"DANMARKS KORTVÆRK"
The Integrated Digital Map (IDM) of Denmark
- Utopia or Existentialism

By Tord Bengtsson, head of department, National Survey and Cadastre - Denmark.

The IDM of Denmark (Danmarks Kortværk) is a new product concept from the National Survey and Cadastre. The IDM consists of all the different map elements and registers, adapted to each other in such a way as to make a coherent whole which can form part of a complete information system. With this product system the relevant georelated information can be handled digitally in the future and adapted to the individual user's need for relevant planning tools.

The National Survey and Cadastre is composed in such a way that it is in a position to cover a wide spectrum of products and services, and it is therefore capable of serving a large and varied circle of users within the field of geodata. As is well known, the activities include e.g. surveying of the basic point networks, cadastral casework, cadastral maps and registers, topographical maps and nautical charts.

Development of technology and society has brought about increased complexity both in public administration and the ordinary casework. The requirement for clear presentations based on complete and up-to-date information is increasing in step with large parts of the administrative information being computerised. However, the full benefit of the "computerised work situation" will not be achieved until all the necessary information, graphical as well as administrative, is available from a computer and immediately accessible from a single terminal. The technical preconditions for this exist and the necessary equipment is becoming cheaper all the time. The graphical data is also being converted into digital information to an increasing extent. The digital maps and charts will make it possible to combine map and chart data with lots of other data and a large number of registers.

The need for a digital map basis

Indeed several projects have been initiated with a view to establishing a digital map and chart basis as quickly as possible. The impression might be given that the digital maps "make up the missing link", so to speak, between the administrative data and the "integrated work station", and that the connection between the two would be secured if the last link in the chain could be forged merely by converting the maps into digital form.

But a digital map system does not in itself create any kind of connection, and only a few (technical) users could possibly benefit from such a system. The connection can only be made by means of a complete information system in which digital maps are only one of the elements. The maps are, of course, a necessary"backdrop" for the other information, but in an integrated whole they will also be the precondition for actual geographical information processing.

The graphical mapping of the country has already taken place, and the public task of national mapping and charting in its original form can therefore be considered as having been performed in part. Future tasks are thus to be concentrated on maintaining these maps, but in addition to that the work should mainly consider the continuous development of the users' needs. These tasks must therefore be performed in close cooperation with these users, and it will be the needs, and the users behind these needs, that form the basis for the formulation of future product requirements.

The objective of the National Survey and Cadastre is to contribute to such a complete information system by supplying one of the bridge piers for it, while at the same time "opening the ball" with a first issue of the digital maps for such a system.

"Danmarks Kortværk", The IDM of Denmark

The classic topographical maps (1:25.000, 1:50.000 and 1:100.000) have to a great extent formed the necessary basis for other basic maps.

The 1:100.000 map, for example, is the basis for overall, nationwide or regional planning.

The 1:50.000 map forms the basis for military activities, among other things. The 1:25.000 map has, in practice, been used as the "municipal basis map", either in its standard form or as a 1:10,000 blow-up, i.e. the map on which the Highways Departments in many municipalities all over the country have based their physical planning or technical sketch planning. Blow-ups as large as 1:4,000 are not uncommon either, the most common use being attempted graphical combinations with the cadastral maps.

The cadastral map has played a similar role, as it has been used as one of the main sources of information in the Highways Departments and the activities of chartered surveyors.

Briefly, the IDM of Denmark is the name given to a complete digital map system comprising all the different elements and registers, adapted to each other in such a way as to make up a coherent whole which can form part of a complete information system.

The IDM of Denmark could constitute the combined technical and administrative planning basis by consisting of an integrated combination of the well-known topographical basis elements and their interrelationships, a geometrical map basis corresponding to 1:10,000, the cadastral map information, the geodetic, topographical and cadastral registers, and, via the cross reference register, secure the connection to the other administrative registers. The IDM will also be adapted so that it is available right from the outset in combination with nautical charts or the chart excerpts with sailing directions, and in this way take account of "horizontal planning tasks", e.g. with regard to the environment.

