NATIONAL PETROLEUM RESOURCE DATA MANAGEMENT

Kjell Reidar Knudsen, *Director of Data Management Department, Norwegian Petroleum Directorate, Prof Olav Hanssens vei 10, P.O. Box 600, 4001 Stavanger, Norway*

Abstract. All data on geological, geophysical and reservoir characteristics, which have been observed by national and international oil companies, must be regarded as a valuable asset for the nation of that area. This recognition should motivate all authorities to formulate a data management strategy. High exploration efficiency and at the same time securing the long term national interests must be the main objective of this strategy.

The Norwegian Petroleum Directorate has established effective routines for data management. In cooperation with multinational oil companies, a modern solution for petroleum data management has been developed. This solution handles confidentiality, data trading, efficient storing and very rapid transfer, both between partner companies in a license and between companies and authorities.

The Norwegian solution to national petroleum data management includes comprehensive use of international standardization and digital reporting. Quality control and unique indexing of wells and geophysical surveys are important elements in an efficient data management strategy.

This paper aims to cover the most critical elements of petroleum data management and share the experience gained by the Norwegian authorities, during several years of focused effort.

INTRODUCTION

During 25 yrs of history, the Norwegian Petroleum Directorate (NPD) has been involved in the petroleum business on a very technical level. As a governmental organization, we have accumulated important experience, which is relevant to petroleum resource data management. This article will summarize our viewpoints, which I believe could be of interest to other nations ministries and state oil companies.

Data management will include elements such as to decide which data are to be acquired and which media and format to use. Data management also includes an active attitude towards reducing the data volume, data transfer and a plan for storing and re-use of the data.

My experience from working with the petroleum industry for 20 yrs is that data management has not been properly taken care of, neither by the oil companies nor by the authorities. This has led to an inefficient use of data and a lack of knowledge about where data is, which standards to use and absence of a strategy for re-use of old data.

If the data management issue is treated more seriously, this will be an important element for increased efficiency both in the exploration, development and operation phases. Having direct access to sufficient and reliable information is a prerequisite for good decisions. This requires adequate standards and procedures for quality control and reliable tools and routines for the maintenance of data.

DATA VOLUME

Data management can be a costly affair. Investigations done in Norway show that almost 15% of total costs, both in the exploration and development phase, is related to data management.

One of the reasons for data management being such a challenge, is the volume of data and the fact that the volume is increasing exponentially. As exploration and production activities continue, more data accumulates. The rapid increase is also due to new technology and new techniques in data acquisition. One typical 3D seismic survey in Norwegian waters covers approximately 15 000 km^2 and generates approximately 2 TB (terabytes) of data on approximately 10 000 (3480) magnetic tape cartridges.

In Norway the oil companies and the authorities store more than 1.5 million tapes containing 3.5 million kilometres of seismic data. Ninety percent is field tapes, the rest is processed data. The problem is not only the cost of storage and physical maintenance of the tapes, but also routines required to know which data exist and how to retrieve particular parts of the old data for new projects.

Proceedings of the 15th World Petroleum Congress

Published by John Wiley & Sons

Professionals spend too much of their time searching for data and checking if the quality of the old information is good enough to be used once more.

VALUE OF DATA

The volume of the data and how the data is organized set limitations for re-use. When planning for a new exploration well, time is often a critical factor and the possibility to re-use old data can be very limited. Often new data is acquired instead of using old data, because the old data could not be found or there were too many questions concerning the quality of the old data sets.

To put a value on old data is difficult. A simple way is to consider the cost when the data were acquired. However, if you are able to re-use your data in planning new exploration wells in a better way, the value can be several times your original acquisition costs.

NEW STANDARDS FOR EFFECTIVE MANAGEMENT OF DATA

More intense competition and the reduced oil price margins have led both the companies and the authorities to focus on cutting costs and operating more efficiently.

In this situation most companies and authorities work on formulating a data management strategy. A typical strategy will focus on the cost elements connected to the life cycle of each data type. It will also focus on how to integrate and standardise computers, formats and exchange of information between databases and analytical software applications. The strategy may also involve the use of shared databases, corporate databases and project databases.

