The Role of the National Topographic Survey of Great Britain

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(Second of two parts)

The uses of large scale surveys

Reference has already been made to large scale surveys as being part of the infrastructure of national life, and this rather sweeping statement needs to be supported by something more specific. What purposes do they serve? In answering that question, we can do no better than to turn to the results of a review into this very matter which was conducted in 1973. During the course of this review, questionnaires were circulated within central government departments and were sent to all major local authorities, to the Local Authority Associations, Public Service Authorities, Statutory Undertakers, and commercial survey companies, as well as to professional bodies representing interests in the engineering, surveying and legal professions. I need hardly add that this institution, which has always taken a lively and proper interest in the affairs of the Ordnance Survey, was among those consulted. From this review, it emerged clearly that large scale surveys, and of course, the maps which result from them, are used for the following main purposes:

1. **Planning.** For example: land use and other planning surveys, town and village maps, planning applications, road routing and traffic studies, and service location planning.
2. **Legal uses.** For example: land registration, conveyancing and litigation.
3. **Survey uses.** For example: as a base for adding further detail, including close contours.
4. **Recording.** For example: land use, location of public services, boundary alignments, and changes, and preservation orders.
5. **Abstracting.** For example: area measurement and parcel numbers, locational referencing, abstracting of quantities, and identification of special items or features.

These are the main purposes. There are, of course, others, but it would be tedious to enlarge the catalogue, except perhaps to mention that map publishers in the private sector also make use of Ordnance Survey maps as a basis from which to compile maps of their own designed to meet particular purposes—such, for example, as street guides.

I mentioned the registration of property as being one of the principal uses to which large scale maps are put, and I think it is worth looking at this in rather greater detail. The great majority of countries in the world have special cadastral surveys for this purpose, which are sometimes though not always the responsibility of a government department other than that which looks after the topographical surveys. Cadastral maps have several important characteristics:

a. Their production is confined to those areas where registerable transactions in land are taking place.

b. Plotting scales tend to vary with the physical extent of the properties being registered and not necessarily with their topographical complexity.

c. They usually include only as much information as is necessary for the purpose for which they are intended—for example, land tenure, land use, or land valuation—and are therefore often incomplete as regards topographical detail.

In countries other than Britain, large scale surveys are more often than not of a cadastral nature, with little or no useful topographical spin-off; and when this is the case, the largest scale of basic topographical survey is usually a good deal smaller than it is in Britain. We, on the other hand, have no maps which are solely cadastral in character; admittedly our maps at the two largest scales lack contours, but in every other respect they can properly be described as topographic. At the same time, they serve a cadastral purpose in that they, or extracts from them, are used by Her Majesty's Land Registry as part of the definitive documentation which registers the title to property. Indeed, the manner and method of registration laid down by Statute and the Rules made thereunder require that the registered description of land in England and Wales should relate to an Ordnance Survey map. The maps do not necessarily define property boundaries as such: they show only the topographical detail as it exists on the ground at the time of the survey. However, the system of registration by what are known as general boundaries, which is used now in England and Wales, and will at some time in the future be brought into use in Scotland, defines a property boundary by reference to the natural or artificial features which exist at the time of registration. An accurate survey of these features, supplemented where necessary with the minimum of additional information, provides a precise definition of the property boundary.

Thus we get the best of both worlds. Our large scale maps serve the needs of property registration, but at the same time they are essentially topographic in character and are suitable for a wide variety of other uses, which have already been described.

The presentation of topographic detail

The historic cost of our national survey runs into hundreds of millions of pounds, and the justification for such expenditure, although almost impossible to quantify, is clearly dependent upon the usefulness of the surveyed information. Usefulness, in turn, depends upon it being up-to-date, and readily available to those who need it. To some extent these two requirements are in conflict, but developments within the last decade have gone a long way towards improving the situation.

The traditional way of storing and presenting surveyed information is graphically as a printed map. The cartographic processes which convert the survey into printed form are, however, time-consuming, so that it is not unknown for a map to be out-of-date in some respect on the day it is published. But the printed map is the end product of a considerable capital investment, and so it has to remain in publication for some time before it can be revised. By this time, it will be even more out-of-date. This is an unsatisfactory state of affairs, and it is aggravated in our case by the vast number of different map sheets which comprise the various large scale series. By about 1981, there will be well over 200,000 large scale maps covering all Britain, and the physical problem of storing and distributing these maps in printed paper form is formidable and very costly. As a data retrival system it leaves much to be desired.

