TECHNOLOGICAL IMPERATIVES IN THE FIELD OF HYDROGRAPHY
AND THEIR IMPACT ON THE PROFESSION OF MARINE CARTOGRAPHY

Ronald A. Furness FAIC
Head, Branch Transition
Royal Australian Navy Hydrographic Office
8 Station Street
Wollongong NSW 2500 Australia
(ph: +61 42 21 86 15   fax: +61 42 21 85 99)

Abstract

In their quest for greater and greater efficiencies in collecting hydrographic data about the Earth, hydrographers have been quick to exploit modern electronics technology to enable them to gather such data with more efficiency. Australia is typical of countries that support modern hydrographic agencies and would rank high on a list of systems innovators, if indeed such a list was ever compiled. Australia has developed, for example, a sophisticated Laser Airborne Depth Sounder (LADS) and uses modern data gathering systems at sea. The Royal Australian Navy's (RAN) Hydrographic Service garners data from other Australian agencies and increasingly, finds that data is available in digital form and is of varying quality.

As the nation's charting authority, the RAN's Hydrographic Service employs marine cartographers in its core business area of chart production. Traditionally these have been technician cartographers who have required, as a minimum, technical college qualifications for their entry into the qualified grades and who have been classified formally as 'technical officers' or 'draftsmen' (*sic*) rather than 'cartographers'. Over the last decade or so, the technological imperatives arising, for example, out of the adoption of modern hydrographic data gathering systems, have had an inexorable and major impact on the way the marine cartographers of the RAN's Hydrographic Service 'go about their business'. At the user end, increasing demands for ship navigation systems, which employ digital hydrographic data and graphics which are at the one time sophisticated and ephemeral, are also challenging the principles of the marine cartography profession. Additionally many other fields are seeing the need for cartographic presentations of hydrographic data which better suit their requirement. For example, coastal zone managers, environmental scientists, geologists, and others.

In its examination of the main impacts from technology on marine cartography the paper briefly will outline the major technology developments within hydrography and link their use to the many more general imperatives which impact on marine cartography. It will make comment on newer and older methodologies and will suggest that marine cartographers in Australia and around the globe are accepting the challenges and are becoming leading innovators in the management, use and presentation of digital hydrographic information.

The paper will point to a need for employers of marine cartographers to recognise that marine cartography, as a result, is becoming far more professional. The paper also argues that, as a result of this increasing degree of professionalism, marine cartographers' future contributions within the hydrographic industry will be greater than in the past and this increase in the level of capability should be recognised by the professional societies, educational institutions, governments and employers and, more importantly, marine cartographers themselves.

Aim

The reader is warned that this is not a rigidly researched paper. Rather, it is a string of personal observances from over thirty five years experience which the author uses to argue that cartography in general, and marine cartography in particular, is increasingly becoming professional and, as a result, an indispensible contributor to meeting the multifarious demands of modern society. These are grand claims, but these are grand times for cartography. The author never fails to be impressed by the capabilities of those cartographers with whom he comes in contact; their collective ability to rise to the occasion and meet the challenges that come their way. Ironically, they seem reticent in singing their own claims so, at least in part, the author aims to trumpet their achievements in a general way in the hope that others who are equally impressed will be "outed" to also promote the achievements and abilities of modern cartography and its cartographers.

Introduction

Since the mid-seventies, perhaps the dominant imperative impacting on the field of marine cartography has been that coming from the advent of increasingly powerful computer systems. The seemingly never ending compaction of computer hardware, its increasing power and graphics capability together with incredibly powerful, user friendly software, the innovation of geographic information systems philosophies and the downward spiralling of costs, plus the advent of open systems philosophies with matching capabilities, have brought to cartography the most powerful of tools which are now almost as ubiquitous as the crow quill nib perhaps once was.

This technological imperative brought with it a reappraisal of how cartographers need to view data and products. It has impacted on the way we design our cartographic organisations and how we reorganise our work and reskill our professionals. Generally, it has uplifted the productivity of cartographers who generally are more skilled as a result.

Notwithstanding the impact of technology there have been other imperatives which have also brought with them major impacts on the profession of cartography.

A degree of economic rationalism imposed by governments around the (western) world has brought with it imperatives which have challenged cartographers to reappraise their roles. "Public good" views of cartography have frequently given way to views of public sector cartography which are more akin to those which drive the public sector's more commercial colleagues. There are probably less cartographers around the world than there were twenty or so years ago, but those that remain are picking up the challenges presented to them and, as a result, are a "different breed" to the cartographer of yesteryear. No longer bound by a single technology or by hidebound hierarchical structures successful modern cartographers are becoming *truly* professional.

