UNIFIED AUTOMATION PRODUCTS

A FLEXIBLE CONCEPT FOR ALL
LEVELS OF PRESENT AND FUTURE
SHIP AUTOMATION SYSTEMS.

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NOR CONTROL AUTOMATION

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1 INTRODUCTION

Ship owners today focus more on life-cycle costs than they did a few years ago, when reducing initial costs was the main consideration. This can be seen with new classes of ships becoming very complex with much effort being put into work-reduction methods onboard.

In such ships, automation is extensive and might present installation, operation, maintenance and upgrading problems.

Norcontrol has developed a concept of unified automation products. In this concept, standard products are used to form automation systems of varying complexity adapted to the requirements of the ship.

These standardized products (for process I/O, generator control, level gauging, RPM control, man-machine systems, etc.) each use the same microprocessor technology.

One achievement in the development of these units has been to provide a very high degree of interchangeability of parts.

Ship owners benefit from these products by reduced stock-keeping, reduced maintenance training and safer operation because man machine systems are more uniform.

For the shipyard this means:

- A system concept for every type of ship, small and large, basic and advanced.
- Standardized units for minimum installation and commissioning costs.

  When new operational requirements occur, no change of technology is needed.

2 CURRENT TRENDS IN SHIP AUTOMATION

2.1 General

In most major shipping nations, research programs are performed to establish new standards for ship operation. The main driving force behind this is to maintain or to increase the competitive power of ship operation in relation to that of other countries. For the industrialized countries, this means that technological measures will be applied with respect to:

- Management by ship owners
- Design of ships
- Economic propulsion methods
- On-board automation

Such research programs are performed in Germany, Netherlands, Great Britain, USA, Japan and Norway. In Norway the activities under the program "Ship Operation of the Future" cover most aspects of ship operation such as:

- Health and environment
- Maintenance, energy conservation and operational efficiency
- Manning
- Automation and communication
- Training, education and management by ship-owners

The research program has led to the building of 3 pilot ships with which experience is now starting to be gained. These ships are equipped with an integrated ship automation system covering:

- Navigation
- Engine room control
- Cargo control
- Ship administrative functions
- Data communication with ship owner's office

This integrated automation system represents the probable future pattern in ship automation developments.

2.2

Life-Cycle Costs

For some time (and it is still continuing) shipbuilding has been focused on minimizing investments. In recent years, however, the cost of fuel has led to a fierce competition between engine builders on specific fuel consumption, g/ehkh. The reduction is from about 150 g/ehkh to 115 g/ehkh over a period of 10 years - more than 20%. In addition to this advances in hull and propeller design has led to similar reductions. While the increased complexity of the engines and ships has not led to an excessive increase in investment, life-cycle costs have been reduced. We expect this fuel race to continue, but attention is now starting to focus on other aspects of life cycle cost reduction. For some advanced ships, this means the captical expenditures ammounts to as much as 65%, on a yearly basis, as part of the operational costs. Ship owners now seem willing to try such ships in order to increase their competitiveness, as a reduced life-cycle cost is expected.

2.3

Manning levels

The development of allowed manning levels in Norwegian ships is illustrated in page 5. The level at present is a minimum of 14, but it does not take much imagination to foresee smaller crews onboard, to judge from the trend.

The Norwegian Ship Owners Association has published ideas of how to operate ships in the future, assuming a further reduction in manning levels:

- Watch-free operation in engine room from quay to quay. (Super E0)

- One man on bridge only (B1).

- A completely revised organisation of the crew, distinguishing between operation and maintenance personel rather than between engine and deck personel.

This means the man on watch alone must have complete command of the entire ship. This is a vital design factor for future automation.

2.4

Integrated Ship systems

Some concepts for Integrated Ship Systems Automation Systems are shown on pages 9 to 14

Such systems are now being introduced by leading manufacturers, having the inherent possibility of serving one man on the bridge with all relevant information. It also provides information for other purposes in other places on the ship. This information is usually more detailed than on the bridge and not very different from what we see today in the engine room and cargo control room.

Classification Societies are now introducing rules concerning the interaction of the various parts in an integrated control system.

Two key factors are at hand determining the future of such systems:

- International telecommunications

- The technology of interconnection of the various sub-systems into an integrated ship's system.

2.5

Telematics

The present build-up of telecommunication networks made possible by INMARSAT will present new opportunities in the operation of ships.

