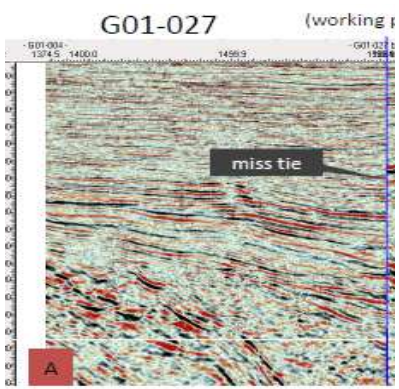
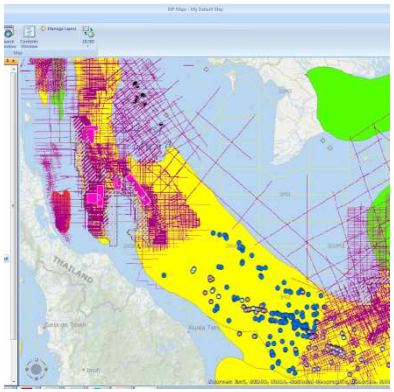
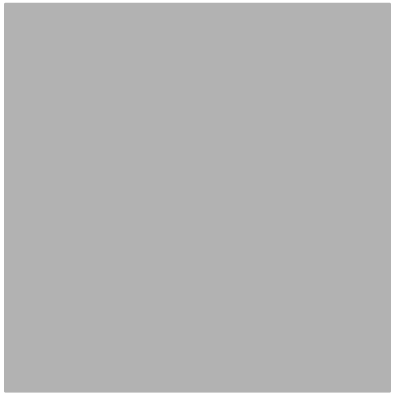
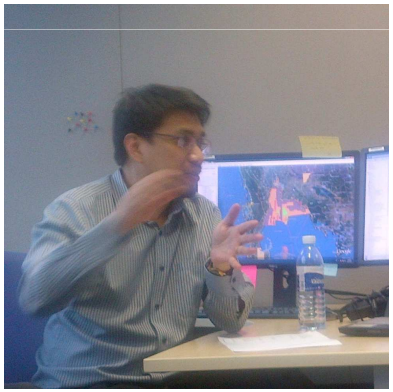
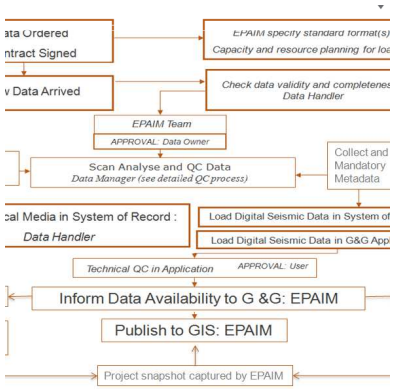
Case study: seismic metadata validation in Thailand











Jess B. Kozman, SouthEast Asia Regional Manager
Exploration and Production Applications – Information Management
Mubadala Petroleum, Singapore

Don Archer, President
Nofri Faruzza Said, Project Manager
Alliance Geotechnical Services, Malaysia/Indonesia

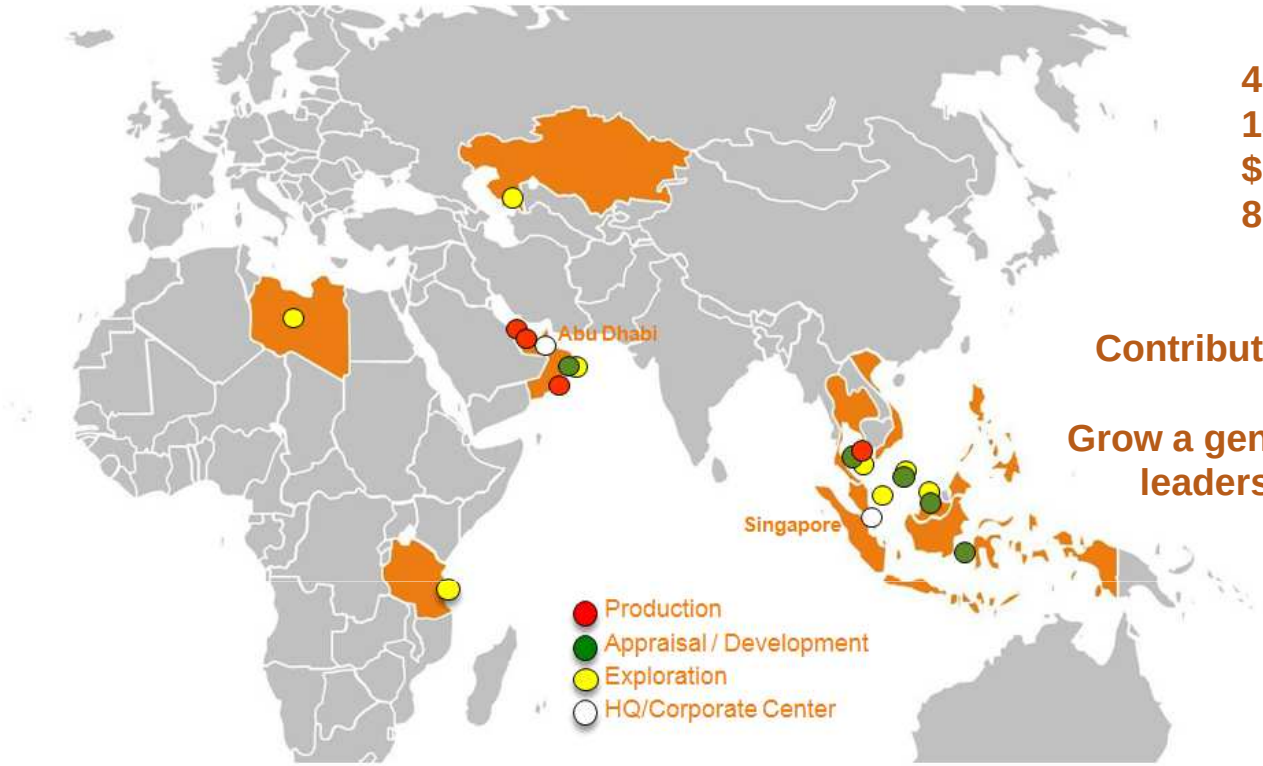
مبادلة
MUBADALA

Mubadala Development Company

- Arabic Word for “Exchange”
- A Principal Agent for Diversification of Abu Dhabi’s economy.
- USD$55 billion investment portfolio
- Crown Prince is Chairman of the Board

