

Personal Point of View



Use of Database in ENC Production

By Andrey V. Sabajdash, HydroService AS, Egersund, Norway

Introduction

The term 'database' is commonly used when describing tools and technologies applied in the modern cartographic production. However there is no precise and commonly used understanding of this term, various sources assume different concepts when referring to a 'database'. Quite often a comparison of approaches to the production and maintenance of nautical charts is substituted with the discussion of various database engines and ways to apply them. This article presents a short overview of use of databases in digital production of nautical charts. The paper also highlights some limitations imposed by the database-driven approach to the cartographic production.

A Single Database – Is It Really Single?

A 'database' may be defined in a number of different ways. The main challenge is that the scenario to be defined is so wide that nearly every set of information structured in some way may be referred to as a database solution. Considering a database as a set of structured information along with tools for information search and retrieval one may feel it intuitively obvious that to deal with a database is easier than to handle a bunch of heterogeneous and non-structured information. Going

further, it seems logical to proceed with the construction of a single source of information – a kind of single unified database, which in our case holds the cartographic information related to a particular region. A chart can be obtained from such a database by setting a query, which selects all the cartographic features related to the specified limits and probably other criteria imposed by the operator. The author wishes to draw attention to the terms 'single' and 'unified' used above. 'Single' means that the database holds all the information required for the production of fully-featured chart/publication. 'Unified' means that all kinds of nautical publications (electronic and paper charts, Notices to Mariners booklets, LL publications, etc.) can be derived from the same database.

At first glance the 'single unified database' approach seems to be practically applicable, especially when considering the production and maintenance of electronic charts and other S-57-compliant types of cartographic products. Indeed, an electronic chart in S-57 notion has been developed as a database, which models a hydrographic reality in terms of objects and attributes. S-57 deals with a subset of hydrographic reality entities related to cartographic presentation, however it seems logical to extend the approach to a wider context when every phenomenon of a hydrographic reality has the unique object-attribute description in the database.

The idea looks very promising since use of a single unified information source may help a lot in achieving higher consistency of various cartographic publications reducing the amount of work at the same time – with every real-world phenomena having unique replica in the database, every editing operation (creation, updating, etc.) can be performed only once in the database and the identical result will be applied to all the affected publications.

The author believes that the single unified database approach that implies that every real-world phenomenon is uniquely modeled in the database presents the most promising way for the development of cartographic production in Hydrographic Offices. The approach will eliminate unnecessary duplication of work and data synchronisation, making the production process more straightforward and manageable.

In other words, the idea of single unified database may be expressed with the following formulae:

Real world object \longleftrightarrow *S-57 object(s)* \longleftrightarrow *Database object(s)*

Unfortunately the practical implementation of this idea is not completely feasible, there are a number of obstacles, some of them purely technical and minor, others more important and determined by the shortcomings of S-57, when trying to apply it outside of the original scope of applicability.

The fundamental notion of S-57 is an object. The main property of an object is that it is uniquely identifiable (i.e. there is always a way to distin-

guish an object among the others). Practically this means that an object cannot be expressed or modelled by combining other entities. Looking through the objects catalogue of S-57 one can easily identify some object classes that do not possess this property. For example bathymetry-related objects, which describe property of a sea bottom surface – a depth contour can always be expressed as a set of isolated spot-soundings and vice versa a spot-sounding is a depth contour of zero length.

The origin of such a deficiency is the fact that those objects do not express any real-world phenomena; they are completely artificial entities that express some characteristic(s) of a real-world entity. A database constructed with the help of such objects will never properly model real-world (e.g. sea bottom surface) just because the modeling 'language' is not capable of describing it properly.

One of the practical implications of the described deficiency is generalisation of data – some S-57 object(s) when changing the compilation scale of the chart change the underlying geometry (e.g. a land area changes from an area to a point geometry), sometimes they even change the object's class. (See Figure 1).