For the ship owner this can mean cheaper and better communications with the ship for:

- Routing
- Maintenance
- Harbour/docking
- Crew
- Cargo

These facilities do not, however, need a data link between the Ship Integrated Automation System and the SatCom system, a normal telex line is sufficient.

But, Satelitte communications will make datatransmission possible in the near future, with the setting-up of connections between the ship-owner's data base and data bases onboard.

Then other functions can be available, such as:

- Internationally recognized digital maps
- Information about the positions of other ships, course, speed and cargo
- Datalogging of maintenance information and other information directly affecting manoeuvring and general operation of the ship

Such information call for an integrated approach to ships automation, requiring some form of Local Area Network on-board.

2.6

Standardization of datacommunication

To achieve and integrated ship's automation system, various methods are possible.

a) All systems can be driven from one computer, eliminating the need for interconnection of a distributed system. The main weakness of this approach is the fatal effect of computer failure.

b) The shipyard could purchase various sub-systems from different manufacturers and by contract with each of them make their systems communicate by data links. This will demand a lot of computer expertise from the yard.

c) The yard could select a main contractor for this task.

d) The yard could buy the total system from one manufacturer.

Methods b), c) and d) are considered by Norcontrol to be possible approaches, but particularily approach b) and c) will mean that major manufacturers must agree on how to communicate on data links. If that is not agreed, the result will be excessive costs on every delivery.

Norcontrol has entered into cooperation with other Norwegian ship automation suppliers and research institutions, with the aim of establishing a communication agreement for a local area network. The nature of this agreement is not to make new standards for communication, but to ensure that major suppliers agree on a common international standard. So far, it seems that the Open System Interconnection model (OSI) from the International Standard Organization will be used. This is a standard which has world-wide recognition for data communication. This research project is coordinated with international bodies for electrical standardization of ships. By this approach, Norcontrol will:

- Deliver complete integrated ship automation systems based on an internationally-recognized data communication standard.

- Deliver part-systems into integrated ship automation systems based on the same standard.

2.7

Standardization of products

On the highly-rationalized ships of the future, easy operation and maintenace will be demanded. This will, in turn, minimize training demands for operational personel. As an example of today's practice, bridge instrumentation currently consists of a large number of different instruments from different suppliers. As the bridge so far has been manned by 2 or 3 persons (by regulations), a more rational bridge design has not been much considered. The present crew manage the bridge effectively anyhow.

Norcontrol assume that this will change and that standardization of products for operation and maintenance reasons will be increasingly specified. Some years ago Norcontrol started a development program with the aim of eventually supplying a total ship's integrated automation package. By using common microprocessor technology with operator stations using the same type of functional keyboards and displays, Norcontrol have designed and produced common technology products for:

- Navigation
- Engine room control
- Cargo control

To a large externt, interchangeability of parts is achieved by this consept. Eventually these systems will be extended with standardized datacommunications as described in para. 2.6, so that an integrated ship's automation system is realized.

These standardized products are described under the heading UNIFIED AUTOMATION.

3 MODULES FOR UNIFIED AUTOMATION

3.1 General

When considering the design of new automation products, Norcontrol had a background of delivering very complex systems. One of the aims was to be able to deliver virtually any level of automation, including complex systems. To be able to do this, Norcontrol razionalized its development of products by creating technology and products which could be used in many applications with slight changes only.

The two first (and basic) modules developed were:

1) **The Signal Acquisition Unit (SAU 8800).** This is basically a microprocessor unit for sensor signal acquisition. The signals are digitized and conditioned and passed to a Signal Processing Unit on two serial data transmission lines. The specification for the SAU single-board computer allows for future extensions.

2) **The Signal Processing Unit (SPU 8600)** was designed originally as an alarm system, using SAU 8800 units as sensor interfaces. The SPU 8600 was also designed with overcapacity as future extensions were planned. It is a multi processor computer using microprocessor technology. The latest extension includes high-resolution colour graphics displays.

All other products in the current range are based on these modules. These products can be connected in various configurations to create different systems.

These products are described later, with particular emphasis on automation. Norcontrol's navigation systems are built with the same parts used for the SPU 8600.

After 15 years of experience with on-board computer, Norcontrol have learnt how such units are treated on-board. The environmental factors affecting the systems are:

- Electromagnetic noise radiation
- Overcurrent
- High/low Temperature
- Weak earthing
- Vibration
- Saltspray
- Moisture

All these factors are tested. The tests are recogniced by Classification Societies, who issue type approval certificates.