"Standard packages" in the Administrative IDM of Denmark:

DK-I, Planning Package:
Scanned topographic map (1:100,000) in raster form,
Selected name theme from the Place name register,
Digital map data (T0) - selected and thinned out,
Address theme,
Title number theme,
Municipality and County borders,

Optional extras:
Cross reference key,
Cadastral boundary theme - thinned out

DK-2, Detailed planning package:
Scanned topographic map (1:25,000) in raster form,
The complete Place name register,
Topologic structured topographic data (TOP-DK),
Address theme,
Title number theme,
Administrative boundaries,
Cross reference key,
Cadastral boundary theme - thinned out

Optional extras:
Fixed point theme,
Digital cadastral map

DK-3, Detailed administrative package:
Digital cadastral map,
The complete Place name register,
Selected topologic structured topographic data (TOP-DK), Address theme,
Title number theme,
Cross reference key,
Administrative boundaries,
Fixed point theme

Optional extras:
The complete TOP-DK,
Contour line theme,
Scanned topographic map (1:25,000)

The following administrative options are available for all packages:
Plan register,
Building and Dwelling register (BBR),
Municipal Register of Property (ESR),
Land register,
Fixed point sketches

Standard packages

In everyday work maps are used in one way or another by planners, administrators and technicians, without there being any fixed boundaries between these groups. When making a standard package, the Survey attempts to meet the varying requirements of the user groups with regard to content, accuracy, completeness, degree of detail etc. The contents of the individual packages make up a complete, matching whole in terms of themes and layout, and are bought and updated coherently for each individual package.

Package use and upgrading

It must be possible to update all packages supplied by the Survey, but the buyer should not be under any obligation to do so.

The situation is different with regard to upgrading. DK-I cannot be upgraded to DK-2 or DK-3, as there are some elements in this package which are specialised products with a specifically simplified (generalised) design for reasons of clarity and brevity. This simplification also makes it faster to work with the contents of this package.

On the other hand, as can be seen from the table, it is easy to expand the DK-2 and DK-3 packages, so that these become relatively similar in terms of content.

The individual elements of the packages

Scanned topographic map. The classic 1:25.000 map is characterised by the standardised uniform interpretation, its generalisations, names, drawing norms, choice of colours etc., with all of these things combining to make the map ideal as a reference work for further information.

The purpose of including the scanned topographical map in the DK-1 and DK-2 packages is to utilise precisely these qualities in the map, and so let the map be the point of entry to the vectorised line maps and administrative information found in the rest of the package.

There are no problems in handling these maps in digital form, as a scanned picture, but the user has to possess a somewhat different technology to handle both the scanned map picture in raster form and the vector graphics behind it at the same time.

As we have decided to use the scanned map in the IDM of Denmark, we must also be able to supply the programs for this part of the process.

The cadastral map has for many years been used as one of the main sources for finding administrative information in the Highway Departments. In the DK-3 packages the digitalised version of the IDM has therefore been selected as the principal part of the package.

On the other hand, there probably will not be a need for the entire cadastral map for planning purposes. Instead the Survey has added a special version of the digital cadastral map in the DK-2 package, consisting only of the boundary theme and in a thinned-out version which excludes some of the bends in the lines but retains recognisable figures.

This special version is available as a supplementary part for the DK-1 package.

The "T0-map data" and "TOP-DK". The contents of the "T0-map", a simplified techno- topographic map, may even be too much for the overall planning basis, DK-1. It
is therefore necessary to select 4 elements, i.e. houses, roads, watercourses and coastlines, and to thin out these data (except houses).

However, this thinning out must be adapted to the "scale" which the map is going be used with. For example, thinning-out for use in the DK-1 and DK-2 versions will not be identical.

In the DK-2 package the entire contents of the topologic structured data (TOP-DK) are included.

As some municipalities would probably prefer their own technical maps (T1-T3) instead of TOP-DK, we have included all the elements found in the DK-1 package in the DK-3 package as well, but with no thinning-out, which provides its users with a clearly presented and easy-to-handle amount of data. But TOP-DK is available as an optional extra for the package. The T1-T3 maps do not have all the same advantages as TOP-DK, i.e. the possibility of making use of

"intelligent" elements in the map (e.g. the possibility of off-setting forest or other topographi-cally defined objects) and the higher degree of detail for topo-graphic objects.

The contour line theme now forms an important part of sketch-planning of e.g. roads and other large-scale construction work. It is also the only information about the form and variation of the terrain. As this is a very comprehensive theme in terms of data, it is not intended to form a basic part of any of the packages, but it is available as an optional extra for DK-3. To begin with, height data will be based on the 5 m contour lines of the 1:50.000 map.