In order to improve matters, we have in recent years been developing a system known by the acronym SUSI, which stands for supply of unpublished survey information. We now rely less upon the publication of formal new editions of large scale maps, which will continue to be printed but at much longer intervals than before, and far more upon maps copied from the surveyors' field sheets. These field sheets begin life as plastic fascimiles of the published maps and gradually, through the years, acquire additions and deletions, as development proceeds. They are, therefore, permanently up-to-date and can be copied by relatively simple processes. One such process takes the form of full scale print-outs from microfilms made from the field sheets at intervals corresponsing to specified levels of surveyed change; that is to say, a predetermined amount of development on the ground will, after it has been surveyed, trigger off the preparation of a new microfilm, from which full scale copies can be made as required. In addition, we have a service by which a diazo print can be made, at any time, from the field sheet, if necessary within 24 hours; a map can be produced in this way which is absolutely up-to-date in all essential respects. By these two types of service, each designed to meet a particular requirement, we aim to satisfy the need for up-to-date information at short notice. The end product, however, is in each case still a graphic. Can we not go further, and dispense with the graphic altogether?

Digital techniques

Well, of course, with the aid of computer technology, we can; and as many of you may know, we have already done so. Since 1973, a proportion of our standard 1:1250 and 1:2500 maps has been produced by a digital technique which captures the relevant topographic data upon a magnetic tape. In this form the data can, if required, be converted into a graphic product, to all intents and purposes identical with that made by manual draughtsmanship; but it can also be manipulated in digital form to serve a variety of purposes. It is the latter capability which is by far the more interesting, if only because of the potential benefits which it offers to all those concerned with the processing of data linked to, or derived from, topographical data. At present, the output is only about 13 per cent of our total large scales mapping output, but even so over 3,000 maps have been published during the three years in which the technique has been in use. The selection of maps to be treated in this way is in general confined to areas in which the local authorities or other bodies, are interested in using digital data and are able to do so.

The processes involved in making a digital map can be quite simply described, and I shall attempt to do so. The starting point, as in the case of a hand-drawn map, is the surveyor's manuscript field sheet. This is placed on a special type of table. The draughtsman controls a cursor which he places accurately over a selected point of detail on the field sheet. By pressing a button on the cursor, the co-ordinates of the position of that point are recorded on magnetic tape with great precision.

Consider now a feature, such as a fence, represented by a straight line. By recording the co-ordinates of the two end points of that line, and by adding an instruction that the two end points are to be joined by a straight line, we shall have, on the magnetic tape, all the essential information needed to determine that line. If we add a descriptor, commonly called a feature code to tell us that the straight line is a fence, we shall have recorded not only where it is, but what it is.

Curved lines are dealt with similarly, but in this case the draughtsman selects, according to his skill and judgement, a number of extra points along the curve as well as the two end points, and a mathematical spline is used during subsequent computer processing to generate a smooth curve through all these points, thereby reproducing the original with quite remarkable fidelity. In this way, all topographical detail represented by points or lines is committed to magnetic tape. Place names too, and their location, can also be recorded on the tape.

The data so acquired is subjected to computer processing, and then editing, the object of the latter being to detect and correct any errors which there may be. The end result is a magnetic tape containing, in digital form, enough information to reconstruct the map in graphical form. This reconstruction can be done by means of a precise plotter, functioning automatically under command from the magnetic tape. Virtually every single item which normally appears on a map can be reproduced in this way, but in practice we find it expedient to add a very few things such as vegetation symbols, and the stipple which indicates roofed areas, by traditional manual means. The penalty for this is the exclusion of those particular items from the digital data bank, but this is of little consequence.

What, you may ask, is the advantage of this process? The end product is a graphic, just as before. Why go to all this trouble to produce exactly the same article? The answer is that it is not the same article, but something much more versatile. A customer can also buy the map, as printed, if he wants to do so. He can also buy the magnetic tape, and if he has an automatic plotter of his own he can make his own map, to any scale he likes, without reference to standard sheet lines, and showing only those features which suit his particular purpose. In other words, the customer is freed from some at least of the constraints of a standardised multipurpose map and can make his own specialised version. This he may use as a base on which to show other information—for example, an underground drainage system—which itself is capable of being held in digital form. We in the Ordnance Survey can also make use of this flexibility to derive our own standard maps at scales smaller than the original. The system permits us to select only those features appropriate to the smaller scale, and the choice of scale is a simple matter of programming. As in all such processes, there are a few practical problems to be resolved which considerably complicate the theoretical simplicity of the approach, but these have been overcome to the extent that production is now in hand of the first 1:10,000 maps to be made from the large scale digital data, the most advanced of which is due to be published before the end of the year.

