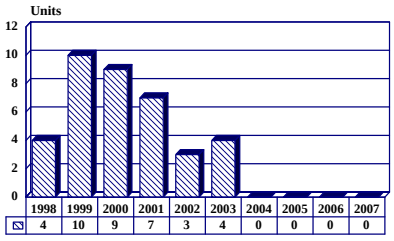
NAUTIS - Archived 10/99

Outlook

- Through 1997, an estimated 15 NAUTIS systems have been delivered and/or are in service
- Seven more NAUTIS-M systems are in production to fill UK order
- US's procurement of NAUTIS encourages future sales

10 Year Unit Production Forecast
1998 - 2007



Orientation

Description. NAUTIS is a modular family of integrated naval command and control systems, based on the MUSL Nautic autonomous intelligent console. The system utilizes distributed processing with a replicated system database in each workstation updated via an international-standard databus or command system highway.

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Status. Production and service.

Total Produced. By the end of 1997, an estimated 15 systems had been delivered.

Application. NAUTIS is tasked with providing a comprehensive, distributed command, control and navigation facility for radar surveillance, target tracking, tactical navigation, and weapons assignment using a fully integrated multi-processing system.

Price Range. Analysis of a 1993 NAUTIS contract indicates that the cost of an individual NAUTIS system is about US$750,000.

Technical Data

Characteristics

Operating temperature range:	0 to 40 deg. C
Storage temperature range:	-40 to +70 deg. C
Non-volatile memory data retention:	-40 to +70 deg. C
Relative humidity (non-condensing):	35 to 95%
Shock and vibration:	NWS1000 and Def Stan 07-55
Electromagnetic compatibility:	UK MoD(N) Spec DGS250B
Magnetic signature:	DefSpec NES617
Acoustic noise:	Less than 60dBA

Design Features. The basis of all NAUTIS systems is the Nautic console. Nautic consoles are designed to UK MoD (N) standards for a naval sheltered environment, including the latest minehunter requirements. Nautic consoles are designed to be hard-mounted on shock-isolated rafts or on fixed deck via shock mounts. Nautic is an autonomous intelligent workstation module that can be used singly or in quantity, according to the precise role of the ship. The operational characteristics of each Nautic console are determined by the selected built-in interfaces, application software, and user controls. The microcomputers installed can hold all the command and control data available within the ship in a non-volatile magnetic bubble memory. The replication of such data provides important advantages in system configuration, workstation task allocation, reduced manning requirements and high system availability. Most importantly, it dramatically reduces vulnerability to combat damage.

System facilities include various combinations of digital, synchronous and analog input and output interfaces for sensors and weapons, interfaces with tactical datalinks, automatic chart plotters and automatic tactical plotters. An extensive system database typically covering an area of 1,000 square nautical miles, maintains radar and sonar tracks, six user-designated tactical maps, 15 synthetic charts, 200 labeled reference points, threat evaluations and weapons assignments, 32 labeled bearing lines and a system status report.

Operator facilities include electronically scissored, high-resolution, 400 mm displays with labeled graphics, totes and an interactive main area; true and relative motion stabilization; six labeled electronic range and bearing lines that can be hooked onto fixed points and moving tracks; and off-centering anywhere within the database area. The whole system is operated using a typewriter keyboard with assignable special function keys and tracker ball.

The console is based on an internationally available Intel iAPX-86 range processor with dual Intel iAPX-286 microprocessors in multi-bus applications. Memory typically comprises 2 Mbyte RAM plus 2 Mbyte non-volatile bubble storage, both memories being fully expandable. Radar interfaces are provided for up to three primary radar videos and eight digital inputs. A radar plot extractor with dual thresholds, constant false alarm rate, clutter mapping and windowing is provided, and manually initiated automatic radar tracking of at least 20 tracks per console is possible. The display is a 4096-pixel resolution cursive monochrome CRT. A comprehensive repertoire of characters, symbols, ellipses and lines together with customized symbology is provided. Repair requirements are indicated by a built-in test and fault-warning facility and executed by module replacement without need for special tools.

Variants/Upgrades

AN/SYQ-15. US Navy nomenclature for NAUTIS-M.

