

THE IMPACT OF AUTOMATION ON HYDROGRAPHIC ORGANIZATIONS

by K. G. BURROWS and M. CALDER
Royal Australian Navy Hydrographic Service

This paper was presented by Capt. M. CALDER at the XIth International Hydrographic Conference, Monte-Carlo, April 1977.

ABSTRACT

Automated hydrography has been facilitated through advances in the technologies of data collection and processing. The gathering momentum of these advances is forcing hydrographic nations to accept these technological challenges in endeavouring to meet their responsibilities to the mariner.

Against such background, this paper discusses the requirement for new approaches to data organization and presentation, together with some of the problems faced by Australia in adapting the traditional methods of surveying and, in particular, chart production.

The paper will point to the growing interdependence of charting and mapping agencies, on both the national and international levels. It will suggest areas where further strengthening of international alignment may be required in order to share the burden of hydrographic responsibility for providing more comprehensive and timely information for tomorrow's mariner.

INTRODUCTION

The size of Australia's Hydrographic Service in relation to its large area of responsibility has placed strain on the traditional methods of supplying hydrographic information to the mariner, and has created the need to seek other, more modern, expeditious methods. To this end Australia has embarked on an ambitious programme of practical automation.

Because Australia has not had the capacity to absorb large research costs — which to date have tended to be concerned with specific applications of technology — we have had, in the case of automated cartographic

procedures in particular, to await their development overseas. We now find ourselves in a position to accept development of applied technology direct from system suppliers, and to concentrate upon the wider ramifications of the changes needed in data presentation and in form of organization.

In our approach to eliminating as much as possible of the labour-intensive aspects of hydrographic surveying and charting, we have looked at the three phases implied in the work of a hydrographic service — namely data acquisition, presentation and dissemination.

AUSTRALIA'S PROBLEM

In Australia our present field forces engaged in the acquisition process are limited. Nevertheless, we have accepted the responsibility of producing and maintaining the chart coverage of Australian waters with a planned total of some 600 charts.

In general it can be said that most of the Australian charting area is covered with some form of survey, even though a great deal of it is a result of work in the old colonial days. Current field forces concentrate on specific shipping routes around the continent and on the approaches to ports, both old and new. This policy enables us to update our charts in the areas of importance, although much of the chart produced may be of dubious value for general navigation.

Unfortunately, the programme of metrication dictates that a revision to a chart to incorporate a modern survey has to be not just an addition to previous reprints, but a complete re-compilation.

The requirement to re-adjust and incorporate existing information, held in a variety of scales, units and projections, places an inordinately heavy workload on the available manpower, out of all proportion to the value of the information incorporated in the chart.

The manpower problem has been further aggravated by the constant flow of additional data from port development projects and from the numerous modern ships fitted with echo sounders, reliable radar, Satellite Navigation Systems, etc., which at times blaze their own trail across apparently safe but often poorly surveyed waters; and this influx results in increased maintenance of charts already published. Geared, as we have been, to manual methods and an inherited set of Admiralty charts, our capacity to complete modern coverage of our area of responsibility is hampered by the more traditional methods of hydrographic production and distribution.

Although our overall policy is for a fully integrated systems approach to the whole range of hydrographic activities, we have identified our area of greatest need; and our initial development is being concentrated upon data base formulation and the automation of production capacity. We have realised that this will allow rapid absorption of field information from seaborne and airborne acquisition systems, which are scheduled to be operational in the early 1980's. In effect, we are developing our capacity

to handle large data flows immediately, and ahead of the time that we shall be forced to absorb them.

Despite the radical nature of the restructuring required, most effort will be behind the scenes. To the mariner in the field there will be little apparent change, and we will attempt to preserve this for the present. Because of our ability to absorb large quantities of data and to manipulate it, we have come to realise that our capacity to disseminate and exchange information will also grow, as will the capacity of others who are involved, or will become involved, in these procedures in the future.