In addition to our expertise about installation of on-board computers, Norcontrol have a very wide knowledge of ship's operations. This expertise is particularily reflected in the design of the operator interfaces. Simplicity is the key factor. Norcontrol is also able to act as consultants for total automation projects.

3.2

Signal Acquisition Unit (SAU 8800)

The Signal Acquisition Unit (SAU 8800) is a complete microprocessor unit for measurement, monitoring and control.

It comprises a 32-channel input-output system. Each channel can be used for analog, digital and/or event counters. Plug-in adaptors on each channel allow for direct connection to a wide range of process sensors and control devices.

The SAU 8800 includes an operator's panel for indications of alarm status and readout of process values for each channel on a four digit display.

Functional pushbuttons enable inspecting or changing values, limits, timedelays, type of channel, etc.

Each channel may be set to either analog or digital, input or output. Five (on-site) channels can in addition be used for time between events measuring. The 32-channels may be any mixture of inputs or outputs.

Each input channel is prepared for two alarm limits, low and high-limit for analog and open or close for digital inputs. The time delay can be selected for each channel from 0 to 60 seconds.

For easy reading of values a choise of scaling factor is included and may be selected individually for each channel. The readout on the numerical display will then be in technical units.

In addition, an on-line test program and a complete off-line faultfinding program are included in the program package.

The SAU 8800 may be controlled by one or by two centrally-located host computers.

Each SAU 8800 is individually addressable with up to 20 SAU 8800 units connected to the host via one asyncronous, full duplex serial link.

To secure the communication between the SAU 8800 and the centrally located host computer, a number of checks are made on the signal.

All changes done from the operator's panel at the host computer such as alarm limits, time delay etc, will be read down to the SAU 8800 and stored in non-volatile memory.

In case of a break-down in communication or host computer, a TIME WATCH-DOG will switch the SAU 8800 to back-up mode. In this mode, the SAU 8800 will function as a complete stand-alone system giving full back-up monitoring and control. Outputs for acoustic alarm and back-up group alarms are provided.

In cases of a SAU 8800 failure, a hardware monitoring circuit will give the alarm and set all outputs to a predetermined FAIL SAFE value.

3.3

Generator Control Unit (GCU 8800)

The Generator Control Unit is a self-contained unit for automatic management and control of electrical power generating equipment.

The GCU 8800 controls start-stop sequences, synchronizing, loadsharing, and monitoring with compact size, high reliability, easy installation and low cost.

The GCU 8800 includes all necessary functions for automatic operation of the most commonly used electrical power generating units:

- Auxillairy Diesel Generator
- Turbo generators
- Maine Engine Driven Generator
- Shaft Generators

All generator parameters are programmed on-site during commissioning. The system's main functions are:

- Start/stop of diesel
- Connect/disconnect of circuital breakers
- Synchronizing
- Symetric load-sharing
- Asymetric load-sharing
- Load-dependent start/stop of stand-by generator
- "Black-out" start of stand-by generator
- Light/blended fuel selection (load and time dependent)

Complete power management systems need one GCU 8800 per generator. Up to ten GCU 8800 can be connected together, interconnected by a communication bus.

The GCU 8800's may be connected to the DataChief-7 system by a serial communication link.

3.4

Level Gauging Unit (LGU 8800)

The LGU 8800 is part of the SAU 8800 family, designed for level measurement.

Special features for level measurement are:

- Specific gravity can be programmed for each measurement point.
- Better resolution of measured values (up to 4 digits).
- Possibility of combining measuring points, i.e. calculate trim/list from draught measuring points.
- When connected to a monochrome monitor 3 different pictures can be selected, displaying tank levels as a bar chart.
- An indicator shows per cent level in the tanks.
- Can display level, ullage and volume.

3.5

Programmable Controller Unit (PCU 8800)

The PCU 8800 is a general-purpose programmable controller for use in rough environments such as ship's engine rooms or industrial plants.

It is designed to take care of process controls such as:

- Sequence control of ships machinery.
- Valve control for cargo systems.
- Control of temperatures, pressure, etc.

The PCU 8800 can combine such tasks in one unit with a maximum of 288 channels. A number of PCU units can be used in paralell. They can be connected to a supervisory system, DC-7, thus forming parts of an integrated supervisory and control system.

