Visual Reliability

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Data Standards Opportunity Survey

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Executive summary: The Standards Committee within the IOGP promotes consistency, efficiency and effectiveness within the global upstream oil and gas industry. It deems digitization as a strategic enabler of this objective and is initiating the development of a Digitization Vision and Strategy. In support of this drive, the IOGP Information Standards Sub Committee (ISSC) is responsible within IOGP for data standards and intends advising its members towards the most valuable information and data standard opportunities. To do this, the Data Standards Opportunity Survey was contracted out to Visual Reliability LLC to harvest evidence on the potential of a variety of data standards from selected respondents in the oil and gas industry through a combination of interviews and surveys.

Around 30 senior oil and gas professionals were interviewed to collect information that was used to develop a shortlist of data standards with high potential. This lead to an online survey of 160 people in which additional information was collected on the standards identified in the shortlist.

Analysis of all the information collected concluded that (1) a Project Information Handover Specification standard; (2) a Vendor Data and Requirements standard; and (3) 3D Model standard, have the potential to have the biggest positive impact on project delivery time. In addition, it was concluded that (1) a Project Information Handover Specification standard; (2) Equipment Reliability standard; and (3) Vendor Data and Requirements standard, have the biggest potentially positive impact on asset availability.

This report details the specific objectives, deliverables, methods, analyses and conclusions of the Data Standards Opportunity Survey. The conclusions of this survey is as vulnerable to sample size, sample selection, question formulation, statistical error and bias as any other survey and should be interpreted accordingly.

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1 Background

The Terms of Reference (TOR) of this project is included in the report as Appendix A. For convenience, the objectives in the TOR are repeated below:

(a) To formulate a generic, industry-level architecture of processes, enabling data clusters and associated standard requirements;
(b) To collect evidence to guide a high-level prioritization of data standards focus areas. Evidence could be expressed in organizational maturity, organizational readiness, opportunity value, business climate and/or any other meaningful metric;
(c) To develop insight into how these focus areas can cause an accelerated industry-wide digitization drive;
(d) Gain feedback on the methodology and approach, together with lessons learned during the conduct of the survey.

With the objectives in mind, the TOR specifies the following two deliverables:

(1) A generic, industry-level architecture of processes, enabling data clusters and associated standard requirements based on the information gathered in the survey;
(2) An evidence-based, high-level prioritization of data standards focus areas, together with sufficient supporting evidence to make initial prioritization decisions; and a recommendation for the standard organization(s) to do develop the standard(s).

It was anticipated in the TOR that agility will be required to achieve the objectives since the project relies on industry professionals to participate on a voluntary basis. This turned out to be the case and the path to achieve the deliverables is described in the next section.

2 Path to deliverables

The project had two distinct phases during its execution:

Phase I: A series of personal interviews with 30 senior oil and gas professionals for two purposes:
(1) to develop and/or determine the generic architecture described in Deliverable (1) in the previous section; and

(2) to develop a short list of data standards to rank based on the generic architecture.

Participants were briefed on the project and interviews with a general information sheet (see Appendix B) and they were requested to complete a pre-interview data sheet (see Appendix C). The pre-interview data sheet was used to lead conversations;

Phase II: An online survey in which two metrics were assessed for seven different standards (identified during Phase I) by 160 respondends.

2.1 Phase I participants

The following organizations participated in Phase I: Chevron, ExxonMobil, BP and Suncor. Shell participated by sharing some previous work that was done on this subject to use (in some respects) as a building block for this work. More organizations were invited to participate or even agreed to participate but for a variety of reasons and constrains only the ones listed contributed. A total of 30 individuals participated in Phase I.

2.2 Phase II participants

Phase II consisted of 160 participants from a total of 56 companies. The requested participating companies were (in alphabetical order):

Aibel, ANCAP, Anschutz Exploration Corporation, ANTS GeoConsulting Pty Ltd, Apache Corp, Aramco, Arrow Energy, BHP, BP, BPX Energy, Cenovus, Cepsa, CEPSA EP, Chevron, Chevron Canada, CNOOC Uganda Limited, COGCC, Continental Houston, DATAVEDIK, DNV GL, Encana Oil and Gas, Ecopetrol, EnerVest Operating, LLC, Eni, EniProgetti, EnQuest, Equinor, Equinor ASA, ExxonMobil, geoLOGIC system ltd., Geomatic Solutions, Halliburton, Infosys, IntegraShare Dimensions, Inc., Kraken IM, NOPSEMA, Occidental Oil and Gas Corp., OPRAL Ltd, P2 Energy Solutions, Petróleos de Venezuela S.A. (PDVSA), Petrosys USA, REC Advantage, Redfish Research, llc, REPSOL, Saipem, Santos Ltd, Saudi Aramco, Shell, Shell & INPEX, Suncor, Suncor Energy, TECO, Universidad Nacional de Colombia, US Bureau of Land Management, Vår Energi and Vår Energi AS.

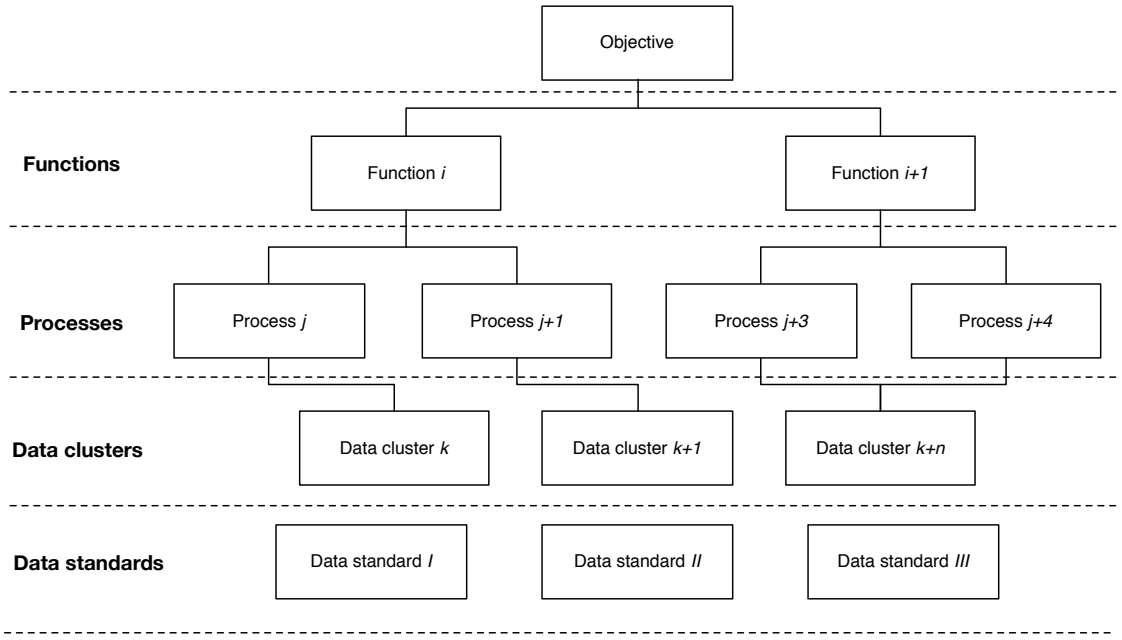


Figure 1. Functions, processes, data clusters and data standards

In the description of Phase II, the online survey (Section 4), more information is provided on qualifying companies and individuals.

3 Architecture

The original intention was to derive the most appropriate general architecture depicting functions, processes, data clusters and their associated data standards, to eventually arrive at something similar to the conceptual architecture in Figure 1.

Participants were asked in the pre-interview data sheets (see Appendix C) to provide their understanding of the layout and architecture of functions, processes, data clusters and data standards. This resulted in widely varying responses that were often difficult to interpret independently. Below are examples of some of the responses received through the pre-interview data sheets in Figure 2.

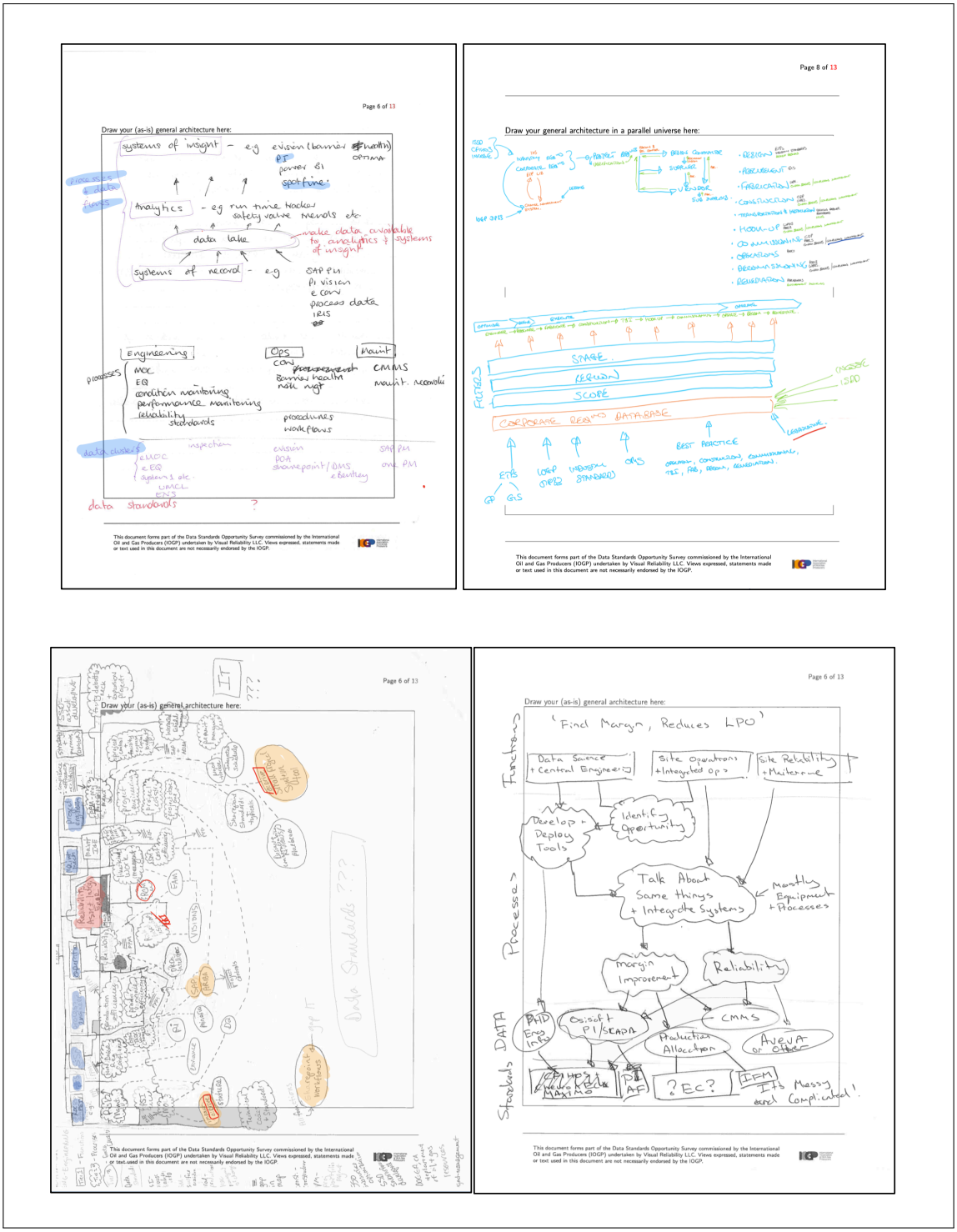


Figure 2. Examples of architectures received through the pre-interview data sheets

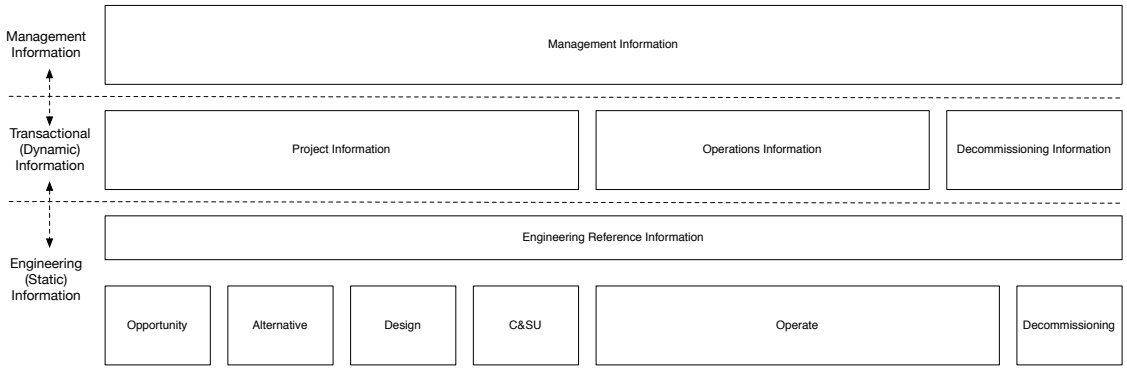


Figure 3. Generic high-level data architecture (POSC Caesar)

During interviews, the responses of participants were evaluated against a list of approximately 80 functional areas and processes shown in Table D1. This list was compiled from many different organizations and used as a point of departure in conversations with participants.

After many one-on-one interviews and a multi-day workshop with one organization with eight participants, it was concluded that given the scope of this survey, the time constraints and its ultimate objective, it was not feasible to develop an architecture from the ground up based on the common views from participants. Following this, the angle of attack was altered to propose the reasonably well known and recognized high level data architecture used by the Petrotechnical Open Software Corporation Caesar Project, i.e. POSC Caesar[1], to participants to discuss their particular views of standards and prioritization of standards against the POSC Caesar architecture. This decision was a productive one and provided sufficient clarity and direction to conversations to lead to the major deliverable of this project, i.e. a ranking of data standards in terms of importance by senior industry professionals.

Thus, the POSC Caesar architecture as shown in Figure 3 is considered to be a sufficient summary of the understanding of participants of the data architecture in industry and will be used as a basis to illustrate the impact areas of the prioritized standards (derived in sections to follow).

4 Prioritizing the list of standards

During interviews with participants on standards in Phase I (as well as in their pre-interview information sheets – see Appendix C, Section 4 and 5), many potential standards were brought up including: a 3D model Design Data Standard, a 3D scanning and photogrammetry standard, Capital cost and planning Data Standard, Civil Engineering Data Specification, Construction Management Data Standard,

[1]See https://en.wikipedia.org/wiki/POSC_Caesar for more information.

Corrosion Management Data Standard, Electrical Design Data Standard, Equipment and Spare Parts Data Specification, Instrument Design Data Standard, Maintenance execution performance data standard, Material coding and classification data standard , Materials Logistics Data Standard, Materials Procurement , Process and Instrumentation Diagram (P andID) Data Standard , Process Design Data Standard, Process Flowsheet Data Standard, Project Information Handover Specification, Requirements Management, Risk and barriers management, Rules of credit for engineering design standard, Standard for equipment configuration management data (IOT), Standard for Maintenance Task List and Library Plans, and Vendor Data and Document Requirements Standard.

Participants were asked to use estimate the inherent value of any particular standard and also estimate how long the return on investment in a standard will be. Based on this information the list above was reduced to seven standards. These standards are summarized in Table 1. The associated definitions were derived from discussions with participants and previous work on any particular subject.

Table 1. Data standards identified in Phase I

Nr	Generic standard name	Short description
1.	3D model standard	A standard for structuring 3D model data to support design, procurement, construction management and corrosion management and other asset management purposes. This will make 3D models consistent and interchangeable.
2.	Project Information Handover Specification	A specification for definitions against which Engineering, Procurement and Construction (EPC) contractors and Module Suppliers shall deliver information to Owner Operators to manage project delivery and reduce the need to reclassify, reformat and rework the documents and data at handover points during the project life cycle. During the course of interviews it became clear that such a standard should extend across the entire asset life cycle. It is therefore suggested that this definition is too narrow.