DISTRIBUTION OF INFORMATION

For many of us hydrographers, our ability to acquire data is increasing and our ability to store data in a quick retrieval format is now a reality; but what of the format and distribution of information? The position facing all maritime nations nowadays — or at least shortly into the future — is that the information which necessitates the updating of any chart will be entered into a data base and, because of the power of the computer, will be capable of immediate integration. Production tapes can be run from the data base, and rapidly we can proceed directly to repromat production, complete with all spatial manipulation, symbology and typography. With a printing press ready to run, an updated reprint of the chart could be published in less than a day.

This is as quick as, if not quicker than, shortened versions of equivalent data published today through the Radio Warnings or Notices to Mariners services. Costly technology, it is true, but cost effective when the relatively low price and large capacity of today's mini-computers and high resolution plotters is compared to the rising cost of manpower, much of which is wasted at present on repetitive procedures.

Because of the power of the computer and the versatility of modern communication systems, we are on the threshold of being able to produce in graphic form, a correction to a chart where and when we like, or in fact the chart itself. Not only this, but we will also be able to produce charts of greater or lesser detail from the same data without the requirement to research the data on each occasion.

National Hydrographic Offices tend to produce chart coverage at the smallest scale that satisfies the general requirements of navigation. More often than not our records contain much more detailed information than shown on the chart. Today, unnecessary additional work — much of which repeats that which has gone before — is required in any drawing office on any occasion that a chart of a different scale is required of an area previously charted.

A REQUIREMENT FOR AN INTERNATIONAL SYMBOLOGY

Hydrographers have long appreciated that the symbology of graphic communication is a powerful tool which cuts through the barriers of

language. In these days of superior communications we need to refine our symbology to a common level so that only a minimum of translation remains. I believe that the IHO is working towards this level with groups like the North Sea International Chart Commission. However, we must come closer to international agreement on a symbology to which all nations can agree; the IHO continues to offer a forum for such cooperation.

In the field of symbology, much needs to be considered. Symbology of course includes typography, which at present has much unnecessary embellishment in type styles. We have come to identify such styles with charting it is true, but is a computer-graphic type style any less informative ?

Given sufficient effort, a computer can reproduce virtually any manual symbol without operator intervention; however, machines have their own efficiency levels, much as man does, and we should become as conscious of these efficiency levels as we are with manpower. There will be a transition from manually-produced symbology to machine-derived symbology which will take years; but I believe we should attempt now to identify a symbology which favours machine manipulation, and discard or modify those symbols which, although artistically pleasing, are wasteful of machine effort.

Present symbol tables — for example the British Admiralty's chart 5011 "Symbols and Abbreviations used on Admiralty Charts" which Australia uses — are in general unsuited for the production of the symbol specifications required for computer recording. For instance the numbers used : A1, G50, etc, often represent a grouping of symbols rather than discrete symbols themselves. As an example let us look closely at K12 — Sector Light. (Sectors are also used elsewhere, in K68 and P4). This symbol has in fact six symbol elements : a light star, a magenta flare, sector rays, sector arcs, arrow heads, and typography.

The initial Australian approach will be to define each symbol element, and to digitize such elements around the central feature position. The computer's Symbol Drawing Table will be addressed and symbols constructed about the recorded feature position, for example a light star position.

Our initial analysis of K12 results in more symbol identification than before. However, this increase is offset by those areas where existing symbology can be reduced or dispensed with. The overall effect of our analysis for the Australian AUTOCHART system of the British Admiralty's 5011 chart symbols is a requirement for approximately 200 discrete symbol specifications. While these specifications for recording could satisfy data exchange standards, we are not overlooking a possible call for the amalgamation of certain symbols to illustrate usage to the mariner. Here though, we should not confuse the specifications for data base assembly with the need for the demonstration of usage. Wherever different output is required, this becomes simply a matter of addressing the appropriate drawing routine. The need for specific data base symbols should not be confused with examples of those symbols in illustrative form.

