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What is a Well? A Practical Implementation

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1. Introduction

The North American oil and gas industry is undergoing a step change that is being driven by tremendous technical advances in the development of unconventional plays. Huge numbers of wells are being drilled and completed with ever increasing complexity while the Well lifecycle from planning through to production is being compressed.

Easy access to integrated data across the full Well lifecycle is a critical success factor for E&P companies. Different people and groups within a company create and consume data at different levels in the Well Hierarchy depending upon their role. For example:

- A landman may be primarily interested in the surface location of a Well
- A reservoir engineer will be concerned with the Wellbore and the producing formation
- Drilling and completions engineers care about the Wellbore, Completions and Perforations
- The production accountant has to deal with all levels of the Well Hierarchy depending upon internal and regulatory reporting requirements

Consistent integration of this data demands the ability to uniquely identify and relate a Well and all of the Components of a Well consistently across the Well lifecycle. The resulting Well Hierarchy can then be used to present a business view of the Well structure to the organization and to link critical information across enterprise data stores to enhance workflow collaboration, reduce errors, and increase efficiency.

The PPDM 'What is a Well?' and Well Identification standards provide the foundation to establish a comprehensive Well Hierarchy and achieve the level of lifecycle integration necessary to meet the evolving needs of the business. These standards are gaining acceptance across industry as an important communications vehicle. Their ultimate value, however, is realized through implementation within a corporate Well Master database and as a foundation for a Master Data Management (MDM) solution.

This paper details a practical approach to implementing the 'What is a Well?' and Well Identification standards to establish a Well Hierarchy within a Corporate Well Master and MDM solution. The examples included are based upon solutions delivered to large independent oil and gas companies through EnergyIQ's commercially available Trusted Data management (TDM) software.

2. Supporting Information

The Well Hierarchy is the relationship between those Components of a Well that are uniquely identified. This section provides background information relating to the four primary processes that are involved in building the Well Hierarchy:

- Well Identification
- Well Matching
- Aggregation
- Blending

When we think of the Well Hierarchy, typically we think of the Well or the Well Origin, the Wellbore, and Completions within a Wellbore. However, there can be other Components that are uniquely identified including Perforations (Contact Interval), Reporting Streams and Wellbore Segments.

The level in the Well Hierarchy refers to the position of the Well Component relative to the other Components of a Well. For example, it would generally be considered that a Completion would be at a lower level than a Wellbore while a Well would be at a higher level in the Well Hierarchy than a Wellbore or a Completion.

2.1. Well Identification

The PPDM 'What is a Well?' initiative was designed to provide a baseline set of definitions and relationships for a Well and the Components of a Well that information is typically attached to. The definitions were established by a consortium of both large and small oil and gas companies along with service providers; see **Figure 2.1**.

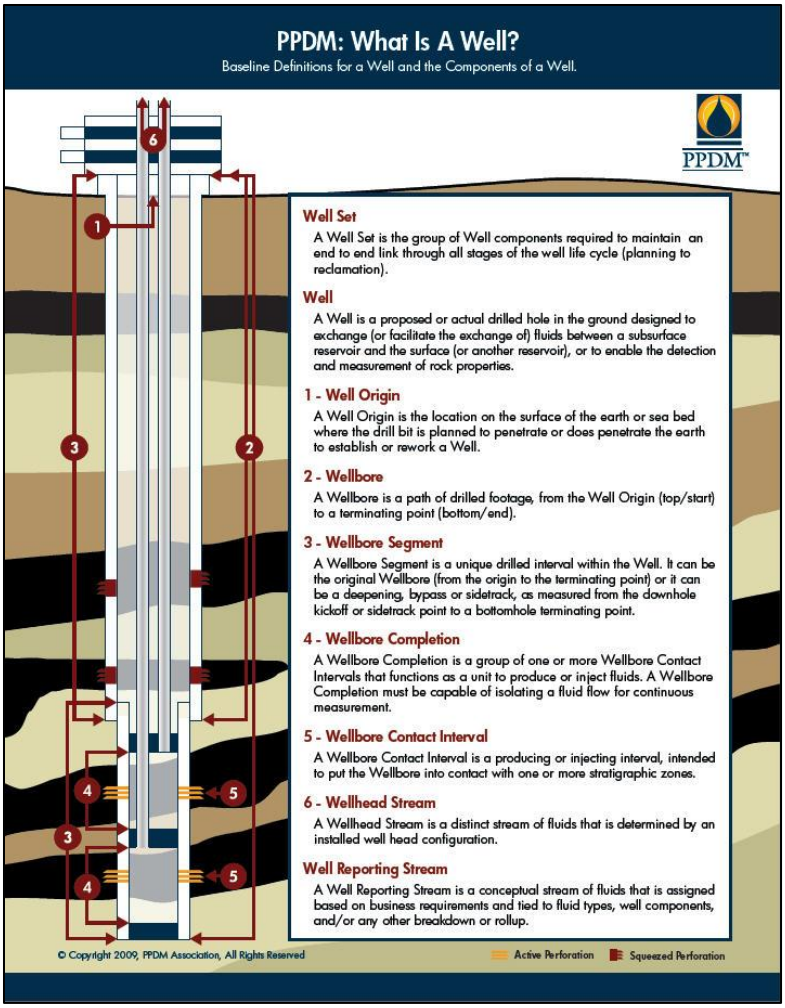


Figure 2.1: What is a Well?