3.	Vendor Data and Document Requirements Standard	A standard for vendor data and document requirements to be furnished by equipment suppliers by equipment class. The scope includes off the shelf, engineered and packaged equipment (i.e. collections of standard equipment classes).
4.	Capital Cost and Planning Data Standard	A hierarchical classification of project costs according to scope, activities and resources . It allows dissecting of e.g. cost data according to different dimensions what was built, activities carried out and manhours / materials consumed. Creates foundation for consistent estimating, benchmarking and actual cost vs budget tracking.
5.	Materials Procurement	A specification for materials procurement to facilitate e-procurement, for Invoicing, Payment, Pricing, Purchase Order Documentation, Prequalification, Service Delivery Management and Data Transfer Protocols
6.	Equipment and Spare Parts Data Specification	For gathering equipment and spare parts information from equipment manufacturers or suppliers, followed by review of the data, processing and enrichment of the information and preparation to transform that data to BOMs.
7.	Equipment Reliability Data	A standard for consistent capture of equipment reliability data. Scope includes equipment data, failure data and maintenance data required for reliability and failure analyses such as FMEA, root cause analysis, etc.

It is important to note that generic names were used to describe the standards. A deliberate decision was made not to attach the name of an established standard or a standard under development to any particular standard in the list because that might create a bias with respondents.

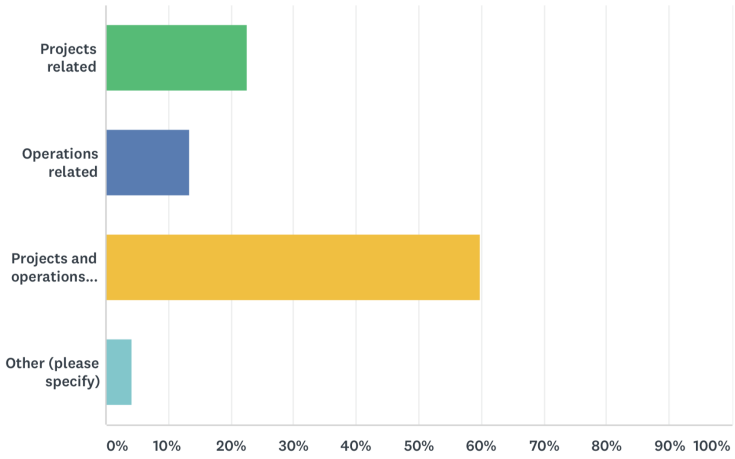
The identified data standards formed the basis of an online survey sent to industry professionals to assess their opinion of the value of any proposed standard. The details of this survey is discussed in the next section.

4.1 Online survey

Designing any survey is a careful balancing act between obtaining valuable information and securing a decent sample size. Since the online survey would rely 100% on industry professionals to participate voluntarily and anonymously, significant care was taken in the design of the survey to ensure that the completion time was less than 10 minutes. It is accepted in literature that voluntary responses to anonymous surveys reduce by 90% if the completion time is over 10 minutes. With these factors in mind, the basic structure of the online survey was as follows:

1. Demographic information
   1.1. Region (dropdown with major regions for assessing geographical representation)
   2.2. Discipline (free text for confirming the respondent's relevance)
   3.3. Asset Phase (dropdown list with options "Projects", "Operations", "Projects and Operations" or "Other')
   4.4. Role (free text for confirming the respondent's relevance)
   5.5. Years of experience in the industry (free text for confirming the respondent's relevance)
2. Technical information about each of the seven identified standards
   2.1. An estimate of the standard's influence on project delivery time (dropdown list from -10% or less to +10% or more in increments of 2%)
   2.2. An estimate of the standard's influence on asset availability post project delivery (dropdown list from -10% or less to +10% or more in increments of 2%)

Surveymonkey.com was used as the online platform to collect the survey responses. The average response time was 8 minutes and 5 seconds for 164 respondents. The full survey with its summarized results are available in Appendix E and will not be discussed in detail. However, the distribution of responses to the question related to "Asset Phase" needs to be reviewed. Figure 4 shows the split on this question. It is hypothesized that respondents involved in the project phase of the asset life cycle will be biased towards standards benefiting that phase. The same argument goes for operations. A total of 22% of respondents were only involved in the project phase, 13% only involved in the operations phase and 60% is both the project and operations phases. The analysis of the responses to the technical questions, i.e. the perceived effect of any particular standard on project delivery time and asset availability, will be stratified by the response to the question on "Asset Phase" as well as the overall response to the question.



ANSWER CHOICES	RESPONSES	
Projects related	22.56%	37
Operations related	13.41%	22
Projects and operations related	59.76%	98
Other (please specify)	4.27%	7
TOTAL		164

Figure 4. Response to the question on "Asset Phase"

4.2 Ranking method

A brief description of the analysis and ranking is presented in this section. The description of the analysis and ranking is not nearly comprehensive enough to withstand academic scrutiny on its own but the actual work done is completely defensible. More information is available on request and on an ad hoc basis.

Suppose only the technical responses to the "3D model standard" described in Table 1 are considered for illustrative purposes. The steps used are summarized as follows:

Step 1: Qualify the responses based on discipline, role and years of experience. For example, the data obtained from a respondent that is a delivery truck driver for a contracting company with many years of experience (as a truck driver) would be eliminated from the data set;

Step 2: Eliminate outliers through density based spatial clustering, extreme value analysis and isolation forests;

Step 3: Review the data in two dimensions, as shown in Figure 5. A distribution has to be fitted over this data set since it is clearly not normally distributed and a simple mean and standard deviation would be misleading. In addition, the maximum values of the data set recorded under "10% or more" are so-called "suspended observations", i.e. we know that respondents thought the effect

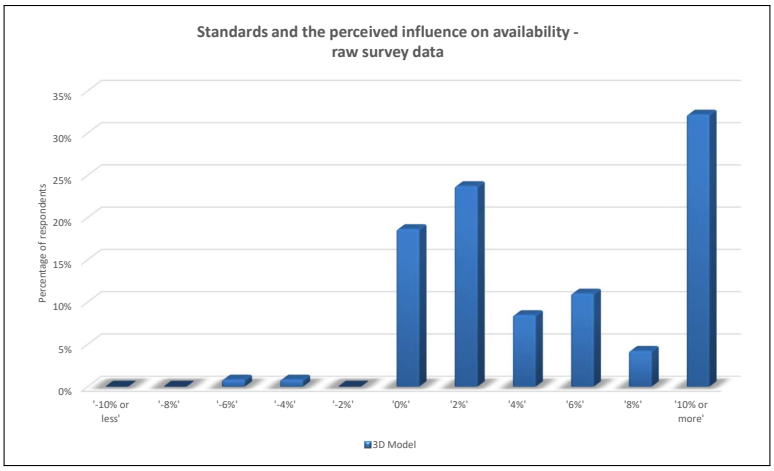


Figure 5. Perceived effect of the 3D Model standard only on availability

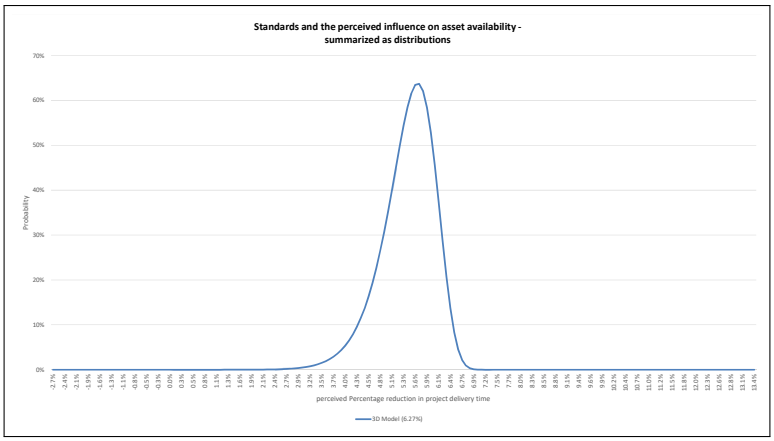


Figure 6. Perceived effect of the 3D Model standard only on availability represented by a Weibull distribution

would be at least 10% but it could be more. These data points should be treated as such in a continuous distribution.

Step 4: Fit a distribution with sufficient flexibility to the data (while dealing with suspended observations) and test for an acceptable fit with the Kolmogorov-Smirnov goodness-of-fit test. All the data passed the goodness-of-fit test using a two parameter Weibull distribution. Figure 6 shows a two parameter Weibull distribution representing the data collected on the 3D Model standard (as it pertains to the effect of availability);

Step 5: Use the scale parameter of the Weibull distribution, i.e. the point in the distribution that represents 63% of observations, as the ranking percentage for any particular standard. This ranking percentage will be referred to as the "Weighted Score"and will determine the relative

ranking of the 7 standards. For the 3D Model standard, the weighted score was 6.27%, i.e. the respondents believed the effect of the 3D Model standard on availability is an improvement of 6.27%.

In sections to follow, the ranking method described above will be performed on the data received for the effect of standards on project delivery time and asset availability, for (a) respondents involved in projects only; (b) respondents involved in operations only; and (c) for all respondents.

4.3 Delivery time

The ranking method described in Section 4.2 was applied to the data received from respondents on the perceived effect on delivery time and it is summarized in Table 3.

Table 2. Standards and their perceived effect on project delivery

	Respondents involved in projects (36)		Respondents involved in operations (21)		All respondents (162)	
Standard	**Rank**	**Weighted score**	**Rank**	**Weighted score**	**Rank**	**Weighted score**
Project Info Handover Spec	1	9.01%	1	9.26%	1	8.26%
Vendor Data and Req	2	8.76%	2	8.76%	2	7.96%
3D Model	7	8.11%	3	8.71%	3	7.60%
Materials Procurement	4	8.56%	3	8.71%	4	7.28%
Equipment and Spare parts	2	8.76%	5	8.31%	5	6.10%
Capital Cost and Planning	5	8.46%	6	7.71%	6	5.71%
Equipment Reliability	6	8.36%	7	7.26%	7	5.36%

Table 2 is shown graphically in Figure 7. The graph shows the relative differences between the groups.

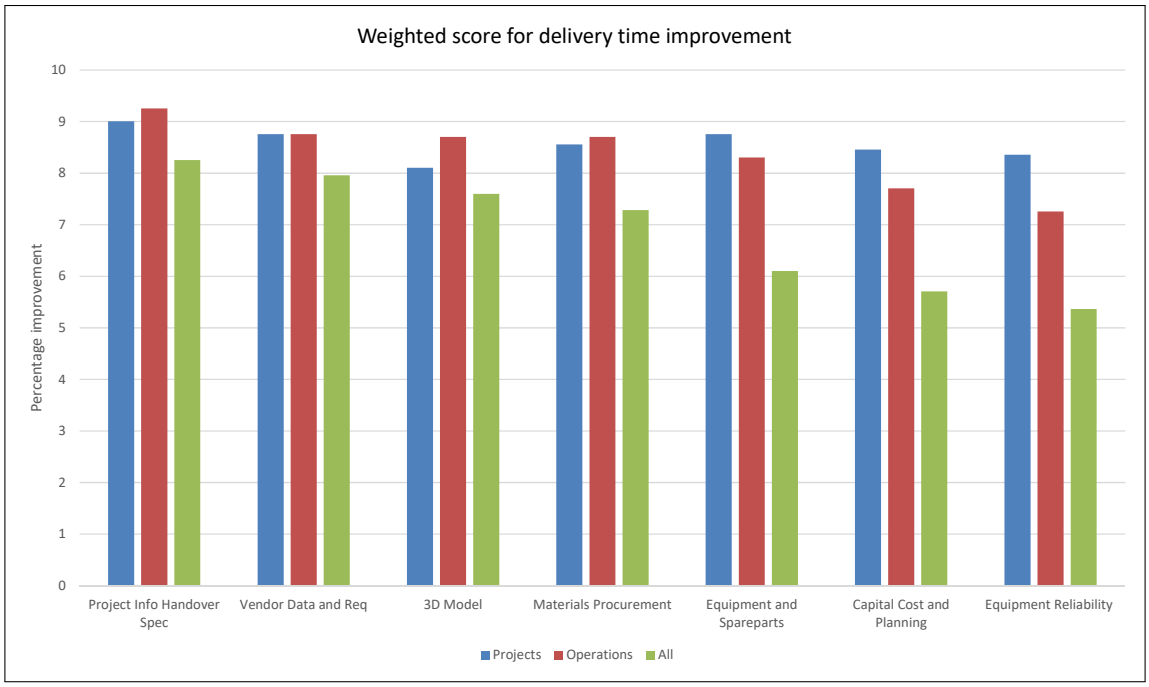


Figure 7. Perceived effect of standards on project delivery ordered by groups

In addition, to better understand the spread of the responses and its corresponding distributions, Figures 8 and 9 are provided below.

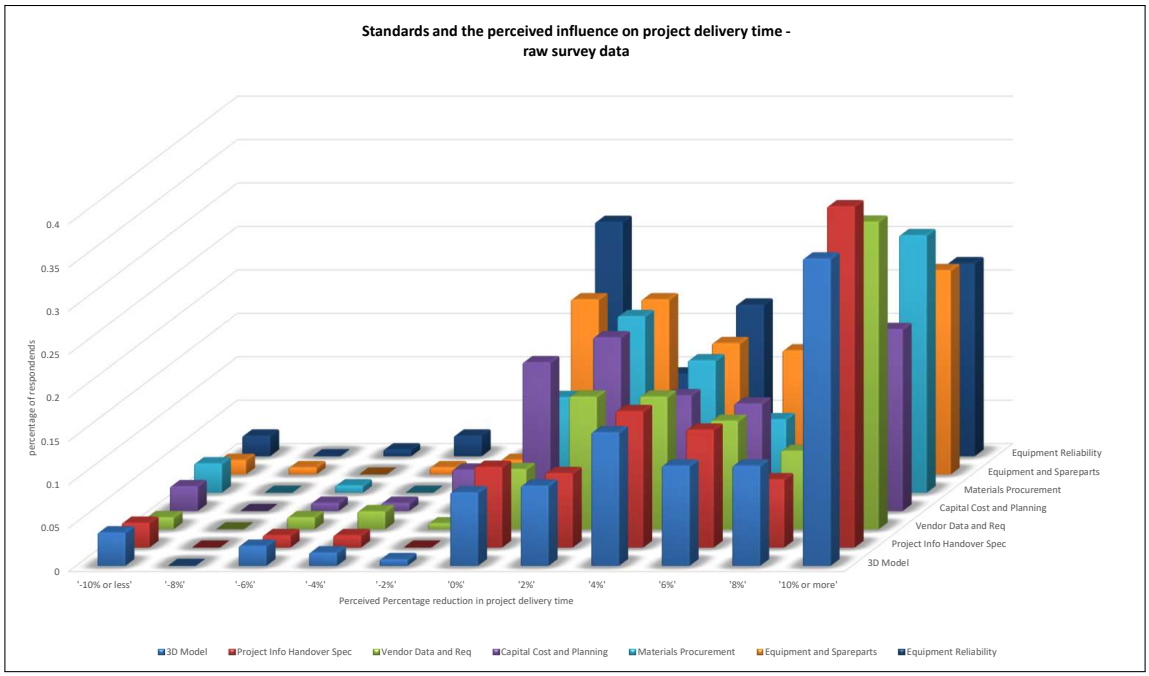


Figure 8. Raw data of standards and their perceived effect on project delivery

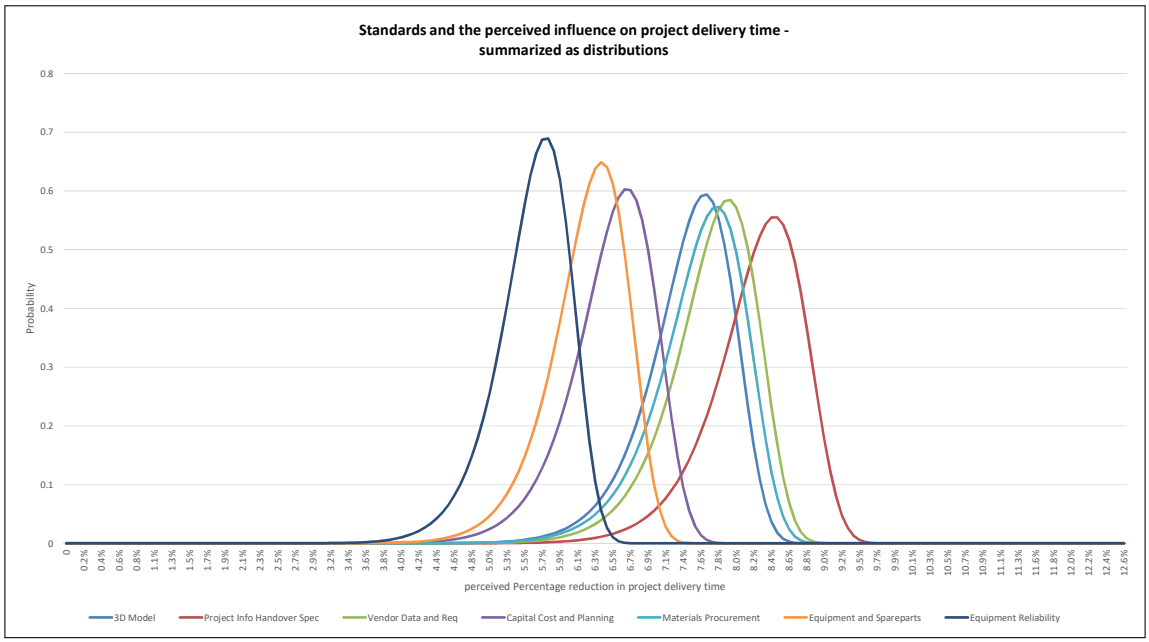


Figure 9. Standards and their perceived effect on project delivery represented as distributions

4.4 Availability

The ranking method described in Section 4.2 was applied to the data received from respondents on the perceived effect on availability and it is summarized in Table 3.