The PCU 8800 is programmable during commissioning using a portable dataterminal. Easy-to understand BASIC is used for programming, replacing ladder-diagrams or logic symbols. The PCU 8800 can be operated from its front panel or remotely from the supervisory system (DataChief-7).

The main purpose of the PCU 8800 is to take care of almost all control tasks in a ship's engine room. It thus can superseed most of the local, stand-alone control equipment normally used in an engine room. It can also be used for cargo control and other processes.

In addition to this, the PCU can be connected to a ship's supervisory system such as the DataChief-7. In this way higher optimization of operation economy can be achieved.

The PCU 8800 is therefore a vital unit for a highly automated future ship, where higher degrees of rationalization and operational economy are needed.

3.6

Digital Governor System (DGS 8800)

The Digital Governor System (DGS 8800) is a complete package which fulfils all tasks for governing the speed of low-speed, diesel engines. The speed setting may be from two different systems, usually the bridge control system and the engine room control system.

The system can be fitted to both fixed pitch (FPP) and controllable pitch (CPP) propeller systems. The system responds to slow-down and shut-down signals from external safety systems. Fuel-saving features, such as load limiting functions, are included.

The DGS 8800 provides computerized handling of all measurements and control signals. It includes panel push-button flexibility to select, adjust, and test the system performance. Movement of the fuel servo is done by an air-cylinder, with compressed air as the power medium.

The main purpose of the DGS 8800 system is to regulate the position of the engine fuel servo, in order to maintain an engine speed equal to a reference setting. The system is composed of two separate and self-contained subsystems: The speed Regulating Function and the fuel Actuating Function.

The main objectives of the Regulating Function are:

- Speed reference computation.
- Speed measurement and filtering.
- Automatic adjustment of regulating filter to adapt to engine and load conditions.
- Set and limit the command signal to the fuel actuating function.

The main objectives of the Actuating Function are:

- Input the fuel-rack position command.
- Positioning the engine fuel-rack.

One of the systems many capabilities is its ability to control 4 cylinder engines using a special notch filter. These engine present a particular problem for conventional hydraulic governors.

3.7

Operator's Control Panel (OCP 8800)

This is an important unit in the 8800 family in that its function is that of a man-machine interface. The unit is designed to be located in a console together with a monochrome CRT or a high resolution colour graphics CRT.

It can easily be re-arranged both with respect to push-button lay-out and software functions. Thus, the OCP 8800 keyboard can be configured to the requirements of the particular system.

When designing this keyboard, Norcontrol used its experience to achieve:

- An easy-to-understand functional lay-out (not a computer-terminal keyboard)
- Relatively large push-button lamps and displayed text giving very clear feedback.

By using alternative SW-packages, the OCP 8800 can be configured to be:

- A complete alarm system
- A cargo-control keyboard
- An engine-control keyboard

It is cabable of driving a printer with its parallel ports (Centronics interface).

3.8

Signal Processing Unit (SPU 8800)

The Signal Processing Unit (SPU 8600) is a powerfull computer for advanced monitoring and control functions. It has a built in facility to operate high resolution colour graphic displays and can be connected to the various products in the 8800 family.

Its architecture is based on a multitude of single-board computers all contained in a 19" rack suitable for printed circuit boards of "Double Europe" size.

Each single-board computer has its own programs stored in on-board EPROM and they all work against a common dynamic data area in RAM. Each computer works in paralell, however.

The Signal Processing Unit is designed from the start for rough environments as encounterd on ships. It is not a converted office- or industrial computer, as its basic components, printed wire boards, connectors, cas[redacted] designed with ship-board use in mi[redacted] all other products in the Unified [redacted] concepts, its design and production is done by Norcontrol, it is not a bought-in part.

Its utilization so far has been to provide computing power to Cargo Control Systems and Engine Room Control Systems. In a slightly different version it has also been used for navigational purposes.

Its most outstanding feature is its ability to support high-resolution colour graphic displays. This is a new technology which has come into use due to provision of cheap and very compact RAM memory. 500 kbytes of RAM memory are used for this purpose only.

This graphic presentation presents alarms and process conditions with a clarity and flexibility not seen so far in ship automation. virtually any kind of pictures can be displayed in a pixel-matrix of 800x600. Its versitility in relation to semi-graphic presentation is its ability to display curves, circles, diagonal lines and irregular shapes. Also any object can be made to move across the screes, if needed. Another most vital feature is its ability to update and change pictures very

fast. A call for a new picture takes about 1 sec. This is an important factor in a critical safety situation.

