Directional Survey Data Object

The PPDM Association

March 2022

Data govern … ogy in which it
managemen … als had
ensure data … Could the audit
and decomm … describe what
has their ow … data
designed, de …

As they are … which the
what "good" … be
many of thes … can be set, and
incomplete …
the diversity …
cause **data d…**
data attenua…
"fix". Sadly, …
adjust it to n…
group.

The PPDM Association Data Objects project considers this question. What if we could design a method for defining clear baselines that allow data to be properly managed

What if we could design a method for defining

clear baselines that allow data to be properly managed and audited,

independent of the technology in which it has been deployed,

and data professionals had appropriate competency and capability?

Abstract

Various standards might be leveraged, but often data professionals are unaware that they exist.

The Professional Petroleum Data Management Association

The Member Driven
Global Society for Data and Data Professionals

+1 (403) 660-7817
LinkedIn
info@PPDM.com
www.PPDM.org

ABOUT US

The PPDM Association is the global, not-for-profit society within the petroleum industry that provides leadership for the professionalization of petroleum data management through the development and dissemination of best practices and standards, education programs, certification programs and professional development opportunities.

30+	18,500+	130+	1,000s
Years of experience	Community supporters	Countries are part of PPDM's global reach	PPDM volunteers have built products and services that benefit industry

SUMMARY

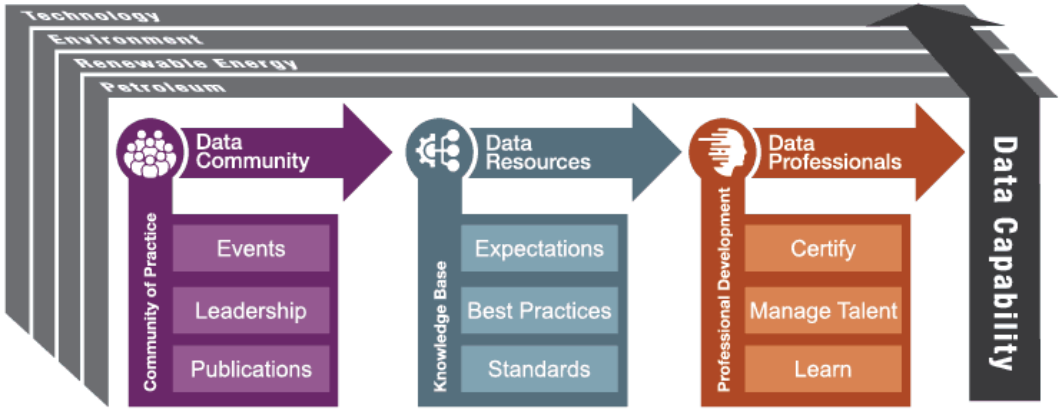
Formed by Industry
October 1991

Governance
Volunteer Board of Directors elected by members

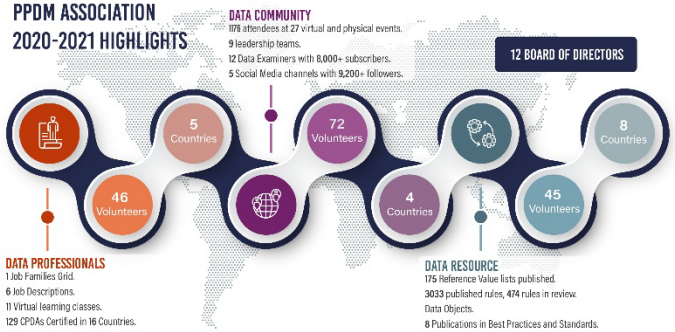
Status
Registered Not for Profit

Locations
HQ Canada
Members Global

The PPDM Strategy

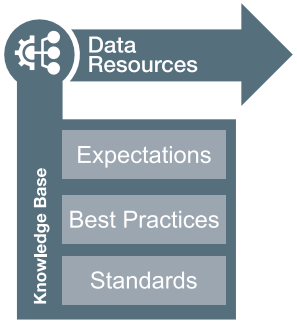


Member collaboration is the heart of PPDM.



The Challenge *(For All Data Types)*

Data struggles to achieve full usefulness because:



We all have a different idea of what "good" is

- What makes a good well log, section, directional survey …
- What vocabulary (mine, my vendor's, service company…)
  - But we are not very good about defining our terms
- We "adjust" the data to fit our expectations

Data disciplines often considered tactical (not strategic)

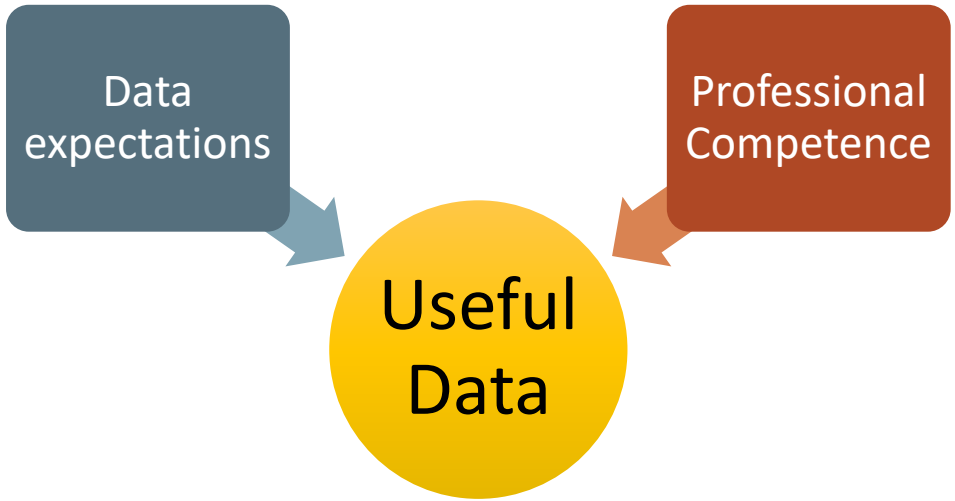
- Limited to the needs of the part of business they are in
  - Data transcends business boundaries
  - Many global data managers are "part time"
- Discipline awareness often poor
- Suitable professional development not available