Mubadala Petroleum

Current Portfolio



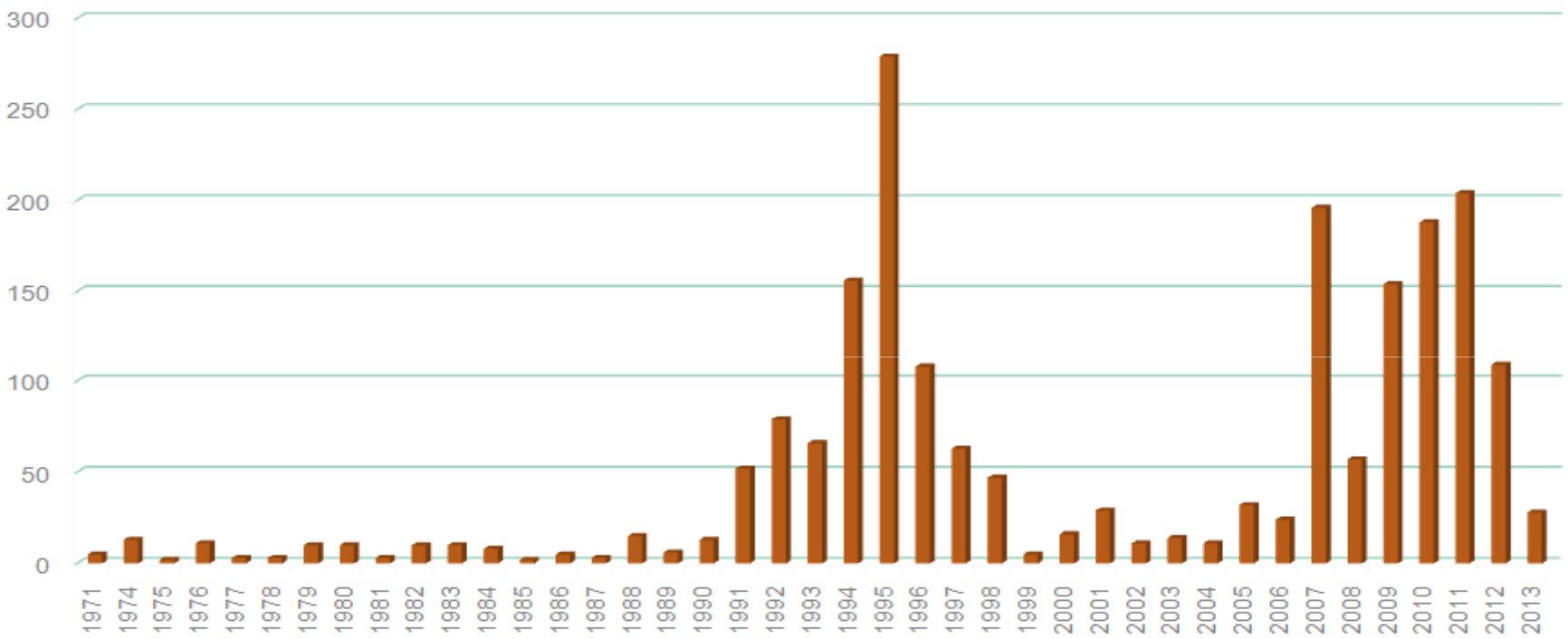
400,000 boepd NWI production
13 countries,
$1 Billion Capex
800+ employees

Mission:
Contribute to UAE strategic energy & gas supply
Grow a generation of internationally-capable leaders in the countries of operation

Information Management Guiding Principles

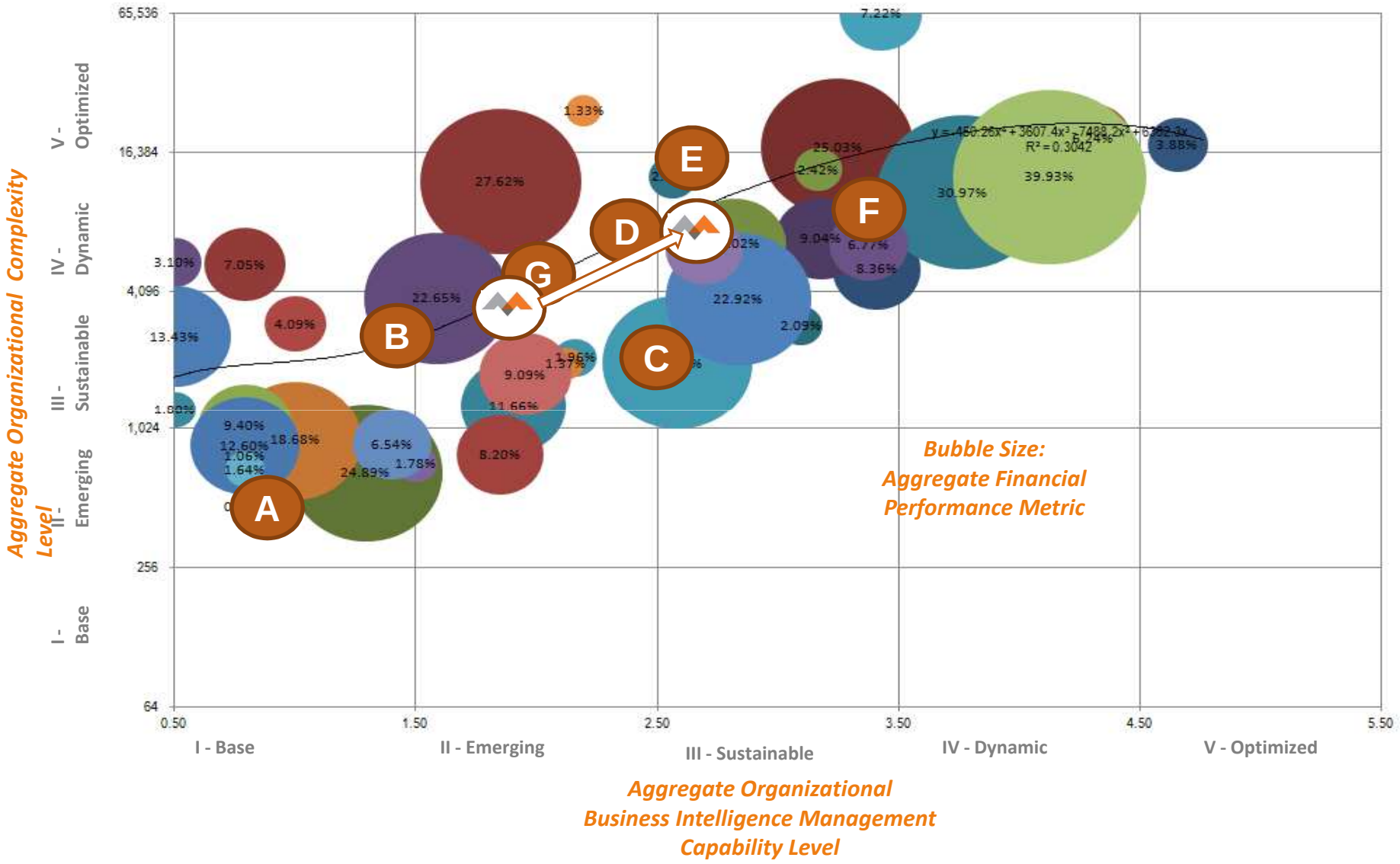
1) *Establish processes prioritized on risk*
2) *Learn in the right place and extend*
3) *Build just enough to be efficient*
4) *Move from evolved to engineered culture*
5) *Don't implement what management won't enforce*