Command Support Tool. The current generation of action information systems has been criticized for deficiencies in their ability to analyze the volume of data generated by sensors and datalinks. The increasing use of passive data collection will add to the difficulties of identifying tactically significant data in real time. In order to investigate the problems resulting from this situation, Marconi has developed the Command Support Tool (CST). This will act as a technology demonstrator to investigate the construction of future action information systems. A simulator provides the CST with a reactive software model of the naval environment. The CST was implemented on a Symbolics workstation running the Genera development environment. This is designed to support rapid software prototyping and interactive

program development. CST software was written in Symbolics Common-LISP, an extension of the common-LISP language providing powerful object-oriented programming constructs.

Also in hand are developments in the system architecture. These will include the introduction of window techniques. A general upgrade to 32-bit processor technology programmed in Ada is also being introduced.

NAUTIS-F is the version of the system optimized for installation on warships of large frigate and upwards in size. The system has the fully developed distributed processing system and data-handling power required to cope with the complex operational requirements facing major warships.

NAUTIS-L is a modular command and control system for amphibious warfare ships providing the comprehensive facilities required for the various phases of amphibious warfare. These include mission planning, surveillance, self defense, control of surface landing craft and helicopters, command and control of landing operations, and task force command.

NAUTIS-M is a third-generation mine countermeasures system providing all command, control and navigation facilities required to combat current and future mining threats. Tactical information is presented graphically on the radar picture, including synthetic tactical maps, charts and totes. NAUTIS-M provides facilities for coordinating and controlling the detection, classification and disposal of mines, including operational planning, accurate ship control, a continuous accurate history of own-ship movements and sonar coverage, underwater and surface pictures and maintenance of a real-time MCM database.

Using NAUTIS-M, a clear and accurate presentation of information relating to MCM search plans with environmental and known contact data superimposed is obtained. This can be used to plan the optimum search path and sonar coverage. If available, the position of mine disposal vehicles derived from acoustic sensors can also be displayed.

NAUTIS-NG is the latest version of the NAUTIS family, intended to exploit technology advances made since the previous upgrades had been made. NAUTIS-NG was originally developed for the new Malaysian Navy Lekiu class of light frigates. It has eight multi-functional consoles (MFC), three of which are weapons control stations. They are linked by a dual-redundant copper Ethernet local area network, ensuring replication of the tactical database across each MFC. Each MFC is fitted with two ruggedized Motorola 68040 processors interconnected by a VME backplane.

Large screen displays are being introduced, with the screen layout based on a windows-oriented graphical user interface. A new software suite has been developed by GEC-Marconi using C code since existing packages were not thought to run fast enough. Operator interaction is via a touch plasma menu panel, QWERTY typewriter keys, tracking ball and a joystick.

NAUTIS-P is optimized for corvettes, patrol ships and light forces. It features simplified installation, training and in-service maintenance appropriate to the small craft environment.

NAUTIS-S is a modular enhancement option which allows desired features of the NAUTIS command system family to be incorporated within other existing command systems.

Spanish MCMV Command System. The Spanish Bazan class minehunters will have a command system based on NAUTIS and using some NAUTIS hardware, but modified to meet with Spanish Navy requirements. These include new display technology and a rewrite from Ada to C computer languages.

Program Review

Background. Following the display of a prototype system at RNEE in 1983, the UK Royal Navy (UKRN) purchased the NAUTIS-M variant for its Sandown class single-role minehunters (SRMHs). An extensive sales effort was also undertaken in the United States, resulting in a single system being supplied to the USN for evaluation and assessment. The year 1986 saw the order of the NAUTIS-L variant for installation in the UKRN assault ship HMS *Fearless*. Early in 1988 the NAUTIS system was specified for installation in three Vosper-designed ASW corvettes ordered by the Royal Thai Navy. By mid-1993, all three had entered service. A fourth, slightly modified ship has also been delivered and is used for anti-piracy work.

During 1988/89, the individual Nautic consoles were upgraded by introducing facilities for color displays interfacing directly with the existing black-and-white systems. This opened out new techniques of display and presentation, cleaning up the existing methodology and considerably improving user friendliness. During this period, firm orders for three ships and options for a further three, identical to standard Royal Navy SRMHs, were placed by Saudi Arabia.

In March 1989, the New Zealand Navy ordered two NAUTIS-F systems for installation in Leander class frigates. These particular NAUTIS systems have been downgraded by the deletion of processing capability in the subsidiary workstations, effectively converting the system into a centralized AIS. The reason for this is purely financial. Work on installation started in 1990 and was completed by early 1993.

