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Putting data science into perspective

Managing idle well data at PETRONAS

The IT behind subsurface data

Moving to a 'platform' approach

Helping Lundin develop a master data system

Why it's hard to change drilling data processes

Reducing drilling costs by cutting the fax

Event Report, Doing More with Subsurface, Production and Drilling Data, Oct 5, 2015, Kuala Lumpur

Special report

Doing more with Subsurface, Production and Drilling Data

October 5, 2015,
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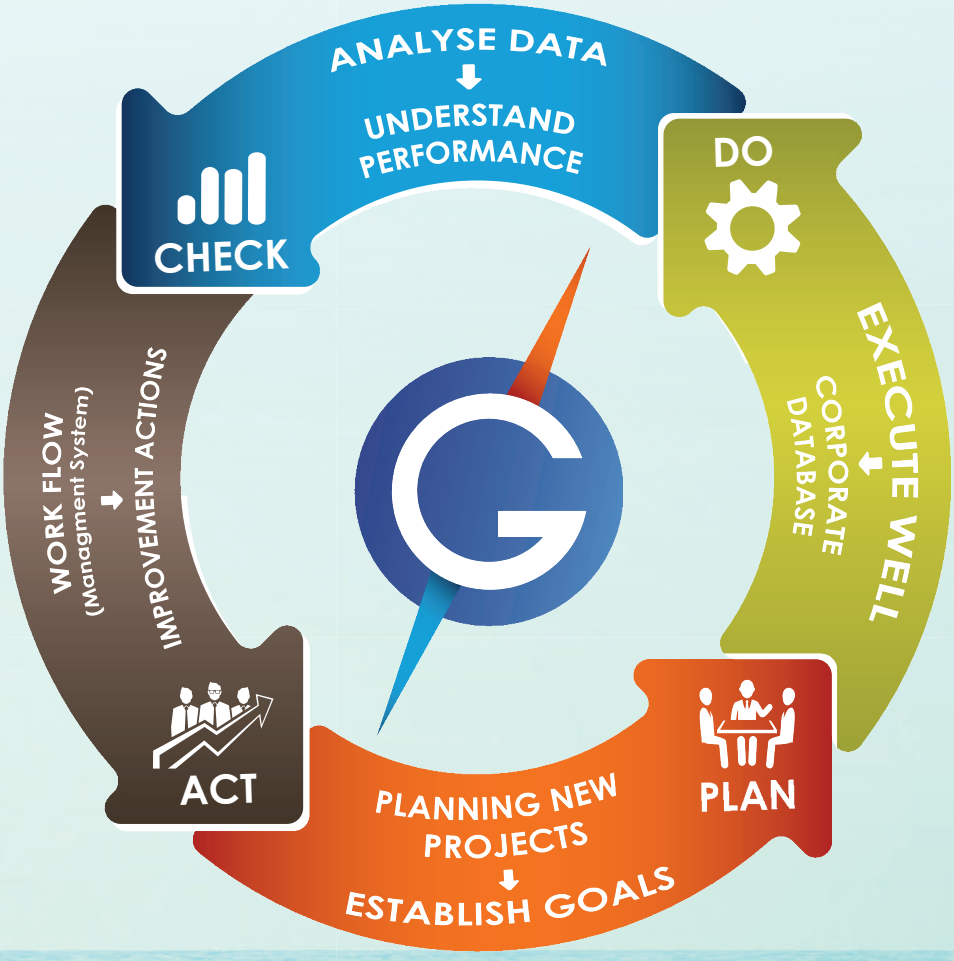

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Subsurface data in Kuala Lumpur

Putting data science into perspective, the challenge of changing driller's processes, master data at Lundin and data standards at PETRONAS – some of the topics covered at Digital Energy Journal's conference in Kuala Lumpur on October 5, "Doing More with Subsurface, Production and Drilling Data"

Digital Energy Journal's conference in Kuala Lumpur on October 5 2015, "Doing More with Subsurface, Production and Drilling Data", covered a range of interesting topics including clarification of data science, the challenge of changing driller's processes, master data at Lundin and data standards at PETRONAS.