These definitions are gaining wide acceptance across industry as they enable companies to establish a platform for communications and build a framework for data integration.

Following on from the 'What is a Well?' standards, the PPDM Association also established a set of guiding principles for building a framework for Identification of the Well and Components:

Framework Guiding Principle 1: A Well Identification System must be capable of assigning an identifier to every Well Origin, Wellbore, or Wellbore Completion in its scope.

Framework Guiding Principle 2: All identifiers assigned by a Well Identification System must be permanent.

Framework Guiding Principle 3: All identifiers assigned by a Well Identification System must be unique within that system.

Framework Guiding Principle 4: A Well Identification System must relate every identified Wellbore to the Well Origin where it begins

Framework Guiding Principle 5: A Well Identification System must relate every identified Wellbore Completion to the Well Origin and/or Wellbore(s) from which it was created.

Framework Guiding Principle 6: The Global Framework must define the information required for each part of the Well Identification System.

Framework Guiding Principle 7: Each part of the Well Identification System must have an identified owner (Authority) and documented processes for the management of change.

Working with a consortium of operating companies, EnergyIQ has adopted the PPDM 'What is a Well?' definitions and these guiding principles to generate a system for enterprise Well Identification, also known as the EKey:

- Each Well and Well Component will be assigned a system generated surrogate key known as the EKey. The EKey will be comprised of two parts; a sequential number to identify the Well (Origin) and an additional suffix to identify all of the Well Components
- This identifier will never change over the life of the Well or Well Component (even after abandonment) and will never be re-used
- The WELL_LEVEL_TYPE attribute in the WELL table will be used to identify the Well Component
- The WELL_ALIAS table will be used to maintain the EKey and the original identifier(s)
- The WELL_XREF table will be used to track relationships between the Well and the Well Components

EKey	WELL_LEVEL_TYPE
10001234	WELL
10001234-000	WELLBORE
10001234-001	WELLBORE
10001234-002	COMPLETION
10001234-003	WELLBORE
10001234-004	COMPLETION

Table 2.1: Surrogate Key

The two part structure of the EKey and the relationship between the Well identifier and the Component identifier is what is important rather than the physical length of each section. **Table 2.1** illustrates a common structure that has been implemented at a number of large independent oil and gas companies:

- The first part of the EKey is a system generated unique 8 digit number starting at 10,000,000 to avoid stripping leading 0's.
- The second part of the EKey is a 3 digit sequential number (starting at 000) that identifies a Component of the Well (Wellbore, Completion, Perforation etc).

Beyond the fact that it identifies a Component of a Well, there is no implied intelligence in the Component extension. Neither the value nor the order of the number should be interpreted as having any significance.

2.2. Well Matching

A key part of building the Well Hierarchy is the ability to load and blend data from multiple sources. As data is loaded from different sources, Well Matching becomes increasingly important to ensure that the correct EKey is assigned to the right record. To add a Wellbore to the Well Hierarchy, for example, it is necessary to determine whether the same Wellbore already exists within the database:

- If this is the case then the same EKey would be assigned
- If not, then it is necessary to determine whether the parent Well has already been defined, in which case the same 8 digit prefix would be assigned with the next Component extension in sequence
- If not, then a new 8 digit Well prefix would be assigned with the Component extension of '000' to identify the Wellbore

To meet these requirements, the Well Matching routines need to be able to support:

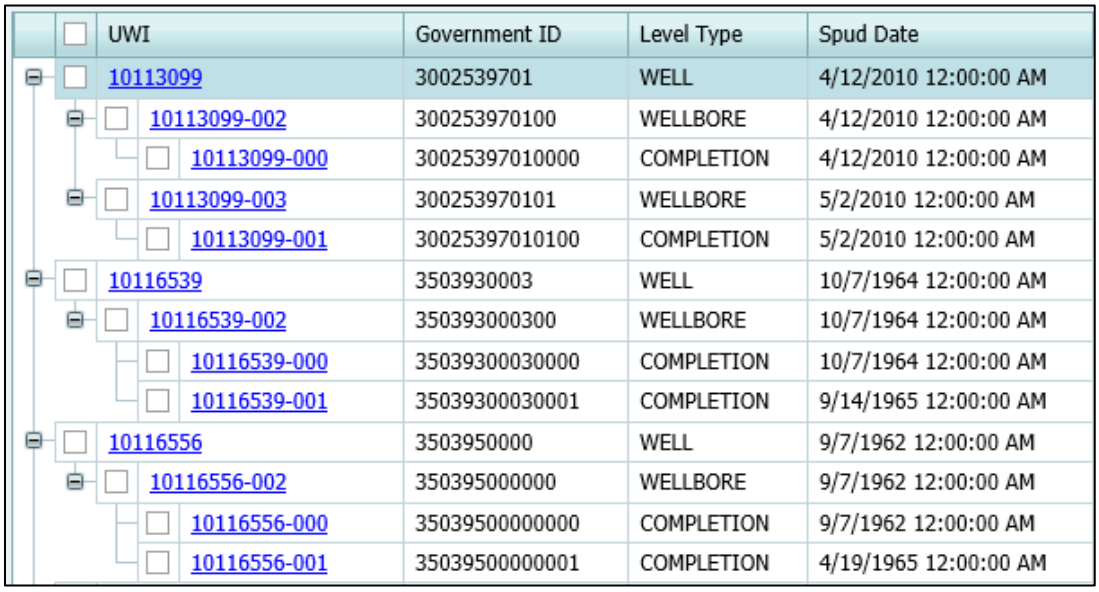
- A set of configurable parameters for matching
- Tolerances e.g. surface location within 5 feet
- Weighting of the matching parameters
- Match percentages e.g. 5 parameters out of 8 meet the match criteria therefore there is a 70% match (after weighting)
- Thresholds to define whether Wells match or not

Well Matching is not an exact science and so it is important to maintain an audit history along with the corresponding tools to be able to review and iteratively improve the matching process over time.

2.3. Aggregation

Aggregation involves the creation of a record at a higher level in the Well Hierarchy from one or more from records at an immediately lower level in the Well Hierarchy. An example of records that have been aggregated to create a full Well Hierarchy is illustrated in **Figure**

2.2. In this case, Completion level records have been Aggregated to create Wellbore records which, in turn, have been Aggregated to create Well level records.



UWI	Government ID	Level Type	Spud Date
10113099	3002539701	WELL	4/12/2010 12:00:00 AM
10113099-002	300253970100	WELLBORE	4/12/2010 12:00:00 AM
10113099-000	30025397010000	COMPLETION	4/12/2010 12:00:00 AM
10113099-003	300253970101	WELLBORE	5/2/2010 12:00:00 AM
10113099-001	30025397010100	COMPLETION	5/2/2010 12:00:00 AM
10116539	3503930003	WELL	10/7/1964 12:00:00 AM
10116539-002	350393000300	WELLBORE	10/7/1964 12:00:00 AM
10116539-000	35039300030000	COMPLETION	10/7/1964 12:00:00 AM
10116539-001	35039300030001	COMPLETION	9/14/1965 12:00:00 AM
10116556	3503950000	WELL	9/7/1962 12:00:00 AM
10116556-002	350395000000	WELLBORE	9/7/1962 12:00:00 AM
10116556-000	35039500000000	COMPLETION	9/7/1962 12:00:00 AM
10116556-001	35039500000001	COMPLETION	4/19/1965 12:00:00 AM

Figure 2.2: Well Hierarchy Aggregation

Aggregation depends upon a set of business rules that determine which attributes will be promoted to the higher level record from the lower level records. By way of illustration, a simple set of Aggregation Rules is included in **Table 2.2** to promote attributes from multiple Completion records to a single Wellbore record (and Wellbore to Well) based upon a comparison between key fields such as Spud Date or Deepest Depth. In some cases, more complex rules are required based upon a comparison of multiple fields and if-then-else logic.

WELL_ATTRIBUTE	Completion to Wellbore Rule	Wellbore to Well Rule
UWI	Sequence/Calculated	Sequence/Calculated
ABANDONMENT_DATE	MIN(SPUD_DATE)	MIN(SPUD_DATE)
ACTIVE_IND	MAX(COMPLETION_DATE)	MAX(COMPLETION_DATE)
ASSIGNED_FIELD	MIN(SPUD_DATE)	MIN(SPUD_DATE)
BASE_NODE_ID	MAX(DEEPEST_DEPTH)	MAX(DEEPEST_DEPTH)
BOTTOM_HOLE_LATITUDE	MAX(DEEPEST_DEPTH)	MAX(DEEPEST_DEPTH)
BOTTOM_HOLE_LONGITUDE	MAX(DEEPEST_DEPTH)	MAX(DEEPEST_DEPTH)
CASING_FLANGE_ELEV	MIN(SPUD_DATE)	MIN(SPUD_DATE)
CASING_FLANGE_ELEV_OUOM	MIN(SPUD_DATE)	MIN(SPUD_DATE)
COMPLETION_DATE	MAX(COMPLETION_DATE)	MAX(COMPLETION_DATE)
CONFIDENTIAL_DATE	MIN(SPUD_DATE)	MIN(SPUD_DATE)

Table 2.2: Sample Aggregation Rules

Aggregation can become a complex process when it is considered that data can already exist at various levels within the Well Hierarchy from different sources and this must be factored into the processes.