The DISKOS project, which is explained at the end of this paper, will describe how these elements are implemented in Norway.

NPD'S ROLE IN DATA MANAGEMENT

NPD is a governmental organization reporting to the Ministry of Petroleum and Energy for performing administrative and technical supervision of the exploration and producing activities of the approximately 20 international oil companies working in Norway.

NPD performs its own seismic acquisition in areas prior to granting exploration licences to oil companies. These data have to be processed and stored as well as being made available for sale to the companies.

The Norwegian Petroleum Act and the related regulations also guaranties NPD access to all data acquired by oil companies present on the Norwegian Continental Shelf.

The regulations specify some of the data to be reported routinely to NPD.

During the exploration and production phases NPD receives tremendous amounts of reported data from the oil companies. Many datatypes are reported digitally to NPD, some even 'on-line'. This information is kept in NPD for its own professional work, for supervising the activity, and in order to give advice to the Ministry. These data must be stored in an efficient manner. NPD utilizes a great variety of computer databases and computer software interpretation tools for its professional work and NPD is continuously looking into new ways of reducing the costs of data management and more advanced ways of achieving rapid access to quality controlled data.

NPD's objective is, amongst others, also to organize the activity, so that the oil companies can operate efficiently. We are aware of the importance of formulating regulations in such a way that the data management can benefit from new technology and that data can be used several times in order to give a maximum exploration success. I believe that use of new technology, a better organized system for sharing information and a sound competition among contractor companies will add to more efficient activity.

Our involvement is based on the fact that more extensive use of existing data, through release and re-use of old data, will lead to additional discoveries and less expensive exploration and production.

The data management strategy includes performing quality enhancement of old data, offering high quality datasets to oil companies. NPD is also making core material from storage available for inspection. Our experience tells us that a governmental body can act as a catalyst for co-operation between competing companies. The oil companies in Norway show a very positive attitude to co-operate on management and quality control of raw data, while still competing on intelligent interpretation of the same data.

DATA MODEL

Efficient data flow between software applications, organizations and oil companies requires a common data model. The challenge of data flow between dif-

ferent applications has been solved by defining common exchange formats or so called 'half links'.

However, so far there is no such thing as a common data model that defines all entities and attributes used in the E&P business. For some of the data types, some proprietary industry standards have been established.

For seismic data, we have the SEG formats and for well logs the LIS formats. Even if these formats are not tied up to a clearly defined data model, they can still be used as exchange formats between analytical applications, databases and also among organizations. There are, however, often different versions of these standards, which make transfer of data difficult.

As a consequence of the lack of a common data model, NPD has, during the past 10 yrs, defined reporting standards for oil companies to use. NPD receives information from 15–20 oil companies, and to assure an efficient data management a common reporting format is vital.

POSC

The need for an industry standard, on a data model and an open system software integration platform for the E&P industry led some major oil companies (BP, Chevron, ELF, Mobil and Texaco) to an initiative to establish the Petrotechnical Open Software Corporation (POSC), which today has about 130 member organizations. The objective is to establish a common data model (Epicentre) and define standards for exchange formats (PEF), dataflow between databases (DAE), application programming interface (API), user interface and hardware.

NPD regards this work as crucial. As a member of POSC (since 1992), we feel committed to implementing the POSC recommendations as they emerge. We have especially concentrated on using the Epicentre data model for new developments and re-engineering of own software.

The same attitude will also be seen in the future regulations defining reporting formats to NPD.

Today there is a very positive attitude towards the POSC initiative, and a lot of software vendors have committed themselves to be POSC compliant during the next few years.

QUALITY CONTROL OF DATA

There are various needs for accuracy:

- A geologist requires accuracy within a few million years,
- a geophysicist requires accuracy within a few milliseconds,
- while a geodet would like to be within nanoseconds.

The common problem, however, is to be able to assess the uncertainty of the data. In order to use data with confidence, professionals need to know to what level of uncertainty the specific data can be trusted.

Quality Control is of vital importance for management of large data volumes. There are two main aspects of quality control: The first is related to the administrative information about the data, while the second area concerns the actual quality of the data itself.

