HYDROGRAPHIC SURVEY SYSTEMS FOR THE 1980's : A TECHNOLOGICAL FORECAST

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Paper presented at the 13th Annual Canadian Hydrographic Conference in March 1974.

ABSTRACT

Increasing numbers of engineers and scientists are forecasting developments for the future. These anticipated technological developments have hydrographic survey applications. Technological forecasting provides alternatives that may be selected for development, utilizing new technology to reduce costs and improve products. The forecasts facilitate communication and cooperation among those engaged in survey system planning and allocation of funds, ships, men and equipment.

Engineers and scientists who are aware of future system requirements can prepare for them. Knowledge of alternatives enables decision makers to choose what sort of hydrographic survey systems they wish to design and build. Expanding technology will be shaped by those who are willing to improve, promote, develop, and try new concepts.

INTRODUCTION

The sea and its natural resources are a part of the common heritage of mankind. The United States, like many nations, is looking to the sea for ways to satisfy human needs for energy, food, environmental quality, and national security. Effective use of the sea and development of its natural resources are now and will remain major challenges for society during our lifetimes. To achieve efficiency and effectiveness in discovery, exploitation and use of marine resources, it will be necessary to learn more of man's heritage. Hydrographic survey ships with sophisticated data

acquisition systems are necessary for learning more about the sea. These ships and systems represent a twenty to thirty year investment of funds and manpower. For economic reasons it is necessary to obtain forecasts for analysis and use before the large-scale commitment of such expendables.

It is the purpose of this paper : (1) to provide background on technological forecasting for potential users; (2) to show how forecasts may be used by the hydrographic community; and (3) to identify rapidly changing technologies with potential applications and impacts on survey systems.

BACKGROUND

Technological forecasting utilizes systems to induce probabilistic assessments of future developments and impacts on technology. It deals with change; and social-economic forecasts should be considered at the same time as the technological ones. Forecasting has developed gradually since World War II, and it is currently being used by many organizations. Earlier attempts were not considered rigorous enough to be classified as technological forecasts. Today, forecasts are essential for planning large complex systems such as hydrographic survey systems.

The United States Navy has used forecasts for years to help establish priorities and to distribute resources. In this process, technological forecasts were employed to define Navy needs, to evaluate alternatives for meeting those needs and to determine what capabilities were required to implement the chosen approaches. At the Naval Oceanographic Office, scientists, engineers, and managers at various levels were asked to make forecasts for their areas of competence (*). To participate intelligently, they needed to learn some of the basic tools and techniques, as well as the pitfalls, of forecasting systems.

At this point, the distinction must be made between short-, medium-, and long-range forecasting. For the purpose of this paper, the time period for a short-range forecast does not exceed three years; the medium-range is three to ten years; and the long-range is greater than ten years.

Without going into great detail, it should be pointed out that there are two major categories of technological forecasts: opportunity-oriented and mission-oriented. Opportunity-oriented forecasts are frequently called exploratory, and mission-oriented forecasts are the type used when goals are known in advance. There are, of course, advantages and disadvantages to each in terms of cost, time involved, data required, repeatability, objectivity, work required, and confidence in accuracy, method and assumptions.

The 1980 time period ranges from five to fifteen years into the future. For medium-range to long-range forecasting, many forecasters consider

(*) In December 1972, the U.S. Naval Oceanographic Office made a beginning in the field of technological forecasting when requests were submitted to organizational components for "Capability Development Objective Proposals" for the 1976 to 1993 time period.

the most reliable forecasting techniques to be single trend extrapolation, growth analogy, correlation analysis and substitution. Forecasts utilizing personal judgment, a knowledgeable person, or consensus techniques are accurate only for short-range time periods. For the 1980's, the best forecasts may be obtained by using combinations of the medium-range and long-range methods.

In total, forecasts allow marine oriented enterprises to deal with the problem of change. Changes are rapidly taking place in computers, microelectronics, communications, management, education and other areas. In planning for the long-range future, it is necessary to allow for technological changes. The ability of our society to satisfy human needs in the future depends on man's ability to cope with change.

THE TECHNOLOGY

Hydrographic survey systems for the 1980's are expected to follow the trends established during the 1960's and the 1970's. In the past, survey systems made effective use of technologies developed by military and space interests. Automation has been continuous in hydrography, as manpower costs are rising at a higher rate than the cost of equipment. If this trend continues in the 1980's, not only will attempts be made to reduce the manual burdens of surveys, but also steps will be taken to reduce the use of manpower in survey operations. With this concept in mind, it is possible to anticipate technologies that will be used for the 1980's. The following areas have potential applications for hydrographic survey systems.

Computers

First, the electronic computer could become the single, most important tool for survey systems as it can aid in acceleration of the rate of technological change. The computer will most certainly reduce the time required to collect, process and transfer hydrographic data to a user. Forecasting data, in the form of growth and trend curves, provides an indication of what should happen to shipboard systems. There will be small, low-cost, hand-carried computers and large, time-shared types used in networks.

By 1980, computers that weigh 25 grammes, are less than 3 000 cm^3 in size, and use one-half watt of power to operate should be available for use [1]. Shipboard computers will follow the general trends of today by becoming small, more powerful, plentiful and less expensive. In many cases, computers will be built into special purpose equipment as modules [2].