The Opportunity

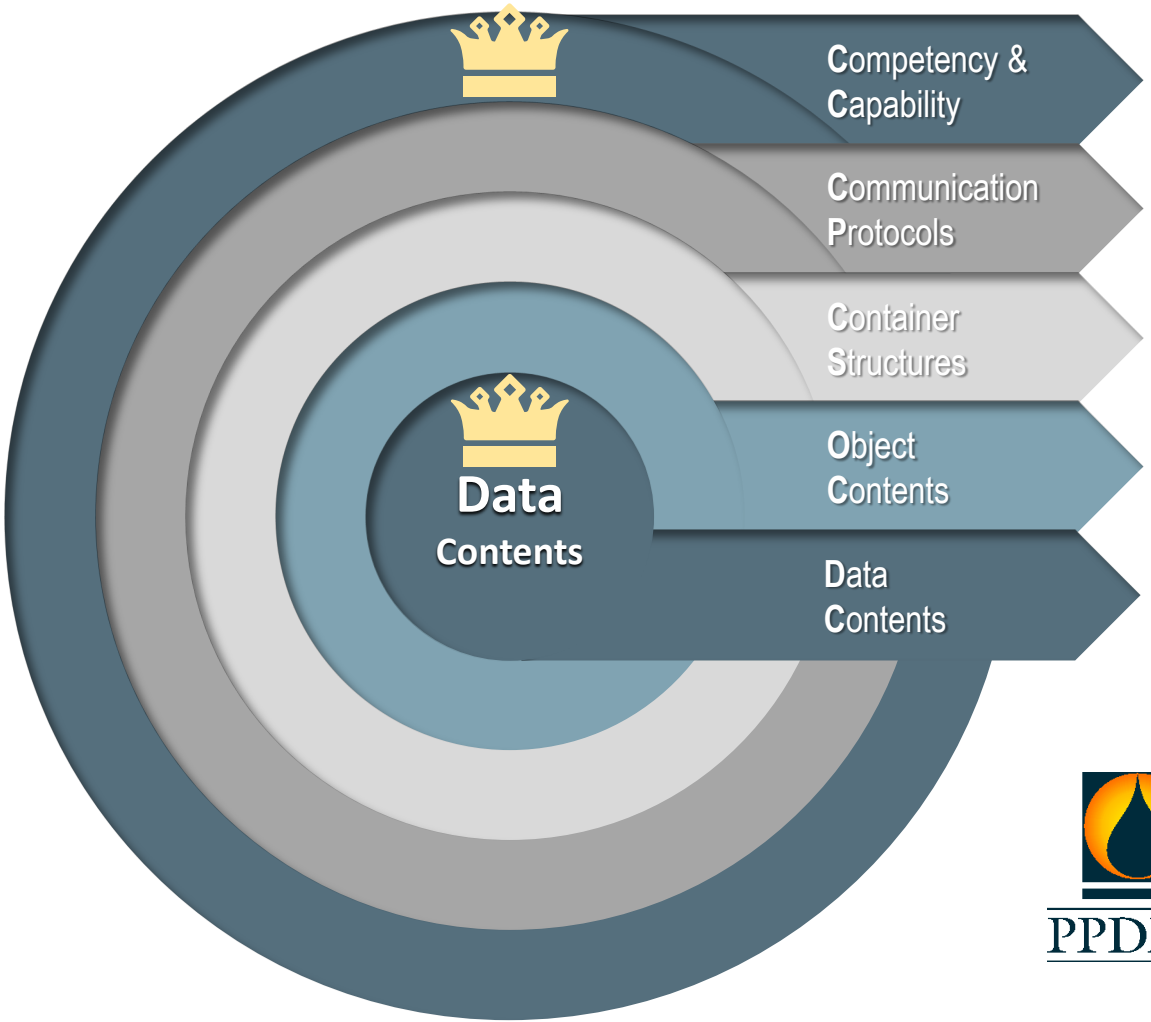
Can we create a baseline for what "good" data looks like?

Instead of fixing data again and again, can we get it right and keep it right?

Can we help data professionals master the core competencies and capabilities to steward data through all users and business processes?



Measurable expectations must be established



Trained, credentialed professionals maintain the strategic data asset to support the needs of all users.

Communication protocols ensure data is used and transported between systems without attenuation.

Technical containers (databases, ML, spreadsheets), keep contents organized and accessible by SW.

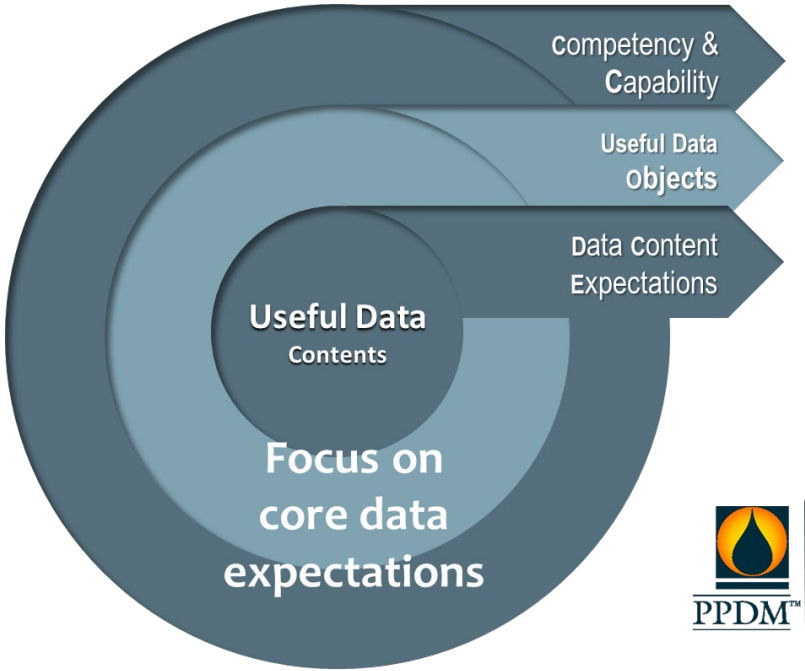
Object contents describe how each object should behave. Consistency drives interoperability.

Data contents support shared vocabularies and other information needed to drive trust and usefulness.