Imperatives have come too from areas which have perhaps been traditionally thought of as being outside the cartographic domain. Take, as one example, that of surveying. All areas of surveying too, have been impacted by technology and the general pressures faced by cartography. Precise satellite positioning and digital data collection technologies are transforming the outputs of surveying and thus, to the extent that these outputs are the inputs for many cartographic functions, the impacts are parallel in their eventual effects. The collection of data at sea is a good example. Another area is that of computer science: many cartographers have embraced computer programming, for example, as one more tool in their productive armoury. I wonder though how many computer programmers have switched to cartography? I think it more likely that the cartographer has contributed more to the

development of systems! Cartographers too, early recognised the need for international data exchange standards and have been prominent in their development and introduction.

Let me now showcase my own reflections on what has impacted on marine cartography over the last twenty or so years within the RAN Hydrographic Service. By doing so, I hope to identify with sufficient strength my claims about cartographic trends. In so doing I am conscious always that I am arguing from the specific to the general case. I hope that others will support my claims or otherwise, depending on *their* experiences. If they cannot, then I am wrong, but it will take much convincing for me to change my views.

The "Cartographic" Imperatives

The RAN's Hydrographic Service largely owes its existence to World War II when the government of the day realised that Australia needed a local charting capability for Defence and trade purposes. The Federal Cabinet had given thé charting authority to the RAN back in 1920 but the country in 1945 remained charted primarily by the Royal Navy. World War II was an important imperative as it cemented the national charting role within Defence. As a result, some fifty or so years later, the RAN Hydrographic Service provides a service to both defence and civilian maritime sectors.

Technological

Chart production, as an entrenched cartographic methodology, always has adopted modern technology, thus it is no surprise to find that cartographers have readily embraced the technology of computer systems. By the term "entrenched" I mean to imply that the methodology was dominant within cartographic production organisations and formalised in the standing operational procedures of the day. Employment for cartographers was solely as "qualified technicians" and even then, qualifications only became mandatory from the early 1970s. Even so, the marine cartographers (or "draftsmen" as they were then more likely to be known) embraced and adapted the use of many technologies.

Thus we see the use of copper engraving (not by the RAN Hydrographic Service, but by the Royal Navy in its chart production), lithographic techniques, hand drawn originals and photo gravure techniques, the plastic film scribing and photographic techniques of the nineteen sixties (in themselves, a revolution) and the early use of computing machines for computational relief and coordinatorgraph machines for plotting. There can be no doubt that most of these techniques are still employed where appropriate and in some cases, very productively for few professions completely give up the hard won skills gained of yesteryear.

Each technological imperative though has brought with it a commensurate impact on the profession of cartography. We tend to see the computer as somehow special because its impact has been so profound. Its impact has permeated each and every aspect of cartography and has changed, in the author's opinion, the very face of cartography. Let's return to the example at hand.

The mid-seventies saw the first introduction of computers in the RAN Hydrographic Service. Building on the then pioneering work of the Royal Australian Army's Survey Corps' work to computerise its map production the RAN Hydrographic Service adapted the available production system for charting purposes. Those involved in the adaptation quickly distinguished differences between mapping and charting and those differences have carried through their influence on chart production to this day.

Charts are different from maps in at least the following ways:
- they are compiled from data that varies greatly in quality, fidelity, age and accuracy.
- they overlap and nestle in order to facilitate their navigational purpose.
- they follow international specification, representing the fact that a nation's charting is used by the mariners of many nations.
- they use relatively few projections - Mercator and Gnomic being predominant.
- they MUST be continuously updated.

Charts are NOT different from maps in at least the following ways:
- they are compiled for a single purpose.
- they are difficult and costly to maintain.

The general trends in computer hardware and software capability identified earlier in this paper have brought within the grasp of the marine cartographer the capability of overcoming the limitations of the paper chart but in turn, the marine cartographer has needed to become competent in the computer fields of digital data storage analysis and visualisation, data base design and implementation, records management and control, multiple output design to meet specific and ephemeral user needs. Above all the marine cartographer has had to become cost effective in meeting these challenges.