2.4. Blending

Blending is the process of creating a single, most trusted record at a given level in the Well Hierarchy from two or more records at the same level in the Well Hierarchy from different sources. **Figure 2.3** illustrates multiple sources of Well Header records that have been Blended to create a most trusted version for consumption by the organization.

	Well	Well Version #1	Well Version #2	Well Version #4	Well Version #5
Last Changed					
By	COMPOSITE	scooper	scooper	scooper	MASTER_PIDM
Date	COMPOSITE	2/20/2014 10:56:00 AM	3/20/2014 2:22:46 PM	12/13/2013 7:07:23 AM	8/24/2011 12:00:00 AM
Identifiers					
UWI	10113148-000	10113148-000	10113148-000	10113148-000	10113148-000
Source	COMPOSITE	CORP MASTER	CORP EMPLOYEE	ENERGYIQ	PETROLEUM INFORMATION
Well Level	COMPLETION	COMPLETION	COMPLETION	COMPLETION	COMPLETION
Government Id	49013052000000				49013052000000
Operator	DEVON ENERGY CORPORATION	DEVON ENERGY CORPORATION	COOPER OIL & GAS		SINCLAIR OIL & GAS COMPAN...
Well Name	UNIT #4	UNIT #4	Unit No 4	UNIT #4	UNIT
Well Number	5	5	4		3
Plot Name	Test Well No 1	Test Well No 1	Test Well #1		
Plot Symbol	PRODUCER - OIL				PRODUCER - OIL
Profile	HORIZONTAL PROFILE	HORIZONTAL PROFILE			VERTICAL PROFILE
Lease Name	GREEN RIVER	GREEN RIVER	BLUE RIVER	MESA VERDE	UNIT
Lease Number	Mesa 1234		Mesa 1234	2891-A	2891
Event Number					

Figure 2.3: Multi-Source Record Blending

The Blending Rules are typically built around the source of the data. Each source of data within the database is assigned a priority and, during the Blending process, the first not null attribute is promoted to the trusted version based upon source priority. This is illustrated in **Figure 2.3** where the versions are displayed from left to right in order of descending priority. The blue boxes reflect those attributes that have been promoted to the trusted version.

The Blending Rules can be applied at an individual attribute or at a record level and they can vary by region according to the available data and the preferences of different asset teams. **Figure 2.4** illustrates a Source Preference List for a subset of attributes within the Well Version table (PPDM data model) that establishes preferences by table and attribute by

region to provide a high degree of flexibility in how the final Well Header data is blended and presented to the organization.

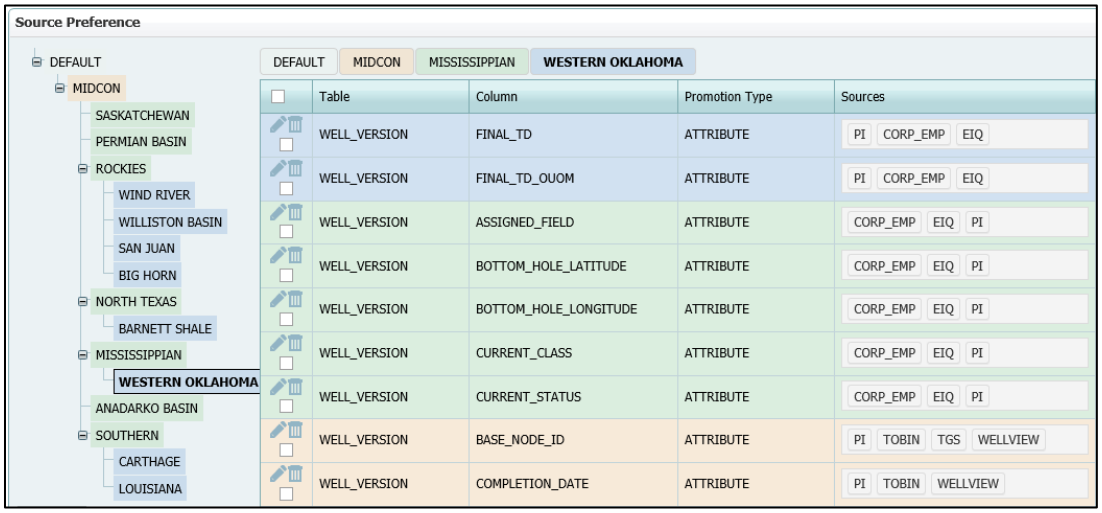


Figure 2.4: Source Preference List

As enterprise data management solutions evolve, it is also likely that companies will want to establish source preference lists that are tied to the current phase of the Well lifecycle. As the Well moves through the lifecycle, the Blending Rules would change to reflect the varying sources of data and the improving quality of the data.