The way to overcome the deficiency is use of 'scale layers', then the same real-world phenomena has several replicas in the database (e.g. one for large scale charts, another one for small scale charts, etc.). Here the author wishes to emphasise that such an approach is rather artificial – instead of having a single database, we end up with a set of databases. (See Figure 2). Therefore technically speaking the

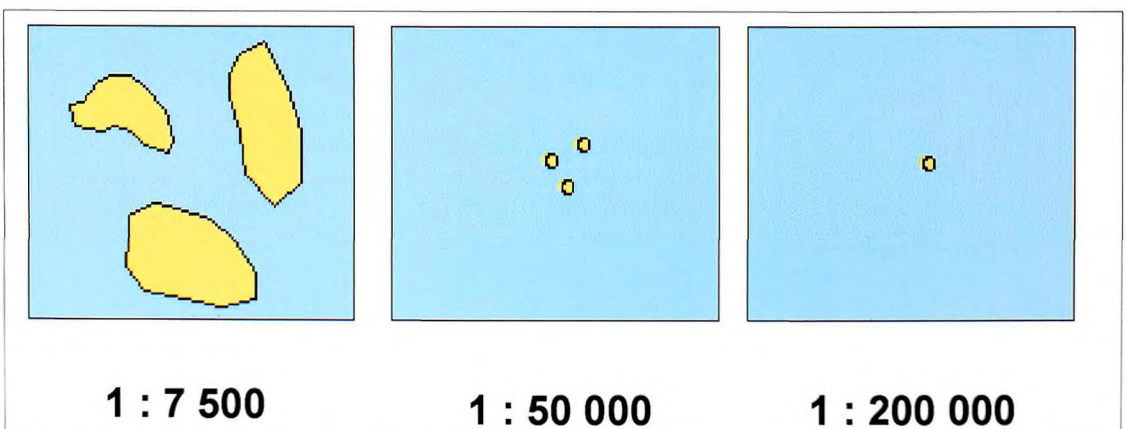


Figure 1: Scale issue.

database is not a single database anymore, even if the producer claims it to be so. Use of the 'single database' term in such a case is a kind of trick that helps avoiding unpleasant questions on how such a database is populated and maintained (e.g. what to do with a depth contour that has different geometry on 10,000 and 100,000 scale and what to do with it when even further scale bands appear).

The interim conclusion is quite straightforward – S-57 should be used within the limits of applicability and it cannot be used for constructing a single unified database that will cover all the kinds of cartographic data. Another conclusion is that in practice a single unified database may turn out to be not as single and unified as it is claimed to be.

What Do We Miss – Term Or Solution?

What is the reason for having all the problems with 'single database' term? At first glance it is as simple as misuse of a word. However the author believes that the problem is more serious – instead of (or in addition to) terminology, there is no proper technical solution available on the market.

It is obvious that the experienced user will prefer a database-driven solution to a file-based solution. However, when making such a choice, the user

expects to have a single source of information where no information is duplicated or at least all the technically necessary duplication is performed and maintained automatically. However, the real situation is different and in the majority of cases the user is just not aware about the deficiencies of a 'single' database. The fact is that the database approach is not bad, but it cannot, with the technology available today, be seen as a 'Holy Grail' that automatically will solve all the problems in cartographic production.

Let us take a look at two main issues related to construction of a S-57-based hydrographic database.

The first issue is that strictly speaking S-57 is not a means for real-world modelling, instead S-57 is a means to model a cartographic model of a real world. The origin of an S-57 object in many cases is not a real-world object but some cartographic entity that is commonly used to depict a real-world object on a chart. As a result we have a situation when it is relatively easy to create a database, which holds information on objects of a particular chart, but it is very difficult to combine information from several overlapping charts and other cartographic sources in order to build a comprehensive description of a hydrographic reality.