The larger computers will be needed to generate lists, tables, handbooks, and to handle frequent updating of large digital data files. In the medium-range future, large computers will be used for simulation and

modeling of hydrographic phenomena. Low-cost computer techniques will make many expensive physical laboratory models obsolete. For example, data on tides, water currents, and winds can be fed to a computer for use in a dynamic model and display. On the spot decisions could then be made as to when and how to run hydrographic survey lines and to adjust charting data [3].

Microelectronics

A second technological area of significance is microelectronics, which will have a major impact on the design and operation of systems in the late 1970's and 1980's. The U.S. Navy has studied trends in microelectronics [4], and three main ideas are applicable to hydrography.

First, the need for shipboard and shore-based electronic repair facilities with skilled personnel will diminish and possibly disappear because of the necessity to return assemblies to the producer for repairs. Repairs will require the special costly equipment that was used in the production processes. The manufacture of highly-reliable equipment and implementation of factory exchange programs will be used for complex assemblies and instruments. Microelectronic equipment will be sealed at the factory to prevent shipboard personnel from tampering with the hardware [5].

Second, electronic equipment will have redundant circuitry built-in to obviate the need for exchanging parts. When a circuit fails, spare circuits will bypass automatically the failure area. A large number of alternative modes of operation and redundant components will be available for most of the shipboard hardware systems. This concept is based on the premise that equipment which is not working has no value to the survey operation.

Third, microelectronic circuits and microminiaturized parts will be used by all major manufacturers of electronic equipment.

Videographic Systems

Videographic technology is a third area that will have a major impact on traditional hydrographic survey methods. Video systems will be used to collect, store, retrieve, transfer and display hydrographic data. Video products, containing hydrographic, navigational and related information, offer a wide variety of alternatives for production and distribution. In addition, hydrographic personnel will use video devices for library, training, education, and recreation applications.

Copies of video data can be produced at high speed and very low cost. For example, a twenty-minute video tape can be duplicated in thirty seconds from a master film for less than thirty-five dollars. A full video cartridge can store 180 000 frames of film [6]. Videographic playback devices have slow-motion and stop-action options which would allow the complete storage and selective retrieval of nautical charts and other textgraphic data on a single video cartridge.

The video disc is another device which has a high potential for the economic storage of marine data in text and graphic forms. The video disc is thin, and durable copies are cheap and easy to reproduce for mailing to a user. Videographic technology will be well developed by the late 1970's, and hydrographic applications should be implemented during the early 1980's. Improvements in indexing and cataloging will no doubt have been achieved before then.

Display technology may have applications for the survey ship's bridge. In the late 1980's, holographic systems should encourage the use of large wall screens to display holographic images of navigation and hydrographic data. Color holograms may be developed that are similar in nature to the holograms produced for Disney World's haunted mansion in Florida. This display technology could be used to show bottom relief features of the sea floor, environmental phenomena for analysis, or navigation information for positive position fixing. These new recording, processing and display techniques will result in new applications for the long-range future.

Information Handling

Fourth, information handling systems will affect future survey systems. Most hydrographic data will be acquired in computer processable forms, but for reasons of economy and convenience, computer compatible data will be supplemented by microfilm and video tapes. The automated hydrographic charting processes will need large, cheap, direct access, computer compatible data files. New production processes will use these to eliminate 90% of the present manual effort and reduce production times required to less than one-third of present day systems.

In relation to the cost of living, manpower and materials will cost more while equipment and communication costs will go down. The consequences of this will be to replace the use of high-cost manpower by substitution of low-cost automated equipment and communication systems. This could result in full processing and reproduction of shipboard data prior to transfer.

The People

Most important to any hydrographic activity are the people. By 1980, computer routines will be common, matching the backgrounds of personnel to billets in the organization. Managers will still be making the decisions on personnel assignments, but the computer will search and locate the most likely candidates for reassignment to special teams for survey operations.

Fast, accurate communications will allow the development and use of new survey techniques and methods. Hydrographic specialists will be able

to control a wide variety of operations because of improvements in communications and computing tools.

By 1980, new data acquisition systems will be required to satisfy the data needs of diverse clientele. From an economic point of view, it should be more practical to collect simultaneously data for several interest groups rather than pay the cost of operating independent systems. This technological change will stimulate the development and growth of career training and education programs. Personnel files will be computer based for easy access and updating of career data, and will incorporate capability and motivational assessments.

Hydrographic survey teams will be expected to achieve results more quickly, and the performance of the group as a whole will be monitored and analysed to see if its goals are being reached. The hydrographic data acquisition systems will be designed to collect new types of data, in new ways, to produce new products.

CONCLUSIONS AND RECOMMENDATIONS

In the past decade, enterprises have become increasingly interested and involved in technological forecasting as an aid to planning and allocation of resources. Old methods of distributing funds, ships, men and equipment have become obsolete as more managers realize that forecasts can be used to reach desired goals with better economy of resources. The user of forecasts not only sees the probable direction that technology will take, but he can see alternative paths and obstacles for the organization.

Managers of hydrographic programs are aware of weaknesses in techniques of resource allocation. New techniques are now available to produce hard facts for analysis and decision-making. The information must be combined, however, with good judgement and common sense in order to obtain the best decisions. Technological forecasting can only supply a part of the required information, but the absence of this information can lead to relatively poor decisions and a waste of resources.

For organizations involved in hydrographic activities, it is recommended that they focus more attention on studying the techniques of forecasting, that they use technological forecasting to identify program requirements and that forecasting should be taught to their professional employees.

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