Foundations

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1st Place Foundations Photo Contest Winner; *"Energy and Persistence Conquer All Things."* (Vikrant Lakhanpal)

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PLUS PHOTO CONTEST:

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ABOUT PPDM

The Professional Petroleum Data Management Association (PPDM) is the not for profit, global society that enables the development of professional data managers, engages them in community, and endorses a collective body of knowledge for data management across the oil and gas industry.

Getting to the Next Level of Interoperability

By Harry Schultz, Oilware

***Everyone loves a** standard, that's why there's so many of them!* And the corollary: *Everyone loves a standard, as long as it's one they already use.* While these aphorisms are humorous, they also have a ring of truth to them.

Interoperability between software systems has been the goal of numerous standards organizations for decades now, so why does true interoperability still seem so elusive? A common understanding of the organization or packaging of data (syntax) is necessary, but not sufficient for true interoperability. The meaning of the data (semantics) must also be shared and unambiguous.

The first level, ***Syntactic Interoperability***, can be achieved through the use of standard database models, data exchange formats, and communication protocols. As an industry, we've actually done pretty well at this level. The PPDM data model (aka PPDM) is, for all intents and purposes, ***THE*** public petroleum data model. It is mature and has been utilized very effectively by many energy industry organizations including Oil & Gas Companies, Governmental Agencies, Software Providers, and Data Providers. There are also many equally mature data exchange formats and transfer protocols, yet interoperability has not been achieved through the use of these standards. Syntactic interoperability alone is not sufficient. We need to take it to the next level.

Semantic Interoperability is achieved when two systems can *automatically* exchange *information* (not just data) meaningfully and accurately. In the context of PPDM, that means shared conventions for usage of the data model and a set of *shared* reference data. Please note that the word *shared* in the previous sentence was carefully chosen and should not be interpreted as *standard*. More about that later.

Shared usage conventions for the PPDM data model are still evolving, but a fully functional set of metadata and reference data is attainable today by integrating semantic data standards with the syntactic PPDM data model.

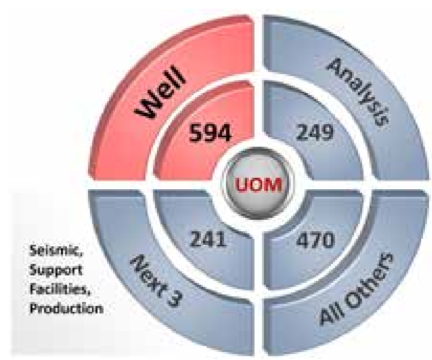
BACKGROUND

Oilware is primarily focused on the interchange and management of digital well log data, so basic reference data and rigorous handling of Units of Measure are extremely important. There are also many dictionaries and code values that have to be managed, interpreted and understood so that well log data can be loaded into a PPDM database in a meaningful way, easily identified once loaded, and intelligently exported. Integration of metadata and reference data into PPDM has been ongoing in our company for many years, but we recently made a concerted six-month effort to integrate the Energistics Units of Measure Standard, the Energistics Practical Well Log Standard, and several service company Well Log dictionaries into PPDM 3.9.

PPDM 3.9 is now composed of **2,688** tables with a total of **71,171** columns spread over **47** major subject areas. Of those **71,171** columns, **1,554** are direct references to units of measure. The use of units of measure within PPDM, however, is very heavily concentrated in just a few key subject areas as shown in Figure 1. Over one third of all Unit of Measure references occur in the Well Subject area alone. Clearly, the management of well and well-related data in PPDM requires a rigorous implementation of Units of Measure and all of its related metadata.

PPDM UNITS OF MEASURE REFERENCES BY SUBJECT AREA

Figure 1.



Energistics Units of Measure Standard (UOMS) V1.0 – This standard was released in June 2014 after literally years of work and collaboration by Energistics, PPDM, members of the SLC, and many member company representatives. The standard that was created is exceptional in both detail and completeness. In addition to Units of Measure symbols and conversion factors, it also includes a grammar for constructing more complex Unit of Measure expressions, classification of units by quantity class, a dimensional analysis, and basic mapping documents to other common Unit of Measure sets and quantity class definitions. Another important aspect of this standard is that it identifies many different quantity classes applicable for seemingly dimensionless values. For example, weight ratios, volume ratios, and molar ratios are all dimensionless, but are not directly interconvertible as their lack of units might imply. This standard also recognizes that some special unit symbols (e.g. %) are commonly applied to more than one quantity class, a relationship that is not currently modeled in PPDM 3.9.

Practical Well Log Standards (PWLS) V2.0 – This standard was last released in 2003 and Energistics has been working on V3.0 since 2014. The primary content of PWLS is a set of dictionaries for digital well log channels, parameters, property classes, logging tools, and the relationships between them all. These dictionaries are not meant to set a standard for channel and parameter naming, but rather to inventory and classify logging company specific channel and parameter names using standardized classification systems. The current industry slowdown has severely impacted the progress of this working group and it has been virtually stagnant for the past year.

CURRENT STATUS

Oilware has worked for many years with both Energistics and the PPDM Association to develop industry standards. Our original plan was to wait for the completion of PWLS V3.0 before beginning integration, but the industry slowdown put that on indefinite hold. We needed this data integrated into PPDM, so we decided to take on the task of completing PWLS ourselves. Despite the independent initiative, it was not done in a vacuum. Oilware has been in communication with both the PPDM Association and Energistics during the course of the entire process. We are actively working with PPDM to revise the PPDM model before the release of PPDM 3.10, and also with Energistics to update their Practical Well Log Standards data for 2016 and beyond.

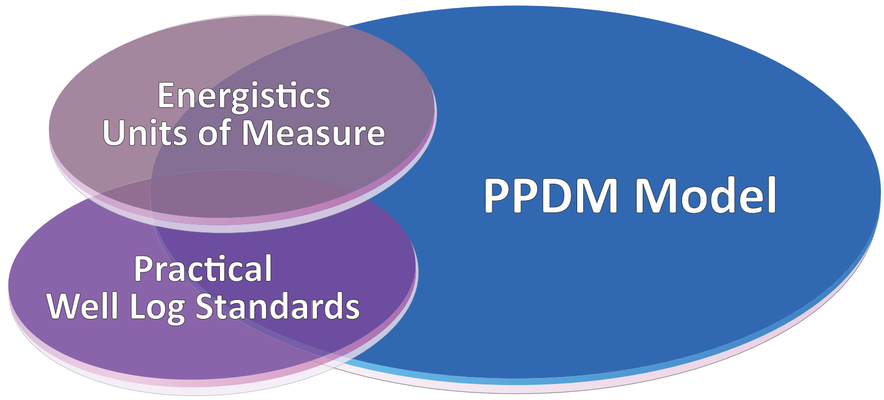


Figure 2.

All three of the standards viewed individually are well designed, coherent and complete. However, combining them proved to be much more difficult than expected. The Venn diagram in Figure 2 shows that while there is significant overlap between the three standards, the effort required is much more than just *loading data*. Service company dictionaries, while not explicitly shown in Figure 1, share the same footprint as PWLS.

ANALYTICAL PROCESS

The analytical process of rationalizing all the pieces of data necessary for meaningful well log representation turned out to be more daunting than anticipated. The sheer volume of information combined with ambiguity, redundancy, and inconsistency present in the various sets of data required a multi-step process that often became iterative as work progressed. The basic process steps are below.

1. Analyze the explicit and implied data models of all of the Energistics and Service company reference data sets to be integrated into PPDM. In some cases, this included normalizing and restructuring the data to eliminate redundancy, inconsistency, and ambiguity.
2. Create separate databases for each of the individual data sets using the models derived above.
3. Populate the various reference data models and apply referential integrity constraints. This proved to be a particularly tedious process since some of the data sets contained thousands of incorrect or unresolved internal references. All of these incorrect / unresolved references had to be addressed in order to proceed with rationalization analysis.
4. Fix all of the data issues in each of the individual data sets and validate the data models created for each one.
5. Create a new PPDM 3.9 database with all referential integrity constraints turned on. Then build all of the PPDM metadata tables that describe the data model. These include PPDM_SYSTEM, PPDM_TABLE, PPDM_COLUMN, PPDM_CONSTRAINT, PPDM_INDEX, all of their child tables, and their underlying reference tables.
6. Map all of the individual data set models onto PPDM to determine where they align and where

PPDM needs to be extended.

7. Revise and extend the PPDM model to handle all of the data in the reference data sets. Create new tables, add columns to existing tables and populate all related PPDM metadata tables.
8. The Energistics UOMS data is the most fundamental, so map and load it first.
9. PWLS and the Service company dictionaries all specified similar concepts of properties, quantity classes, units of measure, and grouping of units of measure into classes. However, these concepts were modeled differently from PPDM in both their structure (syntax) and in their values and meanings (semantics). The concepts and data from each had to be mapped and loaded into PPDM. This included many company specific translation tables.
10. Create new reference data and fill in missing reference data to bridge the gaps in the reference data sets being integrated.

To the greatest degree possible, all of the steps listed above were programmatically scripted. This provides the ability to roll back to a previous step if necessary or start over completely if any of the underlying data sets are updated. While scripting every step took much longer than just interactively manipulating the data, it provides both flexibility for change and documentation of every decision made and every step taken along the way.

NOTABLE INTEGRATION ISSUES ENCOUNTERED

The Energistics UOMS data does not map directly into PPDM 3.9.

- Some of the UOMS data did not have a home in PPDM and required additional tables. Oilware has contributed these changes to PPDM to be used in PPDM 3.10.
- Cardinality of data relationships in UOMS is more complex than had been modeled in PPDM.
- Some existing PPDM columns and, in some cases, complete tables need to be deprecated.
- The conversion factors provided in UOMS are for a different conversion formula than the one used in PPDM. Even though they both label the factors as A, B, C, and D, they are not the same. All of the Energistics values had to be transformed before they could be loaded into PPDM.
- The data as provided in the standard is not sufficient to handle current data. The standard does specify a grammar for creating new Unit of Measure expressions though. Each one has to be created individually along with associated base units and conversion factors.

The two Energistics standards are not fully integrated.