National standards do vary, and much joint effort is required in the

coming years. I fear that the uneven application of electronic data processing throughout hydrographic offices — as a result of heavy investment by some nations in what is now yesterday's technology — may influence, and perhaps retard, the adoption of a more coherent set of symbols and data organization standards where each symbol would be universally capable of identifying some unambiguous graphic output.

Complex symbology is no more than a function of its least divisible part. Let us now press for strong international alignment, with emphasis on efficient machine symbology which meets the mariner's requirement for concise unambiguous communication.

COOPERATION AND CAPTURE

Much of Australia's experience in symbol and data organization stems from close cooperation between its internal mapping organizations, through the national forum of the National Mapping Council (NMC) of which the Hydrographer R.A.N. is a member. It has been recognized that computer technology is the most practical way of planning, preparing and producing cartographic material for an increasing diversity of uses; the day of the large national, or even international, data banks of such information is still some time away, but much progress can be made at the individual organization level. To this end, recognizing a future profusion of individual data banks, the NMC of Australia is attempting to introduce techniques in common data presentation to facilitate data exchange.

The topographic work shown on a chart has its origin largely in the topographic mapper's data base. Certainly, it has different emphasis and symbology; however, this could be described as merely a manipulation of the data base. In order to avoid wasteful duplication, especially of manpower, it is desirable that basic data is available for all to use as they so require. The Hydrographer's data base can and will serve as a foundation for any organization to use for its bathymetry or other work.

Although absolute commonality in computer-based symbology is not essential, and might be looked upon as impractical on a worldwide basis, uniformity of data symbol capture modes is of paramount importance. The mode in which data is captured, and the retention format, should be common to all users, despite variations in the appearance of different user outputs. In certain areas there will be no problems. No-one would dispute the capture and retention of a high-water line in a "continuous" mode, despite the possibility of different user outputs, because the source of this type of data will be held in common format by all.

However, some symbols differ in their emphasis and are likely to be captured differently. Take for example a bridge: here topographic mapmakers' symbology may only require information about the bridge in "point" mode, while the hydrographic requirement could be for "continuous" mode to suit the final portrayal of detail required by the mariner. In fact, both forms can be satisfied by "continuous" capture: the lesser "point" mode can be derived by computation from the "continuous" mode. Alternatively, a mariner might only need to know that an airport exists

(i.e. in "point" mode), and this could be deduced from the greater detail captured in this case by the topographic surveyor. In this matter of modes of data capture, organizations must give attention to the amalgamation of data bases. Information must be captured and stored in the mode with the greatest overall application independent of any single user requirement, but available for all to use as appropriate.

This type of requirement will need to be studied by all nations wishing to enter not only into national exchange programs, but also into international exchange programs.

THE DATA EXPLOSION

The source material which is so crucial for the mariner is the summation of all material available from any reliable source. However, none is more important than the hydrographic survey carried out under arduous and time-consuming conditions in an often inhospitable environment. The interface between the air and sea offers a technological barrier which has tested man's ingenuity for centuries. Even today, when it is possible to analyse vast land areas with aerial photography and remote satellite sensing, the analysis of the seabed is still generally limited to specific sampling profiles, or narrow band scanning with equipments that have basically very low data acquisition rates.

With airborne techniques (currently under development in Australia and elsewhere) the volume of data can become overwhelming. The scanning devices operating at aircraft speed capture data in volumes that only the computer can analyse. Even with data reduction techniques, the amount of information available for charting will far exceed that which any of us — limited as we are to seaborne sensors — have ever known. Airborne techniques of this type are at present limited by water penetration capability, but indications are that they will revolutionize sounding of nearshore and navigable waters of 30 metres or less.