Dates of Acquisition of G&G Data

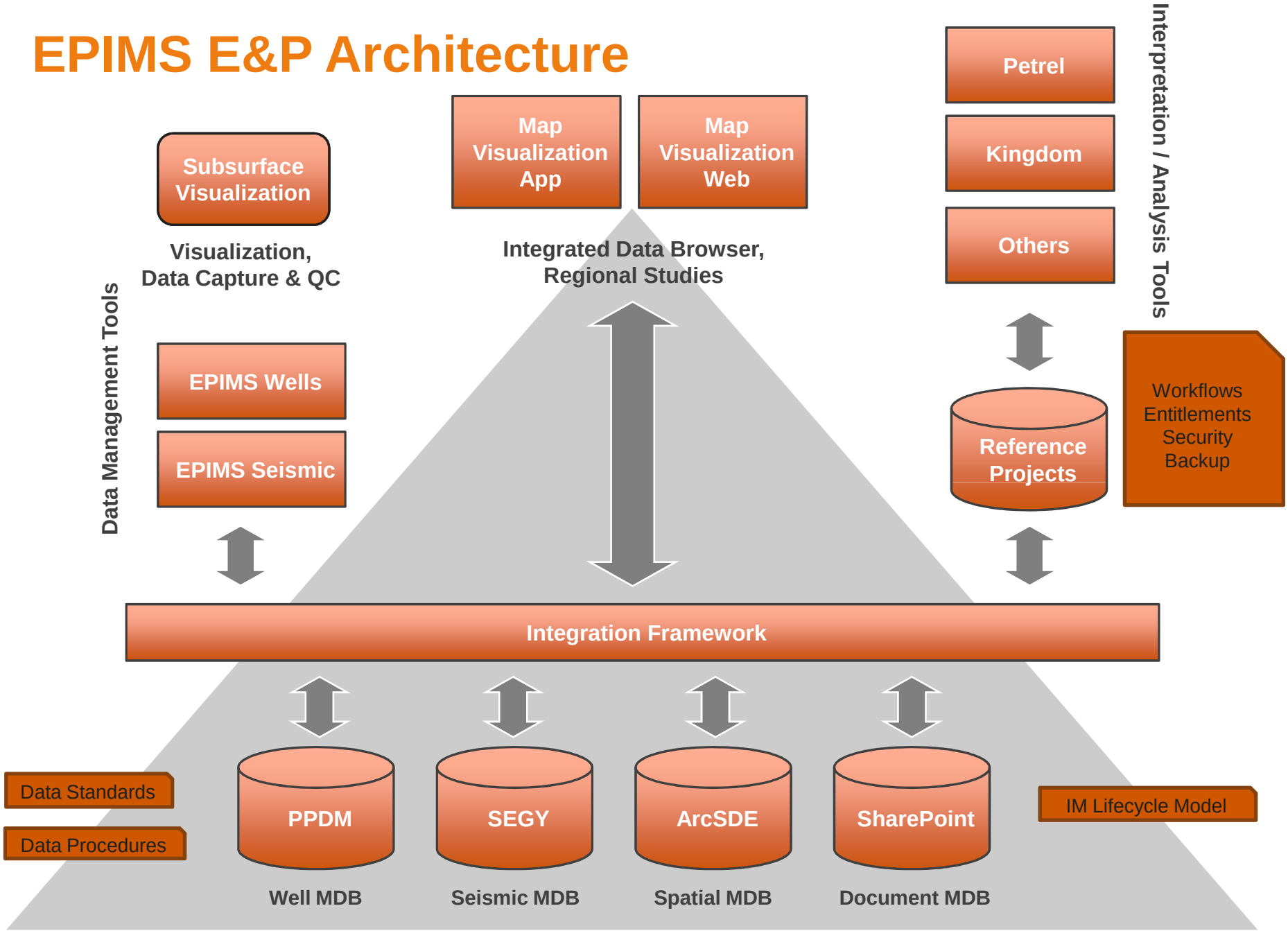


PEARL ENERGY

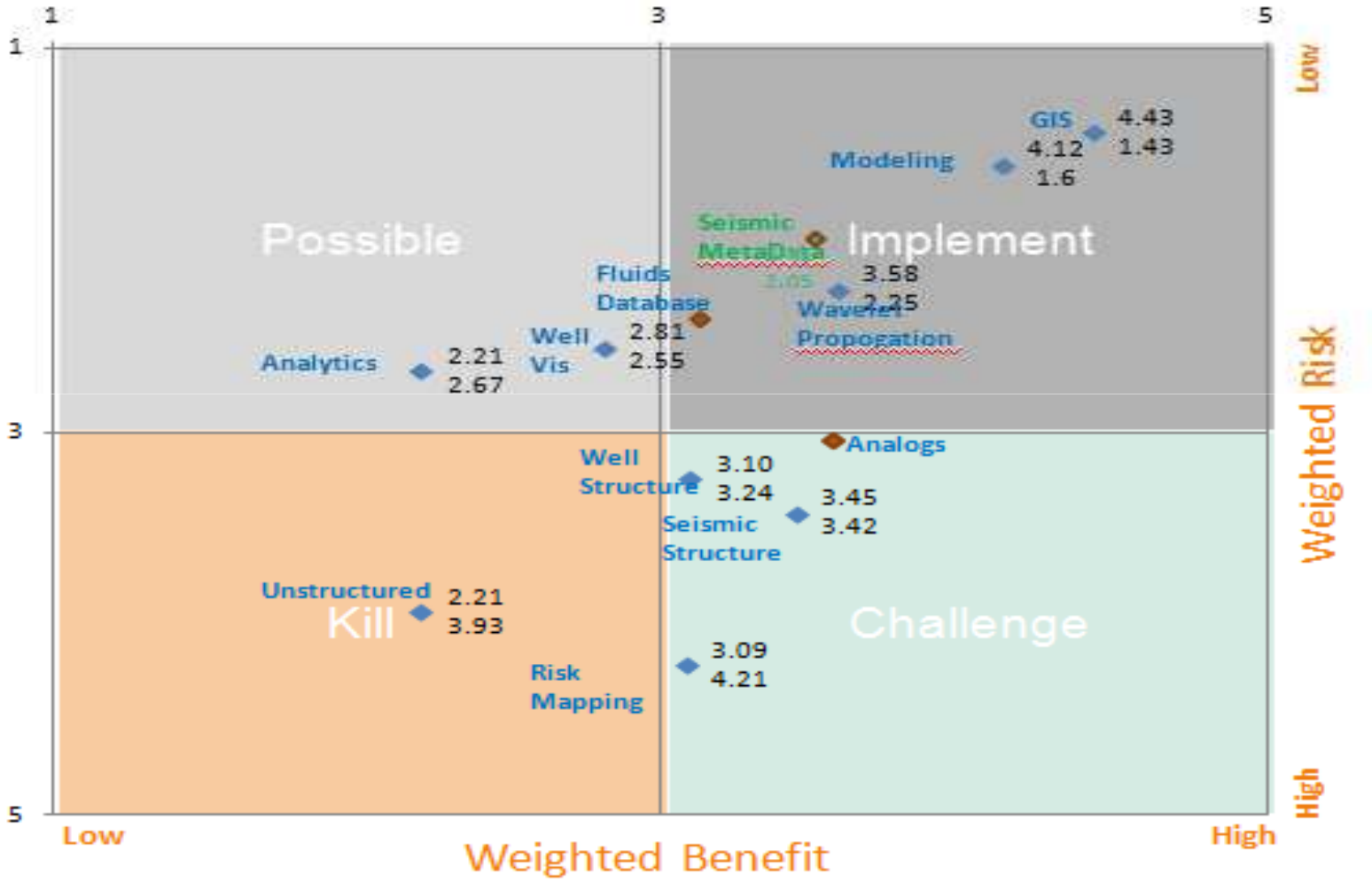
Peer Comparison - Maturity