- The last official release of PWLS predates the UOMS by more than 10 years, and is therefore based on a previous Unit of Measure standard. This incompatibility will be resolved when PWLS V3.0 is eventually published, but this issue had to be resolved in order to complete the integration. Oilware will be contributing part this work back to Energistics to help move PWLS V3.0 along.

Property is only partially defined in PWLS and PPDM

- PWLS introduced the concept of properties, but did not formally define a complete set of properties for general use.
- PPDM 3.9 also introduced the concept of properties, but did not define them either.

Other logging company dictionaries introduced additional concepts that did not exist in either of the Energistics standards or in PPDM.

- Measurement Classes and Measurement Class UOM sets had to be created.
- A hierarchical set of properties had to be created.
- Logging tool tables and tables to express the many-to-many relationships between Tools, Processes, Curves, and Logging Parameters were created.

RESULTS

After much tedious hard work, there now exists a data model populated with the aforementioned data sources all rationalized into a coherent reference data set composed of Units of Measure, Unit of Measure conversions, quantity classes, properties and measurement classes. The reference data is tied to the basic PPDM table/column information and thus facilitates UOM standards through the database. This provides for data validation and allows for data transfer along with reference data values applicable to the destination application or database.

The following was accomplished in the last 6 months:

- Created over **400,000** rows of metadata and reference data.
- Devised a Hierarchical Property Model for PPDM. The data population was derived from PWLS and other industry data.
- Defined a Measurement Class Model to group units for a given quantity class. For example, the measurement class *DepthIndex* might contain the units foot and meter, whereas the measurement class *GeographicalDistance* would contain mile and kilometer.
- Added new tables to PPDM 3.9 to accommodate the more complex relationships and new concepts required. These extensions are also proposals for PPDM 3.10.
- Constructed a *complete* set of PPDM metadata.
- All columns in PPDM are now related to properties, measurement classes and quantity classes.
- Created over 1,500 units of measure and support for all appropriate

Harry is working with PPDM to ensure that PPDM 3.10 will fully accommodate all of the requirements for the units of measure data set.

conversions between them.
- Designed multiple sets of Unit of Measure aliases for data import and export.
- Generated uniform classification of curve mnemonics across all service companies.
- Revealed a data driven mechanism for data validation on import as a result of setting up the reference data and data model. This included range checking for any type of numeric or date data as well as code value validity checking and translation.
- Showed full support for the concept of vertical tables is inherent in the extended data model.

BENEFITS OF INTEGRATION

This work culminated in the generation of a PPDM database fully populated with a complete set of metadata, Units of Measure, properties, quantity classes, measurement classes, well log curve dictionaries, parameter dictionaries, and code translation tables in the PPDM 3.9 database that makes semantic interoperability possible. Benefits of this body of work are:

- Oilware now has a great platform to manage reference data as it continues to grow and evolve.
- It's easy to create and export reference data sets for other database and analysis systems such as Openworks, Recall, or even proprietary client systems.
- Makes software development easier since data import and export tasks can be data driven.
- The relationship of logging parameter mnemonic to properties and measurement classes and the relationship of database columns to properties now makes it possible to identify all parameters that would be good candidates for populating a particular table in PPDM. Likewise, it also becomes easy to identify which parameters to create when exporting data from PPDM.
- Can be retrofitted to PPDM 3.8 and 3.7 databases.
- The translation and alias tables created for data integration become a part of the overall solution.

SUMMARY

Reference Data is a process, not an event. New reference data is created daily by standards bodies, governmental agencies, and a myriad of private companies. It must be monitored, managed, and integrated into existing databases. This task is tedious and greatly underappreciated, yet vital to maintain the quality and reliability of any database.

A new level of interoperability was attained **not** by creating yet another standard, but rather by creating a methodology and a body of **shared** reference data that provides for semantic interoperability. F

About the Author

Harry is President and CEO of Oilware, Inc. which he co-founded in 1986. He has been an active participant in standards development with the API, POSC/Energistics, and PPDM since 1989. Oilware specializes in software development, media/data conversion, and data management products.

Learn more about Units of Measure in Foundations, Volume 1, Issue 3, Pages 11 – 13

Guest Editorial

Voluntarily taking an exam!

AM I CRAZY? INSIGHTS ON THE JOURNEY TO BECOMING A PPDM CERTIFIED PETROLEUM DATA ANALYST.

By Alex Ross,
Government of South Australia

Why would a middle aged geologist, who has worked pretty much all his career in geoscience software, data and information, want to take another exam…didn't those finish when I completed university?

A period of (thankfully not too lengthy) quiet time between consulting engagements mid-2015 prompted some self-reflection on:

- Where is my career taking me?
- What am I best at?
- What am I most passionate about professionally?
- What I could do to get my head above the crowd to gain that oh so important next job?

The short answer to the first three questions was easy - geoscience data and information management.

As for the fourth - it's a combination of: networking…LinkedIn is one great tool for this, using an executive coach to refine my 'brand', and (you guessed it) becoming a PPDM Certified Petroleum Data Analyst (CPDA™).

I'm proud to say that, as of October

2015, I joined a growing number of CPDAs around the world. I'd like to take you on the journey through the ups and downs of that process, with the desire this helps you make a decision to become a CPDA too.

It was at a PPDM technical workshop in Brisbane in July 2015 that becoming a CPDA was suggested to me by Trudy Curtis…more specifically during the post workshop geology fieldtrip run by Jess Kozman – looking at rocks and drinking beer. What a great combination!

My interest piqued, I started by checking the PPDM CPDA website at www.ppdm.org/certification.

I was taken by the overall aims of the program, plus the statement the exam has been constructed upon the competencies expected of a petroleum data analyst with a minimum of 5 years of combined education and experience. I had 30ish years, so it should be relatively straightforward - right? More on this later.

The main source of truth on the CPDA process is without doubt the Certification Handbook. Key to navigating both the CPDA website information and handbook are the eight main competency categories:

- Data Governance
- Data Analysis
- Data Quality Management
- Data Security
- Spatial Data
- Exploration and Production Life-Cycle Processes
- Master Data Management
- Communication

I spent a bunch of time downloading and printing resources for each category. The number one resource for me was the DAMA guide to the data management body of knowledge (DAMA-DMBOK Guide). It's a weighty volume and contains essential information. It also gave me a broader insight into the importance of data management beyond our oil & gas centric space. As an aside - next up a DAMA certification?

Important guidance as to where to focus my study time came from the Certification Handbook, which shows how the exam questions are distributed across each competency. All things being equal, this should direct study efforts:

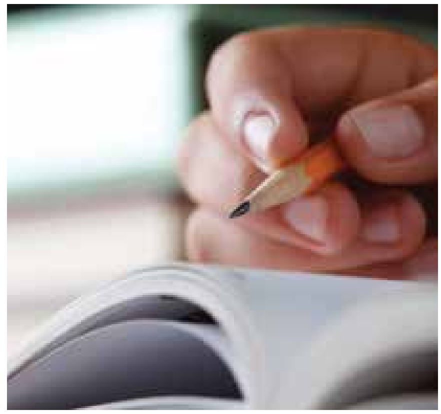
Competency	Approximate Percentage of Questions
Data Governance	11
Data Analysis	30
Data Quality Management	15
Data Security	9
Spatial Data	9
E&P Life-Cycle Processes	15
Master Data Management	9
Communication	2

The reality was that I was more experienced with some competencies than others. Your mileage will vary.

Studying for exams isn't top of my list of fun activities, however, it was definitely worth it, although I underestimated the amount of time required. I learnt a massive amount, particularly in areas I had only briefly touched on previously. Study hard!

Taking the exam was a new experience. It's done by remote proctor - where myself and my immediate environment (kitchen table) was scrutinised via the laptop camera. It's a long exam of 200 multiple choice questions over two sessions of two hours each, with a fifteen-minute break in-between. The time passed all too quickly, although it was sufficient to review questions that I was less sure about.

Overall, I found the exam broad ranging in terms of topics and question style. There



were multi-disciplinary theories and concepts, together with specific technical details on file formats. The nature of the questions assess "knowledge, application and critical thinking." And before you ask, no, I don't have any of the exam questions! There are, however, some sample questions that were shared upon registration for the CPDA exam which were very useful.

So then the nervous wait for the results. To be honest the exam was harder than I expected – I was unsure of what my results would be. Just over a month later I was elated to receive notification I was successful. I am proud to be the first CPDA in Australia.

For me, earning my CPDA was a thoroughly worthwhile venture. As it happened, I landed my current job shortly after I achieved it!

So, definitely not a crazy decision. Would I recommend it to others? Absolutely! In fact I feel so strongly about the value of CPDA that I gladly joined a PPDM Certification Committee.

CPDA's are a growing cadre worldwide. With the right experience and commitment, you too can do it! Follow your passion. Stand out from the crowd. Be proud of what you do. It's a professional career. F

About the Author

Alex Ross is an Adelaide based geologist who effectively combines digital geoscience, design & change for customers.

Leveraging PPDM for Well Log Validation

By Brian Richardson, The Information Store

A CASE STUDY IN WELL LOG FILE QC

Imagine scanning, loading, validating, modifying and reporting on approximately **30,000** LIS/DLIS/LAS files in just **two** weeks. It is possible and the result was a set of well conditioned, parameter synchronized log files with a set of reports detailing the issues detected and the changes made to each physical and logical well log file. All it required was working smarter, not harder.

PROJECT INITIATION

The project request involved a set of well log files that had previously been managed in a well log management software package. Unfortunately, the log management package became obsolete and the well log files succumbed to entropy and fell into chaos. Most of the files (98%) were DLIS with a few LIS and LAS.

The goal of the project was to process the ~30,000 well log files to:

- Rationalize well header information to meet minimum content requirements and be uniform across all log data files for the same well.
- Check parameter values against specified ranges.
- Make NULL values within curves uniform.
- Adjust logical log file depth intervals to match actual curve data intervals.

The LIS and LAS were few and thus trivial to QC and adjust. However, with the bulk of files in DLIS a more systematic, faster approach was needed to verify the files. Initial estimates for individual file checking showed that opening, checking and adjusting the files individually would take between eight to 15 man years, depending on how much time was needed for each file. Clearly a different approach was needed.