In designing pictures, standard CAD techniques are used. This picture design can be done by engineers at the shipyard, after some traning.

There is no limit to the locations of the display screens in relation to the SPU 8600. As an example, screen can be located in the bow connected to a SPU 8600 located in the aft cargo control room of a ship of any size.

3.9

Product Support

Norcontrol deliver products in conformity with Norwegian Standard 5801 which corresponds to the AQAP-1 standard. Factory Acceptance Tests for system deliveries usually demand the presence of a classification society inspector. The customer's QA represenative is also invited.

Concerning documentation of its products, Norcontrol Automation have adapted a military standard. The documentation plan is as follows:

LEVEL ONE:

- Unit manual, a document describing each product delivered by Norcontrol.

- Vendor manual, a document describing each product delivered to Norcontrol, by the manufacturers standard.

LEVEL TWO:

- System manual, which contains all the unit and vendor manuals in addition to; system operation, start-up, preventive maintenance and cabling.

With this documentation, changes of documentation between deliveries are done in level two documents only.

The documentation contains maintenance description. But the computer itself is used for test purposes with both on-line and off-line programs. These test programs reveal errors on circuit board level and cabling. It is not the policy to repair printed circuit cards onboard, but to exchange them.

One advantage of the Uniform Automation concept is the part interchangability. Should spares not be at hand, a faulty card can be moved to a position where the effect of its error is minimal.

4 APPLIED SYSTEMS FOR UNIFIED AUTOMATION

4.1

General

So far, the application of the Unified Automation products onboard ships and mobile rigs has been to engine room automation and liquid cargo control systems. So far, most installations are in the low-cost end of the range using the various 8800 product's panels for the operators control.

In the following chapters, installations of higher complexity are described showing the full flexibility of the range.

But it will not stop there. There are more automation tasks that can be handled on board, one of them is winch control. Automation/ robotization of mooring is one of the [redacted] factors in even higher razionalization onboa[redacted] Our first deliveries in this fields are [redacted] concerned with winch control.

4.2

Datachief-7 MIDI Engine Room Alarm & Monitoring

This is an example of using the computing power of the basic modules to create a low-cost alarm & monitoring system without loosing the clear CRT presentation of more sophisticated systems.

It relies on the basic modules: Signal Acquisition Unit (SAU 8800) and Operator Control Panel (OCP 8800). By using a special-purpose program in the OCP 8800, an alarm & monitoring system is created using a few components for bridge and cabin alarms in addition. The system meets the Classification Societies' rules for alarm systems in UMS applications. As it is fully configurable on site, the system is particularily well-suited for OEM deliveries. Very little training is necessary for yard engineers to learn how to configure, programs and customize this equipment.

The main particulars are:

- Display of alarms and remote inspections of process values on a CRT.
- Extensive log of alarms and periodic reports on a printer
- Group alarm system
- Automatic display of latest alarm on CRT
- Print out of all commissioning parameters with facilities for changing them
- New sensors can be connected and all relevant commissioning parameters for these sensors can be entered and stored permanently in the system
- More than 200 sensors can be handled, beeing analogue or on-off

The latest microprocessor techniques has been used to create a system with a very comfortable cost/performance factor.

4.3

DC-7 Engine Room Control System

This is a general-purpose control system for the ship's machinery (except for the propulsion engines).

It can be configured to the ship's particular needs and, fully extended, it can have following functions:

- Four operator stations with high-resolution colour graphic presentation
- Alarm system
- Power management system
- Pump and valve control
- Temperature control
- Level gauging of machinery tanks
- Trend curves
- Performance monitoring of the propulsion units

The system is built using the standard modules:

- Operator Control Panel (OCP 8800)
- signal Processing Unit (SPU 8600)
- Signal Acquisition Unit (SAU 8800)
- Generator Control Unit (GCU 8800)
- Programmable Controller Unit (PCU 8800)
- Level Gauging Unit (LGU 8800)

In this configuration, it offers full control of all machinery functions allowing remote operation from the bridge if needed, with an operator station located there. Thus it can be employed in systems where "Super E0" is foreseen, i.e. operation of the ship from qay to qay without a watch in the engine room.