PPDM™

Data Ecosystems

Data Objects



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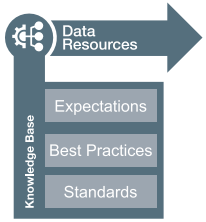
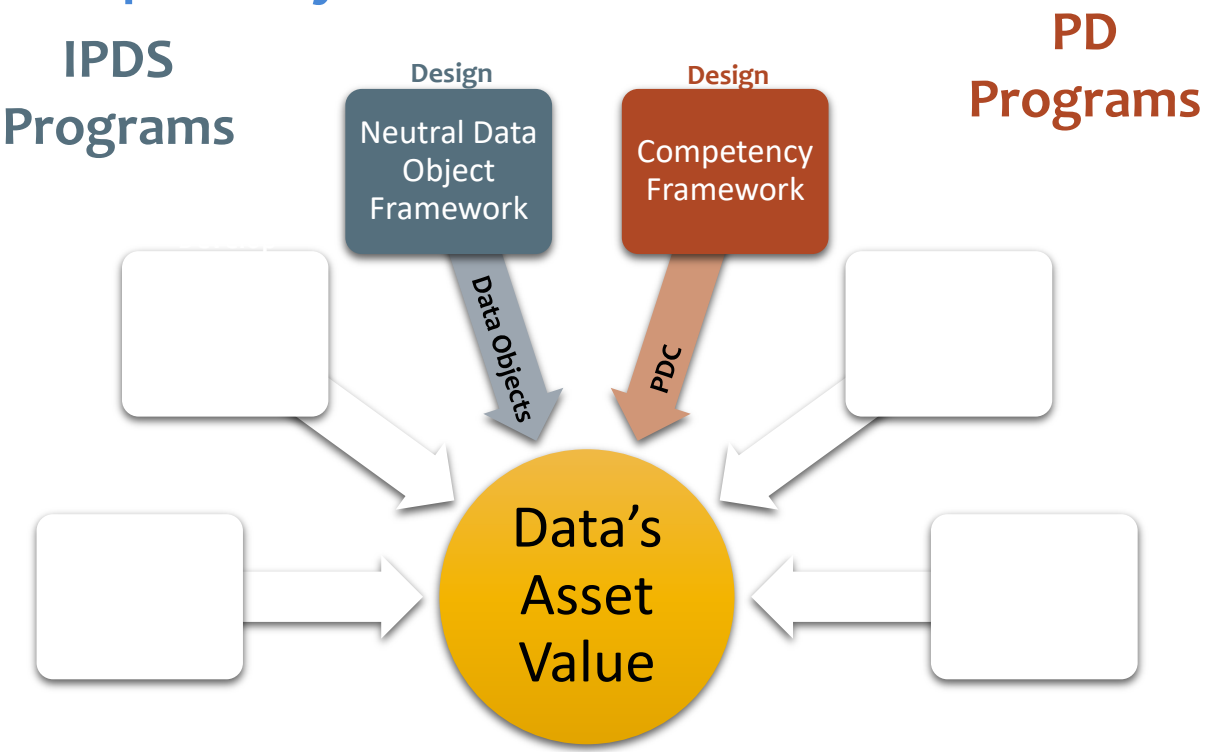


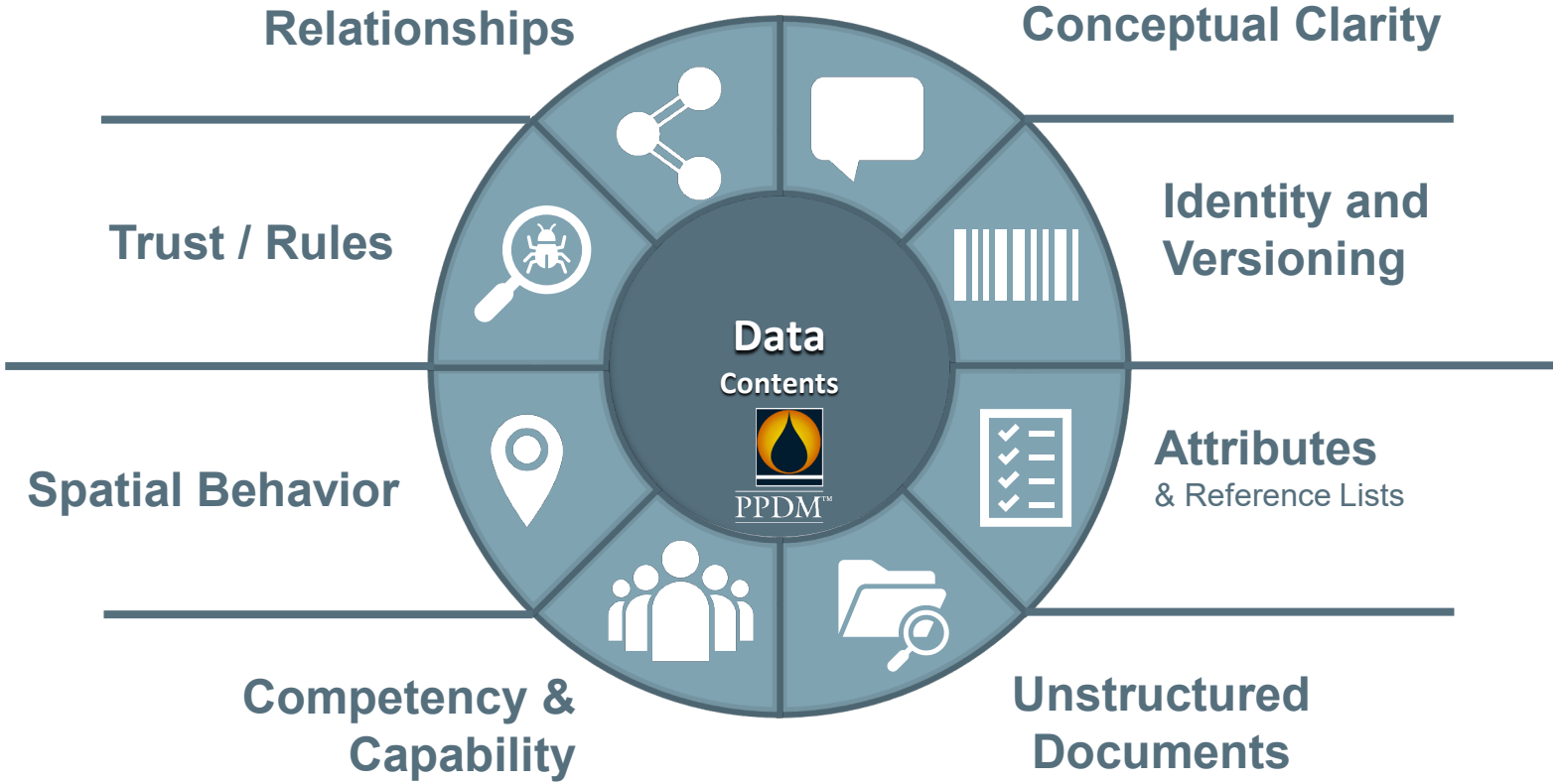
Data Auditability

Professional Accountability

Data and Capability



Data Object Framework



Relationships

Relationships and cardinality describe real world relationships between objects. Knowledge of these relationships ensures that data represents the business, rather than a specific process.