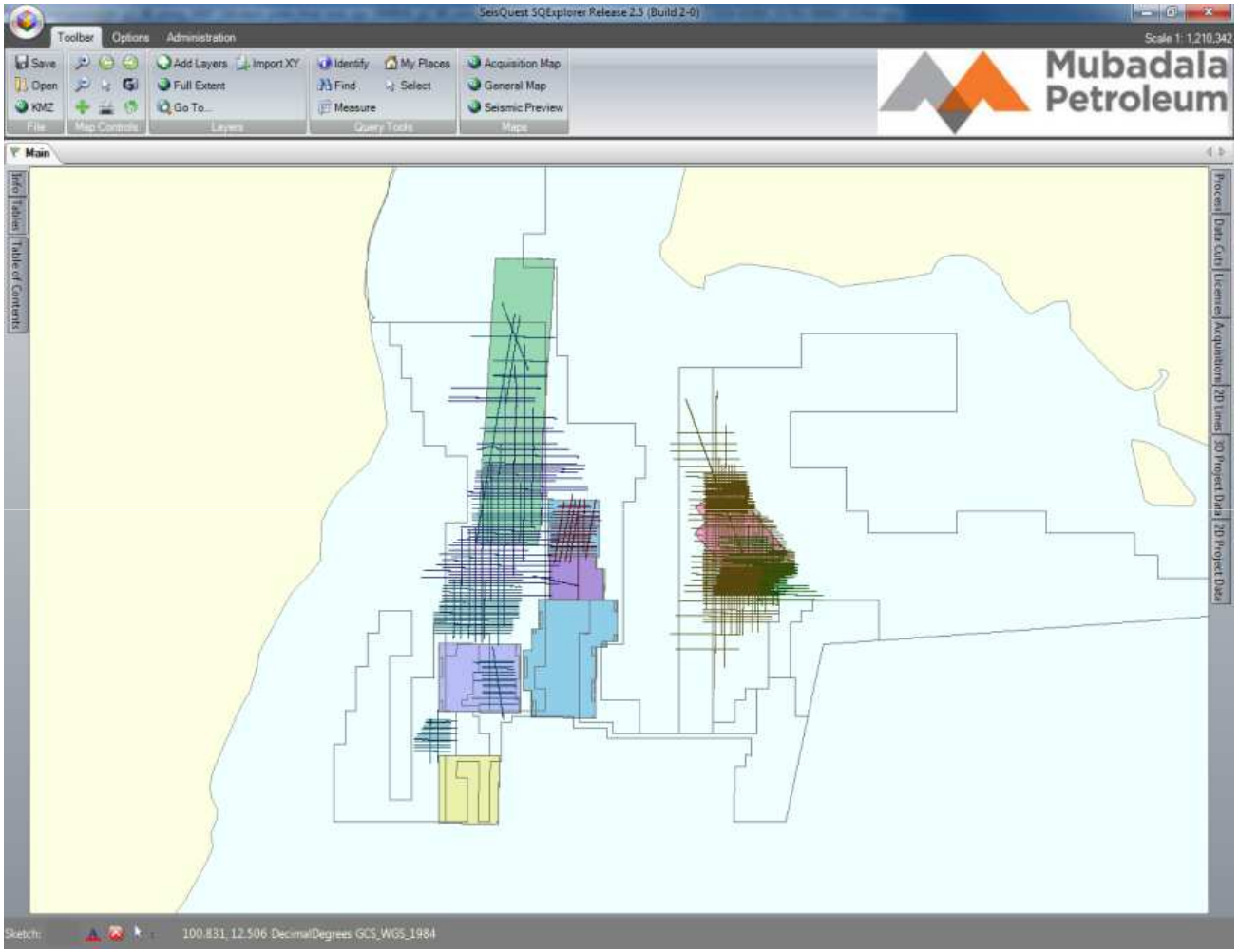
EPIMS E&P Architecture



PICK Analysis



EPIMS Thailand Seismic



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Phase I Scope:

18 2D & 3D surveys

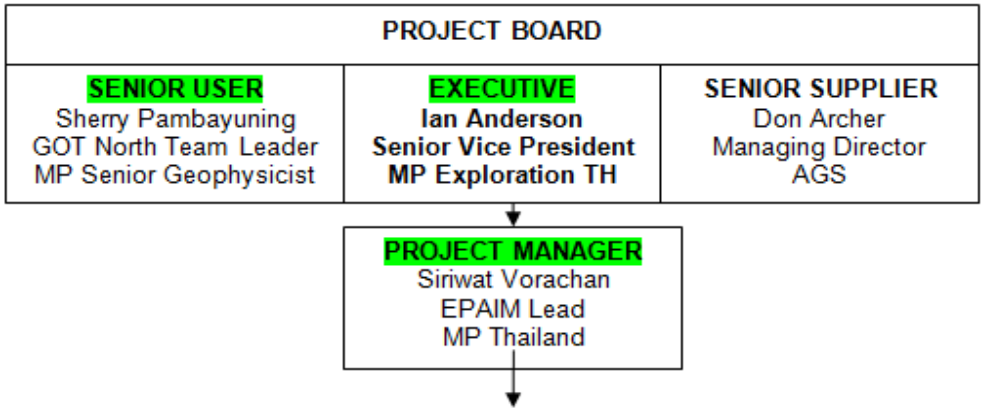
4000+ SEGY files on disk

Over 4.7 Tb of stack data

200+ versions and products

Less than 10% of data in Business Unit

Project Stakeholders



Tolerances:
Budget: +/- 11%
Time: +/- 17%
Resources: 0%

Project Team

Project Assurance	Jess Kozman	SE Asia Regional Manager, MP EPAIM
Project Support	Thirada Kensakoo	Exploration Applications Support - TH
Project Team	Nofri Faruzza Said S Putra	AGS AGS
External Stakeholders:	David Johnson	MP President - Thailand
	David Carter	Chief Geophysicist - TH
	Anoop Pandey	ArcGIS Expert - TH
	Thongchai	IT Manager – TH
	Sebastien Ferreira	EPAIM Manager - MP
	Damion Rudd	Project Leader – Regional Projects - SG
	Kanchanawadee Liemskul	Procurement Manager - TH
	Craig Heschuk	General Counsel – MP - SG

There are THREE kinds of data management projects:

Mubadala Petroleum

Cheap

Quick

Accurate

Pick any TWO!

Data Governance at MP – Thailand Business Unit

Roles	Geology	Geophysics	GIS
Data Owner	*Suburface:* Petrophysicist *Exploration:* Team Lead *Drilling:* Drilling Manager *Development:* Senior Geologist	*Regional:* Chief Geophysicist *Team:* Team Lead	Team Lead
Data Manager	Data Analyst	*Reference:* EPAIM *Working:* Geophysicist	ArcGIS Expert
Data Handler	EPAIM	EPAIM	EPAIM
User	Geologist Geophysicist	Geophysicist	Geologist Data Analyst
System of Record	EPIMS Wells	*Final:* Reference Project *Processed:* EPIMS Seismic	Corporate GIS

What did the users want?