The second issue is data generalisation or, in other words, the answer to the question on how to maintain

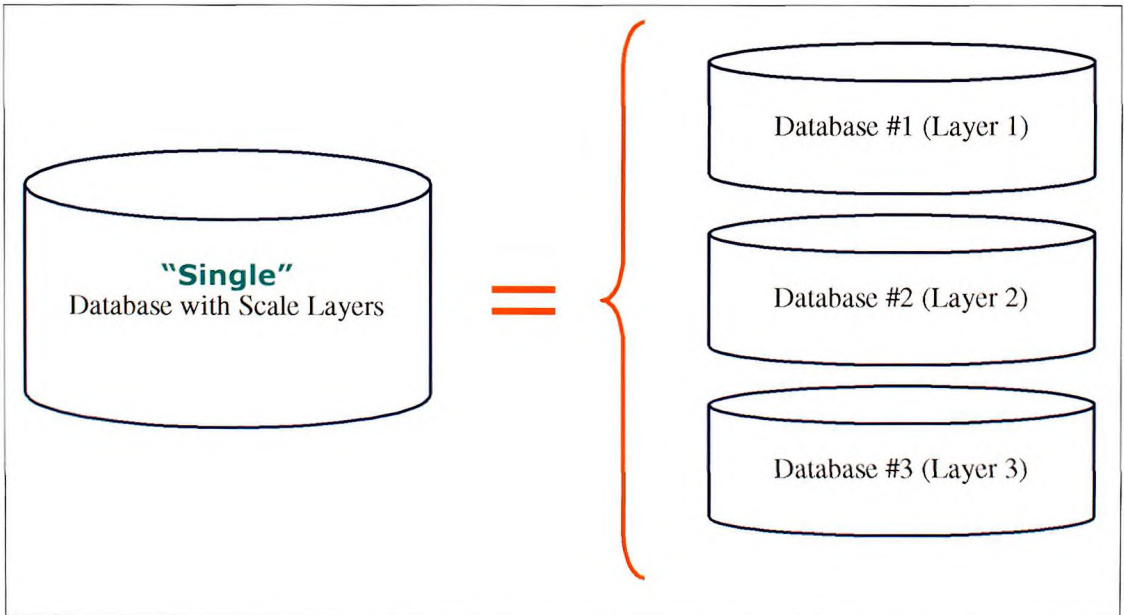


Figure 2: 'Scale layers' vs. 'single' database.

the information in a consistent way between the different scale bands. Indeed the consistency exist in the real world, also when dealing with the traditional paper charts, the cartographer also maintains the consistency. However the solution may exist outside of a database approach or, at least, the use of a database is not the only criteria to achieve the goal. For example a possible solution may be an AI tool ('artificial intelligence') used to cope with data generalisation. Such tools are, in general, irrelevant to the method of data storage, should it be database-base driven or not. Another solution may lie in digital modelling of a surface; the model should be capable of automated generation of required cartographic objects in accordance to the task-defined criteria. Such an approach is, again, irrelevant to the method of data storage.

Conclusions

The use of databases is an appropriate approach that helps in organising modern cartographic work, especially covering production and maintenance of electronic charts. However, the databases should be used when the data domain (or its' subset at least) is properly formalised and the formalisation language is suitable for the database engine. Attempts to use databases and formalisation languages outside of the scope of their applicability leads to the uncertainty on how the information is entered, organised and maintained, thus making the advantages of the database approach quite awkward.

'Single unified' databases that claim to be a universal solution for cartographic data production are not really single and universal because there are no traditional (native) database tools capable of maintaining the information consistency. The complexity of the hydrographic reality phenomenon is too high for tools and technologies available as database solutions today. Such complexity is the main driving force for the creation of new algorithmic tools targeted at maintaining the information consistency and efficiency of the entire solution. The author believes that the optimal solution can be elaborated, but the search for a solution should not be substituted with the search for or use of handsome but delusive means.

Biography of the Author

Andrey Sabajdash has graduated from State Marine Academy, St. Petersburg, Russia as a hydrographer. He holds the position of general director of Morintech Ltd., Russia and is one of the founders of HydroService AS, Norway, which presents a complete set of software tools and technologies for cartographic data production known under the dKart trademark. For more information please refer to www.hydroservice.no.

E-mail: info@hydroservice.no