The application of these four processes enables companies to define, build, and maintain a consistent and reliable Well Hierarchy that is a fundamental requirement for a comprehensive E&P data management solution.

3. Building the Well Hierarchy

This section discusses the workflows and processes to build the Well Hierarchy. The overall workflow, illustrated in **Figure 3.1**, can be divided into 3 main phases:

- Preparation
- Aggregation
- Blending

Well Identification and Matching are a key part of the processes within each of the phases.

The order in which the processes are followed within the workflow will make a difference to the final results that are stored within the Well Hierarchy. The approach detailed in this section is based upon extensive analysis of the different scenarios and, ultimately, decisions made to satisfy the needs of the business.

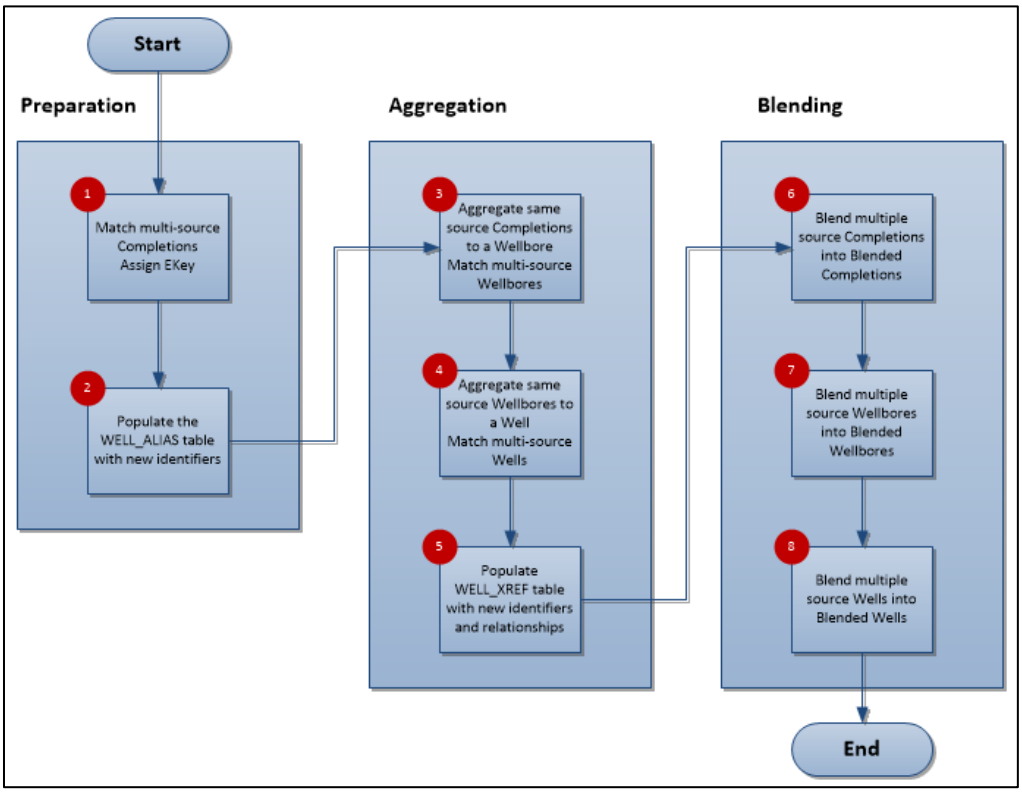


Figure 3.1: Well Hierarchy Workflows

This workflow is illustrated through the following example which walks through the steps associated with loading Completion level data and then Aggregating this to establish Wellbore and Well level records. These records are then Blended to create the final, trusted version.

Note: While this discussion makes specific reference to PPDM tables and US data, the workflow is intended to be generic and would be applicable within any data model for data from any geographic location.

3.1. Preparation

Steps 1 and 2 are considered to be part of the preparation phase.

Step 1: Match Multi-source Records

In the first step, an EKey is assigned to every record in the database according to its level within the Well Hierarchy as defined by the Well Level Type. To be able to assign an EKey correctly it is necessary to match records across different sources. **Figure 3.2** illustrates the process of assigning a new EKey to a group of Completions where they have been matched across multiple sources.

UWI/WELL GOVT ID	EKey	SOURCE	LEVEL
12-123-12345-00-00	10001234-000	STATE	COMPLETION
12-123-12345-00-00	10001234-000	EIQ	COMPLETION
12-123-12345-00-00	10001234-000	PI	COMPLETION
12-123-12345-00-01	10001234-001	PI	COMPLETION
12-123-12345-01-00	10001234-002	EIQ	COMPLETION
12-123-12345-01-01	10001234-003	EIQ	COMPLETION
12-123-12345-01-02	10001234-004	EIQ	COMPLETION
12-123-12345-01-00	10001234-002	PI	COMPLETION

Figure 3.2: EKey Assignment

This step must be completed prior to the Aggregation process in order to be able to assign the correct EKey to the Aggregated Wellbores and Wells.