Administrative boundaries are limited to county and municipal boundaries in the DK-1 package. In the DK-2 and DK-3 packages they are supplemented by boundaries between parishes and various associations of house owners, and by surveying district boundaries.

In the DK-1 and DK-2 packages these data are thinned out to correlate with the "scale of use".

The nautical chart is not included in any of the standard packages, as we do not expect very many to use the charts together with the other elements. However, information about depths in coastal areas does belong together with the contour line picture.

Administrative basis

Cross reference key. In all of the packages the option of graphical presentation of the various administrative registers is secured by means of the cross reference key. In order to ensure as wide a scope of use as possible, some of the central keys of the cross reference register can be supplied separately together with the packages, which facilitates use of the graphical pointer with different administrative keys (title no. and address).

Administrative options

Administrative options can be added to all of the packages in the IDM of Denmark.

The planning register. In connection with preparing the digital cadastral map it will be possible to establish the various planning boundaries. It will therefore also be relevant for the Survey to be able to supply planning register information together with these boundaries.

The BBR and ESR register is usually accessible for the individual municipality/county. It would be natural for other users if the National Survey could market parts of the contents together with the rest of the package, so that these users could be supplied with the "nonsensitive" information from these registers. For municipal users it would perhaps be enough if we supplied only the "pointers" for the registers.

Adaptation of products to each other

The necessary adaptation of the various products so that they match makes it necessary to establish some concrete procedures for the adaptation itself and for subsequent updating. The adaptation can be divided into the two following areas:

- adaptation of themes (e.g. name themes, administrative boundaries and surveying district boundaries). This would include the need for thinning out and generalising certain products.
- adaptation of layout (e.g. title numbers, addresses, street names and fixed point numbers).

Not only do the individual products need to be adapted to the Survey's other products, they also need to be adapted to possible external products which can be used in a natural connection with them. However, prior to such adaptation to external products, it should be assessed what the interfaces between the products are. External adaptation should be performed with great care and in accordance with an overall, coordinated strategy.

Updating

It is true for the IDM of Denmark as for all other maps that updating procedures must be laid down from the beginning.

The existing elements of the IDM of Denmark are presently being updated on the basis of various guidelines. A general and uniform updating policy must be laid down for the entire IDM of Denmark.

The potential user's need for updating intervals for the IDM of Denmark should be examined more closely and form the basis for the overall updating policy.

Some of the users, e.g. counties, municipalities etc., are actually placed very close to the information, and this fact should be exploited. The task of the National Survey could here be to coordinate, manage and monitor this supply and to integrate it with its own updating.

In order to meet needs and expectations, it may be necessary to concentrate updating of the "standard packages" for a number of years, and with that the individual elements of the IDM of Denmark, in the ares where there are users and/or subscribers. To cover the users' need in the best possible way, updating of the individual elements in the IDM of Denmark could be split up into frequent, thematic updating frequencies and a somewhat slower total updating.

The following updating procedures could be relevant for TOP-DK, for example:

- public road network every year
- buildings and boundaries every 2-3 years
- total updating every 5-7 years.

This objective could be reached by intensive use of external updating information, provided this information is uniform and can be checked.

As far as the cadastral map is concerned, which in principle is updated every day, updating dates can be laid down for the standard packages.

System integration

When assessing the possibilities of coordinated production of various geodata products, it is paramount that the National Survey is seen as a whole from the outside as well as from within.

From the external side this perception of the Survey as a whole requires that uniform products and package solutions can be supplied quickly and with a high degree of flexibility.

Internally it will be necessary for data which is used in several places or which is to form part of a joint delivery to also be suitable for "free" relocation and use in the different departments.

As our computer systems are not sufficiently integrated at present, it will be necessary to perform an essential adaptation and integration of the individual physical systems in order to ensure optimum internal application and external access for both retrieval and direct access.

Forms of supply

Data can, of course, be supplied on standard data media, but other forms of supply can become relevant in relation to the application, topicality, updating etc. of the packages.

For example, it should be considered how physical access to the IDM of Denmark can be established - use of fax, CD-ROM, new graphical terminal access etc.

Data must, of course, be available in accordance with accepted standards and norms, but it is also being considered whether we should be capable of supplying packages for hardware in common use, both PCs and larger systems, and in formats for standard software in general use.