World War II gave a great impetus to the development of electronics. The introduction of radar and electronic position fixing at sea impacted in turn on the methodologies of navigation. However, the advent of the echo sounder which replaced the lead line and the sonar swath devices which have all but replaced the need for wire sweeping, have impacted on the hydrographer's means of discovering what is the shape of the sea floor. Gradually the introduction of systems have replaced much of the tedium of hand drafting and plotting survey sheets and digital data collection at sea is commonplace from many innovative swath systems which gradually provide the capability for the hydrographer to win full knowledge of the morphology of the ocean floors. No system is presently more innovative that the Australian LADS system which now routinely offers full survey area coverage to fifty or so metres depth and to acceptable accuracies for navigation. The result of this data collection technology has been in the delivery to the marine cartographer of massive amounts of data that must be managed, interpreted, and above all, visualised. Likewise, the use of interpreted satellite data has proven useful in the depiction of remote, offshore reef areas critical to international heritage, yet threatened by ever increasing shipping traffic. Those readers familiar with the modern presentations of hydrographic data will be suitably impressed by the skills of the marine cartographers in Australia and around the "hydrographic world" as they grapple with the complexity of the data and its presentation while adhering to standards of accuracy only dreamed of by their forebears.

An aside: it is interesting to the author to note that the hard won knowledge of the oceans is still a remote sensing technique, as was the early lead line.

The very success of these data collection systems has created a demand for the data that was at best spasmodic hitherto. The latent demand by others for knowledge of the sea transcends the actual data itself. Thus the marine cartographer is advising environmentalists, developers, governments, and others in addition to his or her primary role of meeting the needs of the navigating mariner at sea.

Thus, it is argued, the modern marine cartographer has accepted the challenges thrown down by the advent of computer technology with the result that marine cartography is truly more professional and increasingly dominant in the resultant professional partnerships, many of which have been forged around the new technologies.

Economic and Institutional

General economic downturns in recent times have seen cartographic establishments, especially those in government, subjected to greater scrutiny by the government of the day. Many have been amalgamated, many have been disbanded, many have been totally restructured and most have been shrunken (if you really wish it - "downsized"). The emergent, and therefore successful, cartographic organisation will generally comprise a band of multi skilled cartographers, fluent with their technology, managerial in their ethos and effective in their service delivery. Actively they will be seeking clients with unique and novel requirements which can best be met by innovative responses. No longer can monolithic cartographic production houses churn out map after map to meet specifications which bear little, if any, resemblance to the needs of the client base.

There has been a consequential increase in strategic partnerships which minimise duplication in government and exploit business opportunities in regional and national charting and mapping projects. Cartographers have changed many attitudes over the years.

The comments are illustrative too of the case of the RAN Hydrographic Service. Cartographers have revised their views of how charting data needs to be recorded and retrieved. They have formed partnerships with industry that have led to the most innovative presentations of electronic charting information which complies with current international specifications. They now data base their schemas of navigation aids. They continually attempt to meet the voracious demands of both civilian and military sectors for digital hydrographic data.

Organisational and Industrial

The vogue in modern organisational design is for flatter structures and the use of multi disciplined teams working on production and development tasks. Industrial trends have been to encourage a multi disciplined workforce which is empowered to exploit its new won capability in achieving the aims and objectives of the organisation. Management is generally more visible and therefore accountable.

Traditionally, public sector industrial classifications have been monolithic, hierarchical and rigid. Many great improvements have been made within the Australian federal public service and in the administration of the RAN and therefore, the RAN Hydrographic Service. Marine cartographers are more likely to be responsible for more of the design of their work, have a say in their work times and methods, they frequently are called upon to work within multi disciplined groups, especially when engaged on development tasks. Nevertheless, some rigidities remain. One major area is in the way work groups are classified as clerical, professional, technical and informational. Great flexibilities have been achieved over the years in the classification of federal public servants but the transition of the modern marine cartographer from artisan to professional still must gain full and proper recognition. One idiotic remnant of this present classification scheme is that cartographers can be found employed across all four of the major classifications as they multi skill themselves but are restricted to applying for jobs classified in a particular workgroup. While it could be argued that such a case promotes great flexibility, more likely will be found irritating anomalies in individual employment situations. Steps are under way within the RAN Hydrographic Service to bring to the fore, and resolve, these anomalies.