Table 3. Standards and their perceived effect on availability

	Respondents involved in projects (36)		Respondents involved in operations (21)		All respondents (162)	
Standard	**Rank**	**Weighted score**	**Rank**	**Weighted score**	**Rank**	**Weighted score**
Project Info Handover Spec	1	7.42%	2	8.12%	1	7.57%
Equipment Reliability	2	7.33%	1	8.38%	2	7.53%
Vendor Data and Req.	4	7.22%	4	6.37%	3	7.17%
Equipment and Spare parts	3	7.25%	6	6.20%	4	7.15%
Materials Procurement	5	6.87%	5	6.32%	5	6.52%
3D Model	6	5.92%	3	6.82%	6	6.27%
Capital Cost and Planning	7	4.73%	7	4.68%	7	4.73%

Table 3 is shown graphically in Figure 10. The graph shows the relative differences between the groups.

Figure 10. Perceived effect of standards on availability ordered by groups

In addition, to better understand the spread of the responses and its corresponding distributions, Figures 11 and 12 are provided below.

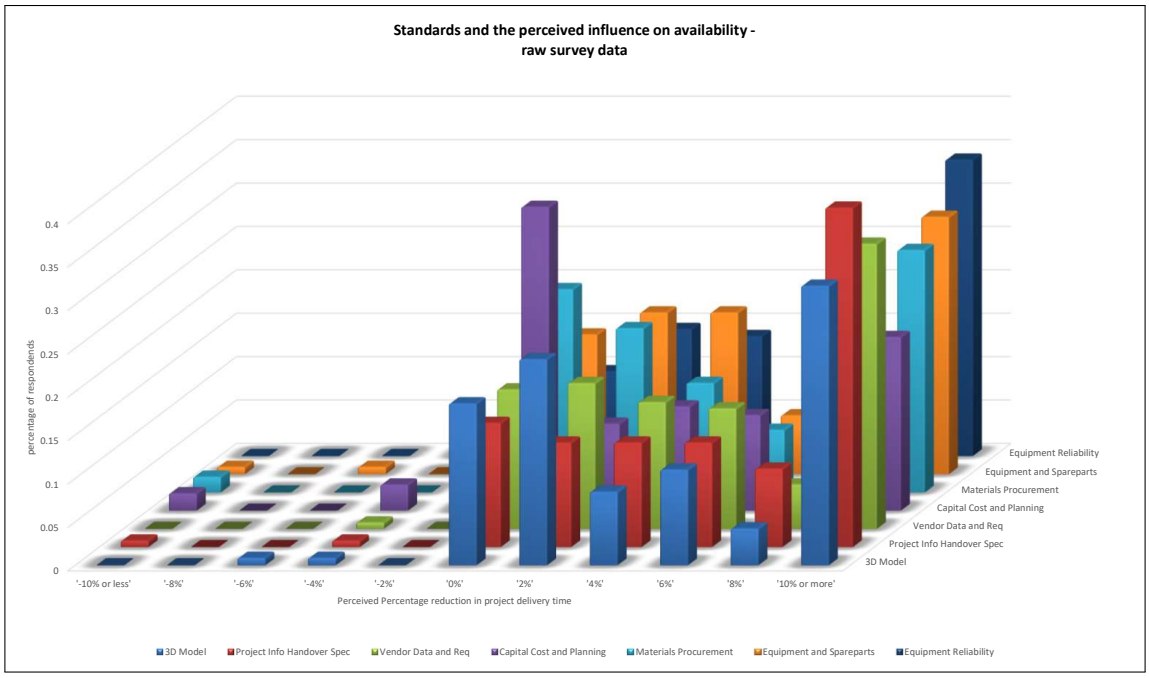


Figure 11. Raw data of standards and their perceived effect on availability

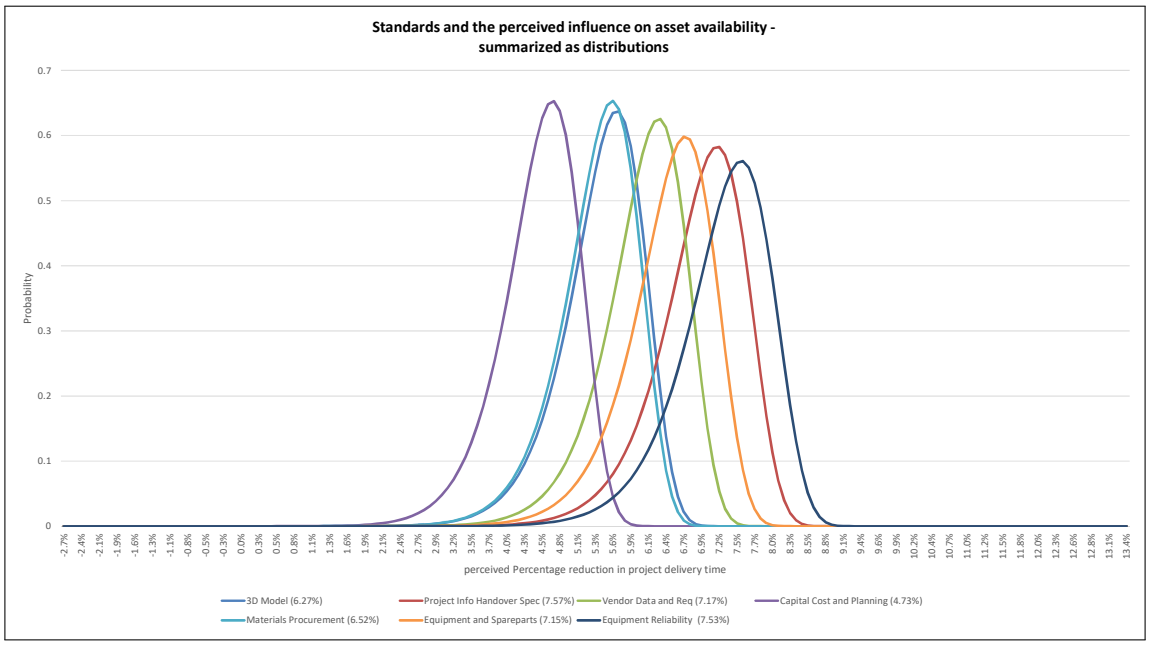


Figure 12. Standards and their perceived effect on availability represented as distributions

4.5 Notes about the analytical results

The outcome of this exercise is as vulnerable to sample size, sample selection, question formulation (leading vs lagging questions), statistical error and bias as any other survey and that is how the results should be interpreted. The scope and constraints of this survey did not allow for refining some of these well known factors. With that said, herewith some notes about the results of the previous sections:

(a) Very few respondents were of the opinion that standards (any of the seven) would have a negative impact on project delivery or availability;
(b) The rankings are fairly close to each other and with a sample size of 162 respondents for example, ranking one standard above the other if there is, for example, only a difference of 0.05% between them, is academic. This narrow difference is significant in itself.
(c) The suspended nature of the data (the fact that the highest score participants could give was "10% or more" and not an absolute number) may make the results much more conservative than reality.

5 Noteworthy observations

During personal interviews with participants, several common themes were identified which may be useful to report even though it wasn't part of the scope of the project. These themes are listed below with no further evidence in the hope that it might support a parallel narrative of sorts that may be under way:

(1) There is not enough opportunity to articulate data standards needs;
(2) Organizational readiness for standards should not be underemphasized as a key success factor for standards implementation;
(3) Analytics suffer severely because of poor data standards and poor data. Respondents typically assessed the level of analytics in their environment at a 3/10 and thought this could be increased to a 8/10 with better data standards (and accompanying data);
(4) Willful violations of data standards in practice are relatively rare – the issue most of the time is a lack of awareness of data standards and the value that it provides;
(5) If standards are not structured to show a return on investment in 5 to 7 years it is unlikely to be supported widely in industry;
(6) Most respondents were well aware of CFIHOS for several years. Many expressed a concern that unless there is wide adoption and implementation, the momentum might decay and it will eventually go out of focus.

6 Conclusion

A total of 30 senior oil and gas professionals were interviewed to (1) develop a high level data standards architecture for the oil and gas industry; and (2) to develop a short list of data standards with high potential. The POSC Caesar data standards architecture (repeated below as Figure 13), was accepted as a sufficient summary of data standards architecture in industry.

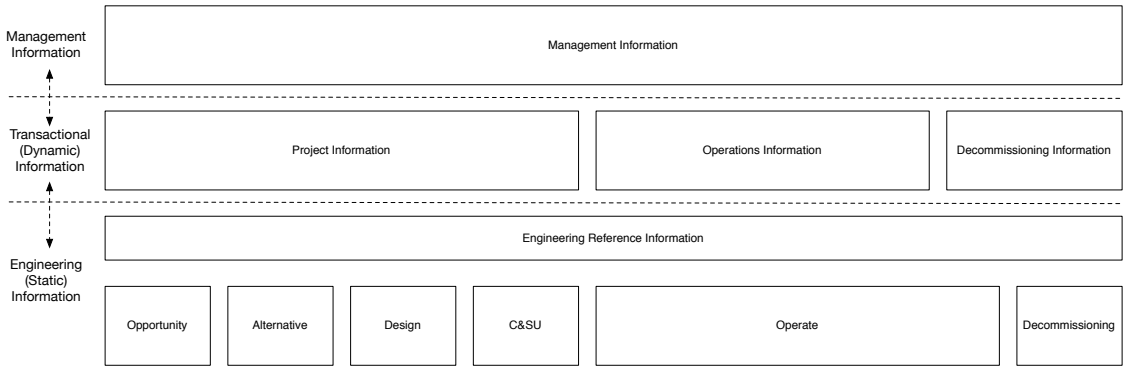


Figure 13. Generic high-level data architecture (POSC Caesar) (repeated)

Seven standards were identified from the high-level data architecture out of a list of 24. The seven standards were:

(1) 3D Model standard
(2) Capital Cost and Planning standard
(3) Equipment and Spare parts standard
(4) Equipment Reliability standard
(5) Materials Procurement standard
(6) Project Info Handover Specification standard
(7) Vendor Data and Requirements standard

An online survey undertaken by 162 qualified participants was used to rank the standards in terms of (1) effect on project delivery time; and (2) effect on asset availability once in operation. The overall ranking of the seven standards in terms of their perceived effect on project delivery time was:

(1) Project Info Handover Specification standard
(2) Vendor Data and Requirements standard
(3) 3D Model standard
(4) Materials Procurement standard
(5) Equipment and Spare parts standard
(6) Capital Cost and Planning standard
(7) Equipment Reliability standard

The overall ranking of the seven standards in terms of their perceived effect on asset availability was:

(1) Project Info Handover Specification standard
(2) Equipment Reliability standard
(3) Vendor Data and Requirements standard
(4) Equipment and Spare parts standard
(5) Materials Procurement standard
(6) 3D Model standard
(7) Capital Cost and Planning standard

Care should be taken to view these rankings in isolation because of the normal pitfalls of surveys discussed in this document.

It was also necessary to illustrate the impact areas of the standards on the generic high-level data standards architecture. This will only be done for the top three standards in terms of both project delivery time and asset availability. Figure 14 below shows the impact areas overlaid on the generic architecture.

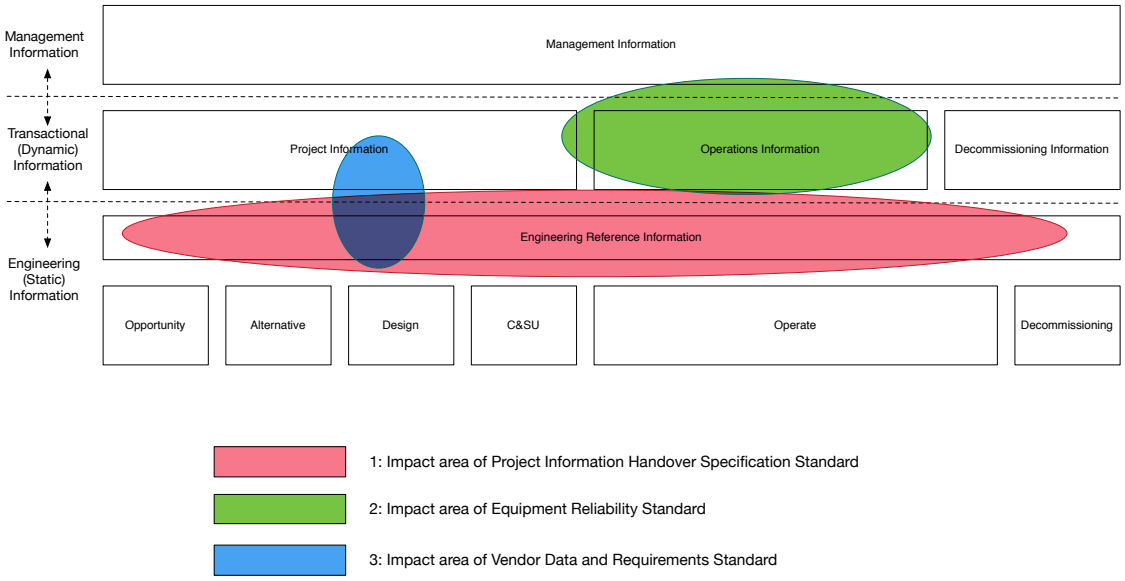


Figure 14. Generic architecture with impact of standards overlaid

End.

