAMIC HULL

by

R.W. Ware,
World Logistics Pty. Ltd.

DISCUSSION AND WRITTEN QUESTIONS

2.11.1 *Captain D. Grant, Torres Strait Pilot Service*

Would this craft be suitable as a pilot launch? If so, how can it be designed for this purpose? Have any been built? What size and power is envisaged for a pilot boat capable of speeds 25/30 knots with a range of at least 200 miles?

2.11.2 *Mr. A.R.L. Tait, Bureau Veritas*

I had the privilege some years ago of meeting Mr. Leon Stolk and he invited me to Pittwater where I actually drove one of the first prototypes. If I remember correctly it had a draft of about 12 inches and when it rose out of the water had, at speed, a draft of about 1 inch. One of the things I noted was exactly what you said. When you drove into the wind the vessel appeared to be actually going faster than going down wind. The only thing I was doubtful of at the time (Mr. Leon Stolk being an aeronautics man) was using an air speed indicator for the pitot tube mounted above the windscreen. I wonder how you now measure the speed specially taking into account the fact that the vessel has a very shallow draft and is skipping over the water. I feel that possibly this craft would lend itself to a light gas turbine engine for propulsion.

2.11.3 *Mr. P.A. Edmonds, Ednav Designs*

There are some aspects you might be able to enlarge upon. Having regard to the various roles for which this type of vehicle could be used as it provides a fairly large deck superstructure of usable space this to me is an area/volume item, how does it work out in terms of payload capacity, i.e. to carry massaround, fuel for endurance etc. when compared with more conventional vessels operating on similar tasks?

2.11.4 *Mr. R.F. Halliday, The University of Sydney*

I have not any first hand experience although I have talked with naval architects who have tested the full size craft and who have tested the model. There seems little doubt that the *Stolkraft* has a better performance at high speed than any other type of marine vehicle.

However, I think it is important to put the *Stolkraft* in proper perspective. It is certainly not the answer to all the problems in marine transport, but a rather special craft looking for a special role to play.

It seems to me to be a stepped planing hull. The step is inverted and trapped between two slender hulls which provide the stability in pitch. This arrangement is quite an innovation, but another feature is added, namely a certain amount of lift due to ram air pressure. This would be destabilising if applied only under the forebody, but by a very ingenious arrangement of ducts and shaping of the afterbody this ram air lift is fully effective aft of the step. Since this is a planing craft, careful attention has been given to the control of spray and the reduction of wetted surface. Now all of this points to the *Stolkraft* having an operating speed range similar to that of a stepped planing hull. At lower speeds the lift due to ram air pressure becomes insignificant and the step inappropriate. Logically one would revert to a 'sea sled' or a normal unstepped hull.

With high speed marine vehicles performance is largely a matter of weight. The *Stolkraft* at high speed is supported almost entirely by dynamic lift provided by the water. It should be appreciated that the ram air pressure does not of itself support the *Stolkraft*, but merely transfers the load to the water below. Buoyancy is likely to be as low as 10% of the weight of the *Stolkraft* at the speed required for the craft to show its superiority. Therefore as an order of magnitude, the drag is given by the following equation borrowed from Lanchester and Prandtl:

$$R = \frac{4Cg^2\Delta^2}{\pi\rho v^2 B^2} + \frac{C_f \rho v^2 S}{2}$$

where R = drag in newtons

g = gravitational field strength = 9.18 metres second

Δ = all up weight in kilograms

ρ = density of water, say 1026 $kg.m^{-3}$

v = speed in metres per second

B = overall beam in metres

C_f = viscous friction coefficient, of order of 0.003

S = wetted surface in square metres

C = a factor allowing for the beamwise distribution of lift not being ideal

While this relationship is not sufficiently accurate for the design of marine craft, it quite validly shows the dependence on low weight, high speed and adequate beam for satisfactory performance.

The first term of the equation also gives some idea of the nuisance value of the craft in creating a wash. This appears mainly as a transverse wave behind the craft and may not be noticed by the casual observer. Nevertheless the energy content of this wave may be quite high and it is likely to disturb moored craft. The form of the expression shows how nuisance value depends on weight and how it becomes quite serious as the craft decelerates on approaching its berth. If a *Stolkraft* were to be used on a commuter service, then its suitability must be assessed on the basis that expensive yachts are likely to be moored at marinas close to the ferry wharves.

The proposed 250 passenger 35 knot ferry proposal provides some interesting figures. One can make a guess that ram air pressure is acting on 150 square metres giving lift of $\frac{1}{2} \times 1.205 \times 18^2 \times 150 = 29300$ newtons able to support 3 tonnes of the normal operating weight 110 tonnes. So much for aerodynamic lift! Assuming the validity of the Lanchester Prandtl formula, but making $C = 2$ because the lift distribution will tend to be concentrated at the outer edges of the inverted vee step, the residuary draft will be around:

$$\frac{4 \times 2 \times 9.8^2 \times 110000^2}{\pi \times 1026 \times 18^2 \times 9.9^2} = 90800 \text{ newtons}$$

Guessing that one third of the plan area is wetted surface, the viscous drag will be around:

$$\frac{0.003}{2} \times 1026 \times 18^2 \times \frac{24.45 \times 9.9}{3} = 40200 \text{ newtons}$$

Guessing at 30 square metres frontal area, the windage will be:

$$\tfrac{1}{2} \times 1.205 \times 18^2 \times 30 = 5900 \text{ newtons}$$

Since propulsion will require the use of pumps coupled to gas turbines, one can make a guess at propulsive efficiency being rather low, say 40%. Thus shaft power required will be:

$$\frac{1}{0.4} \times 18 \times (90800 + 40200 + 5900) = 6160500 \text{ watts}$$

The power available is 5,222,000 watts.

This rather suggests that conditions are fairly tight, and that with water jet propulsion, there might be no great margin of thrust over the 'hump'.

Transport efficiency $\eta_D \times \Delta/T$ is around 3.6 for Froude number $F_{N\nabla} = 2.64$ which leave the *Stolkraft* markedly inferior to surface piercing hydrofoil craft.

What this exercise suggests is that the *Stolkraft* is being used at a Froude number rather less than optimum. This lends force to the concluding remark in the paper. Maybe the ferry should operate at 80 knots!

If my criticism seems to be destructive, then I hasten to deny that such was my intention. I see the *Stolkraft* as a light displacement high speed craft used for rather specialised tasks. Its efficiency and sea kindliness are outstanding in these circumstances. It is not a cargo carrier and not even a good performer at $F_{N\nabla}$ below 4.0, and so it is unwise to misuse it thus. To me it is an extremely interesting craft and I expect to see and hear a lot more about it.

2.11.5 Dr. L.J. Doctors, The University of New South Wales

1) It is difficult to make many comments on the paper because its content is mainly qualitative. There are almost no quantitative statements. I would however like to refer to Figure 2, which shows that the ACV is generally twice as efficient as the *Stolkraft* - over the range of speeds plotted. How does the statement fit in with the many references in the paper to the superiority of the *Stolkraft*?

2) Again, in reference to Figure 2, it is not clear if the speed of the vehicle is considered in computing the 'transport efficiency'. Most vehicle comparisons do consider the velocity - for example the enclosed Figure 43 taken from W.J. Eggington and N. Kobitz, *The Domain of the Surface-Effect Ship*, Trans. SNAME, Vol. 83, pp 268-298 (1975). This graph also shows the relatively poor performance of a planing hull (the *Stolkraft* appears to be almost identical in performance to the planing hull). This figure also shows that air-cushion vehicle and surface-effect ships should not be lumped together in terms of their performance.

3) I would also like to point out that using the total craft weight Δ in the definition of efficiency is probably not very appropriate. One should use the useful cargo weight, or number of passengers, as there is little purpose in transporting an empty vehicle.

4) I would finally like to take issue with the author's statement number 1 on page 233, in which he states that Froude scaling is inappropriate for model tests of a *Stolkraft* because of ram-air pressure effects. This is not true. The air-pressure effects do follow Froude scaling effects, because the pressure is proportional to V^2, V being the craft velocity. Since Froude scaling results in V being proportional to $\sqrt{L}$, L being the craft length, and the surface area is proportional to L^2, we finally obtain the lift as being proportional to L^3, just as the weight of the vehicle is. Thus, in a Froude test, the lift is kept in the correct proportion to the weight.

This analysis should not be construed to imply that there are no other effects: spray and viscosity play a role which is not governed by the Froude scaling law.