PROJECT CONCEPT

iStore and Oilware combined their strengths to attack the well log QC problem from a holistic, systematic approach rather than from a man-power intensive, individual file approach. It was reasoned that scanning all the files into metadata in a PPDM database and then using the power of SQL to validate and modify the files could result in a more accurate, coherent, robust, dynamic and reproducible QC on the files. An initial set of 10 files was processed to verify the technique. Some adjustments were made in the log scan program to capture information on nulls, depth intervals, and curve statistics; and a few data tables were added to the PPDM schema to allow dynamic QC definitions against the log header mnemonics. Oilware provided the log scan and load modules that generated the log and curve statistics and populated the database. iStore prepared the databases, validation modules, data model for validation data, SQL procedures and update statements, report generation and a custom framework website for running the various modules during the project. Oilware and iStore development for the project required one-man month of effort.

Data Validation / Reporting UI

The result was a modular system that solved all the issues in a reduced time frame.

LOGQC DATA MODEL

The custom data model consisted of six tables. These parameter tables, including an audit table, were set up so that they could be correlated with the PPDM standard table WELL_LOG_PARM. These were:

- **PARM_RANGE_INFO:** contains range validation values for header mnemonics.
- **PARM_VALID_VALUES:** contains valid strings for varchar mnemonics.
- **PARM_REQUIRED_MNEMONICS:** contains the mnemonics that should exist in each well log file.
- **PARM_MISSING MNEMONICS:** contains the well log file information and the mnemonics that do not exist in the file, but should exist according to the PARM_REQUIRED_MNEMONICS table entries.
- **PARM_VALIDATION_FAILURE:** contains the result of running parameter validation against the header mnemonics for the well log files.
- **WELL_LOG_PARM_AUDIT:** an audit table that records all DML operations against the WELL_LOG_PARM table so that a report of all data changes can be produced. The table is populated via a trigger on table WELL_LOG_PARM (another custom component).

PROCESSING

Checking the well logs is a multi-step process that was kept very granular to allow adjustments as the processing of the files progressed. This allowed for backing up to previous steps, deleting intermediate results as necessary and regenerating data and reports.

General Process

1. Create a LOAD database (Oracle),
2. Enter the wells, wellbores, field, well surface location data for all wellbores that have logs to be loaded,
3. Set up the wellbore_id ↔ log file relationships for log loading to the database,
4. Scan and load all log files,
5. Backup the LOAD database and copy it to the VALIDATION database,
6. Set the required header parameter mnemonics in table PARM_REQUIRED_MNEMONICS,
   a. Run a procedure that adds the required parameters to the well logs where they are missing,
   b. The procedure populates PARM_MISSING_MNEMONICS for later reporting,
7. Run all validations,
8. Generate validation reports,
9. Correct data as necessary using any/all of the following:
   a. Manually peruse all validation failures and insert correct values in the UI provided,
   b. Utilize an Excel loader to update data amassed in spreadsheets – this is also part of the UI provided,
   c. Run updates of mnemonics from well data as appropriate,
10. Generate reports as specified by the client,
11. Generate new log files that have the desired data.

The first step in the process is to instantiate two PPDM databases; one database for the initial load and another database for validation and changes to the data. Two databases are used to allow for "before and after" reports to be constructed that show the result of QC on the metadata. The databases must be populated with well, wellbore, field and well location data that will be used for file association and for updating mnemonics with standard values across all well logs. Database table data is entered that explicitly ties each physical log file to a well.

The second step is to run the Oilware scan program against all the files. This scan constructs a comprehensive set of metadata in PPDM that allows the validation processes to be performed against all header parameter mnemonics simultaneously. The scan also creates metadata that will be used for generating new well log files after all the QC is complete. In effect, the scan program creates a set of metadata that can recreate the entire well log file. Then the metadata is loaded to the database.

After getting all the metadata into the PPDM database, the LOAD database is exported and restored into the VALIDATION database. The validation database then is used for validating, reporting, updating the contents of the well logs before finally creating a new rationalized, synchronized set of well log files. The first step in this process is to insert a comprehensive list of mnemonics that are desired in every well log file. A procedure is then run that injects each of the required mnemonics into the well logs where it does not exist. Next, the validation procedure runs that uses the PARM validation info to range check and value check all the parameter mnemonics in the PARM validation tables. The result of this is population of table PARM_VALIDATION_FAILURE with all mnemonics, the validation ranges and the invalid values.

After validation is performed and data is corrected, reports are generated to document the issues encountered in the log files. Reports include a "before and after" report between the two databases as well as detailed reports of NULL values, curve statistics, adjusted well log depth intervals and header parameter mnemonics.

The culmination of the project is creating new well log files in the same format as the original, but with standardized header parameters containing exactly the values desired. This process uses Oilware's conversion software to read all the metadata and produce well log files in the desired format.

CONCLUSION

Using the power of bulk processing into the standard PPDM database, the project was completed in mere weeks. For example, the initial scan/load of the ~30,000 files was completed in less than 24 hours. Running the required parameter checks and validation procedures took less than an hour. Report generation was completed in five hours (10 different reports generated by well). Update of all well header parameter mnemonics in all well logs took less than an hour. The completion of the project – generation of a coherent set of standardized well logs – required less than 24 hours. Due to the granular nature of the solution employed, each of the steps could be wiped and repeated easily – in fact, standard mnemonic set definition, validation and report creation were each performed several times in two days to satisfy last minute requests.

In all, from start to finish, the elapsed time for processing the files – scanning, loading, validating, reporting, updating, generation of new output files - was about 72 hours. The project updated over 15 million header parameters and processed more than 100,000 logical well logs from physical files. Most of the project elapsed time consisted of the client examining reports to ascertain the veracity of the process being employed. The success was delivery of a large project ahead of schedule, a coherent set of well log files of documented quality and a documented, reproducible process. F

About the Author

Mr. Brian Richardson has been involved in Exploration and Production data management for more than 15 years and has participated in and led a wide variety of upstream data-related projects over the years.

Collective Action

The Regulatory Data Standards Committee

*"**The good thing** about standards is that there are so many to choose from."* Although computer scientist Andrew Tanenbaum made this proclamation many years ago, it's still often seen as a painful truth. The value of standards has long been recognized as the best way for the industry to improve efficiencies. Significant progress has been (and continues to be) made towards consolidating critical standards development into the hands of a few trusted organizations. The handful of industry standards organizations that exist today are each focussed on specific parts of the E&P value chain.

The Professional Petroleum Data Management (PPDM) Association is focussed on a two-part strategy for creating an environment where data remains available and accessible to all stakeholders and processes through the E&P life cycle without being lost or corrupted. First, we must agree that data management standards and best practices are needed; these must both support and transcend the needs of individual stakeholder groups, to unite industry in a common baseline data framework. Second, we must develop a foundation of data management professionals who are recognized, trained and credentialed to provide a global, solid and consistent resource base for data management.

Standards are tough to develop and even tougher to implement if you want to achieve true life cycle interoperability. This is particularly true today, since standards based implementations often address tactical challenges that are just a subset of what corporate strategies demand. But in a financially challenged industry where everyone must work together in order to resolve our mutual problems, the determination to drive out a family of effective, interoperable standards has never been stronger. Through the Standards Leadership Council, progress is being made towards achieving these lofty goals (www.StandardsLeadershipCouncil.org).

Industry driven, more than twenty work groups and committees at the PPDM Association are working with industry stakeholders to develop standards and programs that improve how data is managed through the life cycle of oil and gas. The PPDM Regulatory Data Standards Committee is examining business challenges and opportunities faced by regulatory agencies internally and through industry interactions. *"During our investigation of these business needs, we found the same needs and challenges over and over through the E&P life cycle,"* says Trudy Curtis, CEO of the PPDM Association. *"Focusing our lens on the regulator - operator relationship while remaining aligned with full life cycle processes allows us to develop useful and practical standards that will apply broadly through the life cycle."*

Mark Snow, Supervisor of the Permits and Bonding Unit at Michigan DEQ – Office of Oil, Gas and Minerals, is clear about the need for developing and deploying data standards. *"Having standards and reducing ambiguity is crucial to ensure that regulators, operators, data vendors, academia, and the public-at-large are all on the same page when looking at activities and actions within this industry. As a regulator of the oil and gas industry in Michigan, we are constantly reviewing data related to oil and gas development activities. Local variation and technological advances within the industry have created various nomenclatures and new terminologies that make it vitally important to invoke standards."*

Floy Baird, Supervisor – Better Data Faster Team, Geoscience Services, with Devon Canada Corporation, endorses this idea and adds that *"as Operators are challenged to increase efficiency, reduce cost and create effectiveness, standards offer a mechanism to remain competitive."* This theme is widely expressed by operators of all sizes. *"The days of plenty are past; that means that our industry habit of internally based 'me' strategies have to be transformed into 'we' based collective standards. We must build together for the benefit of all if we are to solve our data problems,"* insists Curtis.

Arthur Boykiw, VP Information Services with the Alberta Energy Regulator (AER) and Co-Chair of the Committee, has been a proponent of standards throughout his long career. Boykiw has not only participated in standards development, but has implemented them corporately with tremendous success during his decades of experience. He is confident that data standards are the key to efficiencies and cost savings within regulatory infrastructures. *"All regulators are facing the same data challenges, including legacy* *proprietary environments and data silos. We are all asked the same questions by the same environmental and special interest groups. Correct, well defined information is essential to regulator credibility, and for scientific analysis and regulatory success. The cost of building and managing custom built suites of regulatory solutions is too high. For operators, the cost of managing multiple data definitions and data requirements across multiple regulatory jurisdictions is significant. Regulatory data standards are a foundation for increased industry efficiency in dealing with regulators and will be a foundation for common regulatory solutions in the future."*

Peter MacDougall, Director, Customer Data Solutions, Energy with IHS Markit, agrees. *"Regulators are struggling with the volume of data coming in and keeping abreast of the changes that are occurring to the industry. If standards are used by all regulators, operators and vendors, many efficiencies can be gained which will result in significant reductions in operating costs for all."* Alex Ross, Senior Information Strategist with the Government of South Australia, adds that this will require regulators to align with industry standards, something he recognizes as both essential and achievable.