Appendix A: Terms of reference

DATA STANDARDS OPPORTUNITY SURVEY

TERMS OF REFERENCE

OVERVIEW

The Standards Committee within the IOGP promotes consistency, efficiency and effectiveness within the global upstream oil and gas industry. It deems digitization as a strategic enabler of this objective and is initiating the development of a Digitization Vision and Strategy. In support of this drive, the IOGP Information Standards Sub Committee (ISSC) is responsible within IOGP for data standards and intends advising its members towards the most valuable information and data standard opportunities. The guidance will be based on evidence harvested from selected respondents in the oil and gas industry through a combination of interviews and surveys. To provide guidance to this initiative, a generic industry-level survey will be conducted of selected Operating Companies (OpCos), allowing an architecture of processes in oil and gas production to be derived. In addition, the survey will identify the data clusters that enable processes, together with their associated data standard opportunities. It is hypothesized that information harvested from respondents based on the generic architecture of processes would provide sufficient evidence for a high-level prioritization of focus areas on data standards. The insights revealed by this survey will also put the IOGP in a position to decide on the needs and priorities of data standards for our industry.

OBJECTIVES

This survey will engage selected respondents in the oil and gas industry with the following objectives:

1. To formulate a generic, industry-level architecture of processes, enabling data clusters and associated standard requirements;
2. To collect evidence to guide a high-level prioritization of data standards focus areas. Evidence could be expressed in organizational maturity, organizational readiness, opportunity value, business climate and/or any other meaningful metric;
3. To develop insight into how these focus areas can cause an accelerated industry-wide digitization drive;
4. Gain feedback on the methodology and approach, together with lessons learned during the conduct of the survey.

SCOPE

The implicit scope of this work is limited to physical surface facilities, and all related processes and data clusters. The scope is further discussed from the viewpoints outlined below.

Organization

The survey is focused exclusively on a representative sample of Operating Companies (OpCo's), since this is where the demand and expense, and therefore the ultimate value, for the oil and gas industry lies.

Functions

Within OpCo's the target respondent population is ultimately decided by each OpCo. ISSC recommends that most of the following functions are included into the respondent population:

- Organizational Entities: Major Capital Project, Operating Assets, Decommissioning Teams, Information Technology, Information Management

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- Major Capital Projects: Selected Engineers and management at all levels for the listed Disciplines.
- Operating Assets: Selected Operations and Maintenance Leaders, Engineers, and Management for the listed Disciplines.

Life Cycle Phase

Participants deployed in all phases of the asset lifecycle are required, i.e. Project Phases, Operating Phase and Decommissioning Phase.

Geography

The survey will be done in two parts. In the first part of the survey, OpCos with significant presence in Houston, Texas are targeted. This will enable the arrangement of face-to face meetings, whether in focus group or structured interview formats. The individual meetings will enable the development of sufficient context on the part of the Consultant to conduct the second part.

SURVEY DESIGN

For the first part, the following OpCo's will be interviewed face-to-face in Houston:

- CVX
- XOM
- Equinor

The second part is conducted via videoconference to keep costs down, while still harvesting information of adequate quality. For this phase, the following OpCo's are targeted:

- BP
- Total
- Suncor
- Woodside

The scope of the engagements with respondents as part of the surveys is anticipated to be as follows:

1. Completion of short questionnaires by the interviewees before or after the interview to capture contextual information;
2. Interviews, face-to-face or via videoconference, with individuals familiar with the industry and data standards in the disciplines listed above. More details about the selection and number of people are provided under Logistic Considerations;
3. Ad-hoc follow up telephonic conversation post interviews.

Engagements will be designed to take up less than 3 hours of any respondent's time.

LOGISTIC CONSIDERATIONS

Inefficient logistics can have a significant adverse effect on survey results and logistics of the survey should be meticulously planned. Quality delivery is highly contingent upon management sponsorship inside the OpCo. Accordingly, the following arrangements are foreseen:

DATA STANDARDS OPPORTUNITY SURVEY

TERMS OF REFERENCE

- The ISSC should facilitate the management sponsorship before any engagement with respondents;
- Every OpCo should nominate a coordinator inside the organization to work with the Consultant;
- Inputs from many disciplines are ideal but it would be impractical for a limited-scope interview-based survey to have representatives of all disciplines. It is required to work with the OpCo before interviews to select small sensible groups of various disciplines for interviews;
- Respondent groups for survey interviews done via video conference will probably be smaller than for physical interviews but will have to be resolved with the coordinator inside the OpCo.

CONFIDENTIALITY

Due to the potential competitive advantage of survey responses to individual Opco's, the primary data set of the survey is held by an ISSC approved, trusted and neutral 3rd party operating under an NDA. Summary reports are provided to the IOGP disclosing survey results without identifying the identities of individual OpCo's.

Participation is voluntary to ensure unbiased results. The demographic variables (Org Entity, Geography and Discipline) are provided but the identity of the individual respondent is not revealed.

The respondent primary data is held by the third party for a period of one year, after which it is discarded.

DELIVERABLE

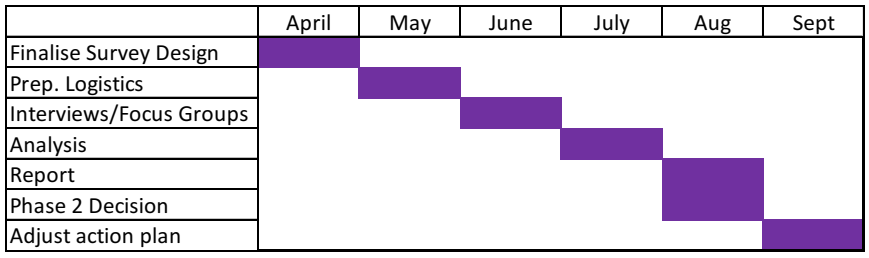
The outcome of this project will be delivered as a report containing three major facets:

1. A generic, industry-level architecture of processes, enabling data clusters and associated standard requirements based on the information gathered in the survey;
2. An evidence-based, high-level prioritization of data standards focus areas, together with sufficient supporting evidence to make initial prioritization decisions; and a recommendation for the standard organization(s) to do develop the standard(s).

SCHEDULE

The expected schedule, assuming no approval or OpCo respondent delays, is as follows:

Subject to no approval delays, work is planned to start on or around May 13, 2019.



DATA STANDARDS OPPORTUNITY SURVEY

TERMS OF REFERENCE

COST

The approved budget for the survey is USD 25k.

APPROVAL

Richard Mortimer Date: May 17, 2019

Standards Committee Chair

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Appendix B: Generic introduction to DSOS

The IOGP Data Standards Opportunity Survey (DSOS)

General information

May 29, 2019

This document aims to provide information about the DSOS to coordinators and sponsors inside participating organizations.

1 What is it in principle?

The Standards Committee within the IOGP promotes consistency, efficiency and effectiveness within the global upstream oil and gas industry. It deems digitization as a strategic enabler of this objective and is initiating the development of a Digitization Vision and Strategy. In support of this drive, the IOGP Information Standards Sub Committee (ISSC) is responsible within IOGP for data standards and intends advising its members towards the most valuable information and data standard opportunities. The guidance will be based on evidence harvested from selected respondents in the oil and gas industry through a combination of interviews and surveys. To provide guidance to this initiative, a generic industry-level survey will be conducted of selected Operating Companies (OpCos), allowing an architecture of processes in oil and gas production to be derived. In addition, the survey will identify the data clusters that enable processes, together with their associated data standard opportunities. It is hypothesized that information harvested from respondents based on the generic architecture of processes would provide sufficient evidence for a high-level prioritization of focus areas on data standards. The insights revealed by this survey will also put the IOGP in a position to decide on the needs and priorities of data standards for our industry.

2 Key Objectives

Two key objectives are pursued in the DSOS:

(i) To formulate a generic, industry-level architecture of processes, enabling data clusters and associated standard requirements; and

(ii) To collect evidence to guide a high-level prioritization of data standards focus areas. Evidence could be expressed in organizational maturity, organizational readiness, opportunity value, business climate and/or any other meaningful metric;

There are additional secondary objectives for the study which falls outside the scope of this document.

3 Scope and content of the survey

The implicit scope of this work is limited to physical surface facilities, physical assets, and all related processes and data clusters.

4 Survey participant profiles

Participants in the exercise will have to be selected by OpCo coordinators in a pragmatic manner to stay within the constraints of the DSOS and adhere to time lines. Some guidelines on participant selection are provided below.

It is recommended that that most of functions below are included in the respondent population. In cases where it makes sense, different functions can be represented by the same individual:

(i) Organizational Entities: Major Capital Projects, Operating Assets, Decommissioning Teams, Information Technology, Information Management

(ii) Major Capital Projects: Selected Engineers and management at all levels for the listed Disciplines.

(iii) Operating Assets: Selected Operations and Maintenance Leaders, Engineers, and Management for the listed Disciplines.

Participants deployed in all phases of the asset lifecycle are required, i.e. Project Phases, Operating Phase and Decommissioning Phase.

5 Time commitments required from participants

Participants will be stretched for time more often than not and any engagement with participants will be very sensitive to this.

In principle, there will be three different engagements over a period of a few weeks with participants (this may be altered somewhat where it makes sense):

(i) Completion of short questionnaires by the interviewees before or after the interview to capture contextual information and to create the basis for a discussion (45 to 60 minutes required);

(ii) Interviews, face-to-face or via videoconference, with participants (90 minutes required); and

(iii) Ad-hoc follow up telephonic or email conversation post interviews (15 minutes required).

Not all participants will be interviewed individually. Some participants will be interviewed in small groups where it makes sense.

6 Confidentiality

Due to the potential competitive advantage of survey responses to individual OpCos, the primary data set of the survey is held by an ISSC approved, trusted and neutral 3rd party operating under an NDA. Summary reports are provided to the IOGP disclosing survey results without identifying the identities of participants or individual OpCos.

The respondent primary data is held by the third party for a period of one year, after which it is discarded.

7 High level sponsorship

It is strongly advised that coordinators obtain high level sponsorship for the survey to encourage participants to contribute.

8 Schedule

Below is a very basic schedule of activities for the next several weeks.

Dates	**Activity**
Today to June 7th 2019	Identification and briefing of sponsor, identification and prepping of participants, broad scheduling of interactions with participants
June 10th to Aug 2nd	Engagement with participants: pre-interview information gathering, interviews, post-interview engagements
Aug 30th	Final report of findings delivered to the IOGP

9 Contact information

For any further information related to the DSOS, contact:

PJ Vlok
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eMail: pjvlok@visualreliability.com
Skype: pjvlok

LinkedIn: https://www.linkedin.com/in/pj-vlok-783aa836/

End.

Appendix C: DSOS pre-interview data collection sheet

IOGP Data Standards Opportunity Survey (DSOS)

Pre-interview data collection sheet

Participant briefing and instructions:

1. Thank you for making yourself available to provide your input on this!
2. There is no right or wrong answer in this document. Simply provide us with your understanding of, or opinion on, any particular concept and we will use this as the basis for a physical conversation later.
3. Any information that you disclose as part of this process will be treated confidential to your organization, i.e. no information will be shared outside of your organization. There is an NDP in place via the IOGP that prohibits sharing of any company documents.
4. If you have standard company information available such as illustrations, slides or documents, that could help you communicate your answers to the questions in the survey, please share those as part of your response.
5. To complete this document should take you around 45 minutes to 1 hour. Thank you again for investing the time!
6. Once you have completed the document, please scan it in and return it to your coordinator.

This document starts off with the background to the study and its objective and then gets into the actual questions and information requests.

Background and contextualization

The Standards Committee within the IOGP promotes consistency, efficiency and effectiveness within the global upstream oil and gas industry. It intends to advise its members towards the most valuable information and data standard opportunities. The guidance will be based on evidence harvested from selected participants (you) in the oil and gas industry through a combination of interviews, surveys and questionnaires.

Step 1 is to understand your organization's general architecture of functions, processes, enabling data clusters and associated data standard requirements. Along the way, we would also like to pick up on the terminology that you use.

Step 2 would be to prioritize opportunities that data standards (as described in Step 1) might offer. For this prioritization we will need some "evidence". *Evidence* in this should be some sort of business case, for example, productivity improvement, enhanced efficiency, new markets, improved morale, etc. Evidence will not be collected in this document but rather in the actual interviews.

We are repeating the same exercise at several different companies and the intention is to have a generic architecture of functions, processes, enabling data clusters and associated standard requirements that represent the majority of organization but also to have a prioritized list of data standards opportunities based on all the evidence collected. The IOGP will communicate these findings to the industry over time.

1 Participant details

Please complete the information in the space provided below to help us to understand your background better:

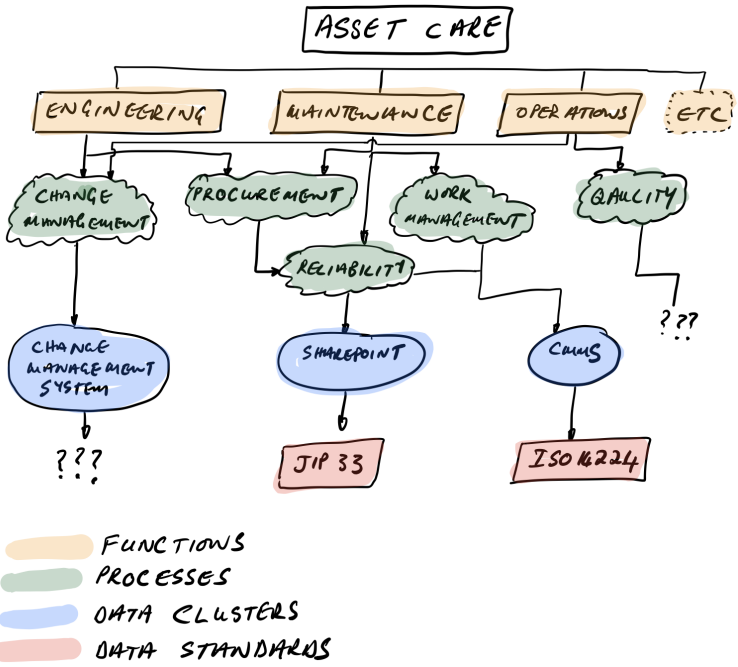
Full name:	
eMail:	
Job title:	
Number of years with the company:	
Number of years in the industry:	

Where do you spend most of your time in the asset life cycle, i.e. C&SU, operations, decommissioning, etc.?

2 General architecture – as is

We would like to capture your summarized understanding of the general architecture of processes in your organization, as it is right now, in this section. Read the guidelines below and use the space provided to document your answers.

1. Structure your description into four main tiers: functions, processes, data clusters and data standards.
2. Focus your description of the functions that affects physical assets in the following disciplines: Mechanical, Electrical, Instrumentation, Planning/Scheduling, Cost Control, Operations/Maintenance, Process/Production Engineering, Information Management and/or Supply Chain Management. You don't have to include all these disciplines in your description and feel free to add more if you think it is important.
3. Draw your summary schematically, similar to the oversimplified example below:



4. Feel free to create your summary freehand or by using drawing software. If you are going to do it by hand, there is space provided below for notes and an empty box on the next page that

you can use for your overall summary.

Draw your (as-is) general architecture here:

3 General architecture of processes – parallel universe

Suppose you have an opportunity to redesign and/or reconfigure the layout, grouping and relationships of the functions, processes, data clusters and data standards that you have summarized in the previous section, from scratch. You also have the luxury to invent new data clusters or data standards, e.g. a universal oil and gas asset naming convention standard or a self-updating data cluster.

Use the empty box on the next page to draw the layout of the functions, processes, data clusters and data standards in your organization in a parallel universe which will solve some of the inefficiencies known to you. Please prove cryptic notes on the lines below on why you have included any "revolutionary" ideas in your layout.

Draw your general architecture in a parallel universe here:

4 Short term investment into a data standard

Suppose you are given $1m today to invest in any three data standards that you have listed in your as-is layout or your parallel universe layout. You can divide the money in any proportions that you want and the wisdom of your investment decisions will be judged in one calendar year from now. There is an upside – you can choose the metric in which you are measured, e.g. you can choose to invest in ISO 14224 and elect to have your success measured in "percentage reduction in downtime due to correct spares in spares warehouse".