Also how PETRONAS manages idle well data, the IT behind subsurface data, the advantages of a 'platform' approach to working with subsurface data, and how one oil company reduced its drilling non-productive time simply by asking the company to send all drilling reports by fax.

The overall success of an oil and gas company comes down to the decisions made by domain specialists (geologists, geophysicists, drilling engineers) and the company senior management – so all the software and data management systems should be geared to providing these people with the best possible information.

But there is plenty of complexity involved in achieving this. The data systems and new technologies need to bring new insights to domain experts. The technical experts need to be happy to move to using standard data formats, and supplying data according to standard requirements.

All of the complex IT underneath subsurface data systems needs to work well – including all the different software systems integrating with each other well, and enough availability of subsurface IT expertise, which is very different to standard IT expertise.

You need good structures for managing the master data.

And perhaps most importantly, there needs to be an acknowledgement by all that the hardest task of all is using data analytics systems together with experts' standard working processes.

Carlos Damski of Genesis Petroleum said that when it comes to drilling data, it is a relatively easy task to gather, communicate, store and visualise data – but actually changing people's drilling processes is a far more difficult task. Although it is a task which many people have solved.

Perhaps this event report will give you some useful ideas how to do it.

The full agenda, with links to some of the presentations and videos, is online at **http://www.digitalenergyjournal.com/event/27a22.aspx**

This special edition of Digital Energy Journal is an Event Report from our forum in Kuala Lumpur on Oct 5, 2015, "Doing more with Subsurface, Production and Drilling Data".

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Philip Lesslar – putting data science into perspective

To add value, data science needs to be used together with domain expertise, said Philip Lesslar of PETRONAS, illustrating his point with a case study using data science to analyse data on fossils, in order to better understand the subsurface

There is a lot of hype about data science at the moment, but it is something which scientists and oil and gas companies have been doing for many years, said Philip Lesslar, Principal Consultant, Regulatory Compliance and Technical Assurance, Technical Data at PETRONAS.

He was speaking at Digital Energy Journal's conference in Kuala Lumpur on October 5, 2015, "Doing More with Subsurface, Production and Drilling Data".

"The idea of data science is not new, just the way it is being packaged."

A common myth is that data science can replace the need for human expertise and structured data management, he said. "I want to put that myth at rest," he said.

To illustrate this point, Mr Lesslar presented a case study of an oil company project from 1987, to create a consistent and objective way of better working with data about fossils found in well cuttings. The task required both high level knowledge of fossils, and high level knowledge of data science.

Oil and gas companies are working with an increasing range of data types, and the volume of data and the resolution of data is increasing.

"There is a school of thought that you can just throw analytics at this data," he said. "The answer is yes and no, we have to tread very carefully."

"Some people think we can replace all data managers just with data scientists. Data science is a subset of data management, not the other way around," he said.

Commercial hydrocarbons are getting hard to find. We have been saying that for many years, and it is still getting harder, he said.

To make better decisions, the business needs timely access to better data, and it needs to do faster analysis of data earlier in the value chain, he said.

Better data can also create connections which trigger new ideas and concepts, he said.

Data science is "still an emerging field," he said. "It is not well defined as an academic subject. The interest in data science has risen as a result of 'big data'", he said.

The topic 'data science' can include a range of subjects, including data visualisation, machine learning, mathematics, statistics and domain expertise. Of these, statistics and mathematics are particularly important, he said.

Statistical techniques aim to help make sense out of diverse data, such as regression analysis.

Mathematics can include mathematical methods to help you make decisions in the face of uncertainty.

Visualisation is about communicating information clearly and effectively, and also making information easier to work with, for example showing patterns visually.

Fossil distribution

Mr Lesslar presented a case study of a project from 1987 to use data about the distribution of fossils to try to better understand the subsurface.

Previously interpretations on 'forams' were done by humans, and was therefore subjective and not always consistent and comparable.

The study focussed on fossils of foraminifera, which are single celled marine organisms, which can be both floaters (planktonic) and bottom dwellers (benthonic). They are usually about 400 microns in size, and there are many different types of them.

The study aimed to develop a "quantitative reference matrix" of foraminifera occurrences for paleo environmental classification.