Previously in *Foundations* ("Regulatory Data Standards Work Group", Volume 3 Issue 1, Page 24), we described the committee's focus on issues with semantics (vocabularies), understanding of what constitutes 'good' data, and common data structures. The first of these workgroups, 'What is a Completion' is underway, and will develop disambiguation tools similar to the globally applauded 'What is a Well'. "*'What is a Well' (WIAW) helps everyone communicate better. It's simple, easy to use, and practical,"* says John Broderick, Business Transformation Project Manager, US Bureau of Land Management (BLM) and Co-Chair of this Committee. *"Standards like WIAW benefit everyone through the value chain."* John goes on to say that BLM is at a convergence that is a great opportunity. *"We are upgrading our existing systems for regulating oil and gas operations at the same time that BLM as a whole is evolving to manage data on an enterprise basis. This, of course, requires the definition and adoption of standards. Where possible we will adopt industry standards. However, while addressing the same objects as industry, regulatory agencies look at these from a different perspective with their own terminology. This is often shaped by the laws and regulations of the jurisdiction."* The Committee's approach is to standardize where possible, but where differences exist, provide definitions and translations so information can be shared efficiently.

Sean Udell, Vice-President, Operations and Technology with geoLOGIC systems ltd. has seen the challenges through his career. *"I've been in this industry for 25 years, and there isn't a day that goes by when someone doesn't ask about some piece of data that exists in one jurisdiction and doesn't seem to exist in another. The thing is, frequently that data does exist in the other jurisdiction – it just has a different name, or is gathered in a slightly different fashion, or is collected by a different regulatory body, or…. It just seems to me that most regulators do care about similar sorts of data, even if their terminology varies, and that if we can find some common ground, and common language, for these submission activities, then it would make life a bit easier for everyone involved."*

Adoption of standards by regulatory agencies is more efficient for both industry and the agencies, but also provides the opportunities and markets for vendors to provide the software to support those standards, adding to the value-chain for all participants.

PPDM work groups have long seen strong and sustained participation from committed industry experts, even during downturns. Alex Ross and Floy Baird, joined the Regulatory Data Standards Committee because of PPDM's history of delivering on its commitments. *"It is always the people that PPDM has managed to pull together for their groups."* adds Peter MacDougall. *"Everyone involved with PPDM groups strives to find solutions to industry problems through standards. The learning*

potential from these groups is incredible."

Mark Ducksbury, Manager, Data Management Team, with the National Offshore Petroleum Titles Administrator (NOPTA), joined the Regulatory Data Standards Committee as a means of improving international collaboration on petroleum data among government entities. *"The opportunity to share ideas and learn different approaches to data management practices is critical. By understanding the perspectives of other regulators we can work together to better define and streamline data strategies – perhaps reducing some of the entry barriers to international operators."* Through his participation, Ducksbury has twin goals of making meaningful improvement to the quality of data submitted and made available and reducing duplication within industry. Lofty goals indeed!

Boykiw agrees. *"It is vital that the Alberta Energy Regulator continue its journey and aspiration for regulatory excellence. The development and use of standards is an essential ingredient in achieving this goal. This committee is a driving force in establishing regulatory data standards."*

There are many differences to reconcile, of course. Operators, regulators, service companies, consultants, software companies and other stakeholders have each made considerable investments in building systems and processes that work for them. Adopting standards will require everyone to make a lot of changes, and most of those will be difficult and complex.

"Standards adoption has to be part of a corporate data strategy - Executives need to see a clear, long term gain before they will commit to a comprehensive standards

based data strategy," points out Curtis. *"It's not realistic to expect standards to be widely and consistently adopted through a series of un-integrated tactical projects. Our biggest data costs come through the many long and complex processes involved in handling data that is received from outside parties – and this is the vast majority of data in every company. The value proposition lies in getting everyone on the same page with standards, so we can stop wasting time doing repetitive and costly tasks that were likely already done by another stakeholder. Standards help us get the data 'fit-for-purpose' when created, and keep it healthy and available to everyone when and how they need it."*

Committed and determined people can get a lot done, especially when they share a vision for a better future. Driving out regulatory data standards will add semantic clarity, common vocabularies and standardized nomenclature to workflows and processes. *"A framework built from common vocabularies, a robust model, and clear expectations about data content and quality will support efficient, repeatable, scalable process,"* Baird adds. Ultimately, the aim is to reduce the regulatory burden on industry, and reduce the costs for each regulator, as they don't have to invent their own data and information standards.

MacDougall brings his experience from previous PPDM work groups to the table. *"Success means that standards are created and adopted by regulators and industry. They need to be relevant and usable for all. If they don't seem pertinent or fail to show value to regulators and industry, they won't be used. The CWIS (Canadian Well Identification System) work group needed to develop a well thought out 'socialization' plan. A lot of work and discussion about needs and value happens in the work groups but the general public does not see all of this work; the benefits have to be clearly shown to all."*

Addressing the "brain drain" challenge facing industry as experienced data managers leave or retire is also important adds MacDougall. *"Many of our most experienced data managers are gate keepers in critical proprietary systems. If they leave the company, there is an operational risk that needs to be managed,"* he says. *"Standards adoption reduces this risk, and broadens the available pool of skilled resources".*

Broad adoption of useful standards is critical, particularly in an industry in the midst of technological development. Once an effective standard is developed and widely adopted, experts can move on to solve other pressing problems. Ducksbury hopes that the work of the Regulatory Data Standards Committee will achieve this result. *"I would like to see a higher level of standardisation of the terms used in petroleum data management internationally, and to some extent, a coming together of reporting standards and requirements. Even though I anticipate there will be remaining wide differences in terms of data availability and data usage between international jurisdictions, it would be nice to be speaking the same language."*

Snow points out that this will require a lot of industry participation and buy-in. *"There is a business value to creating regulatory standards, and getting as many groups to realize that value and implement the standards is a main factor toward achieving success,"* Boykiw agrees and adds: *"My accountability as VP of Information Services includes development and implementation of strategies to advance our information services capability. This committee and regulatory data standards are a fundamental component of the AER strategic Information Systems program."*

MacDougall is enthusiastic about the opportunities that regulatory data standards will offer data vendors. These companies have long served as intermediaries between regulators and operators. *"When the standards are adopted by more than one Regulator, integrating information will become easier. The quality (currency, correctness, consistency and completeness) of the information should be improved by data meeting the published standards. Quality is the core of a vendor's job. If this becomes easier because one of the sources of the information is better, then in the long run the vendor's job will become easier and concentration can be focused on other parts of the business."*

'Fix it, use it, and move on' is a common theme in standards development. Industry experts agree that if you can solve today's problem reasonably well (even if not perfectly), gains in efficiency allow the next level of problems to be tackled. The concept of Collective Action is important here. Collective Action is focussed on long term objectives. It recognizes that compromises need to be made in order to achieve strategic goals. While standards may not be perfect in everyone's eyes, the standards development process allows for continuous collective improvement.

From a strategic perspective, regulatory data standards offer industry powerful opportunities to keep oil and gas data useful, relevant and accessible to all of us. Getting there means we need to work collectively for the good of all. The Regulatory Data Standards Committee believes that this is not only possible, but necessary.

COMMITTEE MEMBERS

Boykiw, says, *"AER supports this initiative at the senior executive level, as do the other regulators involved. We want to call out to other regulators and interested operators to join us as we establish a standards framework that will add value to everyone."*

- Arthur Boykiw, Alberta Energy Regulator (Co-Chair)
- John Broderick, US Bureau of Land Management (Co-Chair)
- Floy Baird, Devon Canada
- Mark Ducksbury, National Offshore Petroleum Title Administrator
- Peter MacDougall, IHS Markit
- Alex Ross, Energy Resource Division, South Australia
- Thomas Schmidt, Saskatchewan Ministry of the Economy
- Mark Snow, Michigan DEQ
- Sean Udell, geoLOGIC systems

COMMUNITY

1991 - 2016
25 Years of Industry Service

MEMBERSHIP

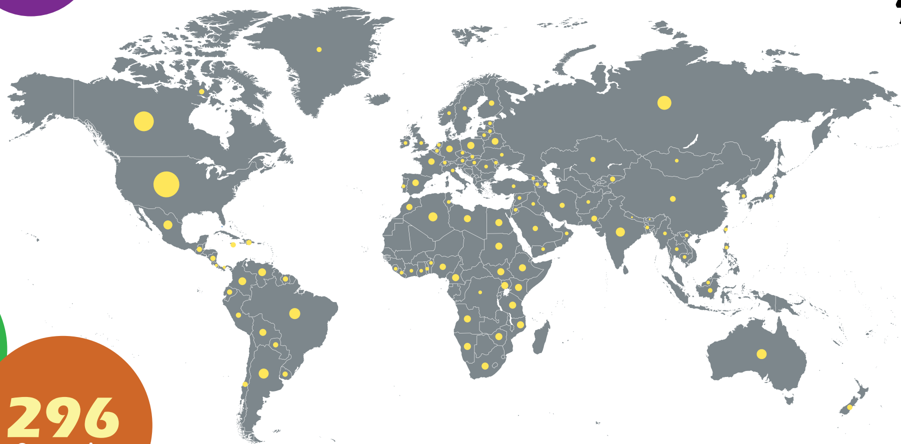
344 Students from 44+ Schools

77 Corporate Members

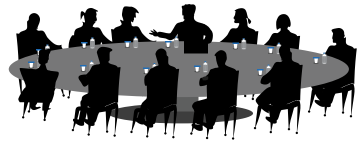
2114 Individual Members

50 Countries

296 Companies



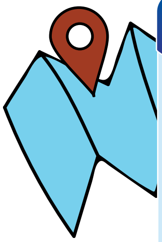
4820+ Followers



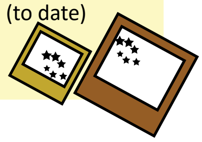
12 BOARD MEMBERS

The Professional Petroleum Data Management Association (PPDM) is the not for profit, global society that enables the development of professional data managers, engages them in community, and endorses a collective body of knowledge for data management across the oil and gas industry.