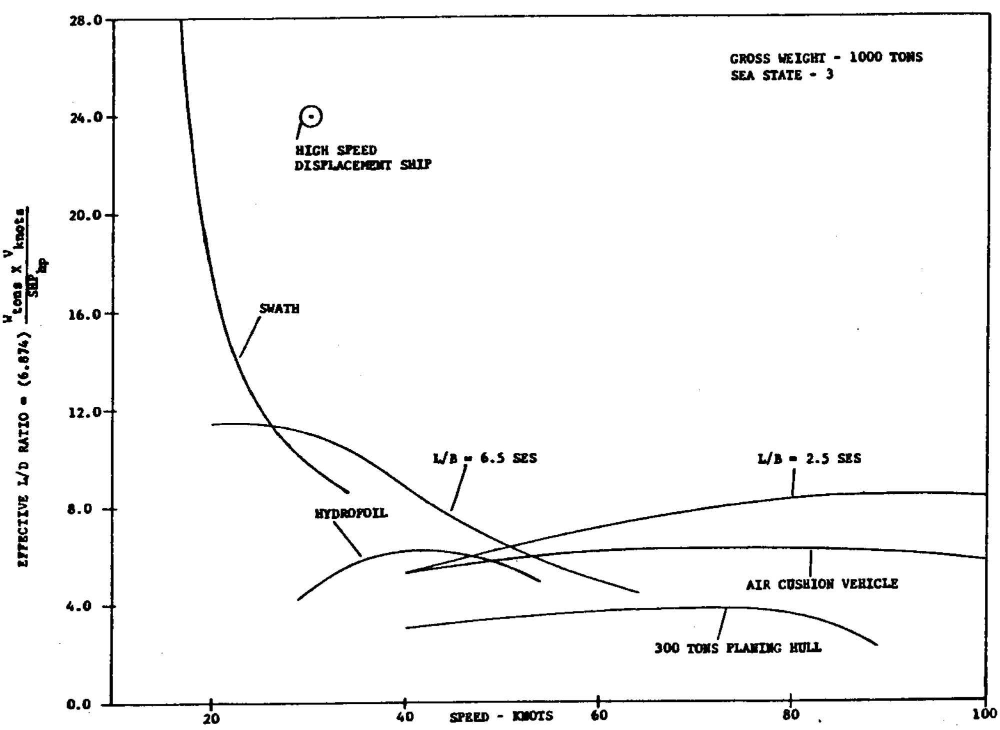


Fig. 43 Modified Fig. 18 of paper

The Domain of the Surface-Effect Ship

W.J. Eggington and N. Kobitz, Trans. SNAME, Vol. 83, 1975, pp 268-298

AUTHOR'S REPLIES

In reply to *Captain Grant*, this is certainly within the capability of *Stolkraft*. The power pack for this at the moment has to be taken off the shelf, but I am quite certain from the enquiries that I have had, being chairman of *Stolkraft* as well, in my discussions with foreign navies as well as with our own people together with commercial interests overseas, is that someone in the future is going to design an engine specifically for the *Stolkraft*. Whatever its type will be I do not know, but if you are looking at activities requiring speeds of 80 to 100 knots (and there is no reason this craft should not be capable of that speed) whether it is for clandestine activities, military forces or whether it is used forhigh speed transits for ferries to Macao through the Phillipines or from Canada where they are currently investigating the vehicle, I am quite certain that eventually the ideal engine is either here now or will be designed.

I thank *Mr. Tait* for his comments and in reply to his questions, I advise that the speed of the craft has been measured by scientists from the Netherlands Ship Model Basin from Holland who have come to Australia on two occasions and have tested the craft over the RAN's torpedo range at Pittwater by quite precise instrumentation. Yes, I feel that there is a possibility of utilising a gas turbine engine. Mr. Ellis has been involved in the design and building of a merchant ship which is using precisely that type of engine and I can see no reason why in Australia and other parts of the world, particularly in the OPEC countries in the Arabian Gulf where natural gas is readily available to provide the fuel,could be in cylinders stowed on the deck for high speed craft of this type.

Mr. Edmonds raised an important question which I overlooked. It is briefly referred to in my paper in the Navy's comment of its exceptional payload capacity and because of its length/beam ratio, the draft is necessarily shallower. However, it has according to the three scientists who tested the craft independently, an exceptional payload carrying capacity. I don't have the precise details at the moment but it is contained in the document for the second test and I am certain that we will be able to provide that for you. The boat or ship really comes into its own at high speeds and if you have a look at the graph on the back of my paper you will find the efficiency of the *Stolkraft* pro rata to other high speed hulls whether they are hydrofoils or hovercraft. The capability of this craft will be enhanced when it gets into the larger sizes. There is a tendency for the craft to be inefficient or apparently inefficient at the slower speeds and one of the reasons for this is the longitudinal centre of gravity of the craft. At the lower speeds, that is, before it becomes airborne, the underwater hull impinges on t he water. When the craft changes from a hydrodynamic situation to an aerodynamic situation the aerodynamics take greater precedence over the hydrodynamics. Captain W. Robey, an ex-Qantas Captain, has recently suggested to me that it could be offset by means of transferring fuel at speed, as you do in a flume situation, which in the lower speed ranges would virtually tend to change the longitudinal centre of gravity.

In reply to *Mr. Halliday*, the formula of Lanchester and Prandtl gives no more than an order of magnitude and it would be incorrect to base any conclusions relative to power-speed performance on it. Mr. Halliday is correct, however, in pointing out that the *Stolkraft* has its best performance potential at the very high speeds.

The comparision with hydrofoils is not very valid since the hydrofoil will have a higher Froude number than the *Stolkraft* for any given displacement or payloads (only the performance of a L/B = 2.0 *Stolkraft* has been considered so far). It is probable that a higher L/B ratio will lead to a much better 'low' speed performance than the results have indicated for the existing prototypes. Also a hydrofoil vessel will be 2 to 3 times as expensive to build than a comparable *Stolkraft*.

In response to the questions received from *Dr. Doctors* I advise:

1) Recent work carried out on high L/B SES and ACV craft has shown that the performance of these craft will markedly improve at the 'low' speeds, up to $F_{n\nabla} = 3.0$, relative to low L/B configurations. The results presented in the paper are for an L/B = 2.0 *Stolkraft*, designed for optimum performance in excess of $F_{n\nabla} = 5.0$.

Research recently carried out for a 'low' speed *Stolkraft* hull on Pittwater has demonstrated a significant increase in performance up to $F_{n\nabla} = 4.0$.

2) It is agreed that the effective transport efficiency should show a dependence on speed. Figure 2 should, therefore, be used for comparison purposes at a specific absolute speed, preferably not on a Froude number base only. In the figure referred to by Doctors, the 8.53 metre *Stolkraft* at 40 knots would be approximately equal to the value for the hydrofoil shown.

3) It is also agreed that a better definition of transport efficiency would be one based on useful load or payload. The figure in the paper was used because it was available. The performance of the *Stolkraft* would show up much better if the information would be available to construct a diagram of transport efficiency (based on payload and speed) against absolute speed, because of the high payload of the *Stolkraft*, relative to ACV, SES and hydrofoil ships.

4) Doctors has not understood the statement in the paper referring to Froude scaling of performance. Tests on a geosim series of *Stolkraft* models at NSMB have indicated that on small models the air flow through the air-intakes to the cushion breaks down because of flow separation. Thereby the cushion is not fed sufficient air, leading to a significant drop in performance. At low speeds on the 4.95 metre hull this was also found to be the case. It is agreed that with relative equal amounts of air fed into the cushion, *Stolkrafts* of different sizes should display equal performance (lift), as Froude scaling suggests.

Paper 2.12 ADVANCES IN MIRCOPROCESSOR CONTROLS FOR OPTIMISATION IN INDUSTRIAL PROCESSES AND THEIR APPLICATION TO SHIP MANAGEMENT

by

R.M. Sproge,
Honeywell Pty. Ltd.

DISCUSSION AND WRITTEN QUESTIONS

2.12.1 Mr. F. Simpson, Vickers Cockatoo Dockyard Pty. Ltd.

This most interesting and timely paper raises a number of questions, some general, some specific. Firstly, on the subject of costs and reliability, I would pose the question regarding the advantages of using time multiplexing techniques. There is an obvious saving in cable installation using the TDC 2000 system together with an increase in reliability over more conventional marine control and monitoring systems. Therefore, what savings in percentage terms do you foresee in:

(a) New ship installations related to main and auxilliary machinery systems.

(b) Modernisation of existing in service ship machinery systems.

Bearing in mind the questions raised above, can you confirm that the TDC 2000 can accept a comprehensive range of commercially available transducers , i.e. flow, pressure, temperature, speed, etc. without recourse to redesign of the input circuits to the process interface unit (PIU) and controllers?

The system parameters once established are held on magnetic tape in order that they may be retained in the event of a loss of electrical power. If a TDC 2000 system is fitted to a fighting ship (and I include supply ships in this category) what is the minimum time required to re-establish system parameters once power has been returned to the system?

To maintain reliability the TDC 2000 requires the support of an air conditioning system. In the event of a breakdown in air conditioning, for how long will control room equipment function?

2.12.2 Mr. G. Edwards, Sydney Technical College

(1) Unfortunately the descriptive language used in the paper will only be understood by a very small percentage of marine engineers, and

(2) The claims made in respect to increasing boiler plant efficiency by comprehensive and complex

automation seems to indicate some misunderstanding as to just what causes boiler inefficiencies in the first place.

To illustrate point (1), I quote paragraph 7 of Page 1: *The data highway is a redundant pair of coaxial cables along which bit serial, time multiplexed data flows between system elements.* To the average marine engineer this means absolutely nothing.

Why not say that the major system components are connected by duplicated two core coaxial cables. These cables convey the digital logic control signals, i.e. logic one 5 volt and logic zero less than 5 volt (bit). Information between system components, the timing and priority of these signals being governed by a master control unit (multiplexer).