Quality Control is also a cost/benefit issue. It is necessary to have a clear view of which are the critical factors. The critical factors will be different for various data types, but also according to different use of that datatype. For a seismic database one very important issue will be the navigation data. There are, of course, various requirements for position accuracy depending on what the data are used for (well position or basin analysis).

Some quality factors can vary gradually, such as signal/noise level, while other factors are more of the fatal kind; such as missing tapes, missing identifiers etc.

DATABASE STRATEGY

A database strategy involves elements such as 'Master Data Store', 'Corporate Data Store', 'Project Data Store' (Fig. 1). Data can be stored on disk or media such as tape, film and paper. The companies and authorities need to establish procedures for storing, transportation and retrieving data. Procedures for updating, backup and replication of information stored in databases have to be developed. Datamodels for all databases, exchange formats and half-links to different applications are important.

A future strategy must also include a model for handling an integrated project database, a project builder and archivist. This domain involves a lot of uncertainties due to different datatypes, exchange formats and procedures to administrative project databases.

Due to the extensive legislation on reporting in Norway, NPD has a good control regarding which data exist among the oil companies and the quality to which the data are maintained. The database on

all wells drilled and navigation data on all surveys shot in Norwegian waters are of vital importance to a total national petroleum data management strategy.

NETWORK

The need for high capacity wide area network (WAN) services has increased tremendously over the past few years due to the demand for a communication between a company and its local sites geographically spread over long distances. Transfer of data over such a network are pushing for higher bandwidth and faster transfers. A common PC user handles files of several megabytes. When dealing with E&P data, we are dealing with files in the Gigabyte range. A shared database containing seismic trace data, processed and raw, as being the case in Norway, needs maximum bandwidth to operate efficiently.

SECURITY AND DATA MANAGEMENT

Handling, operating and maintaining shared or corporate databases will always involve questions regarding security. The overall system security level must comply with government and company regulations, which again is differentiated according to the data types dealt with.

In general, the following security issues must be considered.

- Network security
- Database security
- Application security
- Data protection level
- Security auditing (logging)

NPD'S DATABASE AND APPLICATION STRATEGY

NPD is running computer applications on two operating systems. For office automation (word processing, spreadsheets, mail etc), MS-Windows has been chosen. E&P applications are based on the UNIX operating system. We have put a lot of effort into integration between the two, and all employees can reach all applications from their local PC.

NPD has since 1984 developed in-house database systems for handling the information reported from the industry. These databases have, unfortunately, their own datamodel. The ILGI exploration data system, the PROFF reserve estimates data system, the PPRS production data system and the RUDI field data system, just to mention some of the most important, can communicate and exchange information by use of half-links, although they have different datamodels.

New developments will standardize user interfaces as well as datamodels and data exchange. The ongoing SAMBA project will streamline the databases to one Epicentre datamodel. The benefit of having a common datamodel and exchange format in the E&P industry is obvious, it will allow for application vendor competition and easy data exchange.

REPORTING TO NPD

During the period of petroleum activity in Norway, extensive routines of reporting to the authorities have been developed. Most of the technical and administrative information to the authorities are routed to NPD.

The purpose of such reporting is to give a sufficient basis for NPD's internal work of planning future activity, supervising operations and foreseeing the consequence of existing activity. But it is also an important source of information for keeping the public aware of what is going on, and a source for the release of data.

As already mentioned, most data are routinely sent to NPD according to the regulations for required content in the applications, or according to regulations for progress and final reports.

The following permits are relevant to reporting petroleum resource data.

Allocation of a non-exclusive 'licence to perform scientific research on the seabed and its substrata and exploration and exploitation of subsea natural resources other than petroleum'.

Such licence may include magnetic-, gravimetric- and seismic surveys, heat flow measurements, radiometric- and geochemical surveys, sampling of seabed and drilling of shallow wells (max 200 m below seabed).