EVENTS & PUBLICATIONS



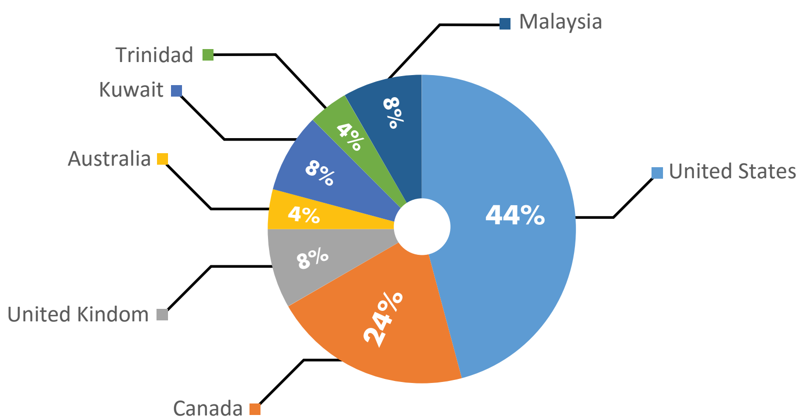
33	1769	6116	45
Events in 10 Cities LFY	Attendees LFY	Receive Foundations	Photo Contest Entries (to date)



PROFESSIONAL DEVELOPMENT

CERTIFICATION

CPDA™ Certified Globally



31+ CLASSES

2906 TRAINED (IN 5 YEARS)

TRAINING

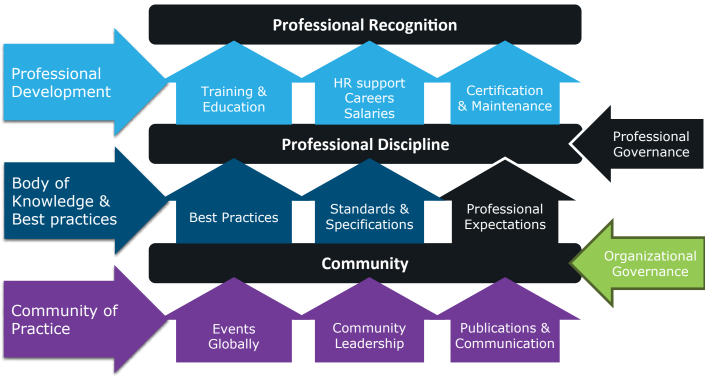
PPDM™

STANDARDS & BEST PRACTICES — 10

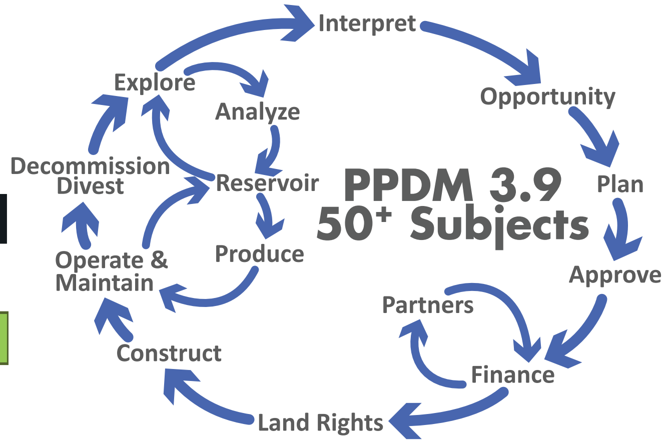
COMMITTEES & WORK GROUPS — 21

RULES — 3000+

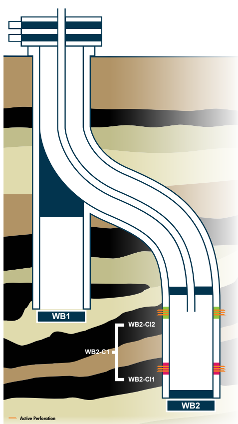
HOW TO BUILD A RECOGNIZED PROFESSION



DATA MODEL



WHAT IS A WELL



9 WIAW Components

WELL STATUS AND CLASSIFICATION

177 Status Values in **16** Well Status Facets

CLASSIFICATION

15 Taxonomy Facets

WELL IDENTIFICATION

7 Guiding Principles for Well Identification

2 Well Identification Standards

BODY OF KNOWLEDGE

Guest Editorial

Information Inequality

By Jim Crompton, Reflections Consulting

The phrase Income Inequality is fast becoming the buzzword of the **2016** US Presidential Election campaign, with candidates addressing this controversial subject in the run-up to the primaries. I do not want to go into politics but what about Information Inequality: the divide between the haves – companies such as Google, Facebook, and Amazon, who create and enjoy access to a treasure trove of valuable data – and, the have-nots? Which one are you?

If you are among "the 99%" to borrow a slogan from the political and economic debate, you have two ways of accessing data: pay for it, or surrender some of your personal information. Of course, you can attempt to compete with the 1% through experience or raw intuition, but, as in marketing and the stock market, having access to key information increases your chance of success.

Information inequality has consequences for the energy industry too. The digital oilfield is becoming more of a reality with each day but it certainly has not reached every oilfield. The increasing information intensity leads to opportunities on the one hand, but also to gaps between the haves and have-nots.

Consider the following examples of how the world's leading oil and gas operators are utilizing digital technologies to leverage the growing information intensity of exploration and production operations.

- In a North Sea trial, **BP** screened 5,000 wells and 250,000 km sq. 3D seismic datasets looking for an analog for the previously overlooked Vorlich discovery. Using big data analytics, this large data set was analyzed in just a few seconds.
- **Chevron** has equipped its Agbami platform (offshore Nigeria) with over 90,000 sensors including 1,500 sensors placed down hole in water injector wells with IWC, or Intelligent Well Completions. The production facility automation system is set up with three sec data sweep of plant and 15 sec sweep of reservoir measurements.
- At **Total's** scientific and technical center in Pau, France, computing power is now rated at 6.7 petaflops (a unit of computing speed equal to one thousand million floating-point operations per second). Along with raw compute power, Total is working on HPC architecture, languages and programming models, and new algorithms for depth imaging and reservoir simulation.

But having lots of data from the oil field doesn't guarantee that everyone has the access they need to make the best data-driven decisions. Even in the digital 1% companies there are many engineers living life in a 99% challenged world. In a sea of digital riches, due to data integration challenges, most engineers make critical decisions with very little data. Several industry studies have documented the amount of time it takes to get access to needed data. When I was a young earth scientist, the problem was that data I needed didn't exist. Today a young petroleum engineer knows that data exists but just can't find it.

The navigation of the data ecosystem is often too difficult. That leads to many engineers having to rely on experience, intuition and sometimes just a wild guess, in areas outside of their experience levels. When poor information access and unmanaged data foundations lead to lower productivity and poor insight into operations, the affect will be seen on the corporate bottom line.

So what is the answer? The focus should be on the challenge of access to data you already own? Developing an internal ecosystem that replicates the capabilities of traditional data management and the best of social media may provide a guide for internal data managers. What if you could have:

- **Networking:** A company version of **Facebook** to find their network connections, to answer their technical and business process questions, and to collaborate and share their work.
- **Learning Environment:** A company version of **YouTube** to go to for training and references when they want, not to schedule class room versions of training classes when the trainer wants.
- **Mobile infrastructure:** A company issued **smartphone and tablet,**

preferably the latest version on the market. Forget your company PC, no one wants them anymore.

- **Collaboration:** A company version of **Skype or FaceTime,** when we meet virtually, which will be most meetings, why can't they see you on their screen?
- **Data Discovery:** And most importantly, a company version of **Google** for their 'get my data button' as the enterprise search tool. Google has changed the way that most of us get data.

These lessons apply both to internal data access and external data publications. Many public agencies are beginning to make data more available to the public. Sites like **Fracfocus.gov** and the individual state oil and gas commissions have usable sites for getting access to valuable data about wells and fields.

Many operators will look at this digital oilfield vision and say they are well along the way to being there. These are the digital 1%ers. Others will say it is too expensive and they will never reach it. They are laggard 99%ers. My recommendations are as follows:

1) First recognize that data is a valuable asset.
2) Invest in the technologies and skills to manage data in today's Big Data environment.
3) Most importantly, create an efficient **data marketplace**, along with an efficient and intuitive, internet-based **delivery mechanism** internally for your engineers and operators, and externally for your customers and suppliers.

Information Inequality doesn't have to be a barrier to realizing value from your data but putting a focus on data is required to become an industry leader, a digital 1%er. F

About the Author

Jim retired from Chevron in 2013 after almost 37 years with a major international oil and gas company. After retiring, Jim established Reflections Data Consulting LLC to continue his work in the area of data management, standards and analytics for the exploration and production industry.

Thanks to our Volunteers

Martin Storey

Martin Storey is PPDM's Summer Volunteer of the Month. Based in Perth, Australia, Martin is the Director and Senior Consultant for Well Data Quality Assurance Pty Ltd, where he provides training and advice to oil and gas industry organizations to increase the quality and value of well data while lowering the costs of acquisition and exploitation. Concurrently, Martin is also an independent consulting petrophysicist and has been working for over 15 years through the company Meranti Consulting Services Pty Ltd for organizations such as Inpex, Total, Shell, Petroci, and AGR TRACS. Martin graduated from Caltech with an MSc in Electrical Engineering and holds a BSc in Math and Computer Sciences from Stanford University.

Martin has been working with the PPDM Association for many years, mostly recently providing guidance on the Perth DMS agenda and facilitating interactive discussions designed to help attendees learn useful skills. "Martin is always available for us to bounce ideas off, generate relevant activities for the Australian community, and help keep the data management community in Australia strong. We appreciate his ideas and continued interest, energy, and interaction with our stakeholders in growing PPDM," said Jess Kozman, PPDM's Asia Pacific Representative.

Siti Zubaidah Abu Bakar

Siti Zubaidah Abu Bakar, also known as Zubai, is our September Volunteer of the Month. One of PPDM's first Certified Petroleum Data Analysts (CPDA), Zubai has since decided to lend her experience to building the data management profession by joining the Professional Development Committee. Zubai currently works as an Exploration Database Specialist at Repsol Oil and Gas Limited Malaysia. Prior to joining Repsol, she worked as a Data Management Assistant with Murphy Oil after graduating from Universiti Teknologi Petronas with a Bachelor of Technology, Information Technology. Zubai is also the Assistant Secretary for the Technical Data Management Community of Practice, which was formed by Petronas, and has a variety of certificates.