Regarding point (2), my experience has shown that the technical equipment which comprises the TDC 2000 is most satisfactory. The College unit has given very little trouble over the past four years. The advantages claimed by being able to change control configurations (taking say a temperature control unit and turning in into a summing unit) by a simple programming adjustment (software change) are very good. The more so when we look at the conventional non-microprocessor electronic control system. In this case a change would usually necessitate the purchase of additional equipment (hardware), plus its cabinet mounting, and interconnecting cabling.

Under the heading energy considerations, a figure of 5% is used to illustrate a $300,000 to $1,000,000 saving per year in fuel. In addition the statement that where TDC 2000 systems have been applied boiler users report up to 20% improvement in boiler efficiency. Such claims must be qualified. For example:

(1) Was the boiler previously a manual control unit?

(2) Was the boiler setting in good repair?

(3) If control was fitted, what type was it?

  (a) On/off
  (b) Parallel
  (c) Cross limited
  (d) As for (c) but with oxygen trim.

(4) Was the combustion equipment to original specification?

Regardless of the claims for TDC 2000 I am of the opinion that we must credit the in stack, or local to stack zirconium oxide oxygen analyser for the great improvements in boiler efficiency. That is providing we can answer yes to item (2) above.

It would not matter how comprehensive a control system was installed, if boiler settings are faulty, i.e. air entering other than via the correct combustion circuit then nothing other than casing repairs will improve efficiency. For example, if the oxygen analyser senses excess air, it will act to reduce that air to the desired value. The only air it can reduce is the combustion air, the leak still persists so, combustion suffers, this in turn affects other areas such as steam generation rates, superheat temperature, etc.

One must always remember that the major deficiency in marine and other boiler controls is the inability or refusal to accurately measure air flow (orifice and suitable ducts). Hence, the tendency to rely on oxygen trim, which in turn can give rise to the problems listed above.

Whilst I have agreed that additions to conventional analogue controls can give problems, I must emphasise that modern systems have very little drift and I doubt if one could establish any difference between a correctly calibrated conventional analogue system with oxygen trim and a TDC 2000 similarly equipped.

We must always remember that the microprocessor like its big brother the computer, functions on the 'garbage in/garbage out' principle. This specifically means that unless transmitters, thermocouples and resistance temperature detectors, etc. are correctly calibrated, i.e. to specification, and kept that way, we cannot obtain accurate control. The same comments apply to the final drive units, as well as the dampers and valves, etc.

As an illustration of the foregoing, let's look at a package boiler of say, the *Maxitherm* Mini D type. That boiler functions on the absolute minimum of controls and returns efficiencies of 75% to 80% at CMR depending on fuel. Efficiency falls off fairly rapidly at reduced loads by virtue of the increase in excess air. This increase, in my opinion, is a safety rather than an efficiency consideration. Provide a method of simply reducing this air with safety at alower loads, and that boiler will be very efficient indeed, without comprehensive instrumentation.

The comments under increased adaptability especially those relating to oxygen trim and opacity control of coal fired boilers were discussed in my MER (Marine Engineers Review) article of September 1980. A well designed system will not need outside help to change from oxygen to opacity control, one simply uses an auctioneer. This is an oversimplification as there are many traps for the unwary.

One further point that illustrates the need for a practical marine engineering outlook is Paragraph 5 of Page 1 which refers to loss of processor memory due to power blackout. A blackout will probably occur about once per voyage. If in the case of a single boiler unit, power is lost, the last thing the engineer wants to have to do is to reprogram the system at this rather busy time. I trust that in this case the instrument companies will provide some form of permanent power supply in the form of batteries and interters to prevent the loss of volatile memory in the control gear. The practical problem of what the automation system will do with a situation of no power, a grate loaded with fuel, the need to conserve steam, plus low drum level will prove rather exciting. You cannot trip fuel in this case.

I am looking forward in anticipation to our new coal fired ships especially in respect to problems outside the scope of automation, i.e. coal volatility, swelling index, grate air leaks, ash fusion temperature, etc. and the effects of low load operation on superheat temperatures all on full automatic control. It will be interesting to see the wheel reinvented.

The sooner purchasers and sellers of instrumentation realise that efficiency and performance not only depend on instrumentation, but also on plant condition the better. Instrument companies cannot avoid their engineering responsibilities. They must know as much about plant operation as they do about their own equipment. They must involve themselves in assisting the operators to obtain the best results from the information supplied by these sophisticated data systems. They must also be able to explain the equipment functions in clear and concise terms which are easily understood by the purchaser and operator alike.

2.12.3 *Mr. A.B. Smith, Blue Star Line*

In seventy years of designing ships for own use, Blue Star Line has been strongly progressive, but always with the underlying principle of cost conserving simplicity. As a result the ships have each provided many years of economical service.

This cautious approach has seen the successful incorporation of bridge controlled main engines in motor and steamships commencing in 1964, and unattended machinery spaces in 1967. Our experience of visual display units is confined to radar and television, which both require constant repair, and the more recent and rugged miracle of satellite navigation sets which are compact and inexpensive.

Assuming that the processor installation described in the paper will represent a capital investment of about $250,000, the equipment must be expected to enjoy an economical lifespan equal to that of the vessel, say 25 years.

Is the author's company able to provide potential users with an accurate prediction of servicing costs, and assurance of world wide availability of all the components comprising the installation, for the vessel's full lifespan?

AUTHOR'S REPLIES

As the questions from *Messrs. Simpson, Edwards* and *Smith* tend to overlap I will answer all three at the one time.

In a typical vessel with two hundred control and monitoring points the reduction in costs are:

(i) Cable cost reduced by around $30,000 to $40,000.

(ii) Installation cost both labour and material (e.g. cable tray installation and cable pulling) reduced by around 10% = $15,000.

(iii) Time required for pre-commissioning and commissioning reduced by 25% to 30% reflecting a cost saving of around $5,000 because the commissioning engineer only has to check one set of terminations which are at the field process unit.

In total this represents a saving of 10% to 15% in a new ship and 10% in a modernisation exercise where you may be using existing cables, trays, etc.

Most commercially available transducers will have an output acceptable to TDC 2000 input.

The range of available inputs are:

High Level PIU (Process Interface Unit):

Analogue	-	0-5 V, 1-5 V, 4-20 mA with 100 mS and 2 mS with variable time filters to filter out noise and spurious pulses in the system
Digital	-	Contact inputs 24 V and 48 V with 24 mS and 1 mS with variable time filters
		TTL logic input
Pulse	-	Slow rate: 16 bit data base Fast rate: 32 bit data base
		The fast rate giving you a much better discrimination by using a 32 bit data base

Low Level PIU/Low Energy:

Millivolts, 4-20 mA, RTD, thermocouple remote multiplexed signals

The type where you take some thermocouples into a box; you could take 64 thermocouples into a remote box and just multiplex those back through a single cable directly into the PIU

Basic Controller:

0-5 V, 4-20 mA, linear, square root RTD, thermocouples (J, K, T and S)

The element used in the control mode for systems as opposed to the direct monitoring mode and alarm mode, the unit will accept 0-5 V inputs, 4-20 mA inputs, it will accept linear square root signals, resistance bulbs, thermocouples and in particular, 4 types of thermocouples: the J, the K, the T and the S thermocouples - so we operate over a range of thermocouple materials which will allow you to measure through into the very high ranges of 15-1800°C

Several levels of protection are available in TDC 2000 to ensure system security during brown outs or complete power failure:

(i) Complete power back up with a UPS system.

(ii) Battery back up for Basic Controllers and PIU's only.

The operator station will shutdown during power failure, however, the Basic Controller and PIU will continue to function normally. Total loop security will be maintained with the controllers operating under the last set of instructions controlling the process as required.

(iii) No battery back up. The Basic Controllers, PIU's and operator station will go down. When power is restored the core memory in the basic controllers, which stores the vital control information, will allow immediate resumption of control in the mode in effect prior to power failure or resumption in manual mode.

Restoration of the complete system on restoration of power using a tape system will take about three minutes where battery back up is used and about four minutes with no battery back up. Using the enhanced on-line floppy disc system will give restoration in five to ten seconds after restoration of power.

Basic Controllers and PIU will operate successfully in ambients up to 50°C. Operator stations will continue to operate at temperatures up to 50°C. It is recommended to install the station in a air-conditioned environment to ensure that over long periods of time condensation, corrosion and dust deposition will not adversely affect the performance of the equipment.

When considering improvements in performance the figure of 20% is used in the context that the more modern control equipment contributes to the performance improvement as a total system which gives better controllability, greater on stream time, continuous monitoring of a greater number of process variables, and variations in control modes to accommodate varying fuel types and boiler loads.

The practice in marine applications is similar to that used in good industrial boiler practice in so far as the boiler protection and safety equipment can operate independently of the TDC 2000 equipment. Specifically, systems are designed to ensure the safety of equipment and personnel is maintained under all operating conditions including power failures in accordance with boiler codes of NFPA and the Classification Societies. It is a requirement of the Classification Societies that the shut down system be able to operate independently of the control and monitoring system.