Step 2: Populate the Well Alias Table

A link between the original identifier and the EKey will be maintained within the Well Alias table for cataloging purposes.

3.2. Aggregation

Steps 3 through 5 represent the Aggregation phase

Step 3: Aggregate and Match Wellbores

The next step involves applying the Aggregation rules to create Wellbore records from each Completion source; see **Figure 3.3**.

Aggregate Same Source COMPLETIONs into WELLBOREs by Source									
UWI/WELL GOVT ID	EKey	SOURCE	LEVEL		ACTION		Well Government ID	New Ekey	SOURCE	NEW LEVEL
12-123-12345-00-00	10001234-000	STATE	COMPLETION	|	Aggregate	->	12-123-12345-00	10001234-005	STATE	WELLBORE
12-123-12345-00-00	10001234-000	EIQ	COMPLETION	|			Not Aggregated - EIQ Wellbore already exists for 12-123-12345-00			
12-123-12345-00-00	10001234-000	PI	COMPLETION	|						
12-123-12345-00-01	10001234-001	PI	COMPLETION	|	Aggregate	->	12-123-12345-00	10001234-005	PI	WELLBORE
12-123-12345-01-00	10001234-002	EIQ	COMPLETION	|						
12-123-12345-01-01	10001234-003	EIQ	COMPLETION	|						
12-123-12345-01-02	10001234-004	EIQ	COMPLETION	|	Aggregate	->	12-123-12345-01	10001234-006	EIQ	WELLBORE
12-123-12345-01-00	10001234-002	PI	COMPLETION	|	Aggregate	->	12-123-12345-01	10001234-006	PI	WELLBORE

Figure 3.3: Wellbore Aggregation

In this example, a 12 digit API number is created from each Source and stored in the Well Government ID field and the Well Level type is set = 'WELLBORE'. The EKey column is set to the next Component number in sequence for the 8 digit Well identifier.

Step 4: Aggregate and Match Wells

Once the Wellbore aggregation has been completed, the next Aggregation step will create Well records by Source. Note that the Aggregation step will include Wellbore records aggregated from Completions in addition to Wellbore records that already existed in the Source at that level.

At this level in the Aggregation process, the EKey should be a simple 8 digit identifier with no Component extension.

Step 5: Populate Well XRef

With this approach, maintenance of relationships through the Well XRef table becomes very important. The purpose of Aggregation is to create a record at a higher level from records at a lower level; the Well XRef table keeps track of which lower level records were Aggregated into the higher level record.

The goal of the Well XRef table is to be able to trace back to determine which records were aggregated together and then blended to produce the final versions. The Well Alias table then enables the user to determine the original identifiers for the records that were involved in the Aggregation process.

3.3. Blending

Steps 6 through 8 represent the Blending phase

Step 6: Blend Multi-source Completions

This is the first phase of blending whereby Completions with the same EKey but different Source values are blended together to generate a single version for presentation to the organization.

As noted previously, the Blending process is driven entirely through a Source Preference List**. Figure 3.4** illustrates the blending process and results; in the example shown, 5 distinct 14 digit Completions are created with attributes promoted according to the SPL. In this case, the EIQ source trumps all other sources of data.

Blend Multiple Source COMPLETIONs into Blended COMPLETIONs										
UWI/WELL GOVT ID	Ekey	SOURCE	LEVEL		ACTION		Well Government ID	Ekey	NEW SOURCE	NEW LEVEL
12-123-12345-00-00	10001234-000	STATE	COMPLETION	|						
12-123-12345-00-00	10001234-000	EIQ	COMPLETION	|						
12-123-12345-00-00	10001234-000	PI	COMPLETION	|	Blend	->	12-123-12345-00-00	10001234-000	BLEND	COMPLETION
12-123-12345-00-01	10001234-001	PI	COMPLETION	|	Blend	->	12-123-12345-00-01	10001234-001	PI	COMPLETION
12-123-12345-01-00	10001234-002	EIQ	COMPLETION	|						
12-123-12345-01-00	10001234-002	PI	COMPLETION	|	Blend	->	12-123-12345-01-00	10001234-002	BLEND	COMPLETION
12-123-12345-01-01	10001234-003	EIQ	COMPLETION	|	Blend	->	12-123-12345-01-01	10001234-003	EIQ	COMPLETION
12-123-12345-01-02	10001234-002	EIQ	COMPLETION	|	Blend	->	12-123-12345-01-02	10001234-004	EIQ	COMPLETION

Figure 3.4: Blending Completion Records

Step 7: Blend Multi-source Wellbores

As with Step 6, a single, Blended Wellbore will be created from the multiple Wellbore records with the same Well Government ID but different Source values.

Step 8: Blend Multi-source Wells

The last Blending step is to blend data from the multiple Wells with the same Well Government ID but a different Source into a single Well record.