By its design, it looks like an integrated control system from the operators viewpoint, as the total function of the system can be controlled from one operator's console. By its configuration however, it is a distributed control system, where each building module is in itself a fully functional system. Thus, extensive back-up is at hand should one or more of the building modules fail.

4.4

Power Management System

The Generator Control Unit (GCU 8800) is in itself a dedicated system for control of one generator in a power management system. More units can be chained together and between them they make up a complete system for power manageent with a high cost/performance factor.

New operational demands have led to very complex systems onboard some ships. These power systems can be summarized:

- Split bus bars
- Multiple engine driven generators
- High voltage equipment
- Redundancy
- Many operational configurations wanted

When such demands occur, the GCU 8800 needs additional control, which can be made by the Programmable Controller Unit (PCU 8800). Into this unit all the different operational modes can be programmed (on-site), whereby safe operation of these complex power systems can be had.

Such a Power Management System can be delivered as a stand-alone unit or as an integrated part of the Datachief-7 system. By the Datachief-7's operator stations, status and control of the power system can be had with high-resolution colour graphics, mimic diagrams, etc.

4.5

Cargo Control System

New demands for full automation of loading/unloading of liquid cargo are now coming forward.

For such purposes, the DataMaster-7 system is already designed, beeing in concept very similar to the DataChief-7 system, but with different functions.

These are:

- High resolution colur graphic presentation
- Manual valve/pump control by trackerball
- Level measurement
- Hull load and stability calculations
- Damage stability calculations
- Automatic loading/unloading by sequence control, and automation of pump and valve operation
- Bow loading (shuttle tankers)

The system is built using the standard modules:

- Operator Control panel (OCP 8800)
- Signal Processing Unit (SPU 8600)
- Level Gauging Unit (LGU 8800)
- Programmable Controller Unit (PCU 8800)

In this configuration, it offers full monitoring and control of all cargo functions, from the bridge if needed. This reduces the workload of the crew who normally perform the loading/unloading.

In the same manner as the Datachief-7 system, it looks like an integrated control system from the operators viewpoint, as the total function of the system can be controlled from one operator's console. But, by its configuration it is a distributed control system, one failure in the system will not kill all system functions.

4.6

AutoChief Propulsion Control System

The Digital Governor System (DGS 8800) is a complete package which fulfils all tasks for governing the speed of low-speed, long-stroke diesel engines. It can be used as an integrated part of a remote propulsion control system.

The system uses the following standard modules:

- Digital Governor Unit (DGU 8800)
- Programmable Controller Unit (PCU 8800)

So far the main applications of this system have been for complex propulsion units, with a multitude of clutches, engines and varying operational demands. For these propulsion systems a very smooth operation is obtained using the advanced regulating and actuator function of the DGS 8800.

4.7

Creation of Systems

As described in Chapter 4, a wide range of systems can be created with a set of basic modules. One of the design factors behind these modules was to simplify the installation and commissioning tasks both for Norcontrol personel and the yard. This means that the modules are particularily well-suited for yards in their creation of systems for all types of ships. The units in the 8800-series can be sold from Norcontrol as O.E.M.-units. Norcontrol is prepared to engage itself into such cooperations, believing that this will strengthen both the yard and Norcontrol, and benefit the end user. Eventually it is probable that this will lead to new applications onboard so far not considered by Norcontrol.

5 CONCLUSIONS

More and more highly rationalized ships will now be built. Aslo, a large number of basic ships will be built. This will mean that shipyards will have to deliver a very wide range of ship automation products. Traditionally such automation products originate from many manufacturers each having differences in operator interfaces, design philosophy, installation and commissioning procedures, maintenance, etc. The yards must now maintain knowledge in handling these different systems.

In this paper a concept of Unified Automation products has been described. It is designed to cover all aspects of ship automation, from the very basic to the Integrated Ship Automation Systems. Standardized solutions are used on all levels.

Major shipyard the world over have now gained experience in using these modules. These yards seem so far to have put priority to the following characteristica:

- Sensor interfaces near sensors
- Low installation costs (cabling)
- Compact dimensions
- Low spare part demand
- Outstanding high-resolution colour graphics
- All major control tasks onboard covered
- Both basic and advanced systems
- Future enhancements possible without change of technology

This has been made possible by a continuous development of products from Norcontrol one of the very few ship automation companies in the world which combines:

- Experience in all kinds of ship operation
- Expertise in computer technology for ships