By way of further explanation, the design of the TDC 2000 system is based on the need to provide continuous control not only in the marine area but in the process control systems area, in places such as refineries, etc. So designed in are several levels of protection to ensure the system security during brown outs and complete power failures. There are three levels: one is the level where you would back up the system completely with the UPS; in other words an inverter operating off batteries which would provide all power requirements for the system and they are fairly modest. The second is the battery back up for the basic controllers and the process interface units and in the case of a power failure when operating from this mode the operator station itself will go down but the basic controllers and the process interface units will continue to function normally. The design of the system is such that all controls can continue to operate without the operator interface, the operator station, the CR2 display. The total loop security is maintained with the controllers operating on the last set of instructions that were issued for control of the process. So in that sense the system will continue to operate as a controlling system. The third level of security is that where you provide no back up at all either from a static inverter or from a battery back up unit. In this case the basic controllers, the process interface units and the operator station will power down. When power is restored, however, the core memory in the basic controller and process interface units which store all vital control information and will allow an immediate resumption of control in the mode prior to the power failure.

There is an alternative which you may elect to take if you wish where you elect to go back to manual control as soon as power is restored. The restoration of the complete system on the restoration of power will require reloading configuration data back into the operator station and there are two systems by which we can relay the configuration data back into the operator station and that is either using a tape system which is just a conventional cassette tape like the audio tapes that we use, or using an on-line floppy disc. As mentioned earlier, if we use the conventional tape system, it takes about three minutes where we use battery back up and where there is no back up at all, it takes about four minutes to reload the system completely. If, however, we use the enhanced on-line floppy disc system restoration will be achieved within five to ten seconds after power restoration. So it is quite quick and speedy.

We would generally advocate, as a minimum, battery back up for basic controls and PIU's and in a larger ship we would advocate the use of the UPS system so that there is a continuous control available both in the monitoring and the control sense available to the operator, the engine room operator on the ship or the engineer of the ship.

When we talk about improvements in efficiency we are stating that this is a complete control system which gives us better controllability, good on stream time, continuous monitoring of more complex and a large number of process variables which allows us to be better able to assess that our equipment is working completely and properly. So that the overall improvement comes from the whole system, not just from the installation of the TDC equipment, but from the fact that you can now monitor the whole equipment. In terms of what happens during power failures, our practice in marine applications is similar to what we use in industrial boiler practice and that is to have the shut down systems separated from the controller monitoring systems and in general, in industrial applications, the shut down system, say, for a large boiler, would be independently powered and backed up apart from the controller monitoring systems which is in accordance with the NFPA requirements and the Classification Societies.

In so far as installation costs are concerned, the cost of the completely installed system will be marginally higher than a conventional system (which will have much less functionality). In this context the life span of the equipment will normally far exceed that of the conventional system, therefore, it can be said that the more modern distributed control system will have a better economic lifespan.

Following the commissioning period on-going maintenance/service costs will be much less than conventional systems for several reasons, viz:

(i) There are essentially (aside from the printer) no wearing parts in the system.

(ii) The total number of units is less, 2 CRT's where there may have been sixty to seventy strip chart recorders.

(iii) Self-diagnostic routines are built into the system thus representing a saving in labour cost for the service man.

(iv) Repairs are effected at a board replacement level rather than component level.

Accurate cost comparisons for marine systems are not yet available, but it is expected that cost could be reduced by up to 40%. This is particularly the case if the service man can locate a fault, using in-built diagnostic routines, in say ten minutes as opposed to four to five hours on a conventional system. What is three to four hours of ship time worth?

Honeywell is a world-wide organization with service commitments in every area of the world. From this stand point Honeywell is able to offer world-wide support to any Honeywell system.

Paper 2.13 MONITORING SHIP SYSTEMS FOR OPTIMUM EFFICIENCY AND SAFETY

by

G. Edwards, Sydney Technical College
N. Holgersson, Digitec Pty. Ltd.
Captain A. Irons, B.H.P. Fleet Operations

DISCUSSION AND WRITTEN QUESTIONS

2.13.1 Mr. G. Griffiths, Australian National Line

I am interested as to whether there are really many engines which have this bearing weakness. We are fronting up ourselves to slow steaming and also increasing the maximum pressures. The people whom I talk to tell me that there is plenty of reserve. Recently, from my own personal experience, and without wishing to name a ship, I do know that there were problems. Is it really a big problem? A worrying problem in respect to the bearing loads when you are reducing the power and you are doing this, is it as serious as you might imagine?

2.13.2 Mr. A.R.L. Tait, Bureau Veritas

I would like to say it is a privilege to make comment to this paper and I have done so by way of comments in small type and questions are brought out in italic type as follows:

The paper is to be applauded for the early statement clearly indicating 'safety' as of paramount importance, as where lives are at stake no risks should be taken in the introduction of devices which by themselves seem to be excellent but in combination with many other pieces of equipment represent information in too cumbersome and too many locations all at once which would tend to distract the decision-maker from essentials.

Thus the idea the paper presents of having a centralized navigation cockpit type of display with a reduced number of parameters appears to be one answer which may go a long way of solving the problem of too much indigestible information.

Therefore I would like to ask the authors -

(1) *How international standardization of a navigational cockpit display and its layout should be achieved?*

This in a similar way of course to the way in which aircraft instrumentation is agreed on to some extent.

(ii) *What is the authors' indication on the preferred method of setting out of the display in preparation for discussions by an international body such as IMCO or similar organization?*

It is certain that the perhaps up to now a somewhat conservative approach to the Maritime Industry has put it in a good position to now make a selective decision from a large choice of electronic devices for presenting information.

My next question is about loading calculators, as these instruments are currently quite sophisticated and have computerised capacity, and though the paper seeks to present data on a way that prevents collisions or damages I would like to ask -

(iii) *Have the authors any views on providing loading calculators with means of determining undue critical stresses that may be caused by a catastrophe such as flooding of various compartments and/or the loss of important parts of the structure, etc. which would thus give the master help in the decision of whether to abandon ship or not, or in the case of a grounding whether the salvage expert should arrange to tow off or leave until some temporary repairs can be effected?*

I can not entirely agree that the shortest distance between two points will achieve the shortest time on passage and most fuel saving. Knowledge of ocean currents and local ones as well as weather patterns and expected sea conditions should be taken into account, and the input of same will form a factor in deciding on the route to be followed. For instance, the facimile weather data could allow a master to decide on whether a high or a low latitude route should be taken between Capetown and Fremantle and which would be most acceptable.

Once the route has been chosen however the idea of redesigning the autopilot to reduce rudder drag is a valid one.

One aspect the paper does not touch upon is the monitoring of skin friction, thus -

(iv) *Do the authors have any ideas on how continuous service knowledge about the hull and paint roughness can be provided apart from the infrequent use of periodic underwater cleaning and dockings, and do they feel any benefit could be so derived?*

The engine room with its multitude of functions and metering devices is one area where the micro-chip can really come into its own and the degree of sophistication now capable whilst aiding and elmiminating certain chores does allow the engineer to pay more attention to containing fuel costs and making economies, and in my view it is this area that good personnel actually on board can make decisions that shore based staff even monitoring by telex constantly would be hard put to be better at in speed and efficiency. The shore based staff are at the disadvantage in time scale and though can and must provide a good overall review it is the 'Johnny on the spot' who has to act.

The possible computer aid of graphical displays telling the engineer in charge how his engine is performing is one solution, so -

(v) *Do the authors have any views on how all the parameters mentioned in thier paper may be best shown graphically against master curves of acceptable upper and lower limits of performance?*

Their very valid point that half the auxiliary power may be absorbed by main engine auxiliary equipment and that savings may be made by variable speed motors and additional smaller units for low-demand situations is worth considering even if it may entail additional capital outlay, the point that secondary units would reduce running hours and wear and tear maintenance on the main units should not be ignored.

The authors suggest the use of ring-main or duplicate loop circuits for relaying information to a VDU (visual display unit) at the central control room -

(vi) *In view of the relatively low cost of computers and VDU's do the authors feel justification in duplicating the computer centre and placing one in the engine room control room and one in the chart room or emergency centre?*

I feel the paper will provide food for thought and interest both ship's staff and management.

Finally, I suggest that though it would be just about possible to design and instal a ship with a conglomerate of gadgetry and so programme it to leave its berth in a European port to arrive safely at an Australian port, but emphatically I fully endorse the author's viewpoint that highly trained personnel are required as a necessity and that sophisticated equipment is there for their assistance and not the other way round.

The emphasis should always be on the choice of calibre of the man selected.

These views are purely personal and not necessarily those of the Society.