It is generally agreed that the appearance of maps produced in this way is superior to those produced by manual methods. The rate of production of these 1:10,000 maps will be quite slow for many years to come because for each one it is necessary first to produce the larger scale maps covering the same area, the number of which will vary between 25 and 100. The point is, however, that the process has been proved, and is in use. Furthermore, we have carried it one stage further and have successfully made a 1:25000 (or 2½ inches to the mile) map from large scale data; but at present this has only reached the stage at which we are seeking the comments of users so that we may improve the specification as much as possible before going into publication.

There are however still further advantages to be gained from our system. It will be appreciated that, as each new large scale map sheet is treated in this way, so the total fund of digital topographical information is increased. Steadily, we are building up a digital topographic data bank which will, one hopes, eventually extend over the whole of Britain—a data bank which can be kept up-dated in much the same way as its graphical counterpart can be kept up-dated. However, the information in the bank is essentially in the form in which it was acquired; it consists, physically, of unsequenced variable length feature records on magnetic tape, where a feature can be a line, a point, a symbol or a piece of text.

Since the draughtsman who does the digitising in the first place is at liberty to record features in any order which suits him, complete entities on the ground (for example fields, houses, lengths of road, and so on) are not necessarily digitised as a whole, but piecemeal. It is however, complete entities with which the manager of land, be he planner, administrator or operator, is primarily concerned, and it is clearly an advantage to him if the limits of such entities can be extracted immediately from the data bank without the necessity of having first to plot a map in order to identify them. Not only the limits, but also the measurement of the enclosed areas and the location of the centroids, may be of interest to him.

With this in mind, the Ordnance Survey, in conjunction with the Department of the Environment, is sponsoring a project which has as its objective the restructuring of our original data so that this type of information can readily be extracted by users. This project, which started in December 1974, is due to end in March 1977; already it has reached the stage at which user trials are about to begin, and we have every hope that it will be successful. If it is, it will greatly enhance the value of our digital data bank for those bodies who have a computer-based land management system of any sort.

We are I believe, witnessing the early days of development of a national topographic data bank, in digital form, which will in due time become as natural, and as essential, a part of the everyday processes of land-management as the graphical data bank has been hitherto. The graphical form will not disappear, because it is readily intelligible to the human mind, which cannot be said of a lot of dots on a magnetic tape. The ultimate repository, however, the original record, will in all probability be the digital store, and for those who have the imagination to exploit it, it will prove a far more versatile servant than the graphical map.

Consultation

A tool is being fashioned by land surveyors, not so much for their own use as for the benefit of present and future generations of land managers, among whom the broadly-based membership of this Institution is playing and will continue to play a major part. We in the Ordnance Survey are acutely aware of the need in this, as in all matters, to maintain an active and constructive dialogue with our users, recognising as we do that it is only with the co-operation of users that new ideas can be developed and flourish. Maps and other survey products are seldom an end in themselves, but a means to an end, or even a means to a means, and as their makers we need guidance as to the form that they should take. This Institution is well placed when it comes to consultation with us, because it provides both the chairman and the secretarial assistance for a consultative body designed specifically to cater for the needs of map users in a number of different professional fields, including surveyors, engineers of several kinds, town planners and architects. Through the medium of this body the Ordnance Survey welcomes the views of members of the Institution, and will in particular welcome views upon the development of digital data for land-management purposes.

Conclusion

The history of survey and mapping throughout the world provides ample proof that the needs of users do not stand still. The massive nature of much of our work, however, makes sudden and frequent change undesirable, if not impracticable, so that the premium on forethought becomes ever greater as the pace of change increases. Greatly as we respect the opinions of the users whom we try to serve today, our sternest judges will be those, some of them yet unborn, who will expect to inherit from us a National Topographic Survey capable of meeting the demands of the 21st century. We must not fail them.