During 1992, NAUTIS-F was specified for two Malaysian ships. Following a detailed evaluation by the US Navy, the NAUTIS-M system was selected for retrofit onboard all 14 US Navy Avenger class MCMs. For this purpose NAUTIS-M has been designated SYQ-15 as a component of the SSN-2 system. Twenty-four NAUTIC terminals, forming 12 ship sets, were ordered in May 1993. Two complete ship sets had already been supplied as part of the evaluation process. Originally, it was suggested that SYQ-15 would be installed on the next US Navy mine warfare vessels, the Osprey class, but the SYQ-13 system was acquired in its place.

The 1993 British Defence White Paper, Defending Our Future, provided details of the future British mine warfare force structure. This will be reduced to 25 ships, 13 Hunt class modernized with the NAUTIS-M command system and 12 Sandown class. The orders necessary to complete this program were placed in July 1994 as part of the 1994 defense review Front Line First. Seven Sandown class ships were ordered at a total cost of US$375 million.

In January 1992, the Royal Australian Navy initiated a program for a class of four minehunters, which would use hull designs and electronic systems proven prior to purchase. Only three hull designs were considered acceptable, these being the Italian Gaeta class, the Swedish Landsort 52, and the British Sandown class. The mine warfare command systems were narrowed down to the US SYQ-13 and NAUTIS-M.

These requirements proved to be excessive in that only the British Sandown/NAUTIS/Type 2093 combination could be considered a proven option. Rather than face a single-competitor race, the RAN relaxed the proven specification to a requirement to demonstrate full compliance with specifications. Eventually, the Italian Gaeta hull was selected, with the NAUTIS mine warfare command system specified to fulfill the tactical data- handling requirements. The contract to supply the fully integrated mine warfare command system and minehunting sonar was signed in August 1994.

On May 11, 1993, VSEL Consortium plc was awarded a US$245 million order for the new British LPH. The contract was awarded to VSEL in partnership with Kvaerner Govan after a tough fight against Swan Hunter. Although the design uses the basic hull form of the Invincible class carriers, it will be built to merchant ship standards and effectively be a large merchant ship with a flight deck and naval features added on. Two new LPDs were ordered in mid-1996, and may also be candidates for a NAUTIS-L installation, possibly using components supplied for HMS *Intrepid* but never installed. The command system for the LPH is the GEC-Marconi ADAWS 2000.

Also during 1996, the Japanese specified the Type 2093 sonar and NAUTIS-M command system for their new minesweeper (coastal) class. In contrast to these positive developments, it was reported that the two Malaysian frigates were being delayed by up to a year due to problems with their command systems. These problems have been greatly exaggerated and distorted. Contrary to many reports, the delays were caused by non-delivery of some of the new software packages, not by inherent problems with the command system itself. The root of the problem is that the Malaysian ships were the first platforms for the new NAUTIS-NG system and were experiencing the delays commonly associated with the introduction of new software-intensive systems.

Funding

NAUTIS arose from the UK Cardinal Points Specification procedure. Under this system, an operational requirement together with technical qualifications was provided and the industry was left to respond. This approach meant that any cost-effective alternative to the specification would be considered, and without such an approach it is unlikely that the privately funded and developed NAUTIS-M system would have been adopted.

Recent Contracts

No recent contracts have been identified through public sources.

Contractor	Award ($ Millions)	Date/Description
MUSL	N/A	*April 1992* — Malaysian order for NAUTIS-F systems to equip new frigates.
GEC	3.0	*September 1993* — Contract for four NAUTIS systems for Spanish minehunter program.
MCS	4.1	*May 1993* — US Navy order for 12 ship sets of NAUTIS-M equipment for retrofit to Avenger class MCMVs.
MCS	42.0	*August 1994* — Royal Australian Navy contract to supply six fully integrated Type 2093 sonar and NAUTIS command system outfits for the Huon class minehunters.

Timetable

Month	Year	Major Development
May	1984	NAUTIS-M selected for Sandown class
Aug	1985	First group Sandown class ordered
Jun	1986	Plessey opens sales effort in US
Oct	1986	NAUTIS-L ordered for HMS *Fearless*
Jan	1987	US Navy starts evaluation of NAUTIS-M
Sep	1987	2nd Group Sandown class ordered
Jan	1988	Contract placed for Thai ASW corvettes
Jul	1988	1st single-role minehunter launched
Sep	1988	US Sea trials of NAUTIS-M commence
Nov	1988	Saudi Arabia orders 6 NAUTIS-M for SRMH
Mar	1989	New Zealand Navy orders 3 NAUTIS. Technology transfer contract with Spain
Sep	1989	Further US Navy contract
Oct	1989	4th Thai corvette ordered
	1991	US order for NAUTIS-M
	1992	Malaysian order for NAUTIS-F
May	1993	Main US procurement contract
Jul	1994	Final group of Sandown class ordered
Dec	1995	Japan order for two NAUTIS-M systems
	1996	NEC becomes licensed producer of NAUTIS