Rules

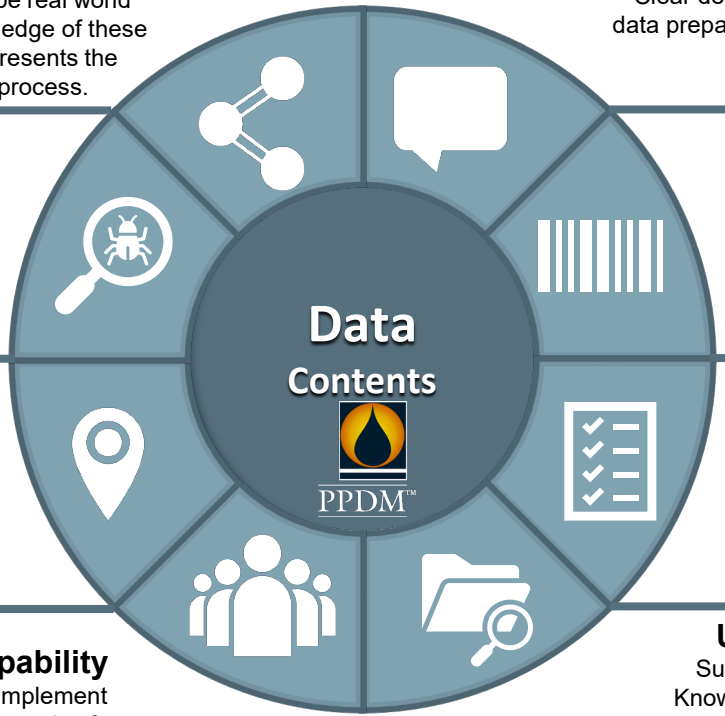
Atomic, measurable, specific and testable expressions that describe "well formed" data, prevent content and contextual attenuation.
May include specifications for when and how terms are to be used.

Spatial Behavior

Most objects can be located on the surface or subsurface. They are subject to change, versioning and interpretation.

Competency and Capability

Data resources develop and implement strategies to ensure that the needs of stakeholders are addressed while supporting the strategic value of data.



Conceptual Clarity

Clear descriptions and definitions ensure that integration and data preparation focus on business concepts, and don't get hung up on proprietary terminology.

Identity and Versioning

Criteria for establishing the data difference between "new" objects and "versions" of the same object must be clearly understood.

Attributes

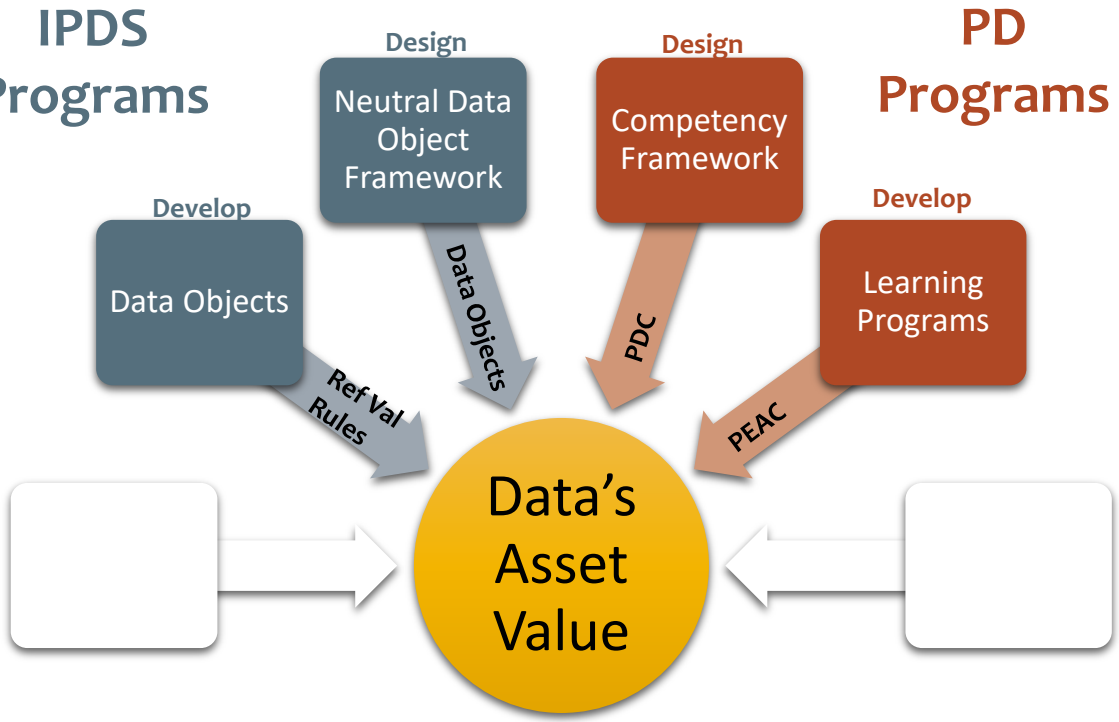
The unique and clear identification of a data object is defined by the presence of specific attributes.

Reference lists support interoperability.

Unstructured Documents

Supporting Documents and Information. Knowledge of what unstructured information needs to be associated with this object (and how it might be created, changed and managed).

Data and Capability

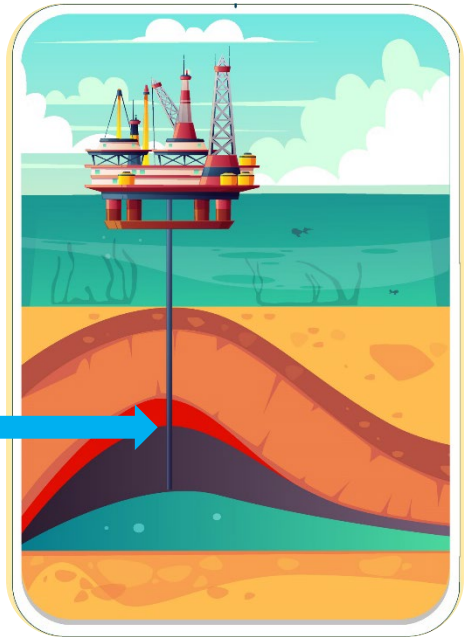


Walk Through Using an Example

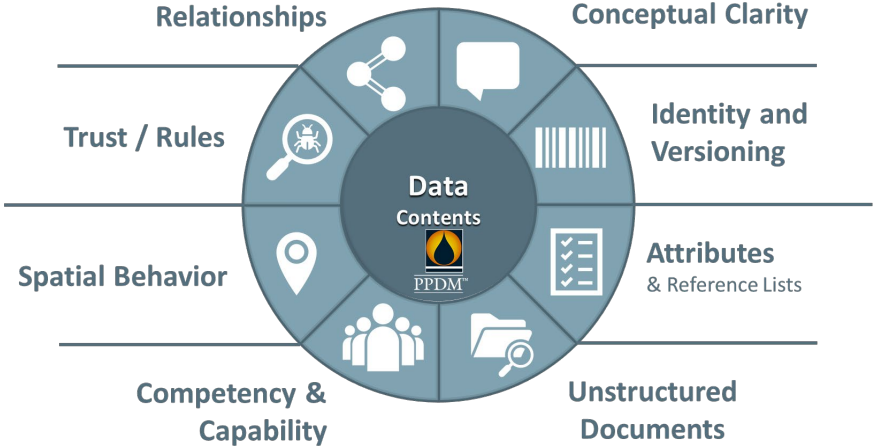
Directional Surveys

Most wellbores are not entirely straight (intentionally or not)

A collection of surveyed points that measure the path of a wellbore in three dimensions.