Once all of these steps have been successfully completed, a fully populated and structured Well Hierarchy will have been established in the Well table. Obviously, this needs to be updated each time that a record is added to or edited within the Hierarchy. The update process will essentially follow the same steps but only on a subset of the records.

4. Benefits of the Well Hierarchy

There are many business and technical benefits associated with building and maintaining a consistent Well Hierarchy around a set of common definitions. This section presents the primary benefits from the perspective of the authors.

4.1. Business View of the Data

Too often, data is presented from a database perspective and not from a business perspective. This is especially true within the US where there is tremendous inconsistency over the identification of Wells through the API number. This results in misinterpretation of the data and miscommunication of information.

Building a consistent Well Hierarchy around the PPDM 'What is a Well?' and Well Identification standards establishes a foundation for organizing and presenting data in a way that makes sense to business users and facilitates enterprise integration and communication; see **Figure 4.1**.

UWI	Government ID	Level Type	Spud Date
10113099	3002539701	WELL	4/12/2010 12:00:00 AM
10113099-002	300253970100	WELLBORE	4/12/2010 12:00:00 AM
10113099-000	30025397010000	COMPLETION	4/12/2010 12:00:00 AM
10113099-003	300253970101	WELLBORE	5/2/2010 12:00:00 AM
10113099-001	30025397010100	COMPLETION	5/2/2010 12:00:00 AM
10116539	3503930003	WELL	10/7/1964 12:00:00 AM
10116539-002	350393000300	WELLBORE	10/7/1964 12:00:00 AM
10116539-000	35039300030000	COMPLETION	10/7/1964 12:00:00 AM
10116539-001	35039300030001	COMPLETION	9/14/1965 12:00:00 AM
10116556	3503950000	WELL	9/7/1962 12:00:00 AM
10116556-002	350395000000	WELLBORE	9/7/1962 12:00:00 AM
10116556-000	35039500000000	COMPLETION	9/7/1962 12:00:00 AM
10116556-001	35039500000001	COMPLETION	4/19/1965 12:00:00 AM

Figure 4.1: Business View of the Data

With a consistent Well Hierarchy in place, queries against the database make more sense as they return the number of Wells, Wellbores, and Completions that satisfy the query, for example, rather than a simple record count. Data can be displayed at different levels of the Well Hierarchy to meet the needs of a particular business unit and to present a consistent story across the whole Well lifecycle.

In addition, the Well Hierarchy enables data to be exported to applications at the Well level that they expect. For example, Aries may need to consume data at the Completion level while Wellview or Petra may want to organize information at the Wellbore level.

4.2. MDM Foundation

The Well Hierarchy also provides a foundation for an enterprise MDM solution. Establishing a structure that uniquely identifies Wells along with all of the Well Components that we care about enables critical data to be matched and integrated across applications. This facilitates enhanced workflows and collaboration between departments and business functions.

When an EKey has been assigned at each level of the Well Hierarchy, this can be matched to key identifiers in end user applications at the correct level using defined attributes and matching processes. For example, the Aries PROPNUM, can be matched at the Completion level using completion attributes (date, depth, formation, …) to determine whether that record (or its parent) already exists within the Well Master and, if so, then the corresponding EKey is assigned. If not, then a new EKey is assigned and the parent Wellbore and Well records are created through the Aggregation process.

A table of the matched enterprise identifiers can then be established that acts as a cross reference table for linking different identifiers and names back to the preferred values stored in the corporate Well Master; see **Figure 4.2**.

			PETROLOOK		PRA	
UWI	Government ID	Well Name	Well Index	Well Name	Well Index	Well Name
10136830-000	35037003660000	ASHER	63454-1	ASHER #1	P12345	
10136831-000	35037209680000	WATER INJECTION	63458-2	ASHER #2	P18654	
10136832-000	35037212720000	HAMMER	89452-1	HAMMER ST1	P65179	
10136833-000	35037256810000	DEPEW	10082-1	SMITH T4WR3S	P10023	
10136834-000	35037277660000	DARNELL	10034-1	GREEN RIVER 1	P67347	
10136835-000	35037280500000	DEVIN MILES	53761-2	DMILES	P35241	
10136836-000	35037282360000	DEVIN MILES	45329-2	MESA VERDE 2	P67251	
10136837-000	35037283200000	REPLOGLE	39965-1	ARAPAHOE 3	P77100	
10136838-000	35037283630000	MILLS	10065-2	MILLS #2	P90012	
10136839-000	35037284920000	WHITE			P36789	

Figure 4.2: Well Alias table

This table then provides a foundation for enterprise activities such as synchronizing critical data between applications and also for generating reports that include information from different data stores.

The EKey can also be passed back and stored within the end user application to facilitate matching and lifecycle identification.