Worldwide Distribution

(Through 1997)

Australia	0 (+6)	NAUTIS-M (Huon/Gaeta class MHC)
Japan	0 +3 (1)	NAUTIS-M (Minesweeper Coastal)
Malaysia	2	NAUTIS-NG (Lekiu class frigates)
New Zealand	2	NAUTIS-F (Leander class frigates)
Saudi Arabia	+3	NAUTIS-M (Sandown class MHC)
Spain	+4	NAUTIS (Segura class MHC)
Thailand	3	NAUTIS-P (Khamronsin corvettes)
United Kingdom	6 + (6)	NAUTIS-M (Sandown)
USA	2 + (12)	NAUTIS-M (Avenger class MCMV)

Forecast Rationale

NAUTIS carved out a name for itself in the mine warfare arena, and practically cultivated the Sandown class minehunters. It is the mine warfare variant of the system that has received the most widespread interest. Malaysia's experience was just one example that demonstrated NAUTIS' capabilities and flexibility, despite the fact that it had to be outfitted on box hulls. The subsequent five hulls of Australia's Huon class ships will be built completely on-site, and the system integration should take place in a more coherent manner. Other difficulties that were reported, such as faulty software that was inherited from other sources in negative condition, have since been rectified. NAUTIS has now proven itself to be an extremely proficient system.

The UK Royal Navy apparently agrees, as it plans to build six more Sandown class minehunters by the year 2001 and upgrade the retained portion of the existing MCMV fleet with NAUTIS-M as well. It is possible that the British will also order more systems for its airborne Blue Vixen combat radar. Spain is building four new Segura class minehunters that will use a yet to be determined model of the NAUTIS command system. Spain is presently in a technology transfer agreement with Vosper Thornycroft.

A Japanese contract is also in the works for at least four NAUTIS systems; however, instead of buying the system directly from the manufacturer, Japan decided to purchase a local production license for NEC. That considered, along with Japan's fluid reputation in shipbuilding projections, it is quite possible that many more Japanese ships may eventually be equipped with the NAUTIS system.

Saudi Arabia is another country dabbling in the market with its purchase of three Sandown class minehunters, all of which are very similar to those bought by the UK Royal Army. Spain has followed suit, planning to buy four Segura class minehunters, all to be equipped with a system based on NAUTIS AIS, but with changes to meet Spanish requirements and incorporating features from NAUTIS-P.

The US Navy has 14 Avenger class mine countermeasure vessels, two of which are equipped with NAUTIS. The remaining 12 will eventually also be fitted with the NAUTIS-M system. This acquisition is believed to have facilitated business because it associates NAUTIS with the US SQQ-32 minehunting sonar system, as well as the British Type 2093.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION

			High Confidence Level			Good Confidence Level				Speculative			
Designation	**Application**	**thru 97**	**98**	**99**	**00**	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**Total 98-07**
NAUTIS	MCMV (UNSPECIFIED)	0	0	1	0	1	0	1	0	0	0	0	3
NAUTIS 2M	MCMV (AUSTRALIAN NAVY)	0	0	2	2	1	1	0	0	0	0	0	6
NAUTIS F	Prior Prod'n:	4	0	0	0	0	0	0	0	0	0	0	0
NAUTIS M	MCMV (JAPAN SDF)	0	0	2	1	0	0	0	0	0	0	0	3
NAUTIS M	MCMV (SAUDI NAVAL FORCES)	0	0	1	0	1	0	1	0	0	0	0	3
NAUTIS M	MCMV (UKRN)	6	1	1	2	2	0	0	0	0	0	0	6
NAUTIS M	MHC (SPANISH NAVY)	0	1	1	2	0	0	0	0	0	0	0	4
NAUTIS M/SYQ-15	MCMV (USN)	2	2	2	2	2	2	2	0	0	0	0	12
NAUTIS P	Prior Prod'n:	3	0	0	0	0	0	0	0	0	0	0	0
Total Production		15	4	10	9	7	3	4	0	0	0	0	37