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DIGITAL MAPPING IN THE ORDNANCE SURVEY*

Submitted by The Government of the United Kingdom

BACKGROUND

The Ordnance Survey (OS) differs from almost every other survey and map making agency in that it possesses complete topographic map cover of its area of responsibility at very large scales; 1:1250 for all cities and major towns, 1:2500 for all arable land and 1:10 000 for highlands and moorlands. By 1980 all the 1:1250 and 1:2500 plans will be fully revised and maintained under our continuous revision system. If this information could be held in some way which is manageable by a computer we would have a complete data bank from which we could extract the information necessary to construct not only the large scale plans but any smaller scale map series. We should also have a bank from which topographic information could be sold to local authorities, public utilities etc. to enable them to marry their own speciality to it and produce an output in co-ordinate or graphical form to suit their requirements. As an example, if all electric power lines could be stored in the same way as our topographical information it would be possible to call out both topography and the electrical information and plot them in any way desired. Topography unessential to the product could be suppressed at will and emphasis given to salient user requirements.

THE OS DEVELOPMENT

It may be said that the Ordnance Survey has been a relatively late starter in the field of digital mapping since it was not until 1968 that the Department began studies on the possible applications of digital mapping systems of the national mapping series. To some extent this was dictated by the methods of compiling the basic scales of mapping published by the Ordnance Survey which are based on the large scale surveys mainly completed by graphical field survey methods within an instrumentally established control network. Because the survey

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information is in graphical form the precision with which the graphical detail is converted into digital form is of primary importance. Until a system had been developed which would assure a precision of digital output to meet these requirements there was little point in acquiring equipment.

Although digital equipments available at that time could not meet the required degree of precision the Department decided to investigate, in general terms, the application of the digital system for the production of derived mapping depending upon the development of improved equipment. To this end, with the assistance of the Experimental Cartography Unit an experiment was undertaken to test the feasibility of deriving small scale mapping from our large scale information. The results of this experiment suggested that we would be right in pursuing the subject in more detail but it was not until May 1970 that the Ordnance Survey itself began detailed investigations into the capabilities of digitising tables and the programme requirements of large scale map production. For this purpose a digitising table and later the same year a drum plotter were installed. Computer programmes were developed over the following 12 months, using this equipment, to provide an integrated system specifically designed for the large scale map production and its subsequent revision. The results of this work were first exhibited in August 1971 and attracted considerable interest.

At about this time an improved solid state digitising table became available and the way seemed clear, from the technical point of view, to establish a production line to handle the drawing of basic scale 1:1250 and 1:2500 mapping. However, it still remained necessary to prove the economics of operating such a system under production conditions. It was, therefore, decided in early 1972 to purchase additional equipment and to turn over a portion of the large scale production to digital methods. This was to be the pilot scheme on which we can prove or disprove the economics of the system.

THE PILOT SCHEME

The system developed to the pilot production stage consists of a series of discrete operations with their associated computer programmes.

It starts with a field survey document, which is an at-scale graphical plot of the field survey on either metal or plastic. This plot has the survey control plotted on it and has been completed by the surveyor in the field by graphical methods. The first stage of digital mapping is to enlarge the field document about one and a half times photographically, to produce a forward reading positive print on stable plastic. A copy of this positive is colour coded to indicate each feature which must be digitised separately. This guides the digitiser operator on the selection of features. It is necessary to break up the digitising into the features to be stored in the data bank so that for the derived mapping or any other requirement it is possible to call for particular features. It will enable generalizing techniques to be incorporated at a later stage.

The digitising operator now converts all line detail to digital form by simple recording of point co-ordinates. For speed and accuracy programmes have been written which allow straight lines to be specified by their end co-ordinates

only and curves by digitising salient points on each curve. This is the mathematical equivalent of laying down a draughtman's wooden spline. At this stage the position names will occupy is specified and the orientation of each name is also recorded on to the magnetic tape.

The magnetic tape now goes to the drum plotter via a computer operation and the output from the plotter is a paper graphic of all the line detail and the position of all names and numbers. Each line has a computer generated unique number and each name and number position is also numbered. This is the first generation edit plot. A draughtsman now edits this document and by using the line numbers he can make most corrections off line from the digitising table. As an example he can specify "join 106 to 209" or "delete 104". He can also list, in manuscript, the names and numbers which have to appear on the map. He does this by quoting the unique reference number shown on the plot and then coding the point size, type style etc.

The correction tape returns to the computer for processing and a second generation graphic is produced on the drum plotter. This plot is the final edit document and is used to prove the tape is error free.

The data bank now has the line, point, name and number detail of that particular map. This information can now be used for the actual production of the large scale plan or forms the basis of subsequent derived mapping. Copies can also be sold to local authorities, etc., for their own particular uses.

If the data is to be used to produce a large scale plan the tape is passed to the master plotting machine which draws out lines and alphanumerics at the required scale to a very high standard, the result is comparable to a normal scribed product. The output from this machine is a forward reading positive on stable plastic. Before a map is printed from it a hand cut stipple mask is prepared and a small amount of ornament is added by conventional stick-down methods. This could be done automatically but it is likely to be much more economical to do it by hand. Standard surround information must also be incorporated at this stage.

REVISION AND STORAGE

We expect that a large scale map made by digital methods will cost approximately the same as that made conventionally. However, at the revision stage we expect considerable savings. Our system allows unwanted detail to be removed from the data tape very easily and new data substituted. One of the many important aspects of this revision method is that no loss of accuracy is involved. Because most of our survey is held in graphical form, currently on galss, it can be seen that the digital method can offer us much more economical storage of the survey. It is in the field of revision and storage that we hope to show our greatest cost benefit.

DERIVED MAPPING

It has been our policy to concentrate our efforts on producing a system to carry out the large scale mapping task and with it the establishment of a topographic data bank. Now the system has turned over to pilot production we intend to exploit its output to assist drawing smaller scale derived maps. Here the problems are challenging but we hope to be able to show some progress in the near future.

CONCLUSIONS

While the work we have done so far has been largely of an experimental nature, the situation is that we have now entered a pilot production project. This is of a limited size but sufficiently large to enable the benefits to both the Ordnance Survey and to any purchaser of digital maps to be evaluated.

To the Ordnance Survey and to any outside customer the advantages appear to lie mainly in the extreme flexibility of the data which will allow exactly what is needed to be extracted very easily for any particular task.

The main area of economy will lie not in the initial large scale mapping operations but in subsequent revision and storage.

The need to progress rapidly so that the data bank can be built up and used for derived mapping at all scales is fully appreciated and development work is proceeding towards this aim.

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