Allocation of a non-exclusive exploration licence. This licence is normally granted for three years and may include the same type of activities as a scientific research licence, but more directly related to oil and gas exploration. For such activities, survey details, such as technical specification and the area affected, have to be reported in advance and progress reports and a final field and processing report must be forwarded to NPD. Also a full scale and half scale geofilm/sepia migrated seismic section have to be reported, and magnetic tapes of navigation (UKOOA-P1/90-format), stacked migrated seismic

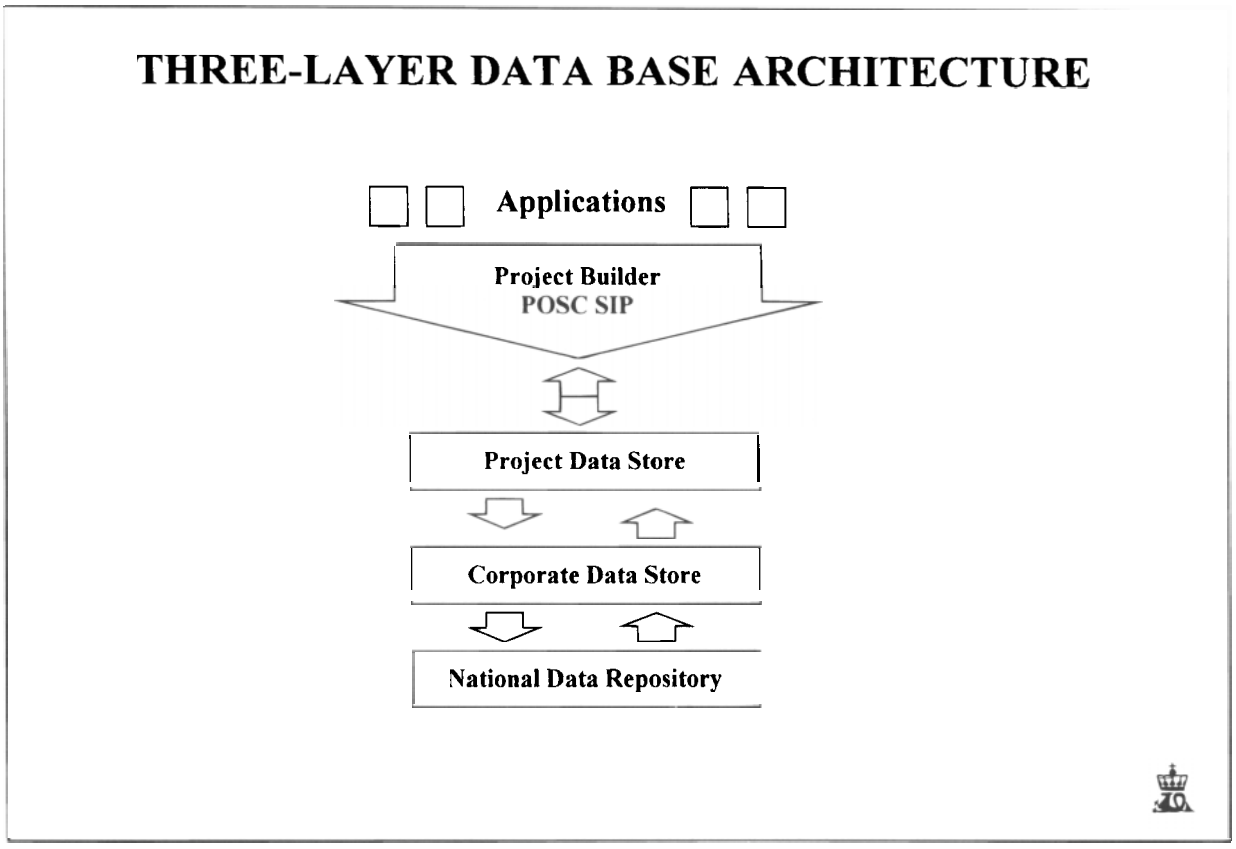

Fig. 1. Three-layer data base architecture.

(SEG-Y-format) or Charisma formatted interpretation data as well as digital stacking velocity data (Esso V-2 or Statoil H-2 format).

When applying for a production licence, a very comprehensive application has to be submitted. The applications contain the companies assessments of all prospects in the area of interest, and as such give NPD important alternative viewpoints to their own.

Before the drilling of exploration- or production wells is allowed, a drilling permit must be granted by NPD. A drilling program must then be forwarded and daily progress reports sent electronically (DDRS-system) to NPD. Within six months after completion, a written final report and a comprehensive digital data-set must be provided by the operator. This includes a copy of logs, test-data, cores, fluidsample, cuttings etc according to detailed regulations.

For discoveries to be developed, a Plan for Development and Operation (PDO) has to be submitted, explaining the geological, reservoir engineering, technical and economical aspects of the plan. These data are the basis for NPD's own evaluation of how the development plan complies with the Petroleum Acts §20 for prudent recovery.

During the production period, daily and monthly reporting on production and sales quantities should be reported, and semi-annual forecasts of production and operation costs. This reporting is done electronically in systems called PPRS and RUDI.

NPD'S RELEASE OF DATA

The general principle in Norway is that all data kept by authorities should be open to the public. There are, however, exceptions for personal data and data where commercial interests would be violated by publication. For different categories of geological-, reservoir engineering and petroleum production data, the regulations state that raw-data are to be kept confidential for 5 or 10 yrs. Interpretations have to be kept confidential for 20 yrs. These rules are known to all companies applying for activity in Norway, and accepted as a balance between company and society interests.

The information is regarded as an asset, of which it is to the nation's interest to utilize for what it is worth. Norwegian authorities want as much of the non-confidential data as possible available to all persons and organizations. We recognize that this will add to effective exploration and production of petroleum in Norway. Data circulation and availability among companies, is therefore wanted, and NPD's activity of offering compilations of non-confidential information to companies is called release of data.

NPD has long traditions of releasing copies of well logs and seismic sections. NPD's annual report and the NPD-map also contain much useful information together with the long list of publications. In the last few years, new digital datasets have been developed and are now available from NPD.

THE HQLD PROJECT (HIGH QUALITY LOG DATA PROJECT)

Co-operation on the management of raw data first began in Norway based on an initiative from a group of petrophysicians. When moving from using log data on paper to digital data on magnetic tape they experienced poor quality of older digital data. At the same time they realized that performing a quality control on old digital datasets, bringing the log data to an acceptable quality level, was not feasible within the economic frames of each company. The only solution to the problem was a co-operation between authorities and several oil companies. A joint quality control project on log data was then established.

A group of petrophysicists representing the majority of oil companies assisted NPD in establishing standards regarding log quality control and the content of final log output to tape. The work involved reading original raw data tapes (wireline, measurement while drilling), optical scanning of original field prints or film (1/200 scale) both main and repeat sections, comparing tape data with scanned data adjusting tape data when required and optical scanning of operator's completion log.

The project also included comparing header information (tape and field prints) to adjust or create new header when required and splicing of logs from top well to bottom and comment if there are differences with the operators completion log.

The final product was:

- **Quality checked original raw data tapes** in LIS **format (both main log and repeat sections);**
- **Quality checked composite data tapes** in LIS format;
- Scanned images of original logs and completion **logs in TIFF format;**
- Inventory of logs in database in ASCII format;
- Verification listing in ASCII format.

This process included all exploration wells in Norway drilled before 1993. NPD collected all input data from its own archive and from oil companies. NPD then contracted a sub-contractor to edit and perform quality control on the data.

Most oil companies in Norway financed the project by buying the compiled data sets on magnetic tape cassettes.

THE DISKOS PROJECT

The DISKOS project is another example of co-operative initiatives in Norway (Fig. 2).

The aim of this project was to establish a joint, central database for quality assured geodata and make it easily accessible for the users. The development of new systems for high capacity data storage and automatic administration by means of robot technology make this type of solution very attractive. The following data types were considered in the initial phase. Navigation data, processed seismic data, including technical data at survey level, seismic velocity data, administrative data and well data.

In phase 2 of the project, seismic field data will be handled and the system will be able to administer non-digital archive material, such as film copies of seismic and log data.

Individual users in the various companies linked to the central data storage are able to log on to the system and search for the data they want through a GIS-like user interface.

This requires on-line access to navigation data as well as systems for controlling the individual company's access to various parts of surveys and individual lines.

The user is then able to start the transmission of the data selected to the local computer via telecommunication lines.

The system operates in a UNIX based client-server environment, where the client part of the system uses a 'standard' work station, and the server part of the system operates on major UNIX based servers.

The functional requirements of the system cover storing of relevant data in different formats. The applications will also cover on-line data trade and sale.

The project was first based on a cooperation between Norsk Hydro, Saga Petroleum, Statoil and

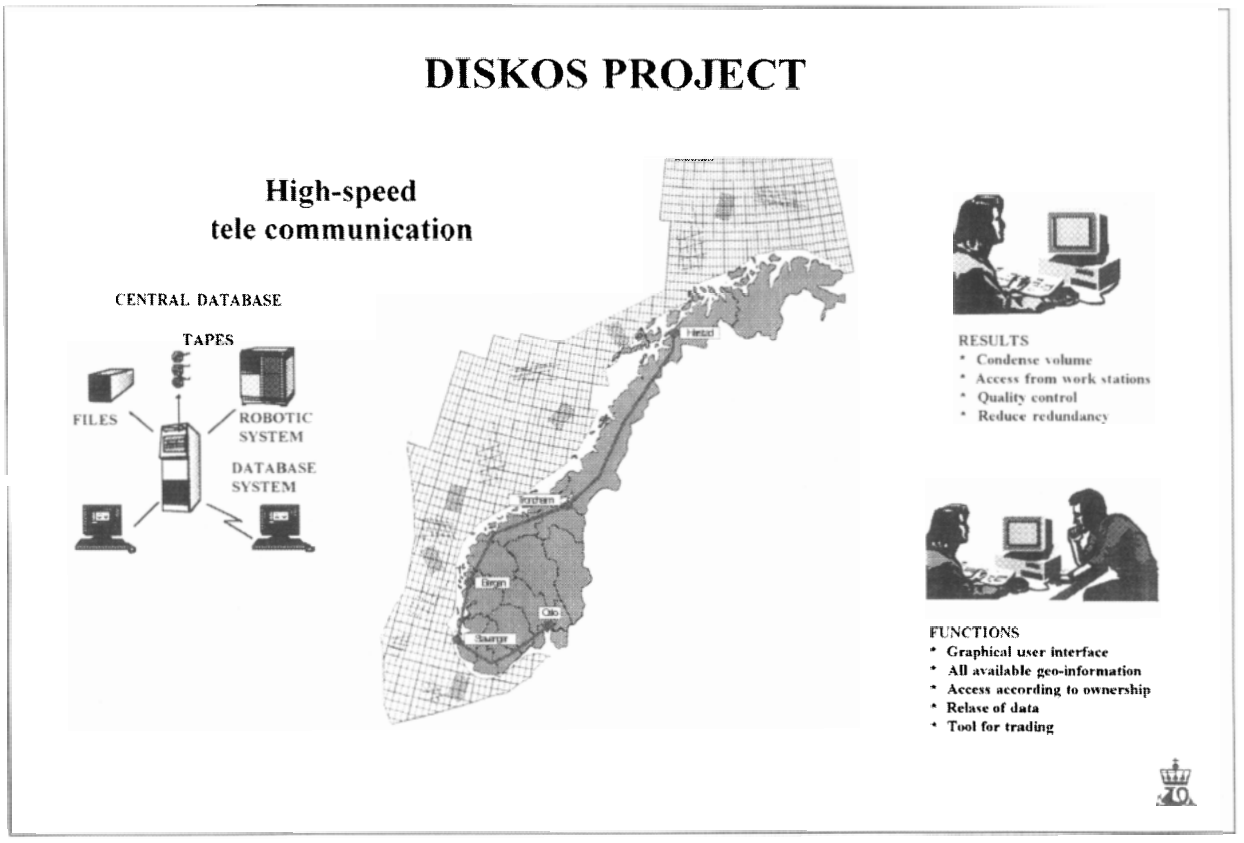

Fig. 2. DISKOS project—high speed telecommunication.

NPD. By December 1996, another ten companies on the Norwegian shelf became partners.

The application (which is named PetroBank) was set into operation in Norway in the second quarter of 1995 and the oil companies have chosen a different bandwidth for their connections, ranging from 64 KBit to 100 Mbit FDDI. By the end of 1996, approximately 5 TB of data have been loaded.