AUTHORS' REPLIES

In reply to Mr. Griffiths: yes, it is a problem. Strange as it may seem, the number of top end failures are more than people care to admit. I have not specifically raised the matter, but we have got another problem too. If we let out engines get out of time to a fairly gross extent, and I refer to maybe 10° or 15° more advanced than they should be, we are compressing not only the compressed air but the burning mix and the load coming on the bearing is extremely high. The bearing is not suitable for good lubrication. It is a rocking action bearing, therefore it does not build up sufficient lubrication. MAN have taken the step in which they use a very high pressure pump to push oil underneath; so they have taken it seriously. Sulzer's use a slightly higher pressure, but on top of that is the problem that without fuels we have got a thing called Cetane number. Not a lot of people have heard about it but it is the ignition quality of the fuel and some of the fuel that is coming forward these days is nothing but a type of almost liquefied coal we are using fuels of 6000 Redwood seconds, an addition of 400 parts per million with sulphur up to 7%. This will rot your boots, let alone what it will do to an engine. Unfortunately, the situation is that we are confronted with these things. By way of explanation, centane number is the rate the fuel burns in the cylinder. Now, because on occasions there is a shortage of fuel type 'A' and an excess of fuel type 'B', the oil companies do their best to give you what you want. Unfortunately, there is a tendency for these different fuels to separate out in the tanks, so today you might be on fuel type 'B'; tomorrow you're on fuel type 'A'. There is a tendency sometimes for certain types of fuel to ignite more quickly than others. So, if one of the fuels ignites more quickly than the other and you have already advanced your injection timing to suit the first fuel then you have a problem when using the second fuel.

Mr. Tait's questions and comments are appreciated and we list hereunder our replies -

(i) We are not altogether convinced that to establish an international standard layout is desirable. What is considered necessary is that the basic idea is given official sanction. What is essential is that individual shipping companies standardise their own layout arrangements. What should be expected of the international organisation, IMCO, is that they should lay down basic principles.

Different ship types by nature of their trade or function, would probably require variations; a bulk carrier, say, would need a different approach to say a cross channel ferry.

(ii) Presumably the questioner is referring to a central display unit as advocated in the paper. If that be so, it is felt that such a display should not dominate the scene, but be located perhaps above the central front wheel house window, with controls at a lower level. The display should be alpha numeric in its data presentation and should be interfaced with all pertinent instruments which are required to be called upon for information under conditions where a multiplicity of information is required quickly. No more than three items of information should be displayed at any one time; more would cause confusion.

We would not agree that the Maritime Industry is conservative, cautious perhaps. The industry has been in the forefront of accepting technological change and has perhaps made better use of it than many other industries. We are of course referring to the responsible operators. The Maritime Industry more than most, recognises that the man himself is the most reliable piece of machinery to invest in. If the investment is not sound, i.e. by employing half trained or even non-trained personnel, then all other investment in modern technology goes down the drain.

Finally, whether IMCO discusses the matter is dependent on pressure from member governments and it is doubtful whether governments are even aware of the problem. Who educates the politicians?

(iii) One major supplier (Kockumation, Sweden) of loading computers has for several years offered an additional Damage Stability program for their computers.

Kockumation also offers a unique system for control of casualty actions called *T 90*. The system is operated by means of a typewriter terminal connected to a conventional telephone line. The *T 90* program is available round-the-clock through General Electric, Mark III Computer services.

The basic program consists of four sections:

AA Lightweight data, capacity table and permissible limits of shear forces and bending moments

BB Description of initial condition

CC Description of casualty (flooding, grounding, etc.)

DD Actions to be taken after casualty.

An extended version of the basic program which takes account of transverse stability is available as an option. This program also covers damaged stability. Additional programs to suit the owner's specific needs will be available on request.

The *T 90* system was recently successfully demonstrated in a simulated rescue operation of a grounded ship at Port Hedland by salvage specialists from United Salvage, Melbourne.

(iv) and (v) An engine monitoring and alarm system designed around a microprocessor including one or several BDU's can be programmed to display engine condition parameters and trends graphically.

The new bulk carrier *M/V Howard Smith*, has such a system with one VDU in the control room and another in the chief engineer's office.

In order to measure and graphically display engine performance parameters, special sensors, fast input devices and high resolution graphic programs are required. It will then be possible to include programs with manufacturer's master curves plus upper and lower limits superimposed. Digitec Pty. Ltd. 'Dieseltune' computer system has these facilities.

EXHIBITION & FILMS

UNISEARCH HOUSE

University of New South Wales

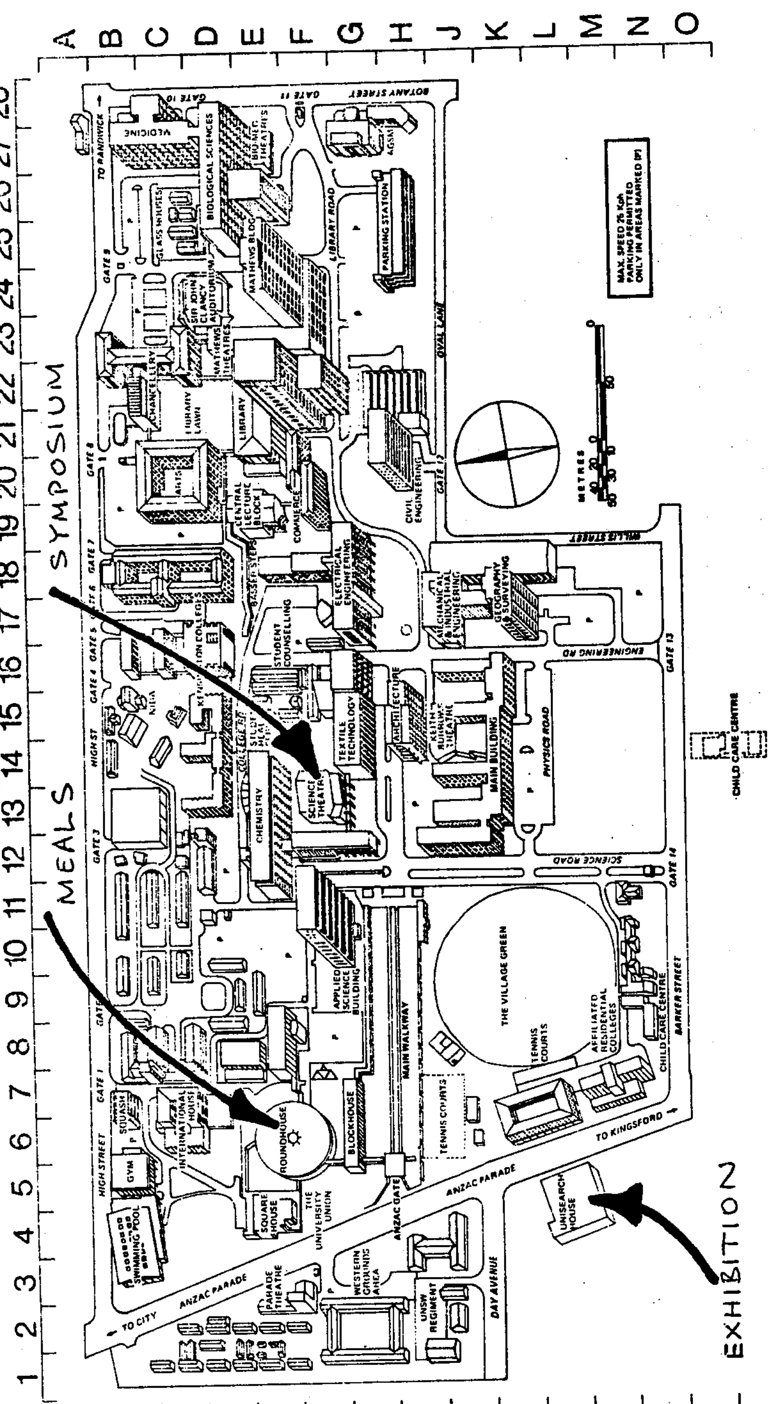
2-5 November 1981

Exhibitors

Alfa-Laval Pty. Ltd.
Amalgamated Wireless Australasia Ltd.
Australian Maritime College
British Petroleum Australia Ltd.
Bureau Veritas
Carrington Slipways Pty. Ltd.
Decca Marine
M.J. Doherty Pty. Ltd.
Det norske Veritas
G.E.C. Diesels Australia Ltd.
Greenwich Marine (Electronics) Pty. Ltd.
Hamworthy Engineering Aust. Pty. Ltd.
Hawker Pacific Pty. Ltd.
Hawker Siddley Aust. Pty. Ltd.
Hercus Marine Design
Honeywell Pty. Ltd.
Krupp Australia Ltd.
Lloyds Register of Shipping
Maritime Services Board of NSW
M.W.M. Diesels-Far East (Pte) Ltd.
New South Wales State Dockyard
Process Oil and Gas Controls Pty. Ltd.
Professional Societies
Ship Technology Group
Vickers Cockatoo Dockyard Pty. Ltd.
Zodiac Inflatable Boats (Aust.)