"Zubai brings a new voice to our Professional Development Committee, working with the Training and Technical Development work stream. She is a pleasure to work with and always willing to lend a hand," says Ingrid Kristel, Project Manager, PPDM Association. "We look forward to seeing what Zubai and the Professional Development Committee build together in the coming months." F

Foundations photo contest

"PUMPJACK OIL WORKERS AT SUNRISE" BY ROGER MILLEY

2nd Place in the Volume 3, Issue 3 Foundations Photo Contest

"This image is a composite of 5 separate pieces, each photographed southwest of Joffre Alberta in Oct 2010. They are all assembled in one digital image in such a way as to suggest a moment of collaboration." – October 7, 2010

Roger Milley expanded his hobby of digital photography to include production of stock photos, primarily focused on oil and gas.

On the cover:

"ENERGY AND PERSISTENCE CONQUER ALL THINGS." BY VIKRANT LAKHANPAL

1st Place in the Volume 3, Issue 3 Foundations Photo Contest

"The industry is in one of its periodic downturns. If we look around, nature has all our answers. A river pays no attention to the obstacles. It doesn't stop, but carves its way out to its destination. Even the Colorado river, one of the mightiest, gets calm through its journey because it knows that there is no hurry and it will reach its destination one day. Now is the time to be diligent and even ruthless to find our way out through this downturn. The answers lie within. Just like a river has numerous branches, a data set has numerous interpretations and answers. The data can tell us what to do. It just needs a voice to become information and lead our way." – March 13, 2016. Vikrant Lakhanpal graduated from University of Houston in May with a Masters in Petroleum Engineering

Enter your favourite photos online at photocontest.ppdm.org for a chance to be featured on the cover of our next issue of *Foundations*!

SLC Corner

PODS Next Generation Update

PODS Next Generation

MOVING TOWARD A STANDARD & TRANSFORMED DATA MODEL

"PODS Next Generation is defining a standard that is easy to understand, simplified, rigorously documented and makes use of current technology. It is important for pipeline data consistency and interoperability. How PODS is implemented makes a difference. This is what we are working toward in PODS Next Generation."

– Peter Veenstra, Co-Chair of the PODS Next Generation Work Group and PODS Association Board member

PODS ASSOCIATION - BACKGROUND

The PODS Data Model is supported and maintained through the dynamic and collaborative PODS Association, consisting of over 170 member companies of Pipeline Operators and Service Providers who work together to continually advance the PODS Data Model. Since 1998, the PODS Association has provided pipeline operators with an enterprise database architecture that is comprehensive, open, vendor-neutral, highly-scalable, and proven. The PODS Data Model is recognized as the best practice integration platform for pipeline data and location information.

COMMITMENT TO PODS AS A STANDARD AND A TRANSFORMED DATA MODEL

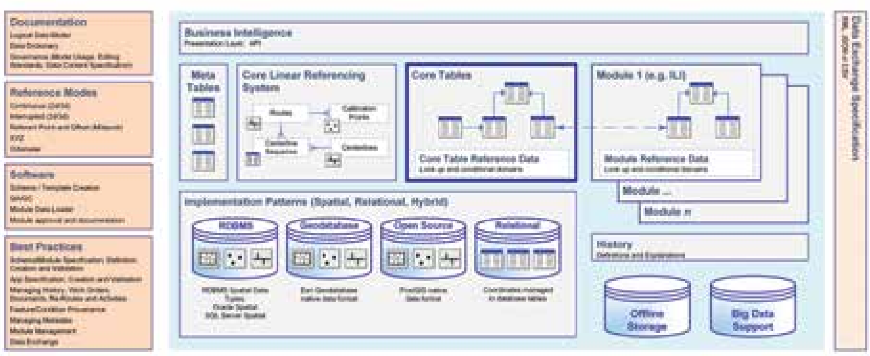
The PODS Board of Directors has chosen to transform the PODS Pipeline Data Standard, going forward. This directive came about after thorough consideration of lessons learned from PODS Association members using the Standard, the exponential growth of data, expanded regulatory reporting requirements (PHSMA and FERC), an increased call for support among international industry partners, and changes in relevant technologies.

NEXT GENERATION DEFINED

Establishing an industry-recognized core data model and stewarding open interchange specifications for data sharing and interoperability are two key goals of the PODS Association.

The next version of the Pipeline Data Model will not be another incremental release, but will be entirely restructured with major improvements and new approaches, as follows:

- **Re-engineered** PODS data model.
- **Defined set of core tables** primarily designed as the system of record for location of pipeline assets.
- **Clearly documented** to support the deployment of the model.
- **Interoperability and data sharing** enabled.
- **Enhanced standards** for governance and communication.



PODS Association

MISSION

Develop and advance global pipeline data standards to support efficient data management and reporting for the oil and gas industry.

VISION

To become the recognized global leader in pipeline data standards and best practices through collaboration with our member community and the development of pipeline data models designed with open specifications.

PROGRESS AND PHASE ONE

A team of industry professionals - data model experts, pipeline operators, and geographic information systems (GIS) software/service providers - have met for the past year to develop the Scope and Phase One implementation of the PODS Next Generation model.

Phase One defines the core tables in the model, including how linearly referenced data are managed, and most importantly, the data exchange specification. The specification provides the ability to validate the structure and content of a PODS data model, and provides the protocol for documenting and expanding the model. All tasks have been performed and documented using industry standards and widely accepted information modeling languages. The team delivered a proof-of-concept demonstration for the data model, data exchange specification and documentation at the 2016 Pipeline Week conference in September 2016.

BENEFITS OF NEXT GENERATION DATA STANDARDS TRANSFORMATION

- **Achieve greater agility to build and extend the data model,** responding to new business requirements.
- **Interoperate** through standard data models and consistent application interface.
- **Share data** within and between organizations using well defined data exchange specifications.
- **Intuitive framework** includes clear and concise guidance and specifications.
- **Well-defined rules** to document content, structure, and editing of data.
- **Performance optimized** for management of bulk loading, reroute, inspection data and history.

PODS NEXT GENERATION SCOPE

- **Core Tables** – tables required for managing core assets in a pipeline system.
- **Modules** – extensions to the core data model to meet specific business requirements.
- **Data Exchange Specification** –a standard data exchange mechanism using readily available and industry-accepted technologies including XML and/or JSON.
- **Linear Referencing Approaches** – several different systems including measure, station and milepost.
- **Location and Spatial Data Management** – vendor- and platform-neutral, ability to implement both with and without spatial (geographic) components.
- **Implementation Resources** – tools and services assist in understanding, implementing, extending, using and sustaining the Data Model.

ACHIEVING RESULTS

The PODS Next Generation effort has been primarily focused on rigorously defining the PODS data model as a standard. The effort includes reducing the size and complexity of the model, allowing for data model structure and content validation, detailed and easy-to-use documentation of the standard and the data exchange mechanism. The result: data can be transferred between different data models, pipeline operators, software and systems by using a coherent and detailed specification. The team has adopted different modeling methods and technologies to create what is the Next Generation of the PODS Standard and Data Model.

Visit the PODS Association at www.pods.org. ■

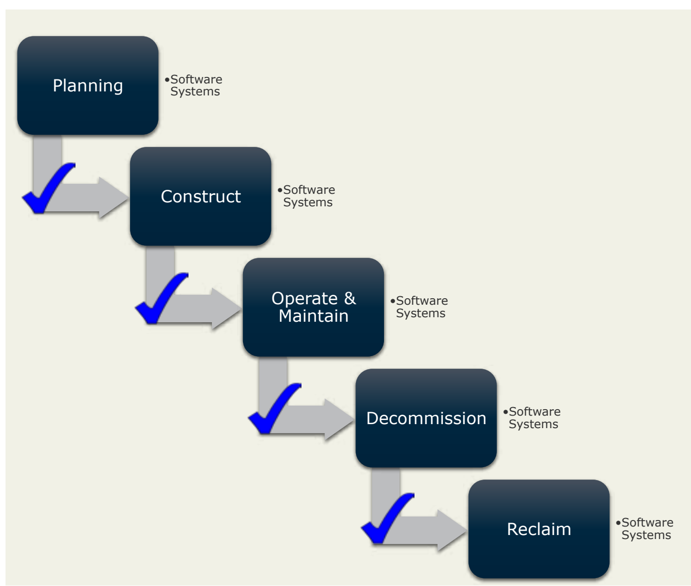
SLC Corner

Standards Interoperability Breaks Silos In Operating Facilities

By Gary Mintchell, The Manufacturing Connection

The problem in operating facilities no longer lies in getting data. Nor is there a problem with not enough IT and data standards. The problem remains that so much data resides in silos of applications and databases. These may all comply with one data standard or another, but those standards sometimes actually conflict with each other. The Internet of Things and

Interoperability of standards help unlock silos of critical data in transfers from system to system to aid decision making, decrease costs, and increase profits.



more powerful databases may provide floods of additional data, yet managers still are searching for information that will aid decision-making and improve performance.

In a word, the problem is lack of interoperability in both IT and systems.

John Palfrey and Urs Gasser, writing in *Interop: The Promise and Perils of Highly Interconnected Systems*, said, "Higher levels of interoperability can lead to systemic efficiencies. The greatest beneficiaries of interoperability are often business operations that use it to streamline their processes and manage costs."

SILOS

Owner/operators recognize that they are in a bind. Custom integration of data horizontally across the horizontal plant lifecycle does not work in the long run, not to mention its expense. They have turned to technology suppliers, but the solution requires a larger industry effort.

The figure on the left shows the problem of passing data from system to system. The problem is both **IT interoperability**—getting the data to flow, and **system-to-system interoperability**—getting the entire facility operations to work together.

The **OpenO&M Initiative** formed driven by this need for achieving interoperability among open standards that, at the same time, allows for use of Commercial Off The Shelf software and solutions from the various technology suppliers. Founding members included ISA (88 and 95 committees), MESA International, MIMOSA, and the OPC Foundation. Other organizations that joined in the work, include Fiatech, POSC Caesar, and Professional Petroleum Data Management Association.

The work has culminated in the **Open Industrial Interoperability Ecosystem (OIIE)**. This ecosystem explains how the various standards are used together to support systems, communications, and applications interoperability. Rather than a "rip-and-replace" attitude of other standards initiatives, OIIE has taken the approach of building upon existing standards and simply getting them to work together. It is estimated that about 80% of the work of moving data from silo to silo across production can be achieved with this methodology.