Mubadala Petroleum

Standard Products

Naming Conventions

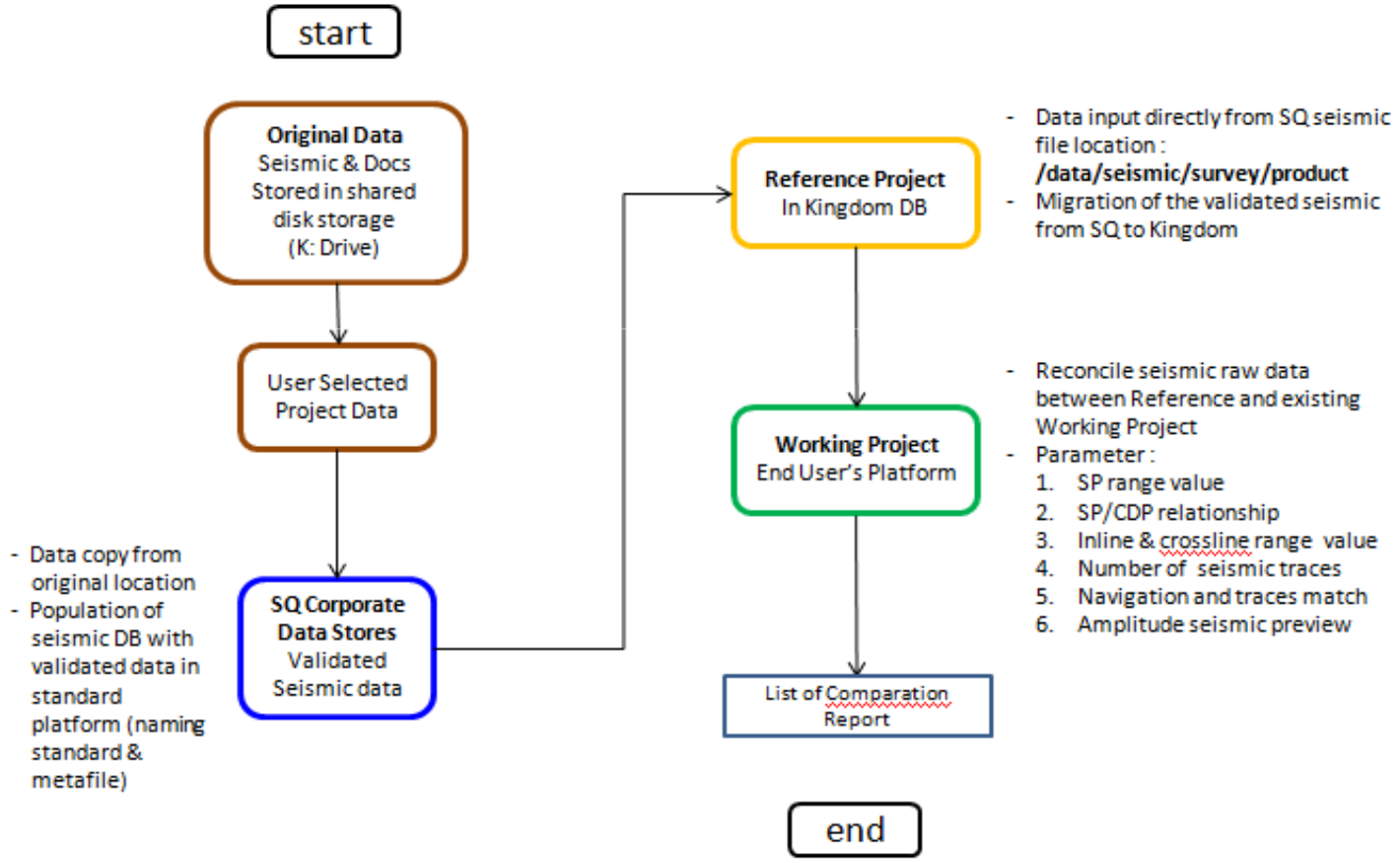
Full processing history

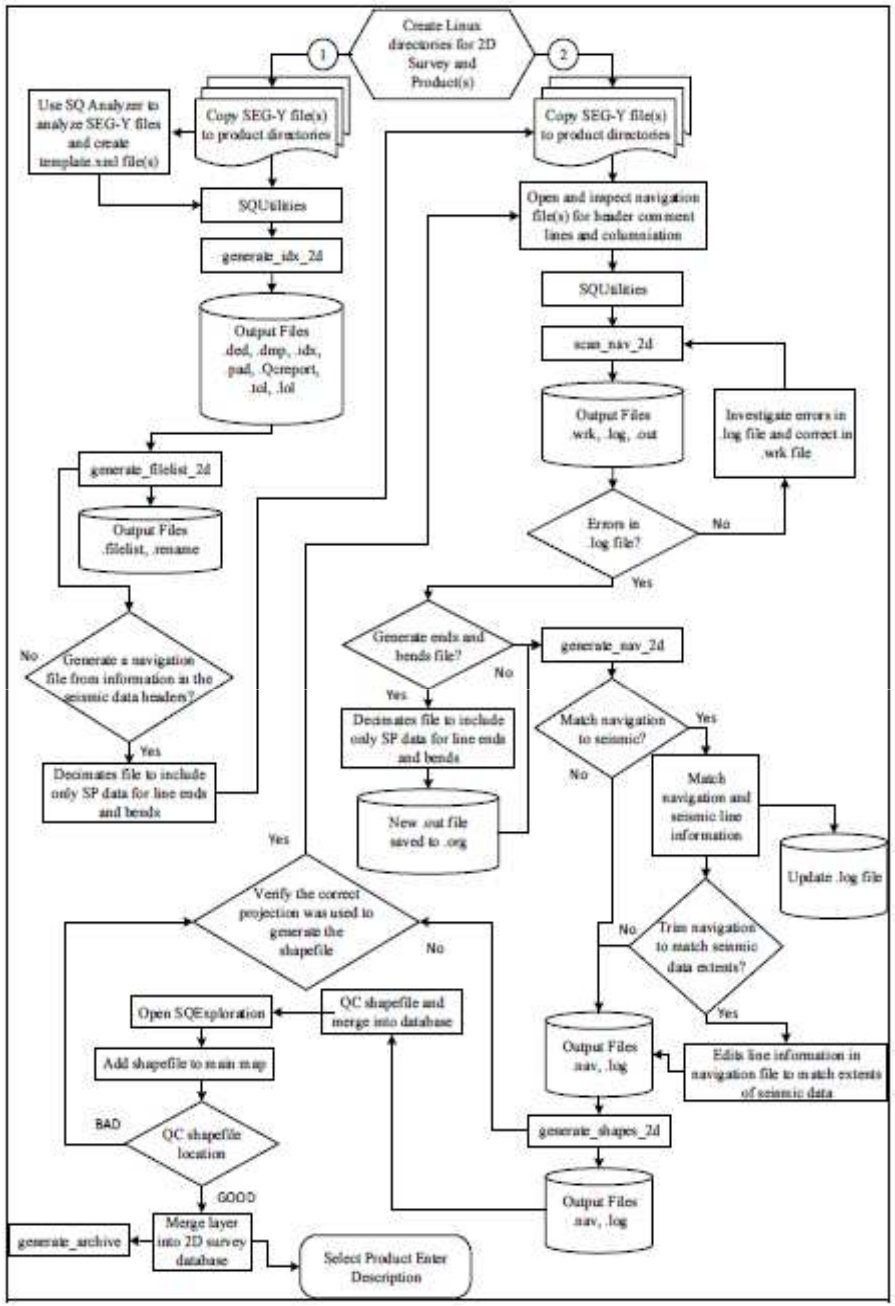
Confidence in QC'd navigations

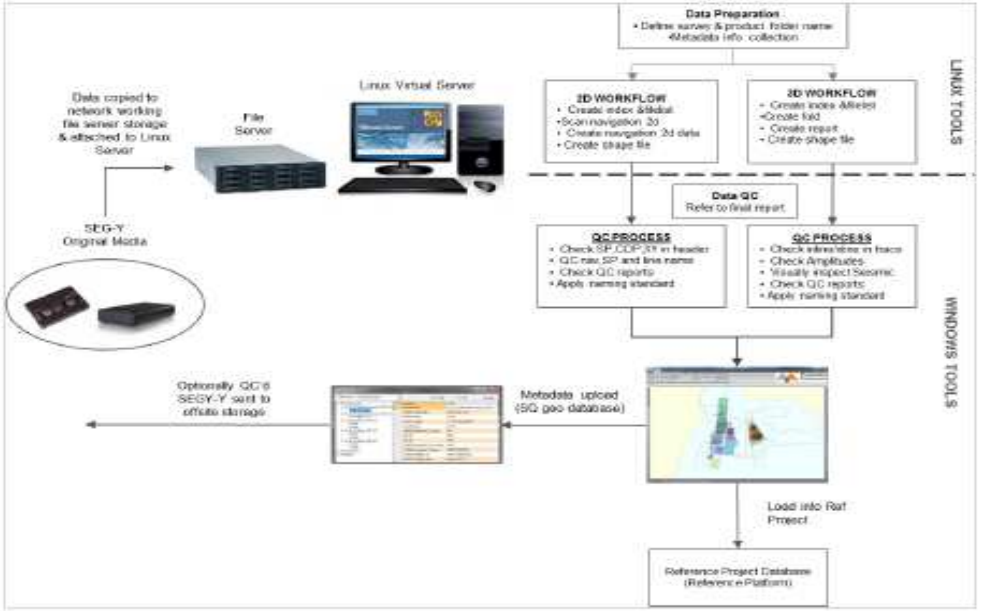
Delivered and populated in Validated Reference Project

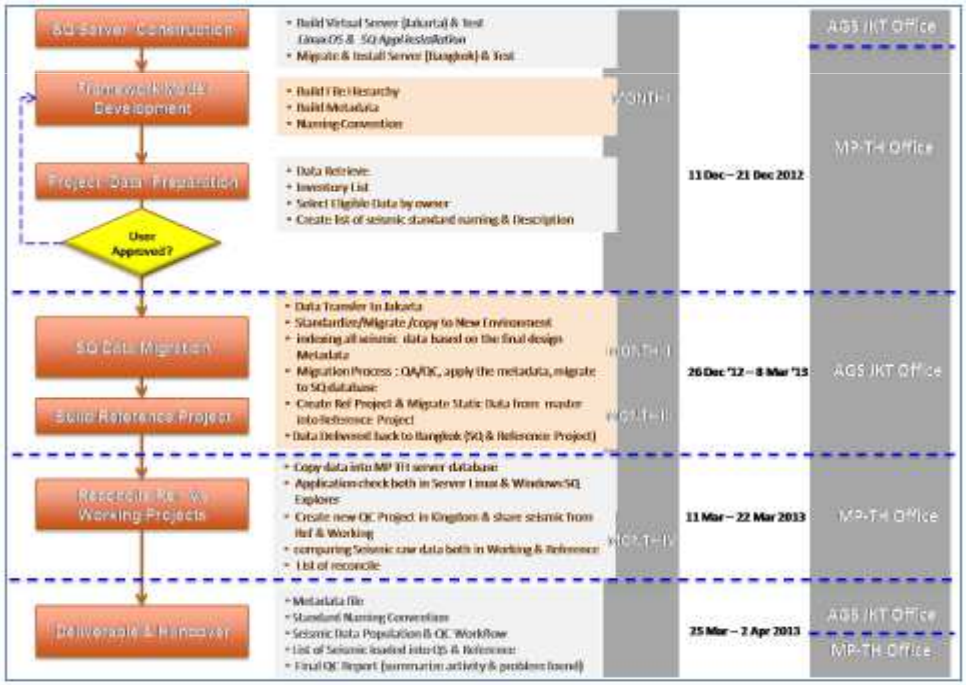
Available on a Map across the Business Units

Reference Project Process




Create Linux directories for 2D Survey and Product(s)
1
2
Use SQ Analyzer to analyze SEG-Y files and create template.xml file(s)
Copy SEG-Y file(s) to product directories
Copy SEG-Y file(s) to product directories
SQUtilities
generate_idx_2d
Output Files ded, .dmp, .idx, pad, Qcreport, tol, .lol
Open and inspect navigation file(s) for header comment lines and colonisation
SQUtilities
scan_nav_2d
Output Files wrk, .log, .out
Investigate errors in log file and correct in .wrk file
Errors in log file?
No
Yes
generate_filelist_2d
Output Files filelist, .rename
Generate a navigation file from information in the seismic data headers?
No
Yes
Decimates file to include only SP data for line ends and bends
Generate ends and bends file?
No
Yes
Decimates file to include only SP data for line ends and bends
New .out file saved to .org
generate_nav_2d
Match navigation to seismic?
Yes
No
Match navigation and seismic line information