Investment 1	
Data standard:	
Investment amount:	
Metric used to measure success:	
Percentage improvement expected in the metric in one year:	
Supplementary notes for your decision:	

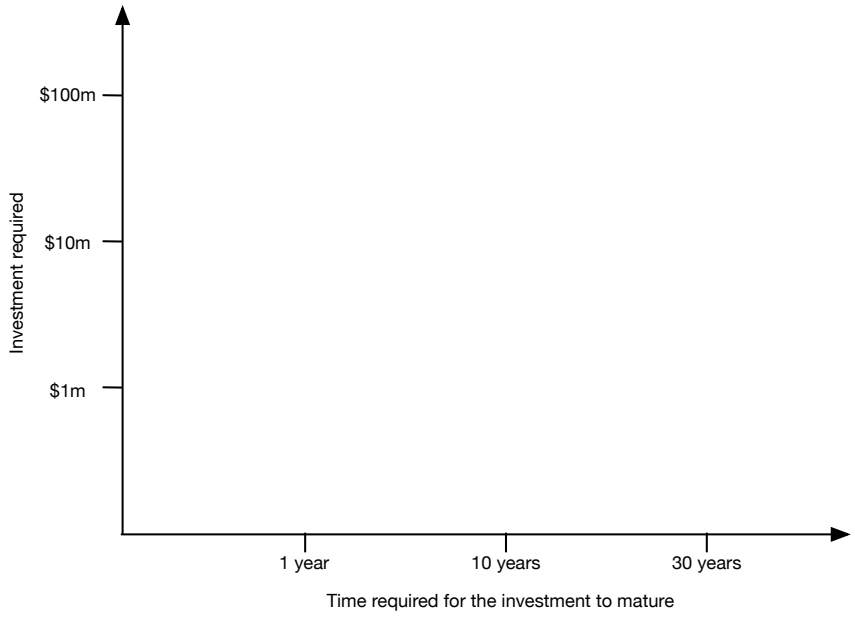
Investment 2	
Data standard:	
Investment amount:	

Metric used to measure success:	
Percentage improvement expected in the metric in one year:	
Supplementary notes for your decision:	

Investment 3	
Data standard:	
Investment amount:	
Metric used to measure success:	
Percentage improvement expected in the metric in one year:	
Supplementary notes for your decision:	

5 Data standards opportunity map

Suppose the same amount of resources is invested in the five data standards with the biggest potential in your organization. Map the five standards on the graph below that links opportunity size to time required for the opportunity to mature. There are lines for notes below the graph if you need them.



6 Any other perspectives on investing or focusing on data standards?

Have you got any other perspectives on investing or focusing on data standards that you would like to capture or discuss as part of the DSOS? Do you agree with the sensibility of focusing on data standards?

7 Questions or queries?

For any further information, questions or queries on anything related to the DSOS or this form in particular, contact:

PJ Vlok
Cell: +1-865-399-1175
eMail: pjvlok@visualreliability.com
Skype: pjvlok
LinkedIn: https://www.linkedin.com/in/pj-vlok-783aa836/

8 Next step

Please hand this completed document and any supporting documents back to the coordinator in your organization.

End.

Appendix D: Functional areas and processes considered

Table D1. Functional areas and processes considered for the generic architecture

Nr.	Functional area	Process
1	Change Management	MOC – Engineering Documents
2	Change Management	P&ID / Critical Document change notice approvals
3	Change Management	RASCI Chart for Eng
4	Change Management	S&E Paragraphs Review / Implementation
5	Change Management	Spec Deviation Process
6	Change Management	Technical Alert Review / Implementation
7	Communication	Eng Surveillance Reporting
8	Communication	Meetings Schedule / Plan - Contractor
9	Communication	Weekly and Monthly Reporting - Contractor
10	Construction	Brownfield Execution
11	Construction	Constructability Reviews
12	Construction	Project Instructions - Site
13	Construction	Site Engineering Plan
14	Construction	Site Query Process
15	Contracting	Concession Register
16	Contracting	Contract Administration
17	Contracting	Contract Change Requests
18	Contracting	Fab Contract – Equipment Timing / Worksplit Section
19	Contracting	Fab Contract – IFC Deliverables / Timing Section
20	Contracting	Fab Contract – Eng SOW / Worksplit Section

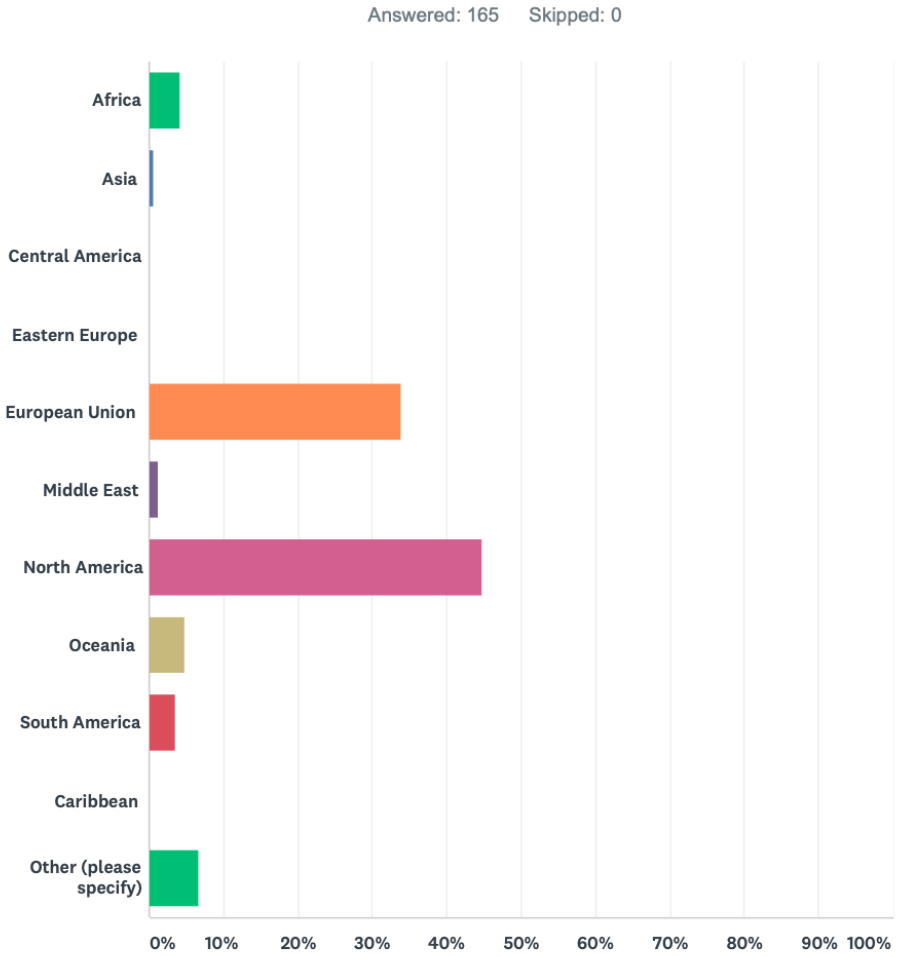
21	Cost	Contractor MH Trends / Approvals
22	Cost	Contractor MHs tracking
23	Cost	Quantities Tracking
24	Doc Control	Doc Control Distribution / Review
25	Doc Control	Document Numbering / Component Tagging
26	Doc Control	Information Management
27	Doc Control	Master Doc Register
28	Eng Execution Management	Contractor Mob / Demob Approvals
29	Eng Execution Management	Demob Plan
30	Eng Execution Management	Design Reviews
31	Eng Execution Management	Engineering Closeout Reporting
32	Eng Execution Management	Engineering Management Plan (Contractor)
33	Eng Execution Management	HVEC Review and Approval
34	Eng Execution Management	Lessons Learned
35	Eng Execution Management	Model Review Criteria / Readiness
36	Eng Execution Management	Team Building / Away Day Plan
37	Interfaces	Interface Management
38	Issue Management	HAZOP followup closeout
39	Issue Management	Issues Tracking and Closeout
40	Issue Management	Model Review Action Item Tracking and Closeout
41	Operations	DFO Plan
42	Operations	Facilities Transition Plan
43	Operations	Field Performance Tests
44	Operations	Human Factors Plan
45	Operations	Operations Support

46	Operations	Systems Completion Plan
47	Organization	Job Descriptions
48	Organization	New Employee Orientation
49	Organization	Office Setup Checklist
50	Organization	Org Chart / Staffing Plan
51	Procurement	Preservation
52	Procurement	Procurement Register Setup
53	Procurement	Procurement Surveillance
54	Procurement	Project Valve Management
55	Procurement	Spare Parts Inventory Development
56	Procurement	Supplier / subcontractor Qualification
57	Procurement	Vendor Data Register Setup
58	Progress	Model Review – Progress Tracking
59	Progress	Schedule - Rules of Credit for Progress Measurement
60	Quality	Engineering Software Approval
61	Quality	Engineering Surveillance - Home Office
62	Quality	Engineering Surveillance - Site
63	Quality	Engineering Systems Criticality
64	Quality	Equipment Criticality
65	Quality	Functional Engagement Plan
66	Quality	Quality Audits
67	Quality	Quality CAR / NCR review / handling
68	Quality	Quality Plan (Contractor)
69	Quality	Third Party Reviews
70	Scheduling	Engineering Schedule / Milestone Monitoring

71	Scheduling	Schedule - Execution Planning Vision / Key Milestones
72	Scheduling	Schedule - KPI metrics
73	Scheduling	Schedule - Milestone Table
74	SHE and Risk	Office Site Safety Plan
75	SHE and Risk	Regulatory Compliance Matrix
76	SHE and Risk	Risk Management
77	SHE and Risk	Office Ergonomics
78	Technical	Alarm Management
79	Technical	Model Implementation Plan
80	Technical	Pipe Stress Philosophy
81	Technical	Project Technology Management
82	Technical	TQMS execution
83	Technical	Weight Management

Appendix E: Online survey

E.1 What region are you based in?



Answer Choices	Responses	
Africa	4.09%	7
Asia	0.58%	1
Central America	0.00%	0
Eastern Europe	0.00%	0
European Union	35.09%	60
Middle East	1.17%	2

North America	44.44%	76
Oceania	4.68%	8
South America	3.51%	6
Caribbean	0.00%	0
Other (please specify)	6.43%	11
	Answered:	171
	Skipped:	0

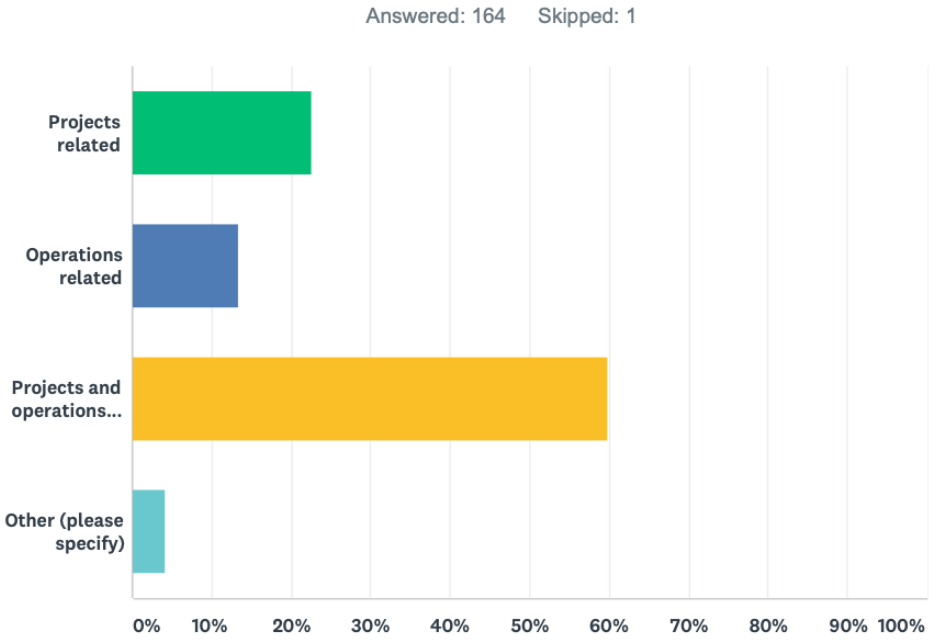
E.2 What discipline do you work in?

The verbatim responses were as follows:

Analysis, Application development, Automation, Automation, Civil engineering, Completions, Corrosion and Materials, D&C, Data, Data Analysis, Data Analysis, Data analysis, Data Analytics, Data Architecture, Data Governance, data management, Data Management, Data management, Data management, Data Management, Data Management, Data Management, Data Science, Data Science, Digitalisation, digitalization implementation and data management, DM/IM, Document Management, Drilling and Completions, Drilling and Completions, Drilling and Completions Engineering, Drilling and Evaluation, Drilling engineering, Education, Electrical, Electrical, Electrical, Engineering, Engineering, Engineering, Engineering, Engineering, Engineering, engineering, Engineering, Engineering - Oil and Gas, Engineering / Project Development, Engineering and Maintenance, Engineering Data Management, Engineering Data Management, Engineering Management, Engineering Management, Engineering Management, Engineering management, Engineering, Fixed Equipment, Managment, Enginnering, Facilities Eng., Facilities Engineering and Construction Information Management, Facility engineering, Floating facilities, geological modelling, Geology, Geology, geology & geophysics, Geomatics, geophysical, Geoscience, Geoscience, Geoscience, Geoscience, Geoscience Data Management, Geoscience Data Manager, Geoscience systems, Geoscientist, Geospatial, Geospatial, Geospatial and geoscience software, GIS, Data Management, Business Intelligence, IM, IM&T, Information management, Information Management, Information Management, Information management, Information management and requirement management, Information Services, Information Systems, Information Technology, Information Technology / Data Management,

Information technology and engineering, instrumentation and control, Integrity Engineering, IT, LCI, Life Cicle Information, life cycle information, Life Cycle Information, Maintenance, Maintenance and Reliability, maintenance engineering, Marine, Material technology and corrosion, mechanical engineering, Oil & Gas Engineering, Oil and Gas, Oil and Gas Engineering, Oil and Gas Production operations, Operations Engineering, Operations, Exploration, Drilling, Planning and field Development (Geologist and Petrophysicst), Operations, Maintenance and Reliability, Petroleum Data Management, petroleum engineering, Petroleum Engineering, Petroleum geoscience, Process, Process Control, Process Safety, Production, Production Chemical, Production Operations, Project Controls, Project Controls, Project Management, Project management, Life cycle information, Project Manager, Project Service, Project/Portfolio Management, Projects, Quality, Reliability, Reliability, Reliability, Reliability and Integrity, Reliability Engineering, Reliability, Business Risk & Performance, Reservoir Engineering, Reservoir Engineering / IT, Rotating Equipment/Material Master Data Management, Seismic, Software Development, Standard and Life Cycle Information Engineering, Sub Surface Data Management, Subsea Engineering, Subsea Reliability, Supply Chain, Supply Chain, Technical asset information lifecycle, Technical Authority/Standard digitalization & Life-Cycle information Management, Technical Data Management, Technical Data Management, Technical information, Technical Information, Technical Information, Technology, Technology, Technology information, Upstream Data Analytics, Data Management, Machine Learning, Upstream Data Management, Upstream Data Management, Upstream Data Management, Upstream project development management

E.3 What asset phase are you involved in predominantly?



Answer Choices	Responses	
Projects related	22.35%	38
Operations related	13.53%	23
Projects and operations related	60.00%	102
Other (please specify)	4.12%	7
	Answered:	170
	Skipped:	1

E.4 What is your current role in the organization?