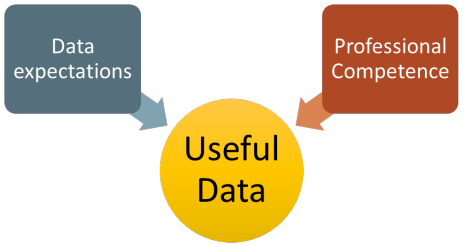


Data Managers Consider These Framework Elements

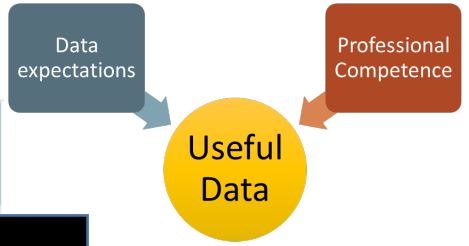


What should "good" data look like?

What should data professionals know?



Each Directional Survey Must Have Attributes



Sub-object	Attribute	Attribute Family	Define or Describe	Reference List	Definition	Data Type
Directional Survey Composite	TVD Reference Elevation UOM					
Directional Survey Station	Accuracy Problem Indicator		Describe			
Directional Survey Station	Accuracy Problem Reason		Describe	Directional Survey Accuracy Reason	[illegible] reason there is a problem, if	Validated Text
					Value for the measurement in angle degrees of the clockwise departure from a reference north to the survey point in the wellbore.	Number
Directional Survey Station	Azimuth UOM		Describe	Units of Measure	Original units of measure for the Azimuth value.	Validated Text
					Pythagorean Theorem from this surve station X and Y Offsets	Number

The attribute name is human readable.

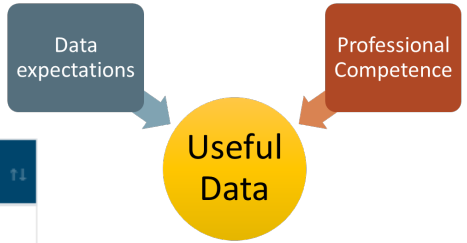
Upgrading to whether mandatory, recommended or optional.

Link to list of values where applicable

Clear, complete definitions.
Can include advice or suggestions.

The kind of data to expect, not container specific.
Considering scale and precision.

Behaviors can be described



Description Type	Description
Spatial Physical	Errors in the north reference type can result in substantial positioning errors.
Spatial Planning	...omposite survey less

Description Type	
Identity Management	
Version Management	Versions of directional surveys are only allowed when different calculation methods are applied to the same rav

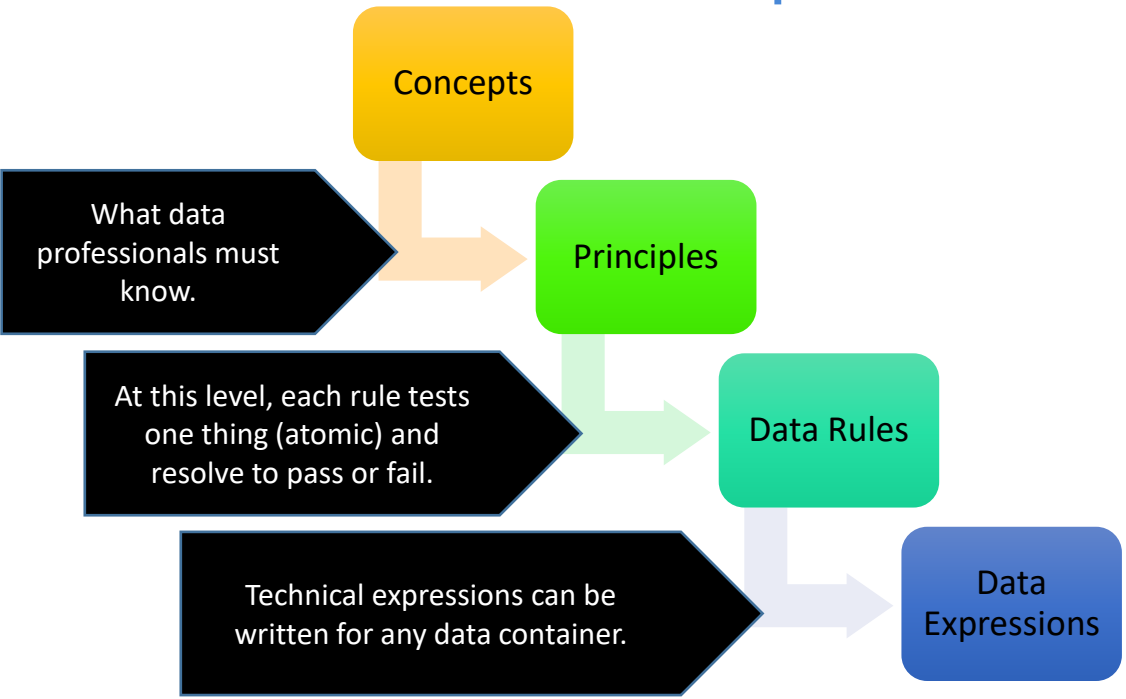
Description Type	Description
Business	Directional surveys should be attached to wellbores.

These starting behaviors need to be expanded.

What do data professionals need to know?
What will drive interoperability?
What will enhance data's usefulness?

Behavioral information is intended to support competence and encourage appropriate implementation in data systems.