REDUCE CAPITAL AND OPERATING COSTS

Work proceeds to further develop the OIIE through a Use Case-based approach. These Use Cases are associated with Interoperability Scenarios that specify the systems involved, event triggers, data content, data formats, and exchange mechanisms that are required to meet the industry requirements. Use Cases are developed within the context of a representative business process. Importantly, the business process itself is not standardized by the OIIE. No attempt is made to require either proprietary application software or a plant's business process to conform to a standard.

The scenarios are intended to include sufficient detail to let them stand on their own as re-usable, interoperable building blocks, which can be implemented in COTS products.

Standardization allows industries to collectively reduce capital and operating costs as well as risks, because software required to support the OIIE can be written and, more importantly, maintained by software suppliers rather than owner/operators.

OGI PILOT DEMONSTRATES SUCCESS

So, does this actually work?

Twelve technology suppliers, universities, standards organizations, and owner/operators worked together to construct a pilot of a debutanizer project. **The Oil & Gas Interoperability (OGI) Pilot**— an instance of the **Open Industrial Interoperability Ecosystem (OIIE)**—showed the feasibility in action of a continuous handover from design to operation and maintenance of a debutanizer. The fully functioning software system was demonstrated live over the Web from the ISA Automation Conference Sept. 25-26, 2012.

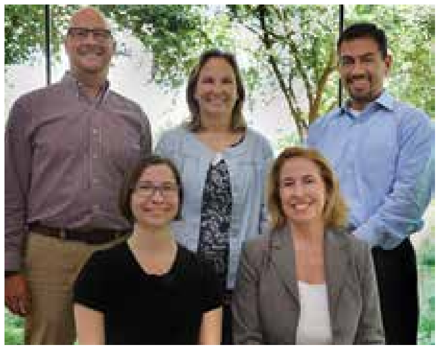
The OGI Pilot environment continues to be updated with more data sets and scenarios to more fully represent a real capital asset flowing through its entire life-cycle. Owner/operator specific proofs of concept have also been successful as they prepare to move to production implementations. Most of those items can be added on an incremental basis, while the baseline OIIE is already functional. The core specifications will be updated periodically as IT evolves, but the OIIE provides a rational alternative to the status quo, which can be implemented in production environments in 2016.

Owner/operators involved in the project have already found value in the work. Work continues to expand the scenarios, identify new projects to prototype the scenarios, and demonstrate success. The work encompasses asset integrity management and operational risk management.

Guest Editorial

Hands On With The PPDM Association Board Of Directors

By Paloma Urbano, ConocoPhillips



Top left to right: Ray Wall, Chris Ring, Raul Lema. Bottom left to right: Ann Clark, Paloma Urbano

Almost every week I hear of how we use the PPDM Association. Yesterday, we got the news that one of our colleagues passed the PPDM certification; last week, that one of our systems is now running with the latest PPDM data model; and, a couple of weeks ago, that an employee joined the PPDM Professional Development Committee.

Are these developments supporting the fact that PPDM is important for Oil & Gas operators like us?

I joined the PPDM Board two years ago, and my biggest discovery was that PPDM is much more than the PPDM Data Model or a Canadian standards association. I feel that the message is sinking in that PPDM is a leading Data Management Professional Association for our industry!

This made me wonder how my peers and colleagues see PPDM, so I decided to reach out to some of them for input.

In talking with Ray Wall, our Global Chief for E&P Technical Data, he explains that **networking** is most important for him – not just for the social aspect but for building relationships with other companies, understanding common issues, and sharing learnings. Ray said, "It expands your problem-solving capabilities because you can pick up the phone and call other companies for ideas."

"Designating a 'well' can be a challenge in a large company with multiple types of assets and interests," said Raul Lema, Supervisor of Wells Integrated Performance. "PPDM's 'What is a Well' facilitates communication between subsurface, drilling, completions and production as we work to leverage our information across functions." He believes that **standard terminology** is key to streamlining our business and enabling value-added decision-making.

"The **PPDM Data Model** is used as the starting point for some of our solutions; however, for strategic reasons we want to see suppliers adopt it in the solutions we purchase," said Chris Ring, GGRE IT Manager. "It gives us the security that their solutions are constructed in a sustainable and open style that follows the industry best practices," she explained.

Ann Clark, Business Analyst, joined the PPDM **Professional Development Committee**. "I want to learn how decisions are made at a high level, and gain project and committee experience," she said. Another goal in joining the group was to expand her personal data management network and learn more about the industry from various companies' perspectives.

From their comments, I was pleased to see that our people have a broad understanding of what PPDM has to offer, as well as how we are contributing and getting the benefit out of their products.

Being a Board member is a balancing act of supporting the PPDM's ongoing traditional initiatives such as the PPDM Data Model, while challenging the Association to progress and meet the ever-changing needs of the industry. For me, participating on the Board offers the unique opportunity to:

- provide perspective from a large exploration and production operator
- highlight the areas where PPDM adds value for our company
- contribute to PPDM's strategic direction

It is the diversity of the PPDM Board and its members that helps the organization with its vision, leadership and accomplishments.

In looking at where we would like to see the PPDM Association focus its efforts, we think PPDM is going in the right direction. As operators, it is important for us that PPDM continues to show leadership in:

- expanding its global presence with PPDM chapters and active network of data management professionals;
- influencing regulators to adopt data consistency and standards;
- consolidating the data management body of knowledge and professional discipline;
- creating practical data management best practices that can be easily adopted, and commercial solutions that accelerate our operations; and,
- driving consistency between Oil & Gas Standards Organizations.

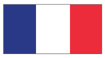
I hope I was able to illustrate that the PPDM Association has a lot to offer to the Oil & Gas Data Management industry, and that it is up to the PPDM members and its Board to continue making it a success!

About the Author

Paloma Urbano is the IT Director, E&P Data Management Portfolio & Strategy with ConocoPhillips.







More on ontologies and databases: modeling wholes and substances

By Mara Abel, Joel Carbonera, Michel Perrin, Luan Fonseca Garcia

When designing corporate databases, data managers aim to model information that is accessed often and needed by many users, and reflects the business view over the domain of activities. Nevertheless, most databases are in fact designed to support particular software applications, instead of supporting the information needs of all users. As a result, information tends to be application centric and can't be easily shared among the community that must further use the data.

In order to attend the requirements of business, a data model should support tasks and behave as a design pattern to communicate between different data formats. To achieve this goal, it should capture the simplest shared view of the information in the domain. The model would set up an organized structure that can define and distribute a common definition of each data object, based on its attributes and relationships that can be shared inside a community of practice. This consensual view allows many applications and professionals to access data and reduce the need for performing data model transformation, when diverse applications refer to the same data model.

However, a shared common view over the data is hardly ever achieved, since several modelers looking at the same domain will produce quite different representations of the same entities. In order to be consensual, a data model should refer to the same set of existent entities, such as things, events, relations and characteristics of things, specified as concepts in a representation based in an agreed-upon vocabulary and semantics.

The main difficulty in achieving a common view is to make clear that a certain word used by a modeler (for example, reservoir) is used with the same meaning by every other user that retrieves the associated information. What, exactly, is a reservoir? A "*defined volume of rock with high level of porosity and permeability,*" "*any porous media made of rock,*" or even "*a particular rock unit that contains petroleum in economic quantities?*" Although the three definitions can easily characterize reservoir entities in the existent E&P database models, they, in fact, correspond to three completely different ontological categories of entities that can't be properly integrated.

Ontology is the study of the nature of existence, and the kinds (or categories) of things that exist (Guarino et al., 2009). A formal ontology is the logical theory that helps to restrain the models according to the way in which semantic (meaning), vocabulary and structure (organization) of models commits to the shared knowledge (ie: they anchor in the same entities of reality). This theory offers a homogenous, problem-independent perspective to analyze the domain, identifying essential concepts and constraints that lead to more uniform and compact conceptual models for information systems that approximates the views of different modelers. In practice, formal ontology can be intended as the theory of a *priori* distinctions among the entities of the world (physical objects, events, regions, quantities of matter), and among the meta-level categories used to model the world (concepts, properties, qualities, states, roles, parts...) (Guarino, 1995).

The ontological analysis of a domain (or of a legacy data model) does not depend on the syntactical choices of its representation (such as choosing OWL, ER or UML), but it distinguishes the entities of the model and classifies them in one of the meta-level categories to determine their ontological nature. It allows verification that two entities modeled with the same name in different models correspond with the same intended concept, according to the view of the two modelers; thus, their descriptions and instances can be integrated. We raise some ontological properties to identify entities that have independent existence (such as a *volcano*); entities that are dependent on one other entity or relation (such as, the *extrusion* of the volcano or the *trap* of a reservoir); entities that are

Domain: *A limited set of activities under analysis.*
Entity: *Types that classify the instances of the domain or every thing that exists.*
Ontology: *The study of the nature of existence and the kinds (or categories) of things that exist.*
Formal ontology: *A logical theory that helps to restrain the models according to the way in which semantic (meaning), vocabulary and structure (organization) of models commits to the shared knowledge.*
Rigidity: *A property of the entity that is essential for all its instances.*
Dependence: *A property of an entity that only exists if the instance of another entity also exists.*
Identity: *Criterion that allows recognized instances that were seen in different places and time as being the same individual.*
Unity: *The property of some entity of having whole individuals as instances.*

dependent on two other entities (like an *unconformity* or a layer *contact*); or entities that happen in time (like an *earthquake* or a *turbidity current*). Each meta-category orients the best way in which these entities should be represented in a model and highlights the inconsistencies between entity representations.

Previously, we have discussed the metaproperties of *rigidity* and *dependence* and how these criteria affect the way in which we model entities in data models ("Ontologies and Data Models" Foundations Volume 3, Issue 1.) We say that a property is *rigid* when it is essential to all its instances (Guarino and Welty, 2000). Rigid properties are the ones that help to track instances among different models. Dependence identifies entities whose existence is dependent on other (rigid) entities. Typically, entities like *client*, *employee* or a *pet* are dependent ones, since, in order for a client to exist, it needs a person who purchases something from an existent company; an employee can only exist if there is a person who has a relationship of being employed in an existent company; and a pet requires an animal and a person who looks after it. A *prospect* is a dependent entity that requires a region and an exploration company to exist. Every entity in the above examples are dependent on the relationship with some other entity in order to exist.