Update .log file
Verify the correct projection was used to generate the shapefile
No
Yes
Trim navigation to match seismic data extents?
No
Yes
Edits line information in navigation file to match extents of seismic data
Open SQExploration
QC shapefile and merge into database
Add shapefile to seam map
BAD
QC shapefile location
GOOD
Output Files nav, .log
generate_shapes_2d
Output Files nav, .log
generate_archive
Merge layer into 2D survey database
Select Product Enter Description


Data Preparation
• Define survey & product folder name
•Metadata info collection
LINUX TOOLS
Data copied to network working file server storage & attached to Linux Server
File Server
Linux Virtual Server
2D WORKFLOW
• Create index &Model
•Scan navigation 2d
• Create navigation 2d data
• Create shape file
2D WORKFLOW
• Create index &Model
•Create bin
• Create report
• Create shape file
Data QC
Refer to final report
SEG-Y Original Media
QC PROCESS
• Check SP, CDP, SI in header
• QC nav SP and line name
• Check QC reports
• Apply naming standard
QC PROCESS
• Check inline/xline in trace
• Check Amplitudes
• Visually inspect Seismic
• Check QC reports
• Apply naming standard
WINDOWS TOOLS
Optionally QC'd SEGY-Y sent to offsite storage
Metadata upload (SQ geo database)
Load into Ref Project
Reference Project Database (Reference Platform)