Data Rules Can Be Captured

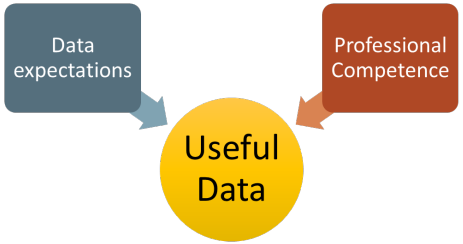


Professional Accountability Programs

- Data Governance
- Data Mastering
- Data Management

Data Auditability Programs

- Human testing
- Machine testing



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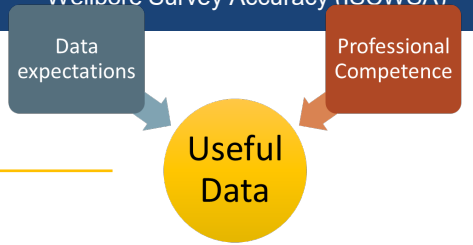

Concepts	Coordinates are provided as a triplet of values: latitude, longitude and coordinate reference system.
Principles	When used in data systems, all three attributes are normally expected. If the CRS is missing, investigate and resolve. Each CRS is valid in specific areas …
Data Rules	If Latitude is present, Longitude must also be present… If Latitude is present, CRS must be present … If CRS is present, it must exist in a list of valid values …
Data Expressions	Manual inspection SQL, Macro Coding language…

Data expectations

Professional Competence

Useful Data

Rule ID	Statement	Description
172	Directional survey date	the rig release date.
240	Well directional survey	bore and operated
241	Directional survey bas wellbore depth at the	bore. It cannot go deeper
243	For a well directional s system value must not	th cannot be referenced to
248	The directional survey as the permanent dep	ce point (elevation al survey should use the c.)
256	Well directional survey release date	there are exceptions for
258	The file for a wellbore header information ab	measurements in the

Rule # 248 - The directional survey depth datum must be the same as the permanent dep...

Print Close

Definitions Comments Metadata

Rule Details

Statement

The directional survey depth datum must be the same as the permanent depth datum for the well.

Description

All depth measurements in a wellbore are referenced to a surface point (elevation reference datum) in order to convert to elevation. The directional survey should use the same datum as the other depth measurements (logs, drilling, etc.)

Coding Example
WELL_DIR_SRVY.REPORT_LOG_DATUM should equal WELL.DEPTH_DATUM

Diagnostic Advice
Not available

Exceptions
Not available

Tolerances
Not available

Business Impact
Elevations are critically important for subsurface interpretation

Data Impact
Not available

Resolution
Not available

Classifications

Subject Area
- Well

Rule Type
- Data Rule

Quality Dimension
- Consistency

Close

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ositioning Technical Section

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The Industry Steering Committee on Wellbore Survey Accuracy (ISCWSA)

3.4 Recommended resolution

The following resolution is recommended for w

- Geodetic parameters (common header)
  - Where possible use the same unit and precision as in the EPSG Dataset. Maintain better than 1 millimetre precision if the unit or representation needs to be converted (e.g., use 8 decimal places for radians or arcseconds converted to decimal degree).
  - 5 decimal places f combined scale fa
- Raw sensor data (M7 an
  - 0 decimal place (in
  - 6 decimal places f
  - 4 decimal places f
  - 0 decimal places f
- MDINCAZ (P7, M7 and G
  - 2 decimal places f
  - 3 decimal places f
  - 3 decimal places f
    - 3 decimal pla (e.g., magneti
- Local coordinates (P7, M
  - 2 decimal places f
  - 2 decimal places f
  - 3 decimal places f
- Geodetic/projected coor
  - 2 decimal places f
  - 2 decimal places f
  - 7 decimal places f corresponds to ap

Note that degree-minute-secc (if it would be, then 3 decimal 1 cm-level precision for coord

Container design

Table 11: Zero-depth Point (ZDP) TYPEID Codes and their abbreviati

ZDPTYPEID	ZDP Type	Description
1	Rig Bracing	The point where the wellbore meets the rig bra
2	Crown Valve	Also known as a swab valve. This is the upperm on the vertical bore of the christmas tree above outlet, sometimes used as a reference point for measurements.
3	Derrick Floor	The point where the wellbore intersects the pla usually 10 feet or more above the ground, or th which drilling operations are carried on. Also c Floor.
4	Ground Level	Onshore. The earth's surface where the drillstr the ground. This reference point is not appropri offshore well.
5	Kelly Bushing	The point in a wellbore where the wellbore inte top of the Kelly bushing.
6	Lowest Astronomic Tide	Depth Datum - The lowest predicted level of th under normal meteorological conditions.
7	Mean Lower Low Water	Depth Datum - Mean of observed lowest water certain period. Used as Chart Datum on US na
8	Mean Sea Level	Depth Datum - The average level of the surface over all stages of tide and seasonal variations.
9	Pipe Top	The top of the wellbore pipe.
10	Sea Floor	Offshore. The point where the wellbore intersec sea floor. This is sometimes used as a referenc wellbore measurements.
11	Top Bottom Flange	The top point of the bottom flange.
12	Top Cellar	Onshore, "hard" point generally close to Groun
13	Top Wellhead Housing	May be used offshore to reference the top of th wellhead housing.
14	Unknown	The type of reference point is unknown.
100 onwards	[User Defined]	[User to define ZDP Type and abbreviation.

Notes:

H7,1,2,0: Well Definition

This record is mandatory. It defines the well horizontal Reference Point (WRP). The wellbore trajectory is cons horizontal error starts to propagate at the WRP.

Additional detail of the WRP can be provided using H7, Position Object Attributes.

Field	Description	Data Type	Reference Code	
5	"Well Definition"	Description		
6	Well Reference Number	Integer	WELLREF	
7	Structure Reference Number	Integer	STRUCTUREREF	
8	Well Reference Point Abbreviation	Text		
9	Well Reference Point Reference Number	Integer	WOBJREF	
10	Primary UWI	Text		
11	Primary Well Name	Text		
12	Primary Authority Name	Text		
13	Alternate UWI(s)	Text List		
14	Alternate Well Name(s)	Text List		
15	Alternate Authority Name(s)	Text List		
16	Well Status	Text		"Unknown", "Proposed", "Permitted", or "As-built"
17	Licence/Lease/Section Name	Text		At surface location
18	Spud Date	Date		YYYY:MM:DD Leave blank if unknown Planned date if proposed or permitted