In other words (roughly speaking) it would be a means of identifying depositional paleo-environments of samples from analysing the foraminifera in them, based on other samples which had a similar mix of foraminifera.

Because the number of species are so large, it is very hard to do with human interpretation. But the computer analysis can calculate clusters - groups of foraminifera which are more likely to be present in certain formations.

Benthonic foraminifera are sensitive to environmental conditions, or in other words their presence or absence will reflect the "paleo environment", ie the condition that piece of rock has been in, over geological time.

Mr Lesslar did an analysis of rock samples from 250 wells in Malaysian waters and the

South China Sea. This included 100 samples from each well, and finding between 20 and 250 different species in each sample, average of 120.

This multiplies to about 3m species occurences altogether.

The data was analysed using cluster analysis, which is "one of the more important techniques in the whole array of what data scientists do," he said.

Cluster analysis enables us to visualise 'n-dimensional' data using a 'dendogram' or tree diagram. The clustering looks at 'measures of proximity', how close one group of samples is to another group.

From a geological point of view, rock samples with a similar mix of foraminifera probably have a similar history in how they were formed.

The larger the data set is, the more sure you can be about the patterns.

"That's the power of doing a cluster analysis," he said.

"You end up being able to make probabilistic calculations, saying that for a certain paleo-environment, the probability of a certain species being present is x."

"Every time there's an occurrence you calculate the positive probability of it being present or absent," he said.

The final "identification matrix" covered 411 different species and 13 depositional environments with a probability for each (ie a probability of species no 200 being in environment no 7).

By assimilating and statistically organising the total set of sample data, the software can then generate a 'probabilistic matrix', ie say that a certain environment would have a certain probability of certain species being present.

"A probabilistic computer assisted interpretation system that would remove the inconsistency associated with human interpretation was developed."

So for a new well, if you can take samples and see what 'forams' are in it, the computer can tell you which formations that well is likely to have been drilled through.

This could all help the seismic interpreters in understanding what they are looking at.

Watch Philip's talk on video and download slides at **http://www.digitalenergyjournal.com/video/1636.aspx**

Managing idle well data at PETRONAS

PETRONAS embarked on a project to keep better track of its idle wells, and make sure it had plans in place to improve them

Malaysian state oil company PETRONAS recently embarked on a major project to improve how it handled data about idle wells, and made sure it had plans in place to reactivate them.

Karenjit Kaur Narinjan Singh Executive Petroleum Engineering Data, Technical Data with PETRONAS, explained how the system worked.

She was speaking at Digital Energy Journal's conference in Kuala Lumpur on October 5, 2015, "Doing More with Subsurface, Production and Drilling Data".

An idle well is simply defined as a well which is not producing anything, but is not yet abandoned.

PETRONAS defines it specifically as a "string that has not produced or injected continuously for 90 days."

Some other parts of the world use a different definition, such as a well which has not produced continuously for 6 months over the past 6 years, Ms Singh said.

The 'idleness' can be due to operational reasons, such as sand in the well, failure in artificial lift equipment, or a delay waiting for additional perforations to be made in the well.

Or it could be idle due to reservoir reasons, such as no oil and gas is flowing into the well, or the well is producing at too high gas oil ratio.

PETRONAS sets a target of well 'availability' or non-idleness, she said, in order to achieve its production targets.

PETRONAS senior management want to be able to better prioritise decisions about which idle wells should be given maintenance or workovers, she said. The maintenance or workover work should be higher priority if it means the biggest increase in production for the least cost.

PETRONAS senior management also want to get a much better idea about which wells are becoming idle.

Ms Singh's team built a software system which would gather data about idle wells from the field in a standard format, and present the data to management, so they could better make decisions.

Inconsistent

Before the project was started, PETRONAS had a problem of no standard system within the company for classifying idle wells, with inconsistent information flow.

Data was being managed by Excel spreadsheets and not always being shared, or with a number of different versions of the spreadsheet in circulation.

When the company management wanted data about idle wells, it would take some time for staff to provide it, because checks needed to be made about the accuracy of the information.