4.3. Well Lifecycle Integration

Having established the Well Hierarchy by matching to key identifiers within applications, it is possible to significantly improve the level of integration and collaboration across

traditional workflows. This has a positive impact on the bottom line of the business by improving efficiencies and reducing errors.

With a fully matched Well Hierarchy in place it is possible to synchronize critical attributes across workflow applications and to track the progress of Wells across the Well lifecycle. This is illustrated in **Figure 4.3**. When a Well is created in Aries, for example, the event and Aries identifier (PROPNUM) is passed to the Well Master where a new EKey is assigned at the Completion level and returned to Aries for storage. At this point the Well Hierarchy is created and events are triggered to:

- Create a new record in the permitting application to initiate the process to apply for permission to drill
- Create a new Wellbore record in Wellview to initiate drilling planning and operations

Later in the Well lifecycle, the spud date will be updated within Wellview; this can then be updated within the Well Master (TDM) based upon matching at the Wellbore level and the Well lifecycle status changed from permitted to drilling. Likewise, when the first production is recorded for a Well in the production accounting package, the Well Master can be updated at the correct level and the Well lifecycle status set to Producing.

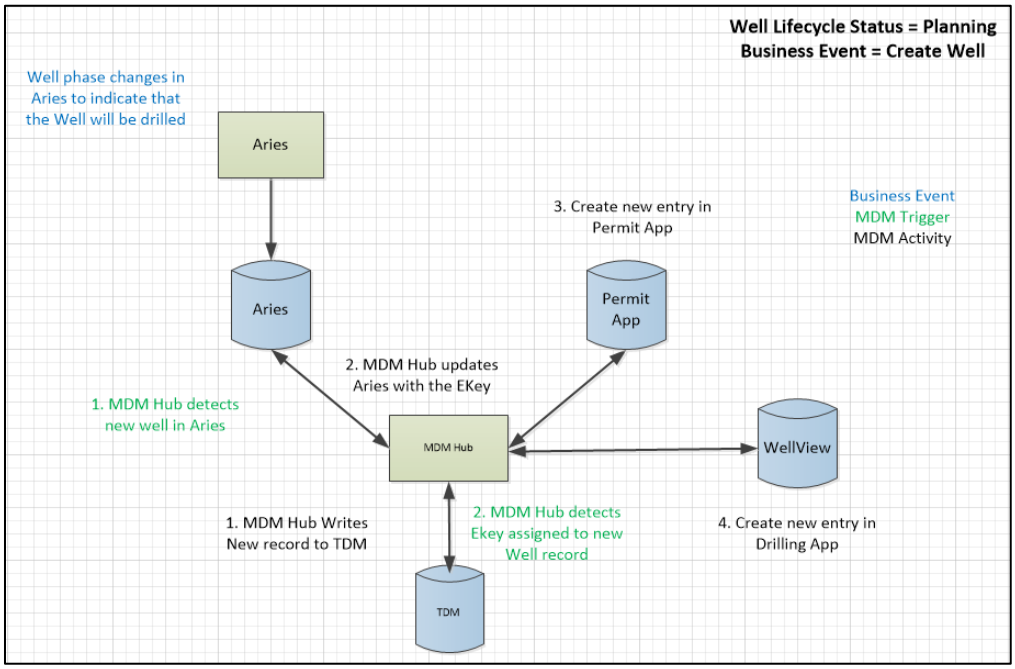


Figure 4.3: Well Lifecycle Support

Traditionally, this type of workflow has involved manually processing and handing off spreadsheets of data between people and departments. This results in errors and

inefficiencies along with an inability to track the history of activities in the future. Establishing a reliable Well Hierarchy enables these workflows to be automated which is becoming essential as the pace of drilling activity increases along with the pressure to operate more efficiently.

5. Summary

The North American oil and gas industry is undergoing a significant, technology driven change. The Well lifecycle is being compressed and the need for collaboration between business units has never been higher.

Easy access to integrated data across the full Well lifecycle is a critical requirement for successful collaboration. The challenge is that data is typically stored in silos and the information is often tied to different levels of the Well Hierarchy which makes matching difficult. Data is typically shared between groups by passing spreadsheets with inconsistent identifiers which makes matching difficult and results in wasted time and significant errors.

To address this issue, companies are increasingly creating a Well Master data store in which they establish a Well Hierarchy with unique identifiers for all Wells and Well Components at relevant levels of the Hierarchy. This can then be used to tie together identifiers across end user applications at the appropriate level to establish a business view of the data and support improved collaboration between work teams.

This paper has described the EnergyIQ approach to building a Well Hierarchy that is based upon PPDM standards and practical experience working with a number of large independent oil and gas companies. Four key components of the process to establish the Well Hierarchy have been described:

- Well Identification
- Well Matching
- Aggregation
- Blending

These processes have been implemented at a number of sites as part of EnergyIQ's TDM solution and have proven to be manageable, flexible, and performant while delivering important benefits that have a measurable impact on the bottom line of the business.