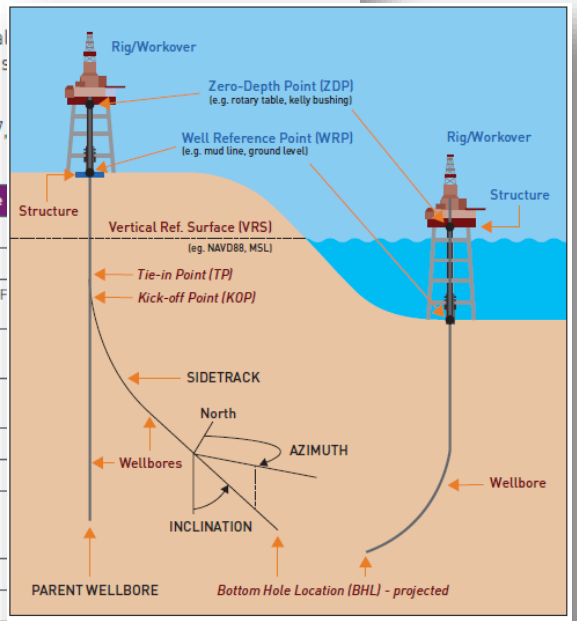
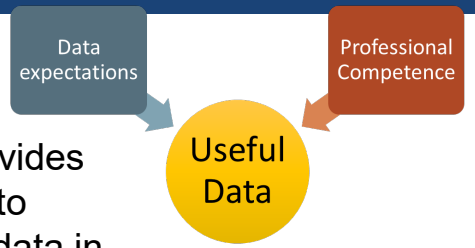


Figure 1: Deviated wellbore terminology.

List of Values

Use Rule

Relationships



Directional survey provides useful spatial context to activities or technical data in the wellbore but it isn't mandatory.

The service job that creates the directional survey is important to some user groups.

The Wellbore that the directional survey describes is critical – this relationship is mandatory. Some business processes attenuate this relationship.

What is this?

What do the numbers mean?

How do I know if the numbers are right?

What should I look for?

What should I do if it's wrong or missing something?

DIRECTIONAL SURVEY

(1)	(2)	(3)	(4)	(5)	(6)	(7)		(8)		(9)
SUBSEA DEPTH FEET	MEAS. DEPTH FEET	TRUE VERTICAL DEPTH FEET	DRIFT ANGLE D M	DRIFT DIREC D M	VERTICAL SECTION FEET	TOTAL RECTANGULAR COORDINATES FEET		CLOSURES DISTANCE FEET	DIRECT D M	DOG LEG SEVERITY DEG/100FT
5299.88	5700	5330.88	31 30	N 37 0 E	1490.00	1390.73 N	536.16 E	1491.22	N 21 9 E	1.04
5385.14	5800	5416.14	31 30	N 32 0 E	1541.27	1433.77 N	567.75 E	1542.09	N 21 36 E	2.61
5470.52	5900	5501.52	31 15	N 25 0 E	1593.10	1479.50 N	592.57 E	1593.76	N 21 50 E	3.65
5556.01	6000	5587.01	31 15	N 20 0 E	1644.95	1527.41 N	612.42 E	1645.61	N 21 51 E	2.59
5641.95	6100	5672.95	30 15	N 14 0 E	1695.73	1576.28 N	627.36 E	1696.54	N 21 42 E	3.23
5728.23	6200	5759.23	30 30	N 10 0 E	1745.28	1625.73 N	637.87 E	1746.39	N 21 25 E	2.04
5814.50	6300	5845.50	30 15	N 8 0 E	1794.24	1675.47 N	645.78 E	1795.81	N 21 5 E	1.04
5900.88	6400	5931.88	30 15	N 8 0 E	1842.79	1725.56 N	652.79 E	1844.91	N 20 43 E	0.00
5987.59	6500	6018.59	29 30	N 10 0 E	1891.02	1774.76 N	660.59 E	1893.71	N 20 25 E	1.25
6075.26	6600	6106.26	28 0	N 12 0 E	1937.98	1821.97 N	669.76 E	1941.17	N 20 11 E	1.78
6164.16	6700	6195.16	26 30	N 12 0 E	1982.85	1866.75 N	679.28 E	1986.50	N 19 60 E	1.50
6254.29	6800	6285.29	25 0	N 13 0 E	2025.50	1909.17 N	688.68 E	2029.58	N 19 50 E	1.56
6344.86	6900	6375.86	25 0	N 16 0 E	2067.24	1950.08 N	699.26 E	2071.66	N 19 46 E	1.27
6435.40	7000	6466.40	25 15	N 18 0 E	2109.43	1990.68 N	711.68 E	2114.07	N 19 40 E	0.89
6525.75	7100	6556.75	25 30	N 20 0 E	2152.15	2031.20 N	725.63 E	2156.92	N 19 40 E	0.89
6616.10	7200	6647.10	25 15	N 20 0 E	2194.92	2071.47 N	740.29 E	2199.77	N 19 40 E	0.25
6706.73	7300	6737.73	24 45	N 20 0 E	2237.11	2111.18 N	754.74 E	2242.03	N 19 40 E	0.50
6797.82	7400	6828.82	24 0	N 20 0 E	2278.30	2149.96 N	768.86 E	2283.30	N 19 41 E	0.75
6889.17	7500	6920.17	24 0	N 20 0 E	2318.90	2188.18 N	782.77 E	2323.98	N 19 41 E	0.00
6980.53	7600	7011.53	24 0	N 20 0 E	2359.50	2226.40 N	796.68 E	2364.65	N 19 41 E	0.00

Radius of Curvature Calculation

Unstructured Data and Examples

It is very helpful for learners and designers to have access to examples.

It's also very useful to provide examples of BAD data, provided some explanation is provided about what went wrong and what to do about it.

We need links to useful articles, illustrations etc., prepared by experts.

What data centric training is available?