The verbatim responses were as follows:

Advisor, Analyst - Regulatory Compliance, Analyst / data architect, Application Specialist, Asset Data and Information Management Leader, Author & Specialist, Business Analyst, Business Development Manager, central engineering team, supporting operations [of electrical system] and projects, CEO,

Chief database architect, Chief of Department, class and verification design review lead, Consulant, Consultant, Consulting, Consultor, Continuous Improvement, Contractor, Coordinator of several digital activities, Corporate Engineering / Internal Consulting, Corporate Process Safety Manager, Data & Analytics Advisor, Data and Geology Analyst, Data Architect, Data Leader, Data Management and Migration, data manager, Data Manager for Operations and Production Engineering, Data Scientist, Data scientist engineer, department manager, Digitalization manager, Dir Customer Success, Director, Director and Reliability Consultant, Director Project Management, Director, Project Support & Technical Specifications, Discipline responsible LCI, Document Control Manager, Drilling supervisor, Electrical Engineer, Engineer, Engineerging Technician, Engineering Authority, Engineering Director, Engineering manager, Engineering managment, Engineering Standards Standardization, Enterprise Data Governance Advisor, Facilities Information Management Supervisor, Geoscience Manager, Geoscientist, GIS Manager, Global Systems (Product) Manager - Subsea Trees, Global Wellbore Positioning Technical Advisor, Information management, instrument and protective systems engineer, Internal Standardization Coordinator, IT Aanalyst Advisor, IT architect and data manager, IT Architecture, IT Director, IT Solutions Leader for international market, IT Specialist, LCI Lead, LCI manager, Lead Upstream Data Management projects, Leader, Leader for Data Management Center, Leading Advisor, Lecturer, looking for work, Maintenance and Reliability Global Process Advisor, maintenance engineer, Maintenance Manager, Manage R&D, Manager, Manager - Database Administration, Manager of Company's Integrated Management System, Manager, Geomatics, Remote Sensing and Geoscience Data, Managing Director, Master Data, Mattersubjectexpert, Model development, Operational Integrity Engineer, Operator, Performance and Programme Analyst, Petro Technical systems Advisor, Petroleum Data Manager, Principal consultant, Principal Engineer, Principal Geologist, Principal Rotating Equipment Engineer, Principle Engineer, Product Owner (IT platform product), Production Engineer, Proejct Manager - Information Stadardisation, Programmer, Project Controls, Project leader, Project leader Management System, Project Manager, Project Services Manager, Quality Engineer, R&D engineering, Reliability, Research & Development, Reservoir Engineer, Retired, Seismic Data Specialist, Seismic Processing, Senior Advisor, Senior Data Analyst, Senior Geologist, Senior Marine Engineer, Senior Reliability & Methods Engineer, Senior Subsea Reliability Engineer, Snr Reliability Engineer, Snr Staff M&R Data and Performance, Specialist Engineering Design – CADD, Sr Geodata Analyst, Sr. process engineer, Sr. Staff Geoscience Technologist, Staff, Standard and Life-Cycle Information Senior Engineer, Standards Drilling Engineer Advisor, student, Subsurface Data Analyst, Supervisor, Team Lead SCM Material Data & MM Groups, Teamleader enginnering projects, Technical Information coordinator., Technical specialist, Tecnical Data Analyst, UC D&C Standards Engineer, Unemployed,

Upstream data management specialist, VP, VP Project Support & Performance, Well and Seismic Data Management specialist

E.5 How many years of experience have you got in the oil and gas industry?

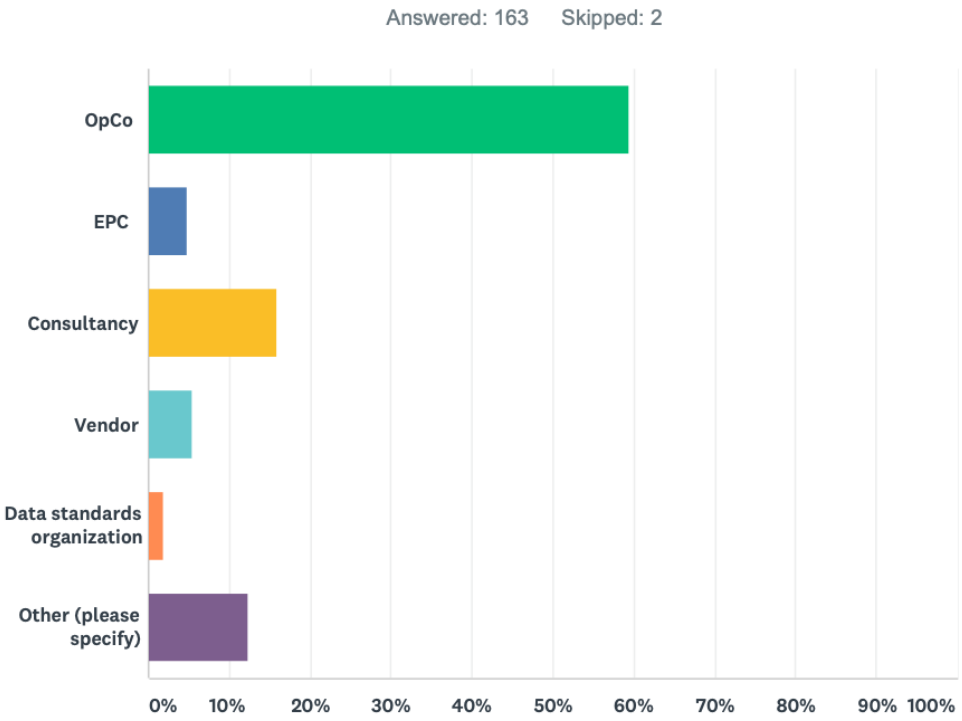
Nr of years	Count
5	8
10	14
15	33
20	23
25	21
30	23
35	13
40	13
45	5
50	0

E.6 What is the name of your employer? (Optional)

The verbatim responses were as follows:

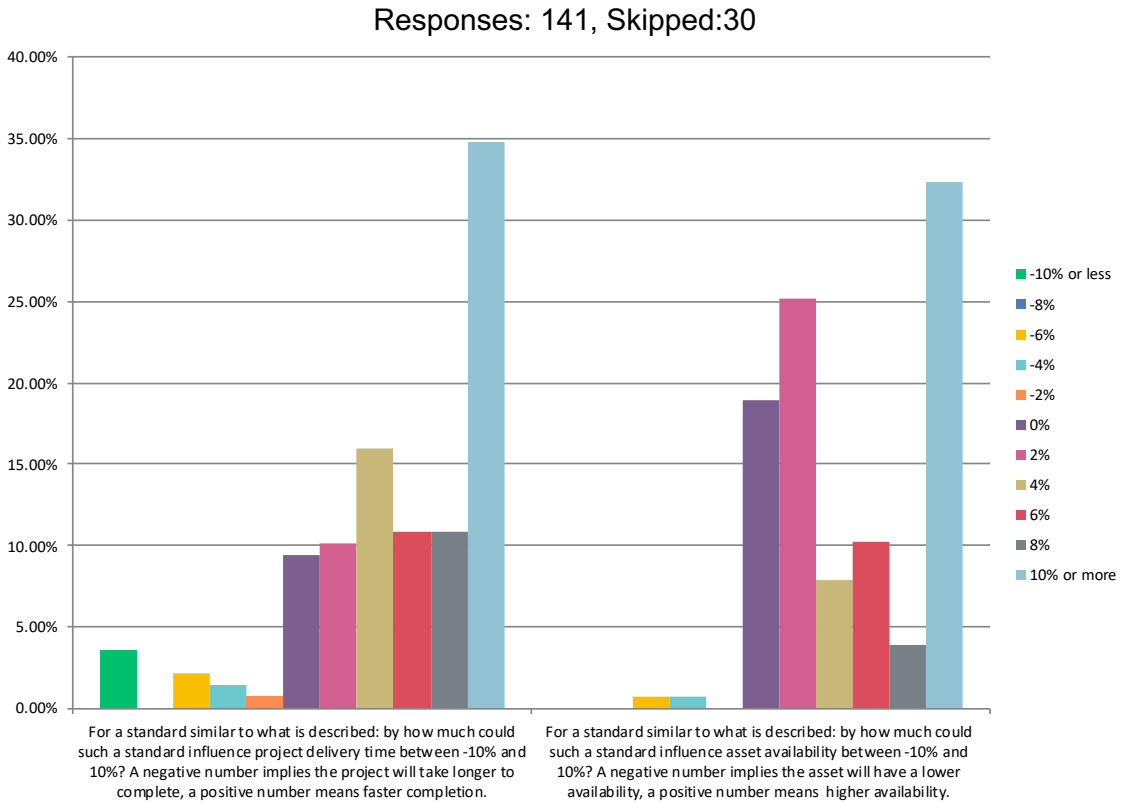
Aibel, Aker BP, ANCAP, Anschutz Exploration Corporation, ANTS GeoConsulting Pty Ltd, Apache Corp, Aramco, Arrow Energy, BHP, BP, BP (Downstream), BPX Energy, Cenovus, Cepsa, CEPSA EP, Chevron, Chevron Canada, CNOOC Uganda Limited, COGCC, Continental Houston, DATAVEDIK, DNV GL, Ecopetrol, Encana Oil and Gas, EnerVest Operating, LLC, Eni, eni s.p.a., EniProgetti, EnQuest, Equinor, Equinor ASA, EXCO Resources, ExxonMobil, geoLOGIC system ltd., Geomatic Solutions, Halliburton, Infosys, IntegraShare Dimensions, Inc., Kraken IM, Marathon Oil, NOPSEMA, Occidental Oil and Gas Corp., OPRAL Ltd, P2 Energy Solutions, Petróleos de Venezuela S.A. (PDVSA), Petrosys USA, REC Advantage, Redfish Research, llc, Repsol, Retired, Robert Gordon University, Saipem, Santos Ltd, Saudi Aramco, Shell, Shell & INPEX, Suncor, Suncor Energy, Suncor Energy Inc, TECO, unemployed, Universidad Nacional de Colombia, US Bureau of Land Management, Vår Energi, Vår Energi AS

E.7 What type of organization are you employed by?

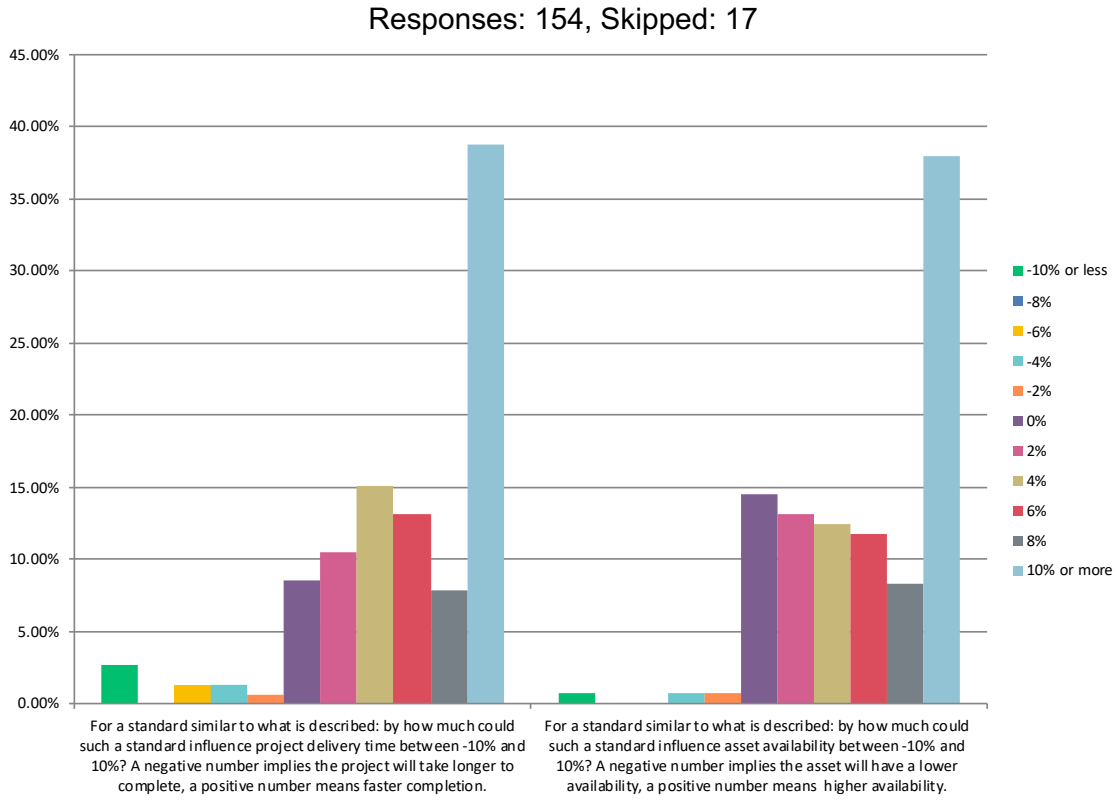


Answer Choices	Responses	
OpCo	59.76%	101
EPC	5.92%	10
Consultancy	15.38%	26
Vendor	5.33%	9
Data standards organization	1.78%	3
Other (please specify)	11.83%	20
	Answered:	169
	Skipped:	2

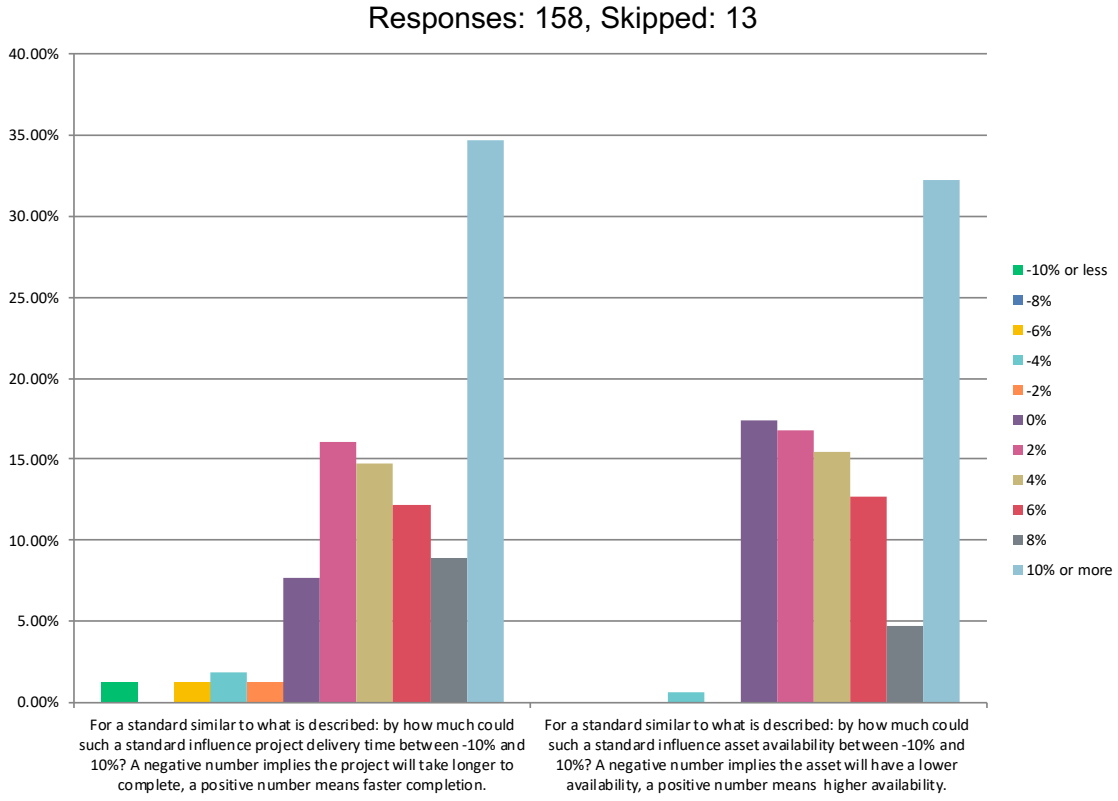
E.8 Possible standard: "3D model standard". A standard for structuring 3D model data to support design, procurement, construction management and corrosion management and other asset management purposes. This will make 3D models consistent and interchangeable.