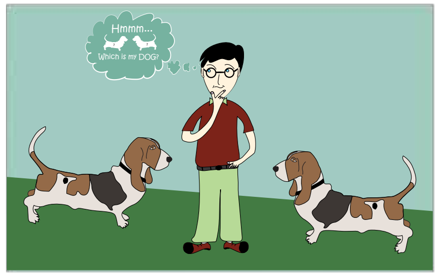
We will consider here two additional ontological properties of particular interest for Earth Science: *identity* and *unity* (Guarino and Welty, 2001). Our experience shows that most discussions in developing data models for Petroleum Geology are based on individual interpretation of these properties (Abel et al., 2015).

Identity refers to criteria applied to determine whether a particular entity that exists at a given time (or in a given place) is the same as one that that exists at an another time (or in another place) (Hirsch, 1982). How can we know that a puppy that we had at home years ago is the same big dog that we have now, since we know that their descriptive qualities (size, color, behavior) are different?

To answer this question we must first recognize the individual entity, puppy or dog, as a distinct *whole* (i.e. recognize all the parts that form the individual). Then we must establish some kind of continuity between these two individual through space and time. Simply put, we need to determine what "*is*" my dog and what "*is not*" my dog. For example, the collar on the neck of my dog is not a part of my dog. So we should not care whether this collar is present or not, in order to determine the identity of my dog. Next, we need to keep track of changes of the original dog, in order to be sure that it is the same dog and that it has not been replaced by some other dog.

Otherwise, for some meta-categories of entities, their instances are not wholes and require the instance of another entity to be individualized. The entities *water* or *wood* are amounts of matter individualized by a glass or a lake in the case of water, or a board for the wood. The *unity* property identifies if an aggregate of matter that instantiates a particular entity is a unitary individual or not, and what are its boundaries. Determining if a succession of snapshots corresponds to stages in the life cycle of a single persisting instance of an entity is the problem of defining the *identity* property of that entity. Identity and unity are determined by the analysis of spatiotemporal and qualitative continuity, the same properties applied for geological correlation.

Some properties pertain to wholes, while others do not. For example, the concepts *salt dome* or *fault* determine whole instances that preserve unity, and they can be identified by their presence inside their boundaries. If we take half of a salt dome, we will not have a salt dome, but a salt dome part. Conversely, the concepts *oil*, *water* or *rock* do not have wholes as instances, since an instance



of *amount of water* can be divided into as many instances of amount of water that we wish without the water losing its identity of being water. Every portion will preserve the essential qualities that provide identity to water, no matter what division is operated. Two pieces of rock that originate from the same homogeneous rock body will constitute *two* instances of *pieces* (or *samples*), but *one* instance of *rock* (in this case, scattered in two pieces). This peculiar way of looking to reality is important because the *sample* doesn't define the identity of the rock entity, but its intrinsic petrological properties (composition, texture and genesis). Otherwise, to determine the identity of a *sample* we need to consider its spatial properties, like size, shape, etc.

All this philosophical discussion is very relevant for modeling geological objects and for information integration, especially because the entities modeled in geological systems and databases (for example, bodies of rocks or faults), cannot be observed directly as wholes. In the course of geological exploration, they result from the interpretation of geophysical survey data (seismic or well log registrations) or from partial samplings (cores and rock samples). Determining the spatio-temporal correspondence of the modeled geological entities is thus the primary goal of data integration.

Many conceptual models in Petroleum Exploration mix the representation of wholes and of amounts of matter, making difficult to map modeled entities between models based on their qualities. Let's

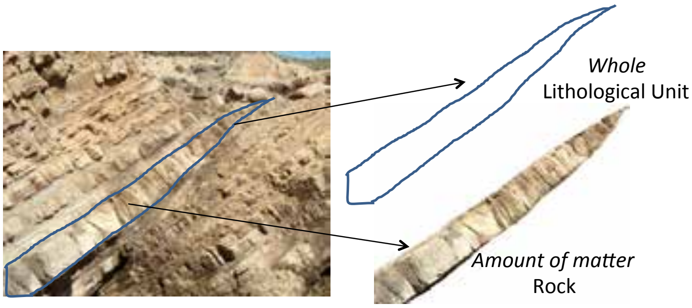


Figure 1. Wholes and amounts of matter have their own ontological properties and should be modeled as separated entities, whose instances are co-located in the space. This philosophical perspective facilitates both the integration of models and the extrapolation of qualities of geological entities.

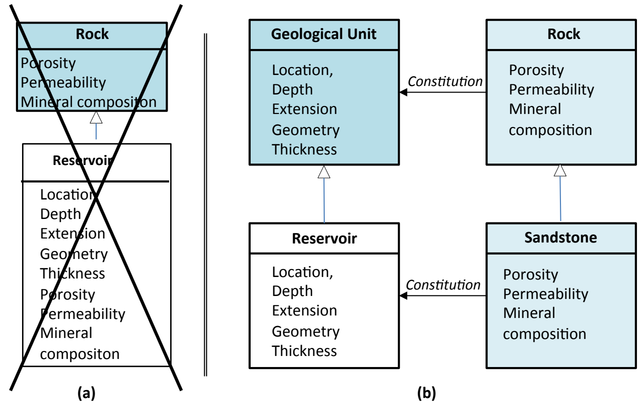


Figure 2: (a) shows an inaccurate model of a reservoir. The identity property of the subclass is not compatible with the identity of the upper class. In (b) we see a more plausible model according to the ontological properties of Rock, Geological Unit and Reservoir.

consider, for example, a geological unit which (locally) plays the role of a reservoir. The unit is the whole that defines the boundary (acts as the container) of the amount of matter of which the unit is made. We have, in this case, an instance of rock and an instance of geological unit co-located in space (see Figure 1). It is necessary to carefully distinguish between these two types of instances.

Several relevant qualities of the reservoir (such as its location, extension, shape, thickness and depth), are related to the geometry and structural position of the geological unit, which can be determined without considering the amount of matter inside it. However, some other qualities (like porosity, permeability or mineralogical composition), are related to the rock itself.

This distinction is relevant because if we take a piece of a lithologically homogeneous geological unit, we cannot determine any of the qualities of the unit as a whole, such as size, weight or shape. However, if we take a piece of a rock, we can obtain all the qualities of this entity, since each piece of an amount of matter preserves the identity of the original entity as an amount of matter and its ontological qualities. Simply, once we know that different occurrences of an entity that do not preserve unity are the same individual, we can extrapolate the qualities of one of the occurrences to the other occurrences. However, keep in mind that we cannot do the same thing with qualities that belong to wholes. For example, size, weight or shape of a geological unit cannot be extrapolated to its portions.

If we follow what we learnt in ontological analysis, we separately model rigid entities that represent amounts of matter (entities that do not preserve unity) from rigid entities that represent the wholes (and define the particular spatial boundaries of the matter).

By combining several samplings of parts of a whole, we determine the quality attributes of this whole. We can, for instance, calculate the volume of a reservoir by considering several seismic sections that show parts of the whole geological unit. Conversely, the quality attributes of an amount of homogeneous matter (petrological properties, oil properties, chemical composition) can be directly assumed by the other occurrences of the same entity.

This approach avoids producing some implausible models, such as Figure 2 (a), where *Reservoir* is modeled as a sub-class of *Rock*. This is not correct, because Reservoir and Rock show incompatible identity criteria. Figure 2 (b) shows a preferable model for these concepts following this ontological interpretation. The concepts in the thick letters in the dark blue boxes are rigid wholes; the concepts in the thin letters in the light blue boxes show non-unity, while the white box represents a non-rigid concept, a *role*. The relation between the amount of matter and its containers were defined as *constituted-by* in (Guarino et al., 2009).

The importance of a common shared data model is particularly evident in integration processes where modeled entities are shared between different information system platforms. We summarize above a perspective of conceptual modeling that helps to create the canonical model with an application- and observer-independent view. We propose some guidelines for the development of geological information models:

- Rigid entities should provide the framework of the model, from which every other entity should be related and derived;

- Properties that do not provide proper ontological identity to their instances (such as roles) should specialize a rigid property that provides them identity. For example, reservoir (role) should specialize a geological unit (rigid);
- Physical objects from which we want to extract quality attributes should be modeled as two entities: one that carries qualities of the whole (spatial qualities), such as *location, depth, extension, geometry* and *thickness* for geological unit, and another one that carries the qualities of the stuff (internal qualities of the amount of matter), such as porosity, permeability and mineral composition for a rock.
- A property that provides unity to its instances (wholes) should only derive by specialization other properties that also provide unity (Guarino et al., 2009). In the same sense, entities that do not provide unity should only derive by specialization other entities that do not provide unity. This means that the entity *Rock* can have *Sandstone* as a specialization, but cannot have *Reservoir unit* as a specialization, since the *Reservoir unit* provides unity and *Rock* doesn't.

We have described here how simple ontological properties can guide the definition of conceptual models designed to achieve integration and interoperability. For simplicity, we have discussed only the modeling of physical objects. Further analysis should cover abstract objects and their representations. This perspective produces a generalized data format to present/define data that makes it simple to share data among multiple applications, tasks and user profiles. ■

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LUNCHEONS

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BRISBANE Q4 DATA MANAGEMENT LUNCHEON
Brisbane, QLD, Australia

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PERTH Q4 DATA MANAGEMENT LUNCHEON
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NOVEMBER 9, 2016
OKLAHOMA CITY Q4 DATA MANAGEMENT LUNCHEON
Oklahoma City, OK, USA

NOVEMBER 17, 2016
TULSA Q4 DATA MANAGEMENT LUNCHEON
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DECEMBER 6, 2016
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MIDLAND Q1 DATA MANAGEMENT LUNCHEON
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FEBRUARY 14, 2017
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OCTOBER 24-26, 2016
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Calgary, AB, Canada

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Houston, TX, USA

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NOVEMBER 2, 2016
CPDA EXAM
(Application Deadline September 21, 2016)

MAY 10, 2017
CPDA EXAM
(Application Deadline March 29, 2017)

NOVEMBER 8, 2017
CPDA EXAM
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