SQ Server Construction
• Build Virtual Server (Jakarta) & Test
Linux OS & SQ Application
• Migrate & Install Server (Bangkok) & Test
AGS JKT Office
Framework for Development
• Build File Hierarchy
• Build Metadata
• Naming Convention
MONTH I
MP-TH Office
Project Data Preparation
• Data Retrieve
• Inventory List
• Select Eligible Data by owner
• Create list of seismic standard naming & Description
11 Dec – 21 Dec 2012
User Approved?
SQ Data Migration
• Data Transfer to Jakarta
• Standardize/Migrate /copy to New Environment
• indexing all seismic data based on the final design Metadata
• Migration Process : QA/QC, apply the metadata, migrate to SQ database
• Create Ref Project & Migrate Static Data from master into Reference Project
• Data Delivered back to Bangkok (SQ & Reference Project)
MONTH II
26 Dec '12 – 8 Mar '13
AGS JKT Office
Setup Reference Project
Reconcile SQ vs Working Projects
• Copy data into MP TH server database
• Application check both in Server Linux & Windows SQ Explorer
• Create new QC Project in Kingdom & Share seismic from Ref & Working
• comparing Seismic raw data both in Working & Reference
• List of reconcile
MONTH III
11 Mar – 22 Mar 2013
MP-TH Office
Deliverable & Handover
• Metadata file
• Standard Naming Convention
• Seismic Data Population & QC Workflow
• List of Seismic loaded into QS & Reference
• Final QC Report (summarize activity & problem found)
25 Mar – 2 Apr 2013
AGS JKT Office
MP-TH Office

Seismic Survey Naming Convention

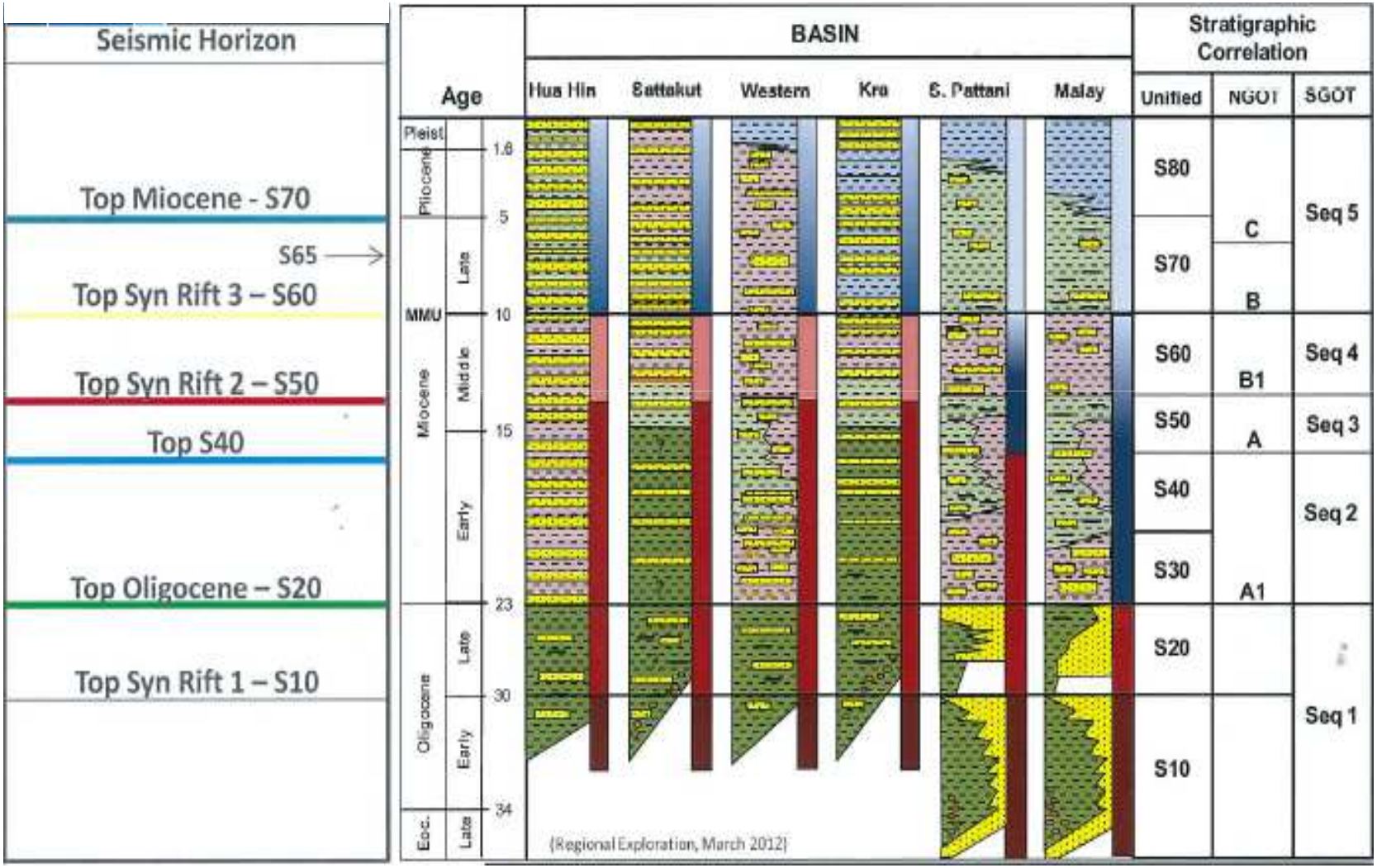
Mubadala Petroleum

Usage : ***country_block_survey_version_year_type***

th_b5_27_south_tantima_wgc_2010_3d	stack_pstm_final_resfar_wgc_2011 (Time)
th_b5_27_south_tantima_wgc_2010_3d	stack_pstm_final_far_wgc_2011 (Time)
th_b5_27_south_tantima_wgc_2010_3d	stack_pstm_final_mid_wgc_2011 (Time)
th_b5_27_south_tantima_wgc_2010_3d	stack_pstm_final_near_wgc_2011 (Time)
th_g3_48_sattakut_wgc_2011_3d	stack_pstm_final_full_wgc_2011 (Time)
th_g3_48_sattakut_wgc_2011_3d	stack_pstm_final_avo_g_wgc_2011 (Time)
th_g1_48_north_kra_cgv_2007_3d_2	stack_psdm_final_avo_g_time_beam_wgc_2011 (Time)
th_g1_48_north_kra_cgv_2007_3d_2	stack_psdm_final_avo_g_time_kirchoff_wgc_2011 (Time)

Business Rule: For each pair of domain and product in a survey, there can be one and only one version with the status of “Final”

Seismic Horizon Naming Convention



User Prioritized MetaData