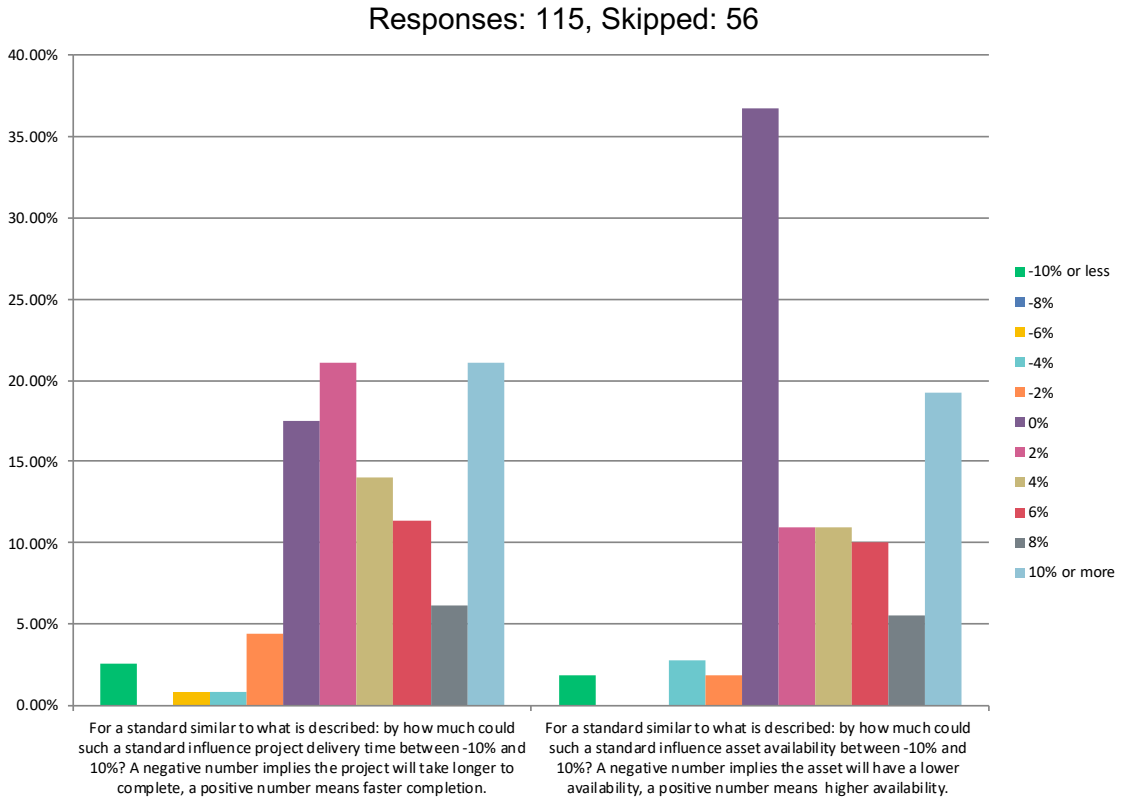
E.9 Possible standard: "Project Information Handover Specification". A specification of definitions against which Engineering, Procurement and Construction (EPC) contractors, equipment suppliers and software vendors will deliver information to owner operators. The standard aims to assist in managing project delivery and reduce the need to reclassify, reformat and rework documents and data at handover points during the project life cycle.



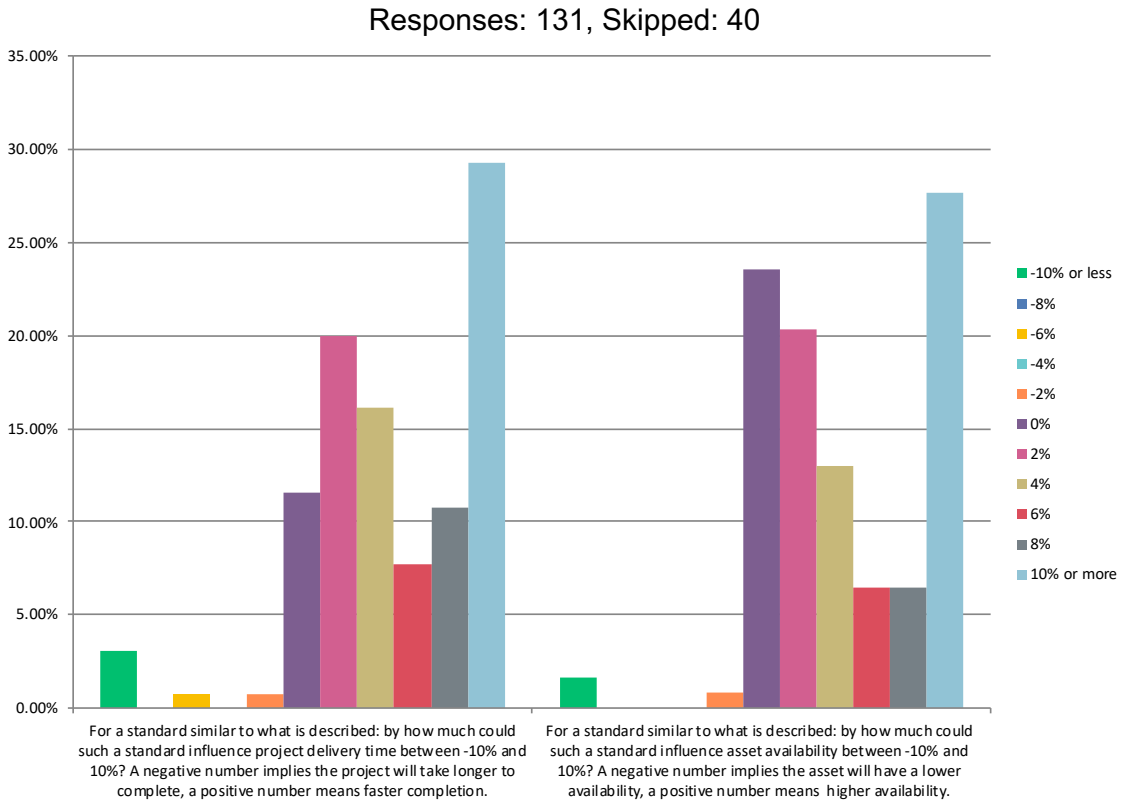
E.10 Possible standard: "Vendor Data and Document Requirements Standard". A standard for vendor data and document requirements to be furnished by equipment suppliers by equipment class. The scope includes off the shelf, engineered and packaged equipment or collections of standard equipment classes.



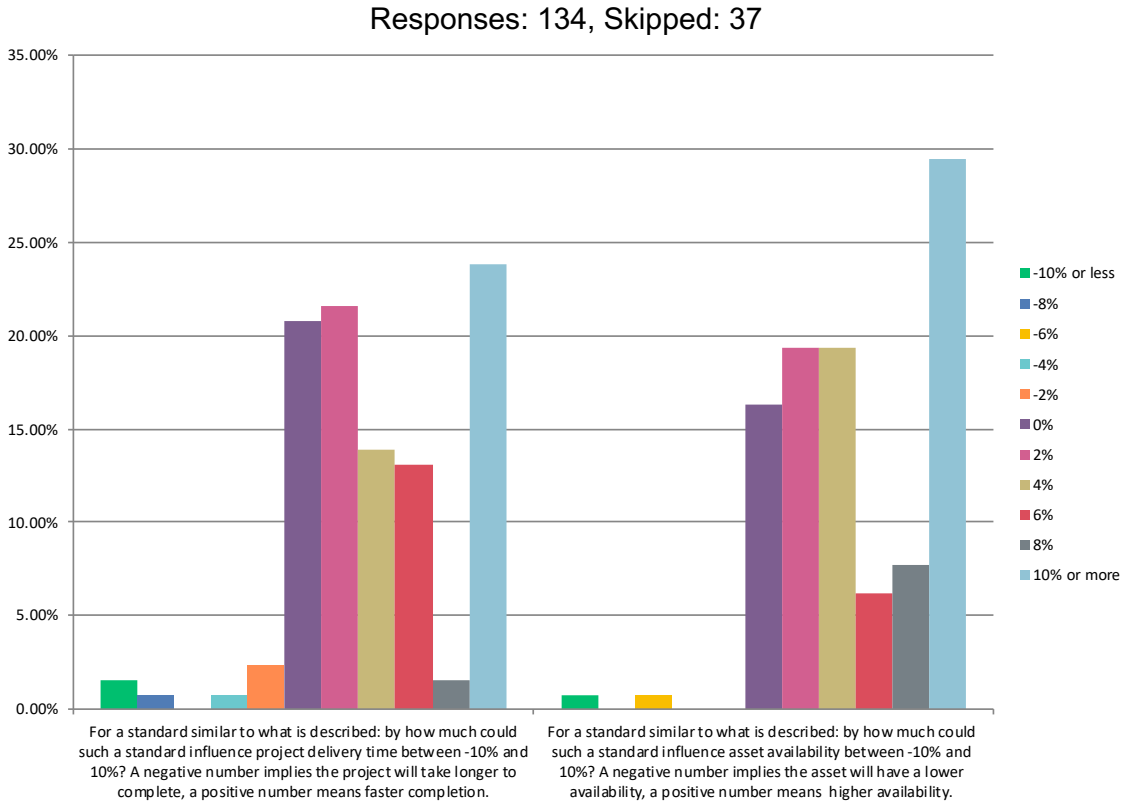
E.11 Possible standard: "Capital Cost & Planning Data Standard". A hierarchical classification of project costs according to scope, activities and resources. It facilitates analysis and review of cost data in several dimensions such as manhours, activities, materials, etc. It creates a consistent foundation for estimating, benchmarking and actual cost vs budget tracking.



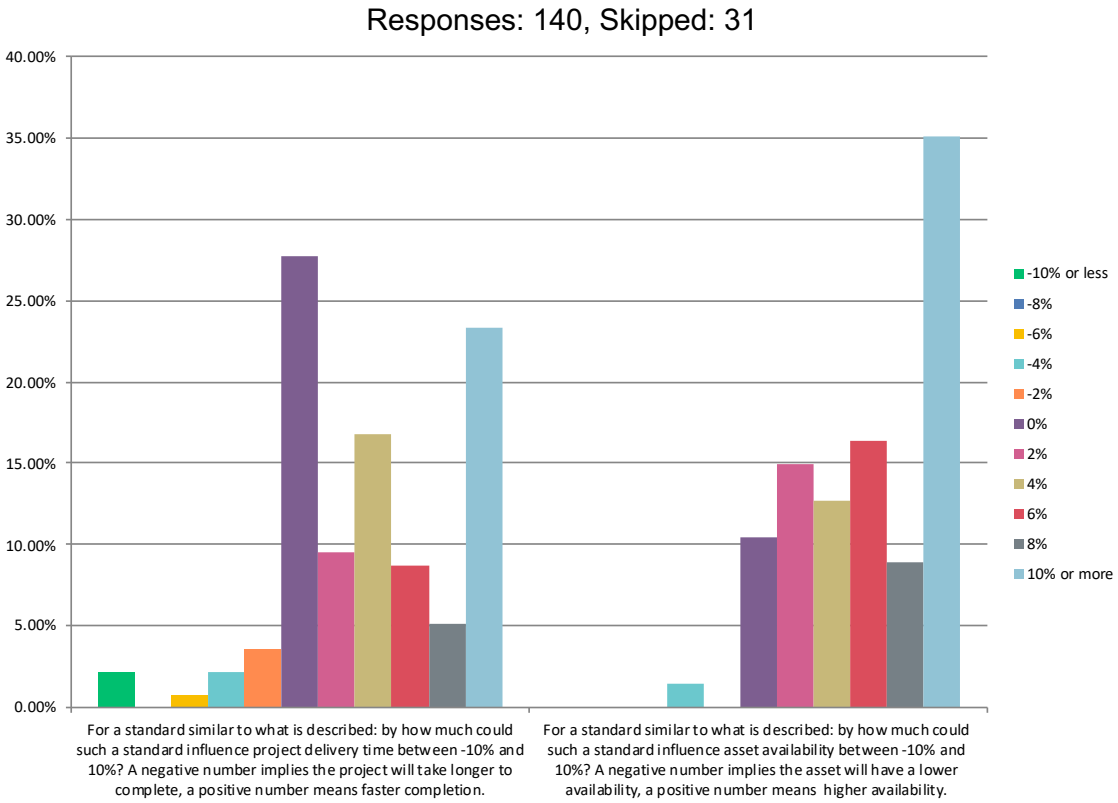
E.12 Possible standard: "Materials Procurement Data Standard". A specification for materials procurement to facilitate e-procurement including invoicing, payment, pricing, purchase orders, prequalifications, delivery and data transfer protocols.



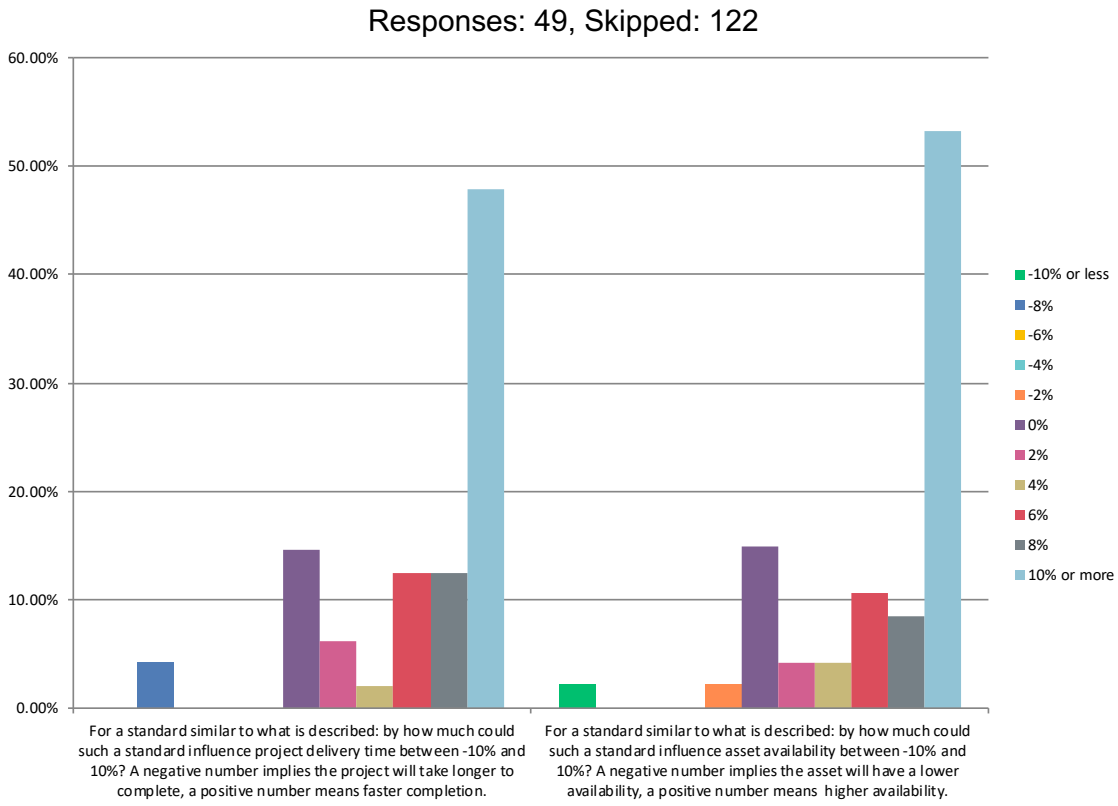
E.13 Possible standard: "Equipment and Spare Parts Data Specification". A standard for gathering equipment and spare parts information from equipment manufacturers or suppliers, processing and enrichment of the information and preparation to transform that data to BOMs.