Films

The Ship And The Engineer	British Petroleum Australia Ltd.
British Adventure (b & w)	" " " "
British Sovereign (b & w)	" " " "
200,000 Reasons	" " " "
We've Come A Long Way	" " " "
They Chose The Sea	" " " "
Tanker	" " " "
Dawn of an Industry	" " " "
Address Antarctica	" " " "
Planet Water	" " " "
Power On Earth	Hawker Siddley Aust. Pty. Ltd.
Game Between Science & Reality	Antelope Engineering Pty. Ltd.
Gas Turbine Power	Rolls Royce of Australia Pty. Ltd.
Australian Offshore Ladies	Australian Offshore Services
Marine Gas Turbine	Rolls Royce of Australia Pty. Ltd.
Introducing Niigata	Ekedo Pty. Ltd.
Z.P. Manufacture	" " "
Z.P. Operation	" " "
Tension Towing Winch	" " "
Gas Transport 'Paul Kayser'	G.A.Z. Transport
Ahoy Tugboat	Dunedin Harbour Board
Sail Assisted Tanker	Japan Trade Centre
Columbus Wellington	Columbus Line
Columbus Tonga	" "


SYMPOSIUM
MEALS
EXHIBITION
ROUNDHOUSE
SCIENCE THEATRE
UNISEARCH HOUSE
THE VILLAGE GREEN
MAIN BUILDING
MAIN WALKWAY
CHEMISTRY
APPLIED SCIENCE BUILDING
TEXTILE TECHNOLOGY
ELECTRICAL ENGINEERING
LIBRARY
BIOLOGICAL SCIENCES
PARKING STATION
CIVIL ENGINEERING
GEOGRAPHY & SURVEYING
BLOCKHOUSE
THE UNIVERSITY UNION
SQUARE HOUSE
INTERNATIONAL HOUSE
SWIMMING POOL
GYM
ANZAC PARADE
HIGH STREET
BARKER STREET
BOTANY STREET
DAY AVENUE
WILLIS STREET
ENGINEERING RD
PHYSICS ROAD
SCIENCE ROAD
LIBRARY ROAD
OVAL LANE
TO CITY
TO KINGSFORD
TO RANDWICK
CHILD CARE CENTRE
MAX. SPEED 25 Kph
PARKING PERMITTED
ONLY IN AREAS MARKED (P)
METRES

The University of New South Wales Kensington Campus 1981

Theatres

Biomedical Theatres E27
Central Lecture Block E19
Classroom Block (Western Grounds) H3
Electrical Engineering Theatre F17
Keith Burrows Theatre J14
Main Building Theatrette K14
Mathews Theatres D23
Parade Theatre E3
Science Theatre F13
Sir John Clancy Auditorium C24

Buildings

Affiliated Residential Colleges
New (Anglican) L6
Shalom (Jewish) N9
Warrane (Roman Catholic) M7
Applied Science F10
Architecture H14
Arts (Morven Brown) C20
Banks F22
Barker Street Gatehouse N11
Basser College C18
Biological Sciences D26
Central Store B13
Chancellery C22
Chemistry
Dalton F12
Robert Heffron E12
Child Care Centre (Off-campus) O14
Civil Engineering H20
Commerce (John Goodsell) F20
Dalton (Chemistry) F12
Electrical Engineering G17
Geography and Surveying K17
Goldstein College D16
Golf House A27
Gymnasium B5
House at Pooh Corner N8
International House C6
John Goodsell (Commerce) F20
Kensington Colleges C17
Basser C18
Goldstein D16
Philip Baxter D14
Main Building K15
Maintenance Workshop B13
Mathews F23
Mechanical and Industrial Engineering J17
Medicine (Administration) B27
Menzies Library E21
Metallurgy E8
Morven Brown (Arts) C20
New College (Anglican) L6
Newton J12
Parking Station H25
Philip Baxter College D14
Robert Heffron (Chemistry) E12
Sam Cracknell Pavilion H8
Shalom College (Jewish) N9
Sir Robert Webster (Textile Technology) G14
Squash Courts B7
Swimming Pool B4
Unisearch House L5
University Regiment J2
University Union (Roundhouse) — Stage I E6
University Union (Blockhouse) — Stage II G6
University Union (Squarehouse) — Stage III E4
Wallace Wurth School of Medicine C27
Warrane College (Roman Catholic) M7
Wool and Pastoral Sciences B8

General

Accountancy F20
Admissions Office C22
Anatomy C27
Applied Geology F10
Applied Science (Faculty Office) F10
Appointments Office C22
Architecture (including Faculty Office) H14
Arts (Faculty Office) C20
Australian Graduate School of Management G27
Biochemistry D26
Biological Sciences (Faculty Office) D26
Biomedical Library F23
Biotechnology D26
Bookshop G17
Botany D26
Building H14
Cashier's Office C22
Centre for Medical Education Research and Development C27
Chaplains E15a
Chemical Engineering and Industrial Chemistry F10
Chemistry E12
Child Care Centre N8
Civil Engineering H20
Closed Circuit Television Centre F20
Commerce (Faculty Office) F20
Committee in Postgraduate Medical Education B27
Community Medicine D26
Computing Services Unit E21
Drama D9
Economics F20
Education G2
Electrical Engineering and Computer Science G17
Engineering (Faculty Office) K17
English C20
Examinations and Student Records C22
Fees Office C22
Food Technology F10
French C20
General Studies C20
Geography K17
German Studies C20
Graduate School of the Built Environment H14
Health Administration C22
History C20
History and Philosophy of Science C20
Industrial Arts C1
Industrial Engineering J17
Institute of Languages G14
Institute of Rural Technology B8b
Kindergarten (House at Pooh Corner/ Child Care Centre) N8
Landscape Architecture H14
Law (Faculty Office) E21
Law Library E21
Librarianship F23
Library E21
Lost Property F20
Marketing F20
Mathematics F23
Mechanical Engineering J17
Medicine (Faculty Office) B27
Metallurgy E8
Microbiology D26
Mining Engineering K15
Music B11b
National Institute of Dramatic Art C15
Nuclear Engineering G17
Optometry J12
Organizational Behaviour F20
Pathology C27
Patrol and Cleaning Services F20
Philosophy C20
Physics K15
Physical Education and Recreation Centre (PERC) B5
Physiology and Pharmacology C27
Political Science C20
Postgraduate Extension Studies (Closed Circuit Television) F20
Postgraduate Extension Studies (Radio Station and Administration) F23
Psychology F23
Public Affairs Unit C22
Regional Teacher Training Centre C27
Russian C20
Science and Mathematics Course Office F23
Social Work G2
Sociology C20
Spanish and Latin American Studies C20
Student Amenities and Recreation E15c
Student Counselling and Research E15c
Student Employment C22
Student Health E15b
Students' Union E4
Surveying K17
Teachers' College Liaison Office F15b
Tertiary Education Research Centre E15d
Textile Technology G14
Town Planning K15
University Union (Blockhouse) G6
Wool and Pastoral Sciences B8a
Zoology D26

SEA TRANSPORT TECHNOLOGY 1981

SYMPOSIUM DINNER

organised by

The Institute of Marine Engineers
(Sydney Branch)

in conjunction with

The Company of Master Mariners of Australia

The Royal Institution of Naval Architects
(Australian Division)

and

The Naval Architecture Section of
The University of New South Wales

TUESDAY, 3rd NOVEMBER, 1981

"THE ROUNDHOUSE"

University of New South Wales
Kensington

Chairman: Mr. W. F. ELLIS F.I.E.(Aust.), F.I.Mar.E.

TOASTS

Her Majesty the Queen

Proposed by Mr. W. F. Ellis, F.I.E. (Aust.), F.I.Mar.E.
Chairman Sydney Branch
The Institute of Marine Engineers

Our Guests

Proposed by Mr. J. C. Jeremy, B.E., C.Eng., F.R.I.N.A.
President Australian Division
The Royal Institution of Naval Architects

Response: Mr. J. M. Wallace, A.S.T.C., F.E.I.(Aust.)
President the Maritime Services Board
of New South Wales

The Chairman will introduce the

Guest of Honour

PROFESSOR H. BENFORD,
B.S.E. (Nav.Arch. & Mar.Eng.)
University of Michigan U.S.A.

Reply by The Chairman

MARITIME TECHNOLOGY AND THE AUSTRALIAN ECONOMY

by

HARRY BENFORD
Professor
Naval Architecture and Marine Engineering
The University of Michigan
Ann Arbor, Michigan, USA

(An address to the November 3 joint meeting of the Sydney Branch of the Institute of Marine Engineers, the Australian Division of the Royal Institution of Naval Architects, the Company of Master Mariners of Australia, and the Naval Architecture Section of the University of New South Wales)

I have been called from halfway around the world to speak to you, which I do now -- but with mixed feelings.

First there is the element of flattery inherent in receiving such an invitation. But, there is also the element of doubt. I am not at all convinced that I am so steeped in wisdom as to have any left over from my own immediate needs.

One of the best illustrations of the dangers of ignorance is told by the American columnist Bill Buckley. It's a true story about his in-laws. His mother-in-law had a fair amount of money in her own name, but was perfectly content to let her rather close-lipped husband handle her investments. She, meanwhile, was active in the local women's club -- to which she was in due course elected President. One evening at the dinner table she proudly announced her first triumph as President: After months of hard politicking and hard negotiating she had succeeded in having the club's monthly luncheon meetings shifted from the Mayflower Hotel to the much superior Algonquin. "Perhaps you ought to know," her husband replied, drily, "you own the Algonquin."

Another example of dealing in ignorance is one I can cite first hand. We once had as house guests a young couple from Berlin. When they first came in the door I meant to say to the young lady (in German) "Won't you take off your coat?" What I actually said (clearly and distinctly in my flawless broken German) was, "Won't you take off your clothes?" Her 200-pound husband, who was hulking right behind her, saw the humor in it -- otherwise I wouldn't be here making a fool of myself tonight.

At the risk of spoiling the fun for you, I have tried to overcome my ignorance by reading some Australian history. In doing so I soon came to realize that few nations on earth have been -- and are -- more dependent on ocean commerce -- a fact made plain by your Governor General in his opening address. Let me cite numbers that I ran across in my studies: Although Australia ranks only about 40th in population among nations of the world, it ranks 17th in amount of international trade (1979 data). I am sure we could go even further and claim that few, if any, nations have benefited so richly from innovations in marine transport. It occurred to me, then, that the theme of my talk should be along the lines of the role of technical innovation: past, present, and future. I do not intend to go into much detail, however. Mr. Evans' opening paper stole my stuff regarding the past. The rest of the papers are saturating the present and -- to an extent -- encroaching on the future.

Despite all that, a few observations may still be in order. In particular, in reading your history I was struck by the number of technological developments that, while not directly pertaining to ship design or construction, have nevertheless improved your nation's maritime links with the rest of the world -- and hence your prosperity and welfare.

I refer, for example, to improvements in navigation. We can start with the inimitable Captain Cook. He was the first explorer to carry such aids to navigation as a nautical almanac and a chronometer. He was also among the first to overcome the curse of scurvy; although -- and this surprised me -- he did it with sauerkraut, not lime juice. Which leaves for further research why we call English sailors "Limeys" and German sailors "Krauts."

In the late 1940's, with the advent of better methods of navigation, came the innovation of great circle sailing. This, they claimed, saved over a thousand miles between the Cape of Good Hope and Melbourne.

In 1855 Matthew Maury (an American, I cannot resist adding) published wind and current charts that were also of great help to Australian commerce -- as were his plots of magnetic compass variations. In asking mariners to send him their observations on wind, weather, and currents, Maury said, "Every ship ... may henceforth be regarded as a floating observatory or a temple of science."

Maury later claimed that as a result of improved knowledge the average voyage time between Europe and Australia was reduced from 18 weeks to 14 -- a 22 percent improvement. Not bad!

The invention of the chronometer and publication of the nautical almanac made exploration more valuable. Indeed, among all the great explorers of history, James Cook was the very first to record precisely the location of any new discovery. John Noble Wilford in his recent book, The Map Makers put it this way: "It would never be said of an island Cook discovered that it could not be found again." The new precision in navigation had a ripple effect in opening for navigation the Torres Straits, the passage inside the Great Barrier Reef, and, finally, Bass Strait. Each such shortcut obviously served to improve Australia's maritime commerce, both domestic and foreign. Of course in this electronic age navigation is undergoing continual improvement -- a fact that I need not belabor here.

So much for improvements in navigation. There were other important technical innovations that came along in other industries and which were exploited in our own. Bessemer's 1880 invention of a new steel-making process is a good example. He at once reduced the cost of steel from 50 per ton to 10. That sealed the doom of wood as a shipbuilding material and made more practical the use of steam propulsion -- another land-based invention exploited for our own maritime purposes.

Improved communications made fleet management a lot easier. The highlight here was the completion of the first submarine cable between Europe and Australia, in 1872. Radio and satellite communications have since then brought Australia even closer to the rest of the world, but the cable was the single biggest step.

My final example of the role of non-maritime ideas adapted to our purposes is mechanical refrigeration. Mr. Evans has spoken eloquently of your own inventors' role in this and the beneficial impact of reefer ships on Australian meat exports. In this regard I was delighted to read how one of the earliest reefers, a ship named the Protos, in 1880 carried a cargo of frozen mutton to England. The holds were insulated with some eight inches of wool. Upon arrival in England, the insulation was ripped out and sold to a textile factory. I can visualize the customs house bureaucrats debating whether the shipowner had thereby sold part of his cargo or part of his ship.

My delving into Australian history uncovered some tid-bits of a sort that may help explain the Australian psyche as we find it today. Let me cite a few examples:

The first settlers, arriving in 1788, brought only one kind of medicine -- that universal cure-all, wine. I don't need to tell you that this affinity for spiritus frumenti has long since disappeared from the antipodean scene. Nevertheless, history records that it had its impact on your transport systems. To be specific, I refer to the primary mode of transport in the outback around the turn of the century: camel caravans. The entrepreneurs who introduced those beasts of burden to Australia found it also expedient to import Muslim drivers from Pakistan. It seems that one of the major cargos carried by those ships of the desert was beer, rum, and gin destined for hotels and other public accommodations. Only Muslims, with their strict religious scruples against imbibing, were found worthy of trust in this tempting trade.

It is also recorded that some of the farmers of Tasmania had a drinking problem forced upon them. Those who lived on the north side of the Derwent River had to use a ferry to get their bullock carts and produce to Hobart. In 1826 the land commissioners complained to the governor about the quality of the ferry service. As they put it:

> The Passenger has to endure the misery of delay for perhaps three or four hours before he can cross, and obliged to listen to the isolence of a set of ruffianly Boatmen ...

The commissioners went on to explain that the problem was exacerbated by the malignant proximity of two public houses, one on each side of the river. Referring to the typical farmer, the commissioners concluded, "... if he steers clear of Scylla, Charbydis in all probability engulphs him."

Here is another pertinent fact from history. In the mid 1800's steerage-class immigrants were expected to sleep four to a berth. These six-foot square mattresses were jammed together, separated only by twelve-inch coamings. Privacy was obviously somewhat less than complete. Worse -- or perhaps better -- still were the interesting connubial and semi-connubial combinations and permutations that might develop, whether by accident or design, as two married couples snuggled down beneath a common blanket. An emigration officer at London named Lieutenant Lean (which rhymes with mean) spoiled all the fun, however, by forcing shipowners to divide those four-place berths with another twelve-inch coaming down the middle. An early example of government interference in private affairs. Really private affairs!

But, enough of looking back. I want to ask you to think for a moment about present directions in maritime technology -- and how we may prepare to adapt ourselves to what is bound to be a rapidly changing future.

I do not mean to go into detail. Let me simple point out that since World War II the basic productivity of merchant seamen (as measured by ton-miles per man per year) has increased by a factor of ten in the liner trades and no less than 25 in the tanker trades. These remarkable achievements have come about because of technological progress, combining sound engineering with entreneurial management. They are all the more remarkable when you consider the hindrances erected by outmoded regulations, the super conservatism of underwriters and financial institutions, and (at times) the obstructing tactics of a few misguided labor leaders.

As regards the future of our technology, I am optimistic enough to believe that the current rate of progress will be maintained -- and possible exceeded -- in the decades ahead. This, however, is by no means assured. The world is full of influential people who overtly or covertly stand in the way of technological change. You know who they are. In addition to those mentioned a moment ago we have overly-zealous environmentalists and a weird spectrum of collectivists who oppose free enterprise and use whatever shillelagh they can to bludgeon the private sector of the marine industry. They are allied with the anti-technologists who dream of a reversion to an idyllic pastoral existence that never was.

(As you can see, like Ko-Ko, I've got a little list. By popular request I shall not try to sing it.)

To continue, there are government employees whose task may be either to support the marine industry or to regulate it. In either case their hands are firmly tied by legal constraints. As time goes on even the most enlightened government administrator may be frustrated in his willingness to help the marine industry adapt to changing economic imperatives or technical improvements.

I cite this dreary litany, not to throw a pall over the proceedings, but because I think it important to recognize and understand our problem. We need to develop our abilities to distinguish real problems from fatuous obstacles put up by obstructionists. We need to communicate and compromise with those reasonable and responsible individuals who speak with justification on the other side of the issues. And, finally, we need to develop an awareness of public relations and to develop the political clout to beat back the gamut of pathological obstructionists of the several varieties just mentioned.

Many of you will recall Noel Mostert's notorious book Supership, published in 1974. There was a diatribe that blackened the collective eye of our entire global marine industry. In truth, there were (and are) a few fly-by-night quick-buck tanker operators who deserve Mostert's harpoon. His wrath, however, encompassed all tanker companies; and, like it or not, the entire maritime fraternity suffered a precipitous drop in public esteem from which it has yet to recover. When Mostert's libelous screed appeared, did any official spokesman for the marine industry anywhere in the world speak up in our defense? To the best of my knowledge the answer in a lamentable no.

Friends, this is but one example of our failure to appreciate the importance of developing public awareness of what we are trying to do. I suggest that each of our maritime-related technical societies formally organize an administrative vehicle to foster public appreciation of our industry. Where technical issues are clear-cut this activity should encompass explaining those facts to political leaders and molders of public opinion. Such a program, I admit, may engender heated debate within our own ranks. Yet, I contend, to determine the truth and to speak it is an inherent part of our responsibilities. We owe it to the public no less than to ourselves.

I am afraid I have been stressing the negative factors, those that inhibit technical progress. Let me go on to speak of some of the positive factors. To begin, let us optimistically recognize that many of our problems can become spurs to progress. The high cost of stevedoring led to the container ship; the high cost of shipboard labor led to shipboard automation and the rationalization of shipboard duties. The high price of fuel oil is now leading to rapid developments in marine engineering, sail-assisted power, and so forth -- as exemplified by a large proportion of the papers being presented at this symposium.

As engineers we should (perhaps selfishly) rejoice that new problems invariable come along to replace those that we have solved. Without problems and the necessity to change, who would need engineers? Managers could make do with old blueprints, and we engineers would be out on the street.

Technological progress, of course, is not something we engineers invented for our own benefit. It has raised mankind from a brutish existence, and its achievements are something of which our profession should be proud. Of more immediate importance, perhaps, is the role technology can play in keeping high-wage nations, such as Australia, competitive in the maritime world.

In my own country -- and I suppose it is true here, too -- one often hears it said that we have to pay our workers high wages because we have a high standard of living. That is a popular misconception. The truth is that we have a high standard of living because (on a national scale) our workers are highly productive; the large number of units (or services) turned out per worker per year generates enough income to allow him to be well paid. Hourly pay is high, but unit labor costs are low.

The question next arises: What is needed to allow our workers to be productive? I should list eight factors, each of which is absolutely essential:

1) First of all, we need large investments in labor-saving devices.

2) If it is a manufacturing enterprise (such as shipbuilding) we need mass production techniques, which need implies a standard design for series construction.

3) We need ambitious, skilled workers who look upon themselves as part of a team encompassing both their fellow workers and all levels of management.

4) As a corollary to No. 3 we need enlightened labor leaders and enlightened managers who can induce esprit de corps and avoid divisive internal confrontations.

5) We need a strong cadre of highly qualified, imaginative entrepreneurial managers -- including energetic salesmen.

6) We need engineers who can envision new designs to meet customers' needs, and who can work with managers to make their designs both easy to build and easy to operate.

7) We need well-funded, well-balanced R&D programs to give our engineers the best possible tools with which to do their work.

8) Finally, we need a rational body of laws administered by reasonably sympathetic bureaucrats. Both the laws and the bureaucrats, moreover, must be readily adaptable to changing needs and opportunities.

Those are the eight ingredients of success. Have I proposed an impossible recipe? Difficult, yes; but impossible, no. Our friends in Japan have put it all together. They work hard, they work smart, and they work together. We in the United States have at last come to realize that Japanese success cannot be explained away simply as the exploitation of cheap labor. The Japanese have set us all a splendid example, and we now have enough humility to admit that we can learn from them.

This leads me to cite an example of how we in the United States are trying to catch up in shipbuilding. I refer to the Ship Production Committee. This large and active group is under the aegis of the Society of Naval Architects and Marine Engineers, but receives its financial support of about $4.4 million a year from the federal government's Maritime Administration and the U.S. Navy. The Committee's central aim is to find ways to lower the cost of building ships in American yards. Most of the participating shipyards take the lead in one or more technological areas and share their findings with the other yards. Most of the brainpower is supplied by the yards (about a million dollars worth per year), but the Maritime Administration and Navy both contribute personnel as do other federal agencies and the American Bureau of Shipping. This collaborative effort has been operating now for a full decade and has produced some remarkable successes -- and only a minimum of failures.

Until a couple of years ago the Ship Production Committee seemed to be oblivious to a serious shortcoming in the U.S. shipbuilding effort. That shortcoming was caused by a gap that had over recent decades developed in our educational programs nationwide. Somehow, as we worked ever harder to improve our students' ability to do high class technical analysis, we had let slip from our teaching nearly all reference to the shipbuilding process itself. At my own institution we suddenly awakened to this sad fact at exactly the same time the realization dawned on the Ship Production Committee. That led in 1980 to our staging (with support of the Committee) a one-week intensive course in shipbuilding technology for the benefit of shipyard managers. Most of the lectures were provided by engineers from Japan's eminently successful IHI shipyards. I am pleased to add that we at The University of Michigan are now moving to institute a regular sequence of courses in ship production and producibility in our undergraduate and graduate curricula.

In his 1969 bombshell book, The American Challenge, Servan-Schreiber predicted eventual American domination of European industry. His foreboding has not come to pass. This is not because he was wrong in assessing America's potential strength, but because our politicians unwisely chose to dissipate our energies. We engaged ourselves in a fruitless war and a program of space research that diverted too large a share of our engineers and scientists from real-world problems. We also allowed our politicians to impose a system of taxation that discouraged the public from investing in corporate stock. Worse yet, that tax money was poured into ever-growing welfare schemes that all but turned our country into a coast-to-coast soup line. As a result, productivity increases over the past decade have slowed almost to a halt. Public sentiment in the States now recognizes our past mistakes, and we may yet prove Servan-Schreiber right. In any event I would call to your attention these key sentences from his book.

> Behind the success story of American industry lies the talent for accepting and mastering change. Technological advance depends on virtuousity in management. Both are rooted in the dynamic vigor of American education. There is no miracle at work here. America is now reaping a staggering profit from the most profitable investment of all -- the education of its citizens.

This leads me at last to the core of my message to you. If you want to survive in world competition you must allow your highly paid workers to be highly productive. The first step is to offer generous support to pertinent R&D (both basic and applied) and to pertinent education of managers and engineers (often in combination). Moreover, if you want your research dollars to be most effective, you should be sure that a reasonable share of them go into your universities. That is where your basic research is most effectively done and where its findings are most efficiently disseminated. Moreover, if the Australian maritime industry is to attract its share of bright young talent, it must offer financial inducements -- and university research contracts provide a convenient vehicle for such support.

I have another suggestion, too. With all its virtues, Australia cannot claim a large population. From this I should conclude that its technical societies might be marginal as regards numbers. From this I should further conclude that there is wisdom in the cooperation that I see here this evening between your four sponsoring groups. I commend Tom Fink and the other pioneers who instituted this cooperation a decade ago. I also commend all of you who are managing the current conference. Your names are too numerous to mention -- but I want you to know that your good work is appreciated, and so is that of your wives. Such joint society efforts seem to me to be the essence of wisdom. My only suggestion is that you should meet more often -- at least once a year.

You will be glad to hear that I am running out of voice and out of time. My emphasis this evening has been on how to look to the future and survive in a changing world. Perhaps it would be appropriate, before closing, to continue this forward look -- but from the perspective of an earlier date. I want to quote one of my heroes, John Scott Russell, the primary founder of the Institution of Naval Architects, professor of science, and builder of the Great Eastern. In 1865 he published a book in which he essayed to tell everything he knew about ship and engine design. The name of his book was "The Modern System of Naval Archtiecture." The sentence I shall read to you is pertinent to this evening's look ahead because it, too, was a look ahead. Moreover, it is made poignantly appropriate by reason of the friendly reception that I have recieved at your hands:

> We are rapidly approaching the time, when every voyage from our country to her colonies will be performed by ships built for the exact purpose of that trade, and so fitted in size and nature to the duty they are to perform, that the trade of the high seas will be performed with as much regularity, as little risk, and at as little, or less, cost as by the most economic and regular of modern railways; and when that happy time comes, we shall no longer have to go out of this world, ignorant of the beauty, and the kindliness, and the helpfulness of so many of the fertile, lovely, and teeming countries God has made, and peopled, and adorned, and blessed with countless food and wealth; but we shall all have been able to take with us a clear knowledge, a kindly recollection, a grateful experience, of its varied climates, of the wide scope of human kindness, of the boundless blessings that come of mutual human help and of the astounding wealth of all the blessings of human life, which in this world have been provided and stored up for us.

What more can I say except to endorse John Scott Russell's thoughts on the role we engineers can play in advancing not only human welfare but also human relations around the world. Ours is an international industry. That implies international competition. But, it also implies international cooperation for, please believe me, we are all better off if we recognize our common interests and strive to enhance our human contacts and exchange of technical information. This theme is echoed in a letter that I bring you from John Nachtsheim, the President of the Society of Naval Architects and Marine Engineers. He writes as follows:

> Dear Harry,
>
> It's my understanding you will be meeting with the Sydney Branch of the Institute of Marine Engineers, the Australian Division of the Royal Institution of Naval Architects, the Company of Master Mariners of Australia and the Naval Architecture Section of the University of New South Wales some time in November.
>
> Would you be kind enough to convey my personal greetings and those of all the members of the Society of Naval Architects and Marine Engineers? We don't learn of personal contacts such as this with our professional colleagues in distant places too often, but when we do, I think we should all be reminded that there is a strong professional bond which we share and we should take such an

opportunity to reinforce it. I would appreciate it very much if you would do that and please, don't ruin it by telling them any of your American jokes.

There is one additional message I would ask that you convey. We have read with great interest of the Australian initiative in commissioning three coal-fired colliers in the 80,000 dwt class. A technical paper conveying the design, economic and operational features of this design would be read with great interest in this country. Please ask if someone has or plans to prepare such a paper on this subject.

Thank you, in advance, for carrying these messages.

Have a safe and rewarding trip.

Very sincerely yours,

John Nachtsheim
President

P.S. Maybe <u>one</u> joke would not damage our international relations too much.

So let me bring this talk to a close.

I am grateful to all of you for this opportunity to express my sentiments. Yours is a nation of seemingly unlimited natural resources. If my thoughts can in even small measure help you to exploit wisely those resources for the benefit of mankind, my efforts will have been amply rewarded.

Dear friends, let me now propose a toast. Please stand and join me in a salute to the societies.

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