It would therefore be natural for the National Survey to be able to supply the new scanned topographic maps in raster form on CD-ROM. A CD-ROM drive for a PC can be pur-chased for less than DKK 10,000 today, and a large number of dictio-naries, administrative databases and map databases are already available on CD-ROM. So technically speaking, the topographic raster-map can now be supplied on a CD-ROM for use on PCs and the like at an acceptable price.

It should be pointed out that the costs of making the CD-ROM printing original are quite high. A fairly high number of disks will therefore be necessary in order to ensure a reasonable production price for the individual CD-ROM. It should also be pointed out that it is not possible to change or update data on CD-ROM. However, it will be possible to

supplement or update existing CD-ROMs with data supplied on e.g. floppy disk.

It could also be relevant for the Survey to supply many of its other products on CD-ROM sometime in the future. Some of these products could be our place name register, the TO-maps, nautical charts, cadastral map and registers.

Demonstration model

The result of our first pilot project is a demonstration model which illustrates the possibilities offered by the concept of *the IDM of Denmark*. The model covers the area around the Great Belt and was shown for the first time at the 1991 annual meeting of the Association of Chartered Surveyors at Hotel Nyborg Strand. To illustrate the various possibilities, the model is composed in slightly different ways for the Nyborg and Korsør sides, cf. figure 1.

The data used have been coupled together in a common database system, so that it is possible to perform both geographical and administrative cross-searches. The user can also enter his own geographical and administrative information in the database, and this provides the basis for a user-adapted and coordinated information system.

But it is one thing to demonstrate or illustrate the possibilities, and something entirely different to complete the system in a form which is suitable for actual practical use. Selection and search criteria must be improved and made more general, facilities concerning use, depiction and output must be improved and expanded, other database systems must also be usable, and finally we must continue to look for a total program system which is particularly suitable for handling such an integrated information system in everyday use.

There was no revolution this time either. But that does not mean that the workday of the map user and map designer remains unchanged. We are all going to be affected by this to a greater or lesser extent. A prerequisite for the development and growth of the information society is a high and integrated level of information. Within the mapping sector this means integration of all georelated information. It is this development that lies behind the foundation of the National Survey and Cadastre, but it will be the concept of the IDM of Denmark that really "creates" the Survey.

The present form and structure of the Survey have their roots in the previous products and product forms of the institutions. An internal structure which can promote the close data and system integration will be necessary. We must think, act and deal in digital information systems and their use to a greater extent, and maps to a lesser extent - be they in their graphical or digital form. We are therefore going to need organisations which, in cooperation with the users, will be capable of supporting the use of the systems and not only of producing the "goods". The idea behind the concept of providing information in the form of finished "packages" with pre-combined contents does, of course, require that a completely new sales and price structure is worked out as well as an organisation to handle all of this.

But users and co-producers will not go altogether scot-free either. They too must undergo an organisational adaptation as a result of the changed work routine, and if it is a question of participating in part of production, e.g. making digital cadastral maps or supplying updating information in general, it will not only be necessary to meet certain system requirements but also to secure adaptation in relation to other data produced either by the National Survey or others. Users, manufacturers and other business partners must become thoroughly familiar with the possibilities and limitations of the new technology, so that a balance is achieved between expectations and realistic circumstances, and so that the perception of reality of all parties is reasonably concordant.

The IDM of Denmark is, in its different variants and versions, designed to make up the future (universal) integrated and generally applicable digital planning tool.

By virtue of its built-in "intelligence" in the shape of the mutually adapted elements, the grouping of logical

objects and the description of topological connections and possibilities of combination with other databases, it will be possible to use the IDM of Denmark as an actual information system which in this way becomes a complete technical and administrative planning tool.

Demonstration model

Total:
outline map D/750, raster picture
outline map D/750, line picture (vector form)
digital chart sheet 143, line picture (vector form)

Nyborg:
digital cadastral map
photogrammetric TO-data

digital address theme
digital contour line theme
fixed point register
fixed point descriptions
land register
place name register
BBR, ESR, X-REF
planning register

Korsør:
D/25 scanned raster picture
photogrammetric To-data
digital title number theme
digital address theme
digital contour line theme
fixed point register
fixed point descriptions
land register
place name register
BBR, ESR, X-REF
planning register

Figure 1. Demonstration model for the IDM of Denmark