Educational

It has been the case within Australia that the RAN Hydrographic Service has rarely been able to take new cartographers from Australia's educational institutions with a good knowledge of the requirements of marine chart production, however good their basic cartographic training. More likely it has had to invest considerable time and resource effort into on-the-job training. This is still the case, though it is evident that the modern cartographic graduate is formally educated to a better level than previously and thus,.becomes fully productive at an earlier stage

Parallel with cartography being perceived as mainly an artisan based technical role most cartographic courses in Australia came into being through the system of Technical Colleges. As tertiary education spread through Colleges of Advanced Education and Institutes of Technology it was no longer the exclusive purview of the Universities to conduct graduate and post graduate training. Therefore, it became more and more likely that the cartographic graduate would be trained to a formal professional level rather than to the technical level although realistically, course availability was at best, geographically patchy, being available only in some States. Recall that this is one of the limiting aspects of the federal Australian public sector classification scheme which was alluded to above.

Consequently, modern Australian cartographers are increasingly professional both in their outlook and in their formal qualification.

Customer Viewpoint

It has already been mentioned that the time has gone when cartographic production houses could produce series upon series of specification rich maps and charts almost without regard to the eventual customer viewpoint. Bushwalkers in Australia during the sixties would be most grateful if they could find an old wartime map of the Blue Mountains area notwithstanding that it was generally hopelessly out of date and inaccurate. It is now more probable that the map customer viewpoint has been carefully considered and incorporated into the product design. In the area of charting the international specification remains supreme on the grounds that standardised products are more likely to promote safety of navigation at sea. Customer viewpoints are not entirely ignored however, and the advent of data based information is gradually providing the means of providing the flexibility demanded of customers such as the recreational boater.

Political Expectations

The mapping and charting professions have become more visible in recent years as governments have been more or less convinced of the benefits of creating data bases of geographically encoded spatial data. The tax bases of most states rests on efficient management of the cadastre. Slowly at first, but with increasing capability, the digitisation of the cadastres has produced some impressive efficiencies which are not lost on our administrators. Similarly, at sea, the issue of boundaries becomes fundamental. What is the baseline? WHERE is the baseline? How can we accurately define (and defend) those exclusive sea areas claimed by our nation? These questions are being asked by governments and legislatures around the world.

Once again, we see examples where cartographic depiction and interpretation of massive amounts of data must be effectively presented to an end user in increasingly accurate and novel ways. The advice and skills of the modern marine cartographer are to the fore.

Environmental

At least one example of the integrative powers of modern computer systems applied to cartography is in the combination of mapping and charting data of land, sea and air. Coastal zone managers, for example, who must manage at the interface of these three Earthly domains, must manage data from a myriad of sources and from disparate timescales. The power of cartographic representation comes to the fore in such applications. Some countries are only just realising the potential of the modern cartographer but there is clearly an increasing need for the skills.

Expectations Raised

The development of ways of cartographically depicting modern massive sets of digital data and derivative products is begetting an increasing realisation, and thus demand for, the skills of the modern cartographer. As the cartographer forges new skills the market for the results of these skills seems presently insatiable. One frequently hears at cartographic demonstrations and exhibitions comments such as "that's fantastic, but can you do such and such...?" It is an exciting time for the marine cartographer and for cartographers generally.

Conclusions

I hope that the reader that has been brave enough to persevere with the reading of this paper will agree that cartography is becoming more professional. I hope too that he or she has been persuaded that, axiomatically, cartographers too are becoming more professional, especially those in the marine cartography arena. Why do I keep harping on this? Well, it seems to me that many cartographers have suffered an identity crisis as they have grappled with the many imperatives which have impacted on them and their profession. Although I have probably only identified but a few, it seems to me that many of my colleagues have been too ready to become identified as "managers", "computer systems engineers", "land information officers", "GIS consultants", "geomaticians", etc. rather than remain as "cartographers".

There have been many reasons for this and our educational institutions and our employing bodies have not helped as they too have reponded with redefined names such as "Land Information Centres" and "Department of Geomatics". The turmoils of a few years ago where each of the professions tried to "restake its claim" with the metaphorical "raising of the picket fences" saw an exodus of many cartographers to the freshly staked and defined "professions?" listed above. The problems with such redefinitions are, in the view of the author, partial views of reality brought about by the self interested need of organisations and professions to survive in an environment of change characterised by extreme turbulence.

However, when all is said and done, a lot more is said than is done! It still needs though to be said, that cartography remains an essential imperative in its own right, an essential tool with which the modern state manages its geographically based information and assets. Thus the modern cartographer needs to come "out" and become more visible and less modest otherwise others will claim the field for their own.