Directional Survey - Learning

Introduction to wellbore positioning

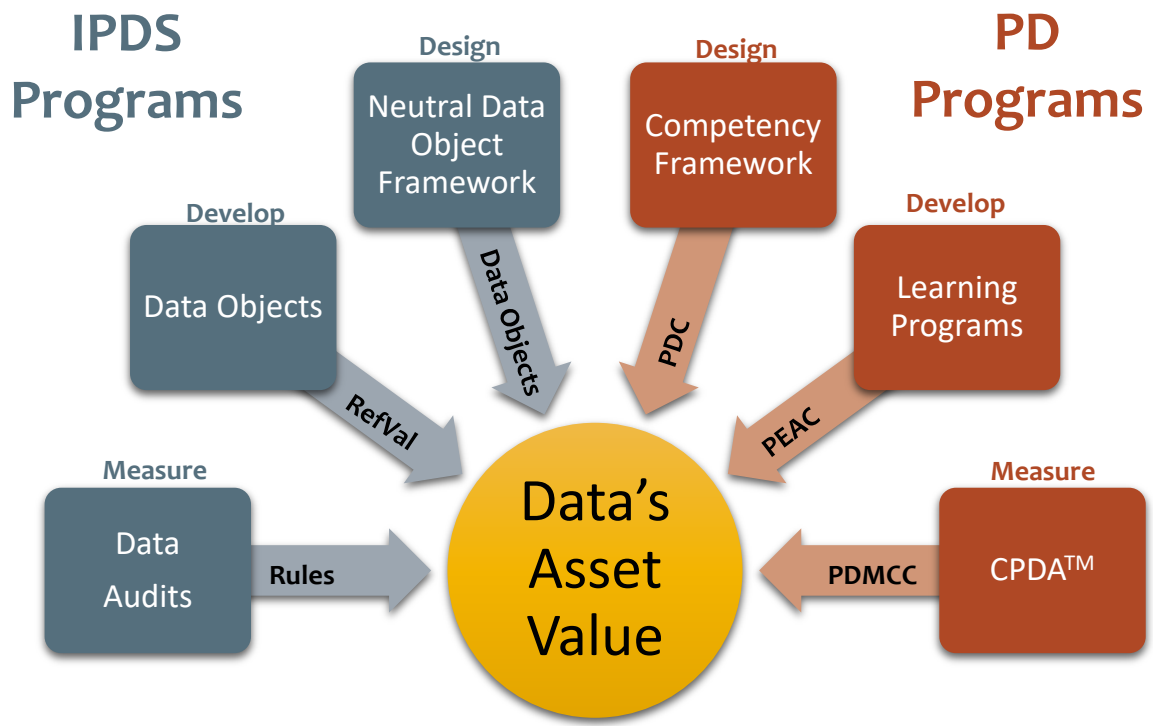
This industry standard publication on directional drilling (accepted by the ISCWSA board) is published through the UHI Research Office, the full eBook is available to view or download below. This publication is constantly updated as techniques change or newer technology is employed, please check this page regularly if it is important to you to have the latest version of the publication. Version information is at the bottom of this page.

Read More

Useful Links:

https://www.wellboreintegrity.com/wp-content/uploads/2021/05/DRILCO_Drilling-Assembly-Hndbk_WIS-BR-MKT-021_r2_ELEC.pdf
https://www.iscwsa.net/articles/api-rp-78-overview-recommended-practices-for-wellbore-positioning/
https://www.uhi.ac.uk/en/t4-media/one-web/university/research/eBook_V9_10_2017-redux.pdf
https://www.iogp.org/bookstore/product/p7-17-wellbore-positioning-data-exchange-format/

Data and Capability



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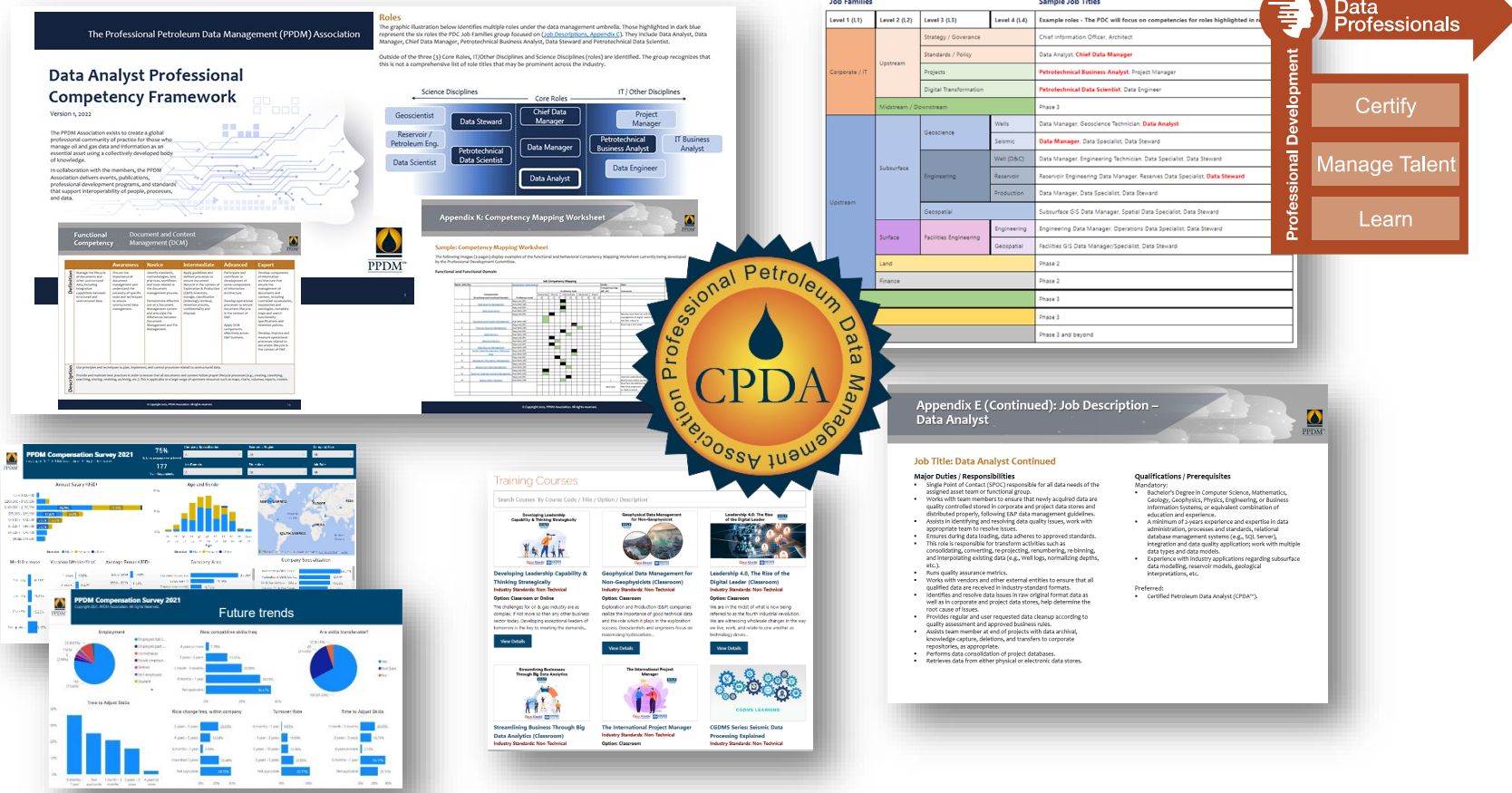
Professional Competence



Data Inspection / Auditability

Once a baseline is developed we can set up measurable expectations for data stores that are technology neutral.

Does verification that a dataset has been inspected / audited add business value?

Who would see the most value?

Regulators?

Operators?

Thanks for listening.

We look forward to your feedback

projects@ppdm.org