E.14 Possible standard: "Equipment Reliability Data". A standard for consistent capture of equipment reliability data. Scope includes equipment data, failure data and maintenance histories required for reliability and failure analyses such as FMEA, criticality analysis and root cause analysis, etc.



E.15 Is there any standard that is not listed above that you feel should have been listed?



Below are the responses – verbatim and unedited:

(1) A move towards standards for health-safety-environmental regulatory data - which globally would require more uniform standards across that space - however, managing a global portfolio of assets, if this was standardiz(s)ed, it could streamline the entire process from design through commissioning of assets; monitoring, maintaining through end of life - even help with acquisition/divestiture and merger impacts.

(2) A SEG-Y format and an .LAS that everyone ACTUALLY follows - so data can be loaded by a computer without needing to be understood and reformatted.

(3) A standard for consist formulation of requirements, a standarized data model for requirement sets and exchange of requirements as single objects and sets of requirements. The standard to enable clear separation of requirements related to functions, products(solutions) and performance.

(4) A standard for sensors, e.g. motion sensors, strain gauges, equipment sensors, what to install, where to install (most effective and reliable positions) and how to install them. How to collect and transfer the data afterwards.

(5) A standard of recommended resource and organizational requirements to improve the success of any of the aforementioned standards; in other words, change all negative values to attractive enabling values.

(6) A standard relating to positioning data. Every datastore containing well data should have the coordinates specified to a certain amount of decimal places, and should have projection, datum, spheroid etc. all specified. Should every datastore of well data have coordinates in Degrees-Minutes-Seconds as well as in projected units? The same applies to other data with coordinates and positions.

(7) A standard to describe the System of Record Architecture (SoRA) for all engineering information from Project to Ops phases, and between data warehouses and transactional systems.

(8) A standardized way of exchanging the information between different stakeholders. Key words: Cloud computing and transfer (Azure Service bus or similar), APIs. In the bullets above you focus on the content, but the exchange is just as important. A lot of delays are due to people waiting for information to be transferred. This should be automated and therefore has to be standardized.

(9) Advanced Work Packaging

(10) Although each of the above standards go a long way to providing consistent data, a standard consolidating all data types for A&D activities would in my opinion help streamline the delivery of a complete data set to acquiring companies.

(11) An asset model according to ISO/IEC 81346 and IACS providing information according to OPC UA companion specifications such as future PA-DIM

(12) AR data standard Digital twin (DT) data standard Interchange standard for 2D/3D/AR/DT

(13) Common identification system Common data model

(14) Data Interchange Standards for G&G, drilling, production and reservoir description. WRT the last one, your first question asks about the need for a 3-D model standard. One already exists, RESQML supported by Energistics, LLC

(15) Data standards for: System integration System of system interoperability Asset model Process & automation Requisition and purchase order Invoice Logistics Due to that thee exsist approx. 30.000 ISO and IEC standards, the oil and gas indsutry should select standards already developed and used in other industries, examples are: ISO 19128 ISO 8601 ISO 80000 ISO 3166 ISO 4217 ISO 55000 ISO 14224 ISO 81346 ISO 15926 ISO 19008 ISO 18101 IEC 61355 IEC 61804 IEC 61987 IEC

62683 IEC 22745 IEC 62541 IEC 61804 IEC 62769 IEC 61630 IEC 62832 IEC 61131 IEC 62714 IEC 62443 IEC 62890 IEC 62264 IEC 61512

(16) Digital transfer specificstion of all above listed information down to each Parameter. Going from Document centric to data centric information transfer.

(17) Digital twin data model specification. Standard describing how all aspects of an asset can be captured based on one common vocabulary. The standard specified vocabulary must be suitable for capturing of machine executable design, construction and operational rules in addition to application independent information shearing. The standard should specify utilization of semantic technology, including semantic reasoning capability, and method of publishing of ontologies containing asset models as well as industry standard types and requirements. (Including and beyond the above 3D model standard) Ref ISO 15926-14 and W3C OWL2-DL.

(18) Facility Information Model standard which at least consist of a System Design Model and an Area Design Model

(19) Field and well and reservoir naming standards Logging Tools and curves and unit of measure

(20) Intra Project Data Standard - how Engineering, Procurement, Fabrication, Construction, Commissioning & Completions transfer data between their respective phases

(21) ISO 14224 ISO 55000

(22) ISO 14224 and ISO 20815

(23) ISO 15926

(24) ISO 15926 - "Industrial automation systems and integration—Integration of life-cycle data for process plants including oil and gas production facilities", https://www.posccaesar.org/wiki/ISO15926.

(25) Item 11: ISO 19008:2016 is a standard that does exist on the cost coding. This is already well established in use and more use will support business objectives Item 14: ISO 14224:2016 is a fundamental standard for reliability and maintenance data and analysis. ISO 20815:2018 is also vital for reliability management and production assurance. ISO 15663 is also relevant for life cycle costing (new revision is soon coming) These ISO have already many industry users and they are actively used.

(26) Job & Skill requirements

(27) Measuring Asset Resilience and risk to determine the likelihood of achieving high availability

(28) Mostly not following the SOP'S . The policies of the company

(29) Possible standard: "Project Development Information and Data management" A standard for defining symbols, templates / datasheets, formats, piping classes, every single data of every object

defined during the EPC Projects. This would lead to an uniformity in porject development ensuring asset integrity.

(30) PPDM Association key standards such as: the Public Petroleum Data Model, What is a Well, Well Status and Classification, Well Identification best practices, data rules and more.

(31) Reference data, often referred to as metadata, is information that describes what is being received. For example, units of measure, depth references, etc. These differ from data source to data source. Many projects have multiple sources of information that are difficult to meld together due to fundamental differences in the metadata. Example, units of measure are often confusing, especially with when LAS files are used. "S" is seconds, sometimes siemens. "F" is fahrenheit in one dataset, feet in another. Feet (foot) can be F, Ft, FT, Feet, Foot, feet, foot, intlft, FtUS, etc. DEG can mean degrees of temperature or pertain to compass bearings. Example: depth reference names can be very different from one dataset to another: KB, Kelly, Kbush, etc. DF, CF,RT are all represented by different values in different systems. Being able to know and cross reference the mnemonics and abbreviations used for different reference data in the industry would facilitate true interoperability between software systems.

(32) Something about core analysis data. Often core data vendors (Corelab, GeoMark, etc.) will present data in significantly different formats. If there were standards in place here, it would greatly help reduce time involved in analyzing the data.

(33) Sort of covered Materials Procurement Data Standard but there should be a development standard for contracting and procurement that covers both procurement but also the deliverables, e.g. payment is tied to information as well as physical equipment/materials. This would also pave the way for smart legal contracts.

(34) Standardization removes ambiguity and generates better consistency throughout the procurement and operational chains. These can only be to our advantage.

(35) Standards for failure reporting to support machine learning and sharing of data amongst companies.

(36) Standards for regulatory data reporting

(37) Subsea standard

(38) There are many silos of data. How do you aggregate those assets to work with a common platform for better security and ease of use, updates etc.,??

(39) There needs to be more alignment of oil company CMMS to ISO14224 which would improve the quality of Equipment Reliability Data

(40) To enable the Digital Factory, from an Automation Evoution perspective, these standards should be important: O-PAS Part 1 - Technical Architecture Overview O-PAS Part 2 – Security O-PAS

Part 4 – Connectivity Framework (OCF) O-PAS Part 6 Information and Exchange Model Platform Industrie 4.0: Details of the Administration Shell, Platform Industrie 4.0, 2018IIC:PUB:G5:V1.01:PB:20180228. The Industrial Internet of Things Volume G5: Connectivity Framework IEC 61804, Function block concept for process control and EDDL IEC 61987, Data structures and elements in process equipment catalogues (Common Data Dictionary) IEC 62683, Low-voltage switchgear and controlgear - Product data and properties for information exchange ISO 13584-43 ? ISO 22745, OTD IEC 62541, OPC UA, Open Platform Communication Unified Architecture IEC 61804-3, EDDL, Electronic Device Description Language IEC 62769, Field Device IntegrationOPC Unified Architecture for Process Automation Device Information Model PA-DIM Companion Specification IEC 61360 ,Standard data element types with associated classification scheme for electric components IEC 62784, Reference model for representation of production facilities (digital factory), REPLACED BY IEC 62832 IEC 62832, Digital factory framework DIN SPEC 91345, Reference Architecture Model Industrie 4.0 REPLACED BY IEC PAS 63088 IEC 61131-3, PLCopen IEC 62714, Automation ML IEC 62443, Security IEC 62890, Life-cycle and Value Stream IEC 62264, Enterprise Control System Integration IEC62264-2:2013, Object Model Attributes (same model as OPC UA for ISA95) IEC 61512, Batch Control IEC 61346, Industrial systems, installations and equipment and industrial products - Structuring principles and reference designations

(41) Well subsurface data, other tan wireline logs (i.e.: geochemistry, samples, shows, well test).

(42) Wellbore Directional Survey data submissions to regulatory bodies. These surveys are typically acquiring while drilling and describe the position of the wellbore in 3D space. It seems each state in USA and every country have their own "standard". In addition, some operators have defined their own standard formats. This information is critical to avoid wellbore collisions and when modeling/evaluating the reservoir for both positioning and TVD and thickness calculations.

(43) Wellbore Quality Metrics as a function of Trajectory Measurements

E.16 Is there any other comment related to data standards that you would like to record and pass on to the IOGP?

Below are the responses – verbatim and unedited:

(1) >3D Model standard- The 3D model vendors have zero interest in letting this happen. There are 3D model standards in other sectors and the support and development is parlous. This should be considered when developing any standard. >Equipment Reliability Data standard- There is one

already? >Spare Parts- This is a huge cost win to be had, the SPIR/SPIL is not fit for the digital age and the lack of consistent spares data means that spares are over-purchased and there is a huge amount of wasted inventory. >Vendor Data and Document Requirements Standard- There is some work in this space but far and away this represents the biggest saving in time and money to projects and construction to be had. The vendors contribute 50% of the data that is needed for engineering, construction and into ops. There is opportunity in requirements but also contracting and payment models as well, vendors are the last frontier for standardisation. Standardisation in general- Standards should be open and openly created, easy to adopt and publicly accessible, closed standards are anti-standardisation i.e. they create a barrier to adoption.

(2) 14224 is the most appropriate existing ISO standard to provide the necessary linkage between the above related standards

(3) Adopting an existing standard and work to improve it, is orders of magnitude more preferable that developing a competing standard

(4) any/all of the above standards could/should be aligned to the existing standards ISO 14224 and ISO 20815, which are already widely used

(5) Field Operations Standards for Fracing, Pumping and Testing documentation would be very helpful to the industry

(6) Focus on lowest hanging fruit first. Assurance of compliance is valuable to operators as there is currently little confidence or understanding from operators of the value and significance of compliance to standards.

(7) Follow the work of IEC and the German industri.

(8) For a standard handling "Project Information Handover" is it important to do it in cooperation with the engineering software vendors. Standards related to retrieving data from vendors is in my mind the most important. you must look into a total package including vendor data, SPIR and also support the inquire process

(9) For work on the Norwegian continental shelf, some of the above mentioned standards are already covered by NORSOK standards.

(10) Good luck!

(11) I am more familiar with data standards for Geoscience subsurface data. I believe by having data standard across different disciplines will definitely help in handing over and beneficial to integrated processes and workflows across various disciplines by providing a good reference for common understanding with the use of technical terms and defined naming conventions. I personally support all the data standard initiatives listed but not in a position to prioritise.

(12) I believe data standards will in no way impede the delivery of projects instead it ensures the success of it. Having data standards pays off in the long run though it may seem to delay certain processes, it guarantees the longevity of the product.

(13) I do believe that all standards developed should be coordinated / harmonized and all be parts of an overall strategy working toward building a single common data platform. In my view - operators would "own" the platform - i.e. gave every supplier / designer / vendor access to their system so all data get uploaded directly to the ultimate owner / operator. That way, "project handover" becomes a given during the entire project phase and we minimize the number of "handover" points where data can get misaligned or lost in translation.

(14) I would consider helping to standarize position uncertainty models and practices for wellbore positioning, geological and sceismic uncertainty models.

(15) ISO 14224 and ISO 20815 cover most aspects related to equipment reliability and asset availability. Vendor Equipment Data and Documentation Requirement standards also exist, but are equipment specific.

(16) ISO 14224 is critical for setting standardisation in RAM modelling, RCM and data exchange with vendors.

(17) ISO/IEC 81346 Industrial systems, installations and equipment and industrial products — Structuring principles and reference designations is one of the core building blocks of information standards to be able to handle data and requirements into a digital twin in a controlled way, by introducing the aspect thinking of objects.

(18) It is easy to agree on a shift from document centric to data centric information. The shift must however be based on the right technology to have the intended effect.

(19) It is very difficult to find IOGP standards. API, ASME and others are much easier and are in the IHS database.

(20) It's important to develop a roadmap for data standards for the oil and gas value- and supply chain

(21) Keep up the great work!

(22) Look at work within the IIC and even the Linux Foundation for standards that are already being promoted/adopted

(23) no

(24) not at this time.

(25) Perhaps "3D model standard" should be qualified as in what type of 3D model you are referring. A static subsurface geological model? A 3D model of reservoir flow? A 3D model of well breakout?

Some 3D models e.g. models built in Petrel(TM) are for different purposes, so the same standard should arguably not be implemented on every Petrel project file created.

(26) Please adopt data management standards as outlined by the PPDM Association.

(27) Please focus on evolving areas first - as they are Wild West... fix them before they get out of hand... the other areas you list most of us already have work arounds for...

(28) Seeing more information collected by regulators so your approach will be helpful

(29) Set of tools should be prepared to secure faster implementation of standards.

(30) Standards has to be implement strictly when and where required otherwise graphs goes down

(31) The above questions were all about the effect these standards have on project delivery time and asset availability. I don't think these are the justifications for the standards - they would be useful to reduce manhours (and therefore project cost) by having clear, well-understood requirements upfront. Having common requirements across the industry makes this easier for everyone, but typically is not critical path, so doesn't affect project overall timelines. The standards would also help sites find data more efficiently to support operational issues, but more by reducing time than improving availability.

(32) The cumulative benefit of deploying a suite of standards is not measured here; that would be an interesting future study.

(33) The Equipment Reliability Standard resonates most with me primarily because of my current role. I do feel they all would appear to add value if implemented correctly in our business.

(34) The foundation for many of these "new standards" can be found in ISO 14224 & ISO 20815

(35) The OPAF initiative is extreamly important for the evolution of automation systems. And the coorporation between Industry4.0, IIC, OPAF, NAMUR are important to succeed with Digital Factory/ Digital Twin

(36) The standards must take into account the complete asset lifecycle where an object can exist as an engineered asset, a material component/assembly or in combination.

(37) The survey appeared to focus on delivery time and operational availability elements. The could be capital cost impacts and benefits to Operators, EPC Contractors and supply chain of standardisation that have not been explored.

(38) The topic of data is part of many business processes, so the data must be defined for its business application area, and the above-mentioned ISOs are multi-disciplinary and have many stakeholders Some of ratings in this survey is unclear. Is equipment availability meant or production availability. 10% relative or nominal increase? I guess you mean relative

(39) This is a great initiative!!! I'm really looking forward to seeing what will be delivered!

(40) This is long overdue. I'd like to see the industry taking inspiration from Building Information Modelling Standards

(41) This should go without saying but standards that are well documented and cater to a 'common sense' approach facilitate significantly faster interaction between those that follow them. Conversely, standards that are poorly documented and/or are onerous are not going to be accepted and will fail miserably.

(42) Yes , HSE is a big one here and while there is a huge resources on this , there are still gaps especially during projects. Also Security and Digitalization is becoming a big part of most project in this industry , right now that space is siloed and immature.