REORGANISATION WITHIN THE DRAWING OFFICE

The challenges deriving from these advanced technologies include pressures upon the organizational structures of hydrographic offices. These pressures may call for drastic alterations in emphasis as to the skills required from available manpower resources; they will undoubtedly call for new skills from specialists who until now have not been considered as potential cartographers. Often a critical look at manpower already available within an organization will enable many new tasks to be absorbed with the recruitment of only a few additional personnel from highly specialised fields.

The changes required will probably manifest themselves in rapid functional redeployment of personnel and a change in production philosophies. Australia's organizational structure for the processing and dissemination of hydrographic information has up to now followed the traditional struc-

ture dictated by the functions of manual processing and by supportive equipment techniques. These being in the main highly labour intensive, much emphasis has been laid upon adequate staffing, training and maintenance of critical procedures in the charting process.

Specialized skills of yesterday have become to some extent diffused into the "general" cartographic employee who can now handle a wide range of skills. The type setting phases of today still equate with the single skill of the engraver, but have permitted somewhat less reliance on critical manpower.

Today, as we look to computer technology and the concept of data base utilization, we sense a return once more to specialized activities and a greater reliance on such critical staff positions as the computer programmer. I believe, however, that this will be short lived, as once again the personnel will become conversant with the new technologies.

Production methods will, of course, change the familiar process of individual chart compilation, which will be divided up into a different series of events related to total data acquisition and amalgamation. Editing, which has tended to remain late in the process, will be brought forward to the point of entry. After validation of data entry and successful amalgamation, no further checking of information should be required, except for "proving edits" on presentation and on general data portrayal.

The functions of compilation will be abandoned in favour of data base entry. Compilations, *per se*, will be the amalgamation of appropriate information in accordance with set specifications. The new compiler will be able to concentrate his skills upon the data amalgamation problem, avoiding for the most part the time-consuming manual assembly process with its own peculiarities and problems.

A GLIMPSE OF THE FUTURE

With the establishment of a well-structured data base, concise production routines and the use of worldwide communications it could become possible for ships to receive an up-to-date graphic output of any area in which they have to operate. It is true that the presentation will differ from the artistic forms of today — but would that "chart" be any less informative?

Such a system would eliminate complex storage of reprostat, bulk storages of charts worldwide, manpower tied up in production and distribution, and correction on board ship. It would eliminate lithographic machines, plates, cameras and printing presses.

Much must happen before such a dream is a practical reality, but it must be remembered that the user is not always aware of the changes that can be made for his benefit. We have the facilities, we know our resources, and we must provide the mariner and others with what they require. However, our responsibility does not end with passively supplying information in only one form because the mariner says he is satisfied. We have the very real responsibility of advertising to the user the technological possibilities available.

CONCLUSION

In approaching the introduction of automation to the hydrographic processes, Australia has chosen as her objective to become operational in the field of chart production prior to the influx of field data in computer-compatible form. Initial development will be in the construction of a chart data base to which all incoming information can be applied directly, and from which it can be extracted with ease.

It is Australia's experience that, with the advent of automated procedures, the chart production and distribution functions in hydrographic offices will change. Initially, the manual drawing and scribing techniques will be replaced, leaving man's superior evaluative skills to be applied to data input. Staff presently used in producing and maintaining repromat manually can be redeployed to data entry.

The capacity to manipulate a data base to reflect changes in requirements will enable hydrographic organizations to enlarge the field of user demand, much of which is at present dormant. We of the hydrographic fraternity must be a catalyst for change, and must introduce such change in an requiring and educative way, in cooperation with the mariner.

The extension of our understanding of other mapping agencies, and our ability to interact with them, can minimize and even eliminate the repetitive effort now so much a part of the preparation and production of our products. Today's exchange of repromat agreements will soon be replaced by data exchange agreements, and we must bear all this in mind when we commence to structure our data bases of the future.

POSTSCRIPT : In November 1977 Australia awarded the contract for the AUTOCHART to Systemhouse Ltd of Ottawa, Canada. It is hoped to be operational in September 1978.