The engineers were required to submit monthly reports about idle wells in their region, and this typically required one week's work to gather the data.

Sometimes staff already had a well activation plan in place, and senior managers were not aware of it.

All of this meant that management don't get a real overview of the well.

New system

The new idle well management system connects with PETRONAS' production database, which has information about production data across the whole company.

It will auto generate an "idle candidate," in other words it will generate alerts for production engineers saying 'it looks like this well is idle, can you verify whether it is or not'.

If the well is idle, the production engineers are asked to provide a reason.

The idle well reporting has been incorporated in the production engineers' existing production data management software, so they don't have to learn a new system.

Company management have a dashboard which will show them where the idle wells are, and how long they haven't been producing. They can also see which wells are becoming idle and which have been idle for a while.

They can see how close they are to the target, and try to fill the gaps.

Management can see which regions have high potential for more production, and put their focus on those areas.

The dashboard has visual indicators, showing for each region the total number of idle wells, how much this number is growing (more idle wells) and how many wells have been restored, and how many have a reactivation plan, whether the plan for the previous month was achieved, and how much additional production would be gained for the re-activation or restoration plan.

The reactivation plan usually starts with a technical study. If an idle well does not have a technical study within 2 months of becoming idle, an alert is sent to management.

Download Ms Karenjit's slides at **http://www.digitalenergyjournal.com/event/27a22.aspx**

Tony Joseph – the IT work behind subsurface data

Subsurface IT managers and specialists do a critical task in helping the subsurface team identify projects. Tony Joseph, Geoscience Analyst with Murphy Oil, explained how it works

Subsurface IT is very different from usual IT, and might be better in a separate department within the geology and geophysics (G+G) business, suggested Tony Joseph, Geoscience Analyst with Murphy Oil.

He was speaking at Digital Energy Journal's conference in Kuala Lumpur on October 5, 2015, "Doing More with Subsurface, Production and Drilling Data".

Mr Joseph has been involved with GIS and geoscience software for 16 years, including working with Shell, PETRONAS and Hess, and his remarks were about his experience at oil companies in general.

The IT department is typically concerned with issues like Microsoft Office installations in the company, ERP, networks and servers, he said.

But the subsurface IT department is concerned with making sure that the company can do as much as possible with the data it has available, to better find oil and gas.

This includes critical tasks like making sure the data fits together, spotting errors, and choosing software packages – and supporting the geologists and geophysicists do their best work.

For example, consider that the subsurface IT manager is probably the best person to know which subsurface software is the fastest. He can see that doing one task takes 3 minutes on one software package, and 10 minutes on another. This is very useful information to know.

Too often, software purchasing decisions are made by senior management, who are mainly concerned with how much the software costs, and are persuaded by a fancy presentation from the software company sales person, he said.

Subsurface software is rarely properly tested and evaluated in the company by qualified software specialists before it is implemented, he said.

Companies are not usually very interested in getting a full understanding of what technology is available and how much it can help them.

Actually, all of the subsurface software packages "have their strengths and weaknesses," he said. "Not one single software is perfect."

One complexity is that the different subsurface software systems all use different symbols for different types of wells, and different colour coding.

There are also many advances in IT which can make subsurface work much faster, including cloud computing, faster hard drives, fibre optic communications and blade servers, but they are not used as much as they could be.

A desirable end goal for oil and gas companies is to have all of the subsurface data integrated together on a geographical information system (GIS), including visualising the petroleum system, showing all of the seismic data, and wells data, he said.

The subsurface IT department can have many different job titles. Mr Joseph's job title is "Geoscience Analyst", and some companies use "Geoscience Technician". But his role is basically to work with the subsurface data.

Workflow

Mr Joseph described a standard workflow to identify oil and gas prospects, from the perspective of a subsurface IT technician.

The first IT task is to put together a base map, gathering together all available geological information about the region, including known wells, known oilfields, water depths and facilities. There may be 'georeference tags' labelling possible geological features.

Well locations on the maps should match with well locations on the well logs and final well reports, and can also be checked against public data about well locations (from companies such as IHS).

The geotechnician will also do the task of converting seismic data from time to depth, based on the velocity model and depth conversion formulae.

Meanwhile, the geophysicists will do seismic interpretation work, including marking out the horizons (dividing line between formation layers) and faults. The faults need to be identified, marked with polygons (multisided shapes) and classified as to what kind of fault they are.

A petroleum systems expert and geologist can then try to work out where the oil and gas might be, looking for the four elements of reservoir, source, seal and trap.

Sometimes this will involve creating a 'common risk segment' map, working out the likelihood of the presence of each of the risk elements of the petroleum system, reservoir, source, seal and charge.

Once prospects have been identified, the geoscience technician will classify and map them, making an estimation of the volume of the storage area and amount of oil and gas which might be in them.

Finally this data is presented to management to make a final decision about where to drill, in an "evaluation montage," he said.

Download Tony's slides at **http://www.digitalenergyjournal.com/event/27a22.aspx**

PETROSYS – helping Lundin develop master data

Petrosys helped Lundin Malaysia develop a master data management system. Rob Bruinsma of Petrosys explained how it worked

Oil and gas subsurface data management company Petrosys recently ran a project with Lundin Petroleum Malaysia, to help the company develop a master data management system.

"Better data management will benefit everybody," said Rob Bruinsma, Senior Database Analyst / Administrator with Petrosys.

He was speaking at Digital Energy Journal's conference in Kuala Lumpur on October 5, 2015, "Doing More with Subsurface, Production and Drilling Data".

"It's pretty clear that communication and trust between business partners will improve if data is managed better than it was before."

Lundin wanted to implement the system so it could improve the data quality, security, accessibility and trustworthiness of its data. It would also help Lundin to comply with the regulatory data reporting requirements, which, in Malaysia, are set by PETRONAS.

In particular, Lundin wanted to centralise data, to make the same data available to all projects and reduce the time that people spend on finding the right data.

Benefits

Before implementing the system, Lundin had data stored on many different software systems and disk drives, making it hard to find.

"One of the first things people would like to see improved is the time to find data," he said.

"And when you find data, you want to be sure of its quality, and you want to be sure it is the same data other people are using in the company," he said. "It's all difficult if it's not centralised," he said.

Other advantages of the centralised data were improved data security, and reduced risk of error.

Also, mistakes are more likely to be identified. "When many people see the same data over time, many people will be able to correct it, say 'this isn't quite right can you please change it here," he said.

If people in the company like data, they will use the data more and more over time, he said.

You want to reach a point where people say, "I'm not interested in going to my C drive there's a world where people say, my data in the central database is of such good quality I'm going to go there first," he said.

System chosen

The project team selected a Linux based server for the data management system, which had good performance and was inexpensive. It chose Oracle for the data management system (because that is the platform on which Petrosys delivers the richest functionality).

Lundin chose the PPDM standard database structure, developed by the Professional Petroleum Data Management Association.

It was keen to use a non-proprietary database structure, ie one developed by an association rather than by a commercial company. This will mean that a variety of software applications from different companies would be able to run from the database, and it would not be tied down to just working with one software company.

"Petrosys believes that PPDM is one of the better open databases on offer," Mr Bruinsma said. "We have been associated with PPDM for 15 years or more."

Before data loading

"Before we do the data loading it's very important to construct what the rules are for this data," he said. For example, what labelling structure you are going to use.

You don't want duplicate data. This means you have to define specifically what 'duplicate data' is. Defining this, and creating other business rules, is the most important starting point.

If you don't do these things, your database will be "thousands of records of meaningless drivel no-one knows how to deal with," he said.

You also need to decide what you are going to store.

For example you can store data about formation tops (what depth of the well different formations start). But some of this data might also be included as part of the well header, where people may also be likely to look for it.

Having detailed data can be helpful, for example in making errors stand out and become more obvious, but you need to balance the need for detail with the need for having a data management task which you can complete and sustain.

Probably there will be some duplication in the end database, since there is no perfect system.

Another issue is how you will work with unstructured data, including documents and videos.

For these, you might just put a note in the master database that the data exists and where the location is on a networked drive. These manual links can be added over time, rather than all at the beginning. In the mean time you will be dependent on automated document catalogue and search systems as well.

You might want to limit the sort of documents which can be included.

Data loading

Once you have made a decision to go to a master data management environment, the initial data loading should be done as quickly as possible, Mr Bruinsma recommends. Decisions can be taken afterwards about what improvements need to be made, and they can be prioritised.

Data is initially loaded in bulk into the database, including Kingdom data and spreadsheet data.

Data can be loaded into intermediate 'staging areas' before being added to the master database.

It is also good to have automatic processes. "You don't want to be manually keeping track of what is loaded," he said. Although automated data checks could make it much slower to load in data, he said.

Once loaded, data should be given an automated quality score that is based on business rules for the data in question; while a confidence score should be attributed to the same data, by users who edit this data. Data quality/confidence monitoring tools are a very important aspect of data management - to drive data quality improvement over time.

Download Rob's talk on video and slides at **http://www.digitalenergyjournal.com/video/1717.aspx**

Carlos Damski – how can we change drilling processes?

Data gathering, processing and visualisation is comparatively easy, said Carlos Damski of Genesis Petroleum. It is changing companies' processes which is hard

When companies are trying to reduce costs, they usually look in 3 areas: people, technology and process, said Carlos Damski of Genesis Petroleum.

He was speaking at Digital Energy Journal's conference in Kuala Lumpur on October 5, 2015, "Doing More with Subsurface, Production and Drilling Data".

Cutting people is the first thing companies do, but there is a limit to how much it can be done, he said.

When they look to cut technology costs, for example by looking for products with lower prices, there is also a limit, because you can't operate without technology, he said.

But companies tend not to look very hard at reducing the costs of their processes.

As an example of how much money can be saved by processes, consider how budget airlines have managed to remove a large amount of costs from operating airlines, although they spend the same on staff (pilots) and technology (the aeroplane) as full price carriers.

Improving processes in oil and gas basically means maximising operational efficiency, or getting more out of the existing assets.

Data is key to achieving this. "If you want to transform or improve our business we have to look harder and harder in the data, and the data's role in the business," he said.

Mr Damski sees data management like a pyramid. At the base you have all the work to acquire and store data. At this level, everything only has cost, for software, hardware and connectivity.

The value from the data comes higher up the pyramid when you start working with it. Ultimately you can do something like provide useful information to a drilling engineer who can work out how to reduce time and cost of drilling operations.

Most parts are easy

Most elements of the data management process are fairly easy.

"No-one says, 'I have a problem with data acquisition,'" he said. "This is very easy."

Data storage is cheap and easy. There have been problems (like people storing data on their own hard drives) – but this can be easily solved (for example by disabling people's ability to store data on their own hard drives).

Doing quality control on data is not a difficult task, with many tools available to help you identify and remove bad data.

Providing access to data, including from multiple data sources, is well understood.

Visualising data is also fairly easy. For example, doing statistical techniques on data to work out the biggest sources of non-productive time, drawing pie charts of your production over the past 6 months.

Processes

But where it gets really difficult, or where companies usually get stuck, is in using the data to improve their processes. "The world of drilling and the world of computing have to come together," he said.

Improving processes requires a continuous improvement feedback loop, which is independent of the people and personality issues.

You need to try to incorporate people's experience better into the process.
It would be very helpful to store lessons learned for the next generation.

We may have mastered how to store data, but we do not yet have technology which can store someone's expertise in a computer system. For now, we are reliant on human expertise.

"It's pretty much a personal thing in terms of improving processes," he said. "We store lessons learned, and try to systemise more what we are doing."

Mr Damski also demonstrated the concepts with some business cases.

Download Carlos' talk on video and slides at **http://www.digitalenergyjournal.com/video/1721.aspx**

Jess Kozman - reducing drilling costs by avoiding fax

One South American company forced all its drilling rigs to submit data by spreadsheet rather than fax, leading to big savings, said Jess Kozman, Regional Representative of PPDM

Drilling downtime is a huge part of total upstream operational costs, said Jess Kozman, Asia Pacific representative of PPDM (the Professional Petroleum Data Management association).

He was speaking at Digital Energy Journal's conference in Kuala Lumpur on October 5, 2015, "Doing More with Subsurface, Production and Drilling Data".

Total drilling downtime cost to the industry can be calculated as three times the actual rental cost of the rig, so if the rental is $600,000 a day, downtime cost could be as much as $1.8m a day.

Many companies are interested in using 'big data' techniques on drilling data, for example using some kind of predictive analytics to try to work out which components will fail.

But companies typically collect and store a lot of data but don't do anything with it, he said. It is easy to analyse data and generate a bunch of numbers, but it doesn't necessarily mean they are useful in business, he said.

For data to be useful in oil and gas decision making, we often need to combine 'managed data', situational awareness data, analytics data and perhaps historical data together.

This makes it a much more complicated challenge than in other fields of analytics, such as internet search, where (for example) the age of the data is often not a concern.

"The idea of bringing all the data together in one place is not really new," he said. But now, computers are trying to bring the data together in a computer system, rather than a person's head.

As an example, consider the idea of 'play based exploration', where an oil company looks for oil by considering where all the factors leading to oil might be present (source, charge, trap and seal).

50 years ago, this task would have been done by one expert geologist, gathering all of the data in his head. Today, people are trying to do this by computer.

Some data is more valuable than others. For example, someone who has been involved in production from a certain basin over a long period of time might be able to tell you that the most valuable data was collected from a certain era of drilling, for example when the first appraisal wells were being drilled.

But a data manager, who is aiming to set up a computerised data management system from all the documents and reports gathered from field operations (some of which may be handwritten) may decide to either start with the most recent data and work backwards, or start with the oldest exploration data and work forward. With both of these approaches the most valuable data might be entered into the system last.

NPT case study

Mr Kozman presented a case study of an oil and gas company in South America, which wanted to reduce the non-productive time for 50 land rigs operating in a single region, using 6 months of performance data.

The company chose to limit the scope of the project (to 6 months of data and one region) so that the amount of data involved wouldn't be overwhelming.

Out of the 50 rigs, 38 were providing data by spreadsheet, and 12 were providing data by fax (which was then re-typed in company headquarters).

The spreadsheet data included notes about rig activity (when the rig was drilling, when it was circulating mud, when it was waiting for supplies), all entered in a different category on the spreadsheet.

So there were a number of different categories of 'non-productive time'.

The oil company found that the 12 rigs sending data by fax were reporting an average of 65 days of non-productive time over 6 months, whilst the 38 rigs using spreadsheets reported an average of 15 days.

Most of the additional nonproductive time was due to delays in transmitting critical data to the headquarters office, where the final budgetary decisions for maintenance are approved.

One thing the data management project clearly showed was the importance of asking the 12 rig operators using faxes to start using spreadsheets, so data between the rigs could be properly compared. Eliminating the data re-entry at company headquarters also reduced the time needed to make decisions about maintenance and rig logistics.

No investment was required for this data management project, apart from buying Microsoft Excel and providing training, communications and change management.

If the rigs using faxes could show non-productive time similar to the other rigs once they were using spreadsheets, that could be calculated as a saving of $23m over 6 months, Mr Kozman said.

Also, by no longer using faxes, the company was able to free up a large amount of time of expert personnel who don't have to type in data from faxes, he said.

"We spend a lot of time saying 'spreadsheets are not a viable long term database store. But in this case, it was improvement over a faxed pdf. I'll take winnings where I can get them."

The company would ultimately like to get a fully automated rig reporting system, or database systems which would give more structure, checks and rules to the data entry process. But this would take many more months to implement, he said.

Download Jess' slides at
http://www.digitalenergyjournal.com/event/27a22.aspx

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Steven Yew, Business Development Manager, Senergy

Steven Yew, Business Development Manager, Senergy

Chin-Fah Heoh, Managing Consultant, Storage Networking Academy

Duncan Irving, Oil and Gas Practice Lead (EMEA/APJ), Teradata

What did you enjoy most about the event?

> **All the speakers delivered a very clear message. It's like being in a classroom.**

> **Excellent speakers and refreshments.**

> **Content of the presenters**

> **Q&A session and Dr Carlos & Jess Kozman's presentation**

> **networking**

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