INTERNATIONAL COUNCIL FOR
THE EXPLORATION OF THE SEA

C.M. 1990/B:18
Fish Capture Committee

INTEGRATING WHEELHOUSE ELECTRONICS AND LAYOUT ON BOARD DUTCH BEAMTRAWLERS

by

A.M. Buys
Netherlands Institute for Fishery Investigations
P.O. Box 68, 1970 AB IJmuiden
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Abstract

Dutch fishing is very individualistic. Most shipping-companies are family businesses. That's why a great diversity of equipment is found in a wheelhouse of a Dutch beamtrawler. The large amount of equipment and all the noise of it can confuse the steersman, which with safety interferes. Investigation proves that more and more fishing vessels are involved in collisions on the North Sea. A state of the art of a modern beamtrawler is given. Studies in the merchant marine prove that an integrated wheelhouse is much safer. In collaboration with the Technical University at Delft a new design for a better wheelhouse is being developed.

Contents:

Introduction

In Holland fishing is an old and traditional industry.
Yet tradition the introduction of modern techniques has not stopped.
Ships grew larger and modern technology is used.
The shipowner is in most cases the skipper.
In the wheelhouse it is full of sophisticated electronics for navigation and also gearhandling. The amount of electronic equipment causes confusion to the steersman, which with safety interferes. Reports and analyses of the last years contribute to the fact that fishing-vessels are involved in more collisions at sea. Studies done for the wheelhouse in Merchant vessels are claiming a new wheelhouse concept with integrated navigation-functions. With a view to ergonomic principles and safety RIVO is investigating the possibility to integrate equipment on Dutch beamtrawlers.
In collaboration with the University of Delft, a new design of an integrated navigation unit is in development.
Also a total redesign of bridge layout will be done in the future.
The state of the art of modern wheelhouse electronic interfacing is presented here.

The modern beamtrawler wheelhouse

The skipper, in consultation with the shipyard has a wide range of the equipment to choose from. Shipyards specialize in mechanical engineering and have less knowledge about electronics, which means that the choise is made by the future skipper. In spite of the almost standard beamtrawler design, no two wheelhouses are the same.
A great diversity of equipment is found in the wheelhouse. Choice of equipment is based on experience with the previous equipment. Time to visit a fishery exhibition was not available. Lack of experience which modern electronics often makes skippers opt for well-tried equipment. Modern equipment is not always understood: 'My son always programs this piece of equipment'. A "package deal" with a supplier is the most common way to install a wheelhouse. So most of the equipment is from a single manufacturer. This is an advantage, when it means that equipment can be interconnected (interfaced). All equipment must have a carefully selected position in the wheelhouse allowing a good view. Equipment is often grouped by type and function.

List of bridge equipment according to bridge tasks:

Cruise planning:	-Sea chart	
	-Video trackplotter	
	-Autopilot	
	-(Communication)	
Track monitoring:	-Compass	
	-Decca, Loran C, Satnav, GPS (Global Position System)	
	-Video trackplotter	
	-Sea chart	
	-Radar or ARPA	(Automatic Radar Plotting Aid)
Observation:	-Radar X-band	
	-Radar S-band	
	-ARPA	(Automatic Radar Plotting Aid)
	-Look-out	
Operating:	-Autopilot	
	-Rudertiller / wheel	(in Manual steering mode)

	-Autopilot overruler -Rudder indicator -Motor controls -(Propeller Pitch controls) -Bow thruster controls
Depth monitoring:	-Sounders, two or more frequencies
Communication:	-VHF (channel 16) -VHF (Fishing frequencies, docks, harbour) -VHF Scrambler -MG / KG-transceiver (2182 kHz) -Satcom, Telex, Fax -Ship's intercom
Engine room monitoring:	-Control panel or computer system -Alarm signal indicators -Video screen with engine-room overview.
Winch operation:	-(Boardmains generator) -Winch motor operation -Fishline drum SB, Fishline drum PS -Topping drum SB, Topping drum PS -Jumper drum SB, Jumper drum PS -Sliplines drums.
Documentation / Updating:	-Video trackplotter -Sea chart -Paperwork (obligatory)
Miscellaneous:	-Watch alarm (obligatory) -Public radio, Stereo equipment -Controls for bridge, deck, fishing en navigation lights -Controls for heating, window wiper etc. -Coffee machine

The layout of modern beamtrawler wheelhouses has been studied by RIVO, and the outcome recorded in a report. Several beamtrawlers of 2000 hp or more were visited so as to obtain a representative picture of this fleet. An inventory was made of their electronic equipment and the layout of the wheelhouse recorded in a layout drawing. A great diversity of layouts was found to exist.
Despite considerable differences, there also are similarities. A front console and two side consoles are found in all wheelhouses. The front console may take various forms. There are types with cut away at the centre, on the wings, to allow access to the windows , or not at all. This is necessary because operating the winches requires a good view on deck. Every skipper / owner has his own ideas on this point. Single handed navigation while operating the winches still presents a problem. Judging by the diversity of wheelhouse layouts, the ideal solution has not yet been found.
Yet the report reveals that there is a tendency towards a standardised layout. An examples is shown in Figure 1.The front console is cut away in the middle.

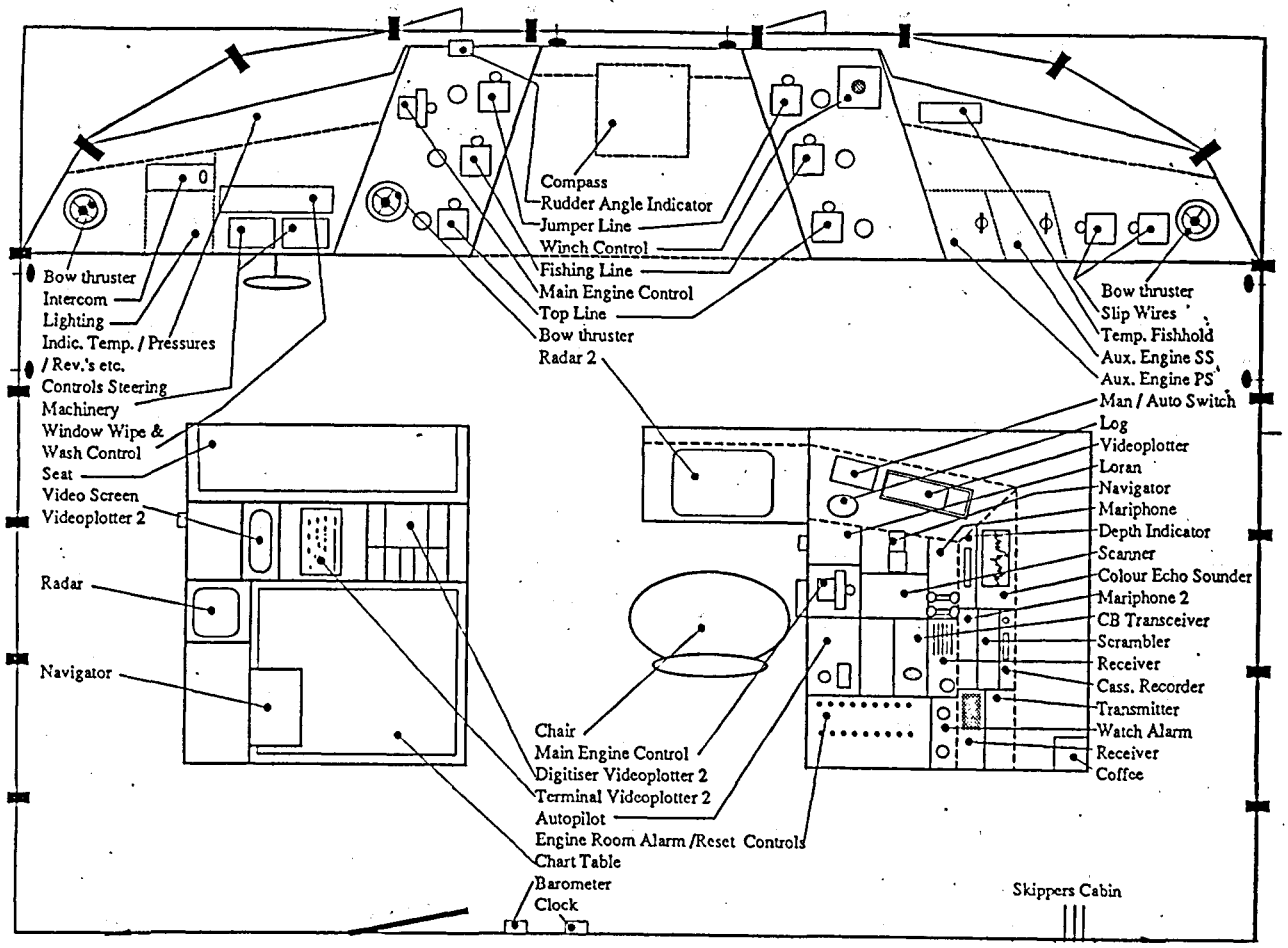

Figure 1, Bridge arrangement of a modern beamtrawler.

Most equipment is in duplicate, as an older and a recent model (e.g. a paper trackplotter and video trackplotter) or with overlapping functions (e.g. X-band radar and S-band radar). De advent of electronic sea chart (called ECDIS = Electronic Chart and Display Instrument) also plays a role. Almost all beamtrawlers still have a chart-table beside a modern video trackplotter. Position-finding equipment used to be found in close proximity to the Sea-chart. Nowadays this equipment is found near the video trackplotter and autopilot. The video trackplotter receives the position data from the position-finding equipment. On one beamtrawler the chart-table has already been abandoned. The introduction of the fully electronic chart still awaits government regulations regarding safety and standardisation. Consultations on this point are still taking place. On one beamtrawler an ARPA has been installed. The obligatory watch-alarm is not fully functional: it is easily switched off or rendered useless with a foot or secret switch.

The report remarks:

- Latest modern beamtrawlers have a similar wheelhouse layout.
- Simultaneous winch operation and navigation is a problem.
- Equipment is in duplicate. As a safety precaution
- Equipment is grouped according to function, with maximum interfacing.
- Navigation is done by means of a video trackplotter: the sea-chart is becoming redundant.
- The obligatory watch-alarm is not fully functional.
- A better watch-schedule in the wheelhouse will reduce problems of drowsiness.

The new wheelhouse in the merchant marine.

Studies have recently been done in West-Germany, Japan, France and the Netherlands, aimed at creating a new type of merchant vessel. Improvements were made in the areas of design, operation, maintenance and performance. Naturally, attention was paid to the wheelhouse layout as well. The principal aim was that of safe navigation with economical, single-handed bridge operation. As Dutch demersal fishing also deals with single-handed bridge operation, a closer look into some wheelhouse designs can be useful. All types of wheelhouses are designed according to ergonomic principles, with due consideration to man / ship interaction.
This covers aspects such as (H.Schuffel *et al* 1987):

Software	-Procedures, rules, regulations
Hardware	-Displays, controls, process dynamics
Environment	-Climate, vibration, noise
Lifeware	-Motivation, stress, skill

The merchant marine wheelhouse is designed for safe sailing from quai to quai. Special arrangements are made for cargo control and route planning. In fishing priority is different. Routing depends on the catch results and winch operation is a major activity in the beamtrawler wheelhouse. Safety aspects are only considered as a personal interest of the skipper and a few regulations.

Example 1: Bridge 90 (1985-1987)

The Dutch TNO Institute for Perception designed a 'Wheelhouse for the Nineties' according to ergonomic principles. An improved wheelhouse results not only from the use of better equipment but also from the integration and automation of equipment and tasks (H. Schuffel *et al*, 1985-1986). This prompted the design of a new wheelhouse where most functions were presented on screens. With recent few years collisions at sea in mind, scenarios were made and tested in the new wheelhouse environment. It emerged that some of this collisions could have been prevented. Also track-keeping simulations, with additional tasks for the steersman, were performed in an old and a new wheelhouse. There was far less route deviation in the new wheelhouse.
The wheelhouse design features an M-shaped console, with holds all the presentations and controling equipment.(Figure 2) This console comprises a navigation display, a motor monitoring system, a panel for telecommunication, manoeuvre operation controls and a semi automatic sea chart.

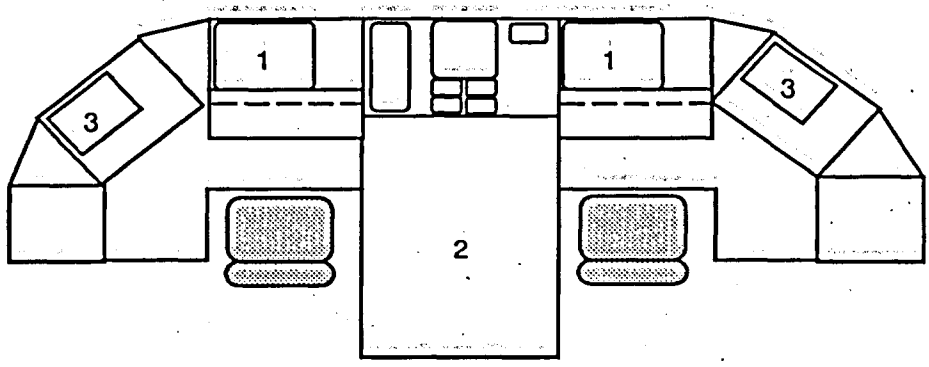

Figure 2, Console of 'BRIDGE 90'
1. Navigation screen, 2. Semi-electronic chart, 3. Engine room monitor

The semi automatic sea chart is designed before the development of electronic sea chart (ECDIS). Nowadays electronic charting, based on computers, is available but not

allowed by government. This console is designed for one operator but a second workspot is provided for a pilot or second officer in difficult waters. The navigation display presents ARPA functions and all shipsmanoeuvre data (Figure 3).

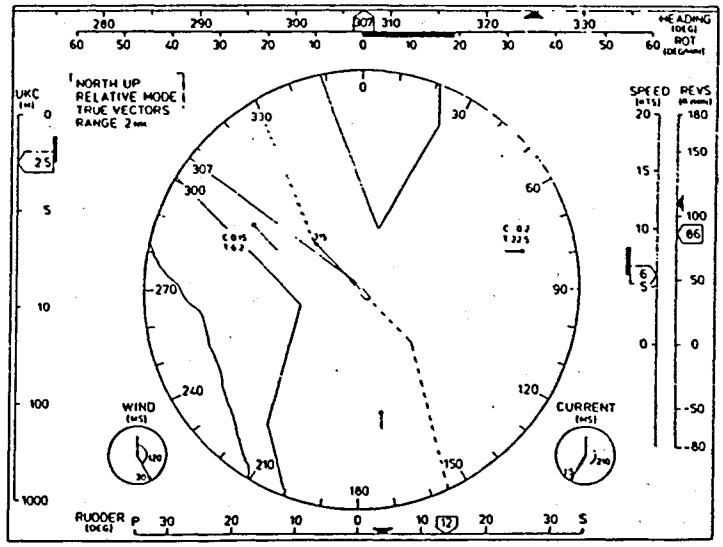

Figure 3, Navigation display of 'BRIDGE 90'.

Example 2: 'Schiff der Zukunft '(1981-1983)

Commissioned by the "Bundesminister für Forsung und Technologie" several German research institutes have designed a "Schiff der Zukunft". In this project some wheelhouse designs were produced. One especially draws attention because of its unusual form. A benefit of this wheelhouse's asymmetrical shape is the availability of good lines of vision in all directions especially to Starboard. Navigation data is presented on screens. In the navigation panel an ARPA is included for the man on duty. An engine room monitor system is also available. There is a panel which contains all telecommunication equipment. A semi automatic chart table is also found in this wheelhouse (Figure 4). This wheelhouse design is already a little bit outdated, but it is implemented in some merchant vessels and also in the German research vessel '*Meteor*'.

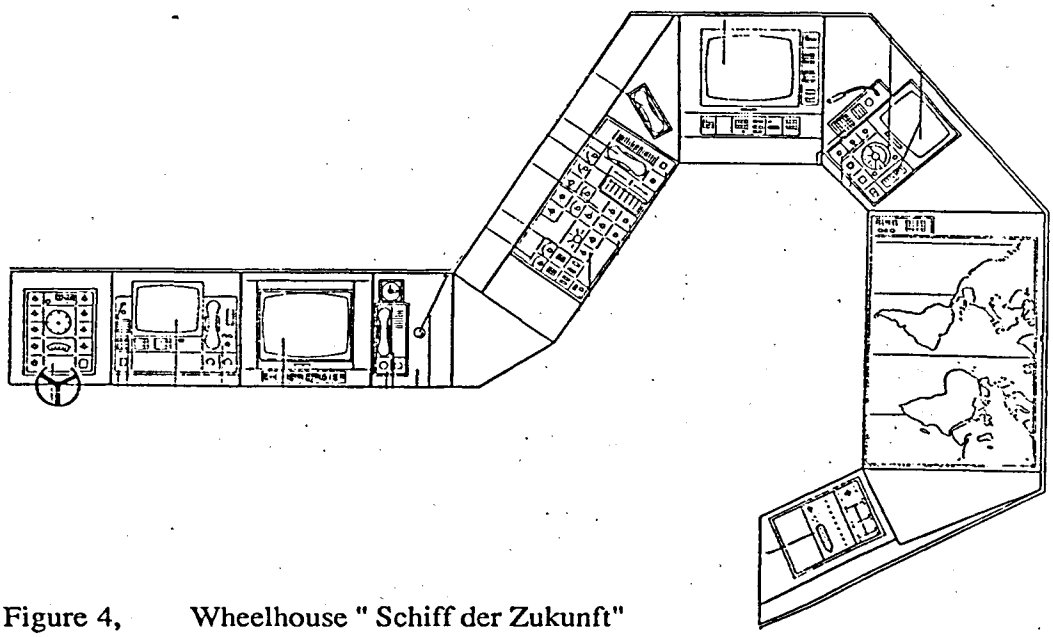

Figure 4, Wheelhouse " Schiff der Zukunft"

Example 3: Commercially available integrated navigation system.

Navigation equipment manufacturers are also developing new wheelhouse systems. Integration made possible by modern electronics is in vogue. The performance of the video trackplotter is more powerfull. The standard radar is transformed to a powerful ARPA. An example of a commercially available bridge is in Appendix 3. The ships's control centre is again an M-shaped console with screens.

Interfacing and integration of Bridge equipment

State of the art.

Bridge equipment was developed in the form of individual units for specific tasks. Today's units are still that way, but they are more sophisticated. With new electronic technology, each unit performs a lot more including the possibility of communicating with other instruments. Dutch fishermen take advantage of these interfacing possibilities. Years ago interfacing with analog signals was already done for DECCA equipment. Nowadays interfacing is done by digital signals.

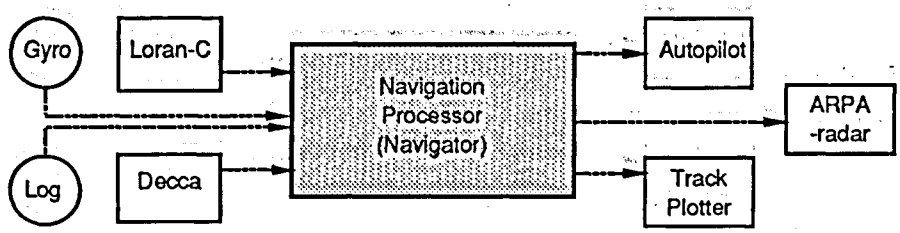

Figure 5, Navigation Interfacing

Problem caused by interfacing is that different units display and operate the same data. Different alarms due to the same data can emerge. Confusion can occur. Problems occur because manufacturers develop there one interface protocols. Interconnect equipment of different manufacturers will be a problem then. To interface most of the units a user has to use equipment of the same manufacture or use some extra interface units. So for finding the best equipment for a new vessel interfacing requires attention. One integration or interfacing problem is still not adequately solved. Merging radar data and plotter data can cause shadow images due to bad position data. In the near further will this be solved by better position data through the use of GPS and fast computers, providing true position calculation.

A fully integrated video plotter is found in Appendix 1. It integrates and simultaneously display data from a Sounder, ARPA, navigator, while also providing telex communication, data logging and plotting functions. A test at the Dutch MARIN Institute showed it to be not yet satisfactory.

Marine Electronic Interfacestandards.

The call for an interface standard is obvious. Since 1980 manufacturers of Loran-C equipment have launched the NMEA-180 standard, the NMEA-182 standard and the NMEA-183 standard (NMEA = National Maritime Electronic Association). The last one is nowadays generally used by manufacturers, but not always compatible . NMEA-183 protocol provides hardware and software protocols. Software protocol must been seen as a telegram, with an device address and data string. The addressed unit will extract the data.
Other accepted interface standards are: Furuno CIF, RS-232 and switched or puls-driven. Furuno's interfacing possibilities are shown on Appendix 2.

Conclusion and follow up

In the merchant marine an integrated bridge is a fact. The merchant marine, of course, is a large market for these kind of products. Fishing industry is not. Nevertheless fishing can have benefit of the new developments in the merchant marine. Special arrangement must be created for implementation in fishing vessels.

Regarding the Dutch beamtrawler wheelhouse the following can be summarised:

- Todays beamtrawler bridge is fitted with dedicated units, with maximum interfacing.
- Interfacing of bridge equipment creates not a better wheelhouse.
- From the point of view of safety an integrated wheelhouse can have his benefits.
- Integration of units and presentation of data can be done by use of CTR-screens.
  1. Central Navigation Display, with all the data of navigation, ships movements and sounder data.
  2. Engine room monitor system. (Already on the market).
  3. A redesign of the wheelhouse layout will be needed to facilitate simultaneously winch-operation and navigation.

Running projects:

- In cooperation with the Technical University at Delft, a user interface is being developed for the Central Navigation Display.
- In cooperation with the Technical University at Delft and the school for fishery, Urk, a layout redesign will be made.

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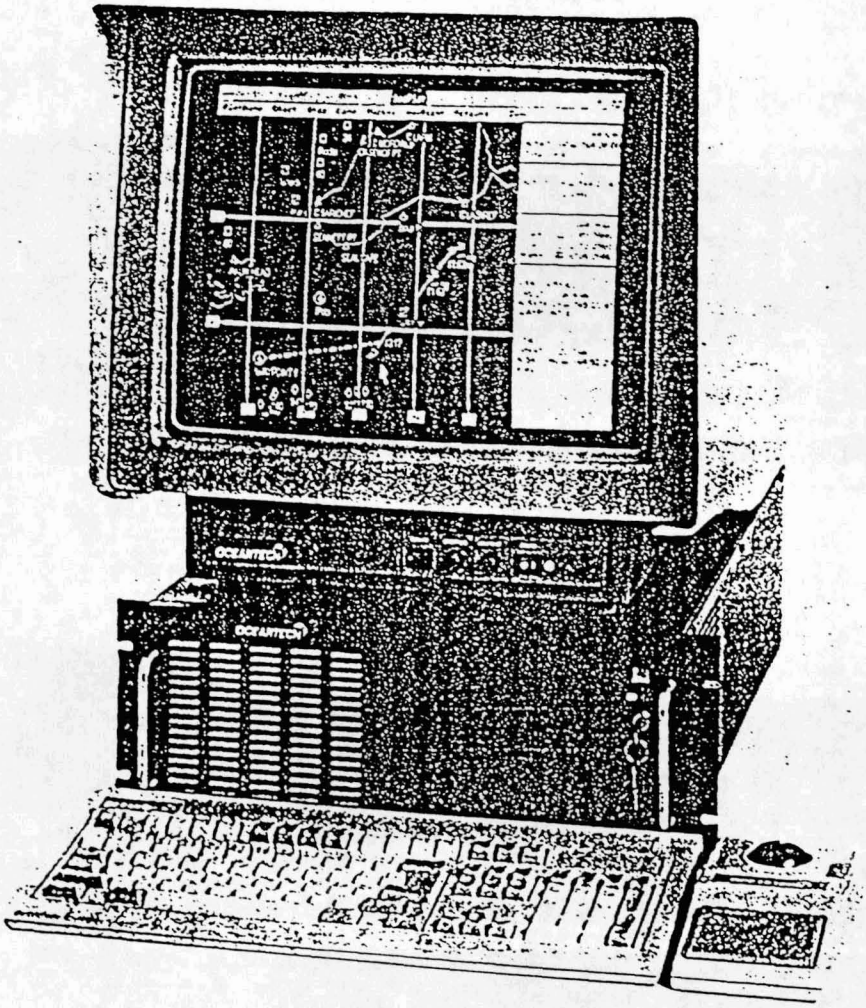
Appendix 1

GEAR & EQUIPMENT

First colour video plotter to be fully integrated

claims OceanTech Inc



The first colour video plotter to integrate and simultaneously display data from a depth sounder, ARPA radar and navigator, while also providing telex communications, data logging and advanced plotting functions has been introduced by OceanTech Inc of Seattle, USA.

SeaPlot 286R automatically displays and saves depth information from an echosounder; fishermen can now have a continuous and accurate collection of depth information for their favoured grounds. Up to five depth strata can be defined and a separate colour assigned to each, allowing the user to display only the desired depth ranges. Colour-coded bathymetric contours can then be created and displayed from depth data collected.

The unit displays up to 40 moving targets, acquired using ARPA radar, and target trails can be turned on or off. This model currently operates with Krupp Atlas ARPA radars, although it will be able to operate with other brands by the middle of this year.

Telex communication is available and SeaPlot serves as a telex terminal for Sitor-capable radios; it can transmit, receive, store and print messages.

Free software upgrades

OceanTech says that this is the first video plotter for the commercial fishing industry that can be maintained as state-of the art, via software upgrades. Software upgrades are supplied free of charge for one year after purchase of the plotter.

Memory capacity

The term performance takes on a new meaning with this model's memory capacity of over three million points of internal storage in up to 400 plots. Access to plots is instantaneous. According to Macgill Lynde, president, "This eliminates low memory problems, having to delete existing plots, slow loading of data and having to keep track of various cartridges, discs or tapes. SeaPlot 286R is very fast and can draw 1000 points in under two seconds. We have eliminated the problems that most fishermen experience with other plotters."

Catch- and ship's log

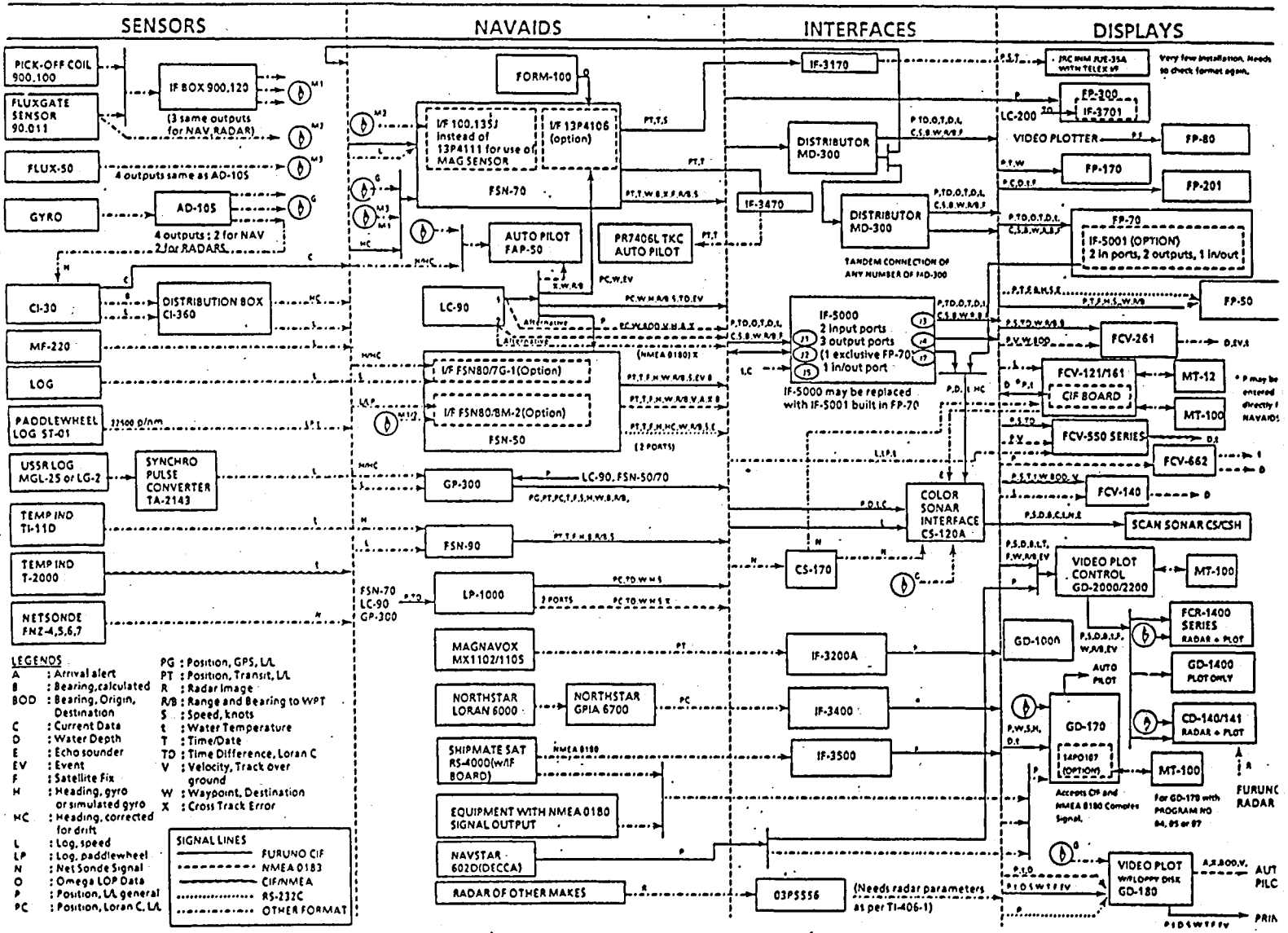
Other features include an automatic and integrated catch log and ship's log. The catch log automatically marks the ship's track, records ship position, date, time, depth, sorts catch data and produces reports.

The SeaPlot 286R is designed for ease of use, with all the commands being selected from on-screen menus, via a trackball. The unit is constructed around the toughest, marine-grade, rack-mountable computer equipment available. It is fully IBM PC/AT compatible and provides the versatility to run other IBM programmes.

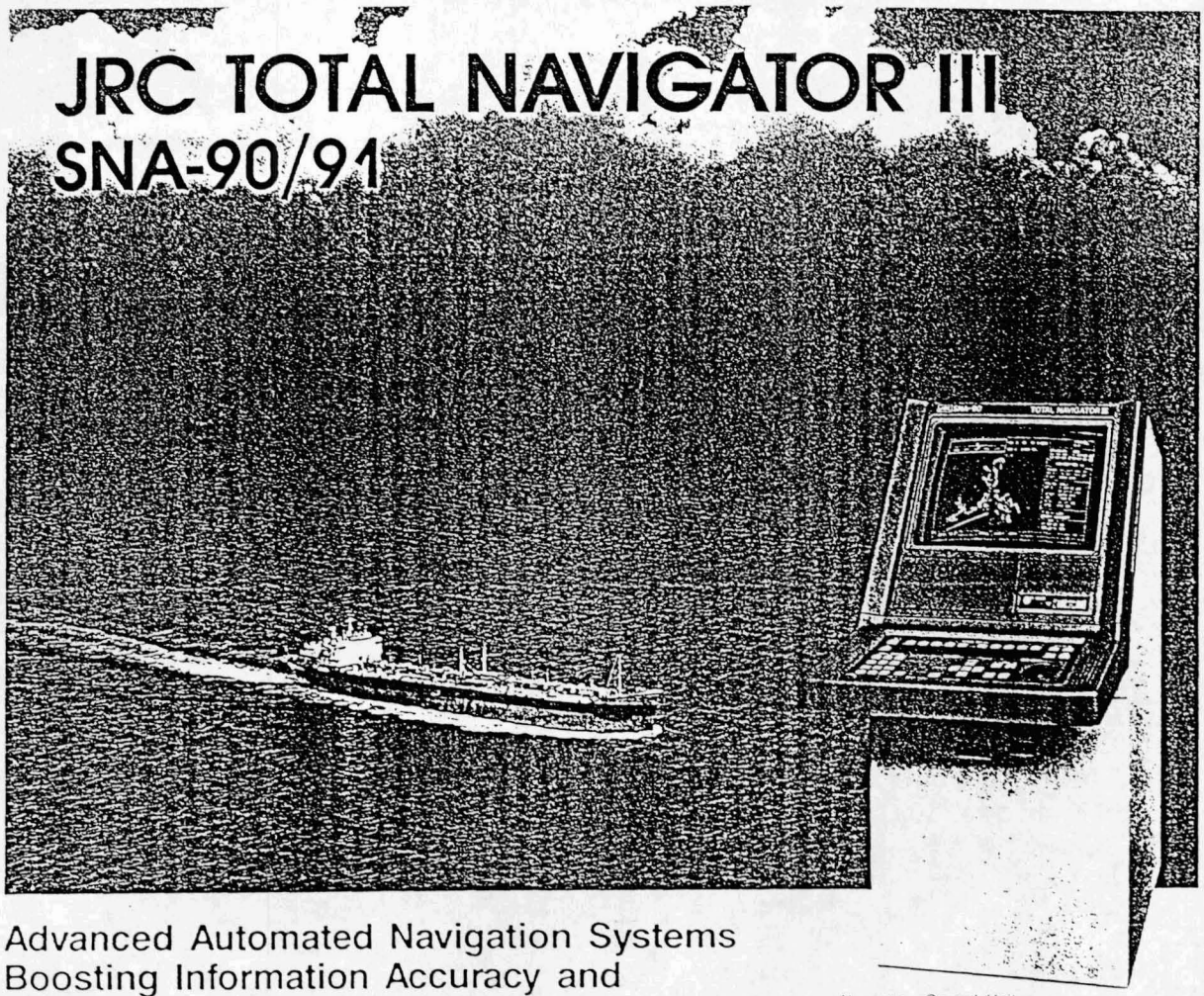
OceanTech has standardised on the NMEA 0183 data format and interfaces with any navigators, Loran, GPS, SatNav, depth sounders and autopilots which use NMEA 0183; Furuno CIF is also supported.

FURUNO

INTERFACING CHART



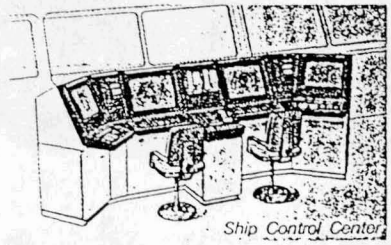
Appendix 3



Advanced Automated Navigation Systems Boosting Information Accuracy and Labor Efficiency

Bridge automation is the most important requirement for today's ocean-going ships. The new SNA-90/91 Total Navigator III automated navigation systems are designed to dramatically enhance bridge operations through the adoption of easy-to-read displays, permitting faster pickup of accurate information, and ergonomically simple operation control.

The basic system consists of a navigation control unit, two ARPAs, a planning terminal, a read-out printer and a digitizer tablet. The navigation control unit, connected to sensors, features a 20" raster-scan multicolor CRT screen that provides a centralized graphic display of necessary information on navigation, weather, hull motions and engine status, as well as electronic charts.



Ship Control Center

Planning Terminal

Navigation Control Unit

- Centralized color graphic display of needed information
- High reliability backed by fail-safe functions and self-testing facility
- Automated navigation
  - Route planning based on ARPA data
  - Ship trail prediction according to planned route
  - Automatic autopilot control
  - Auto-logging and navigational calculations

Chart Digitizer *Printer*

*The SNA-90 is integrated with JRC 28" CRT type ARPAs, the SNA-91 features Raytheon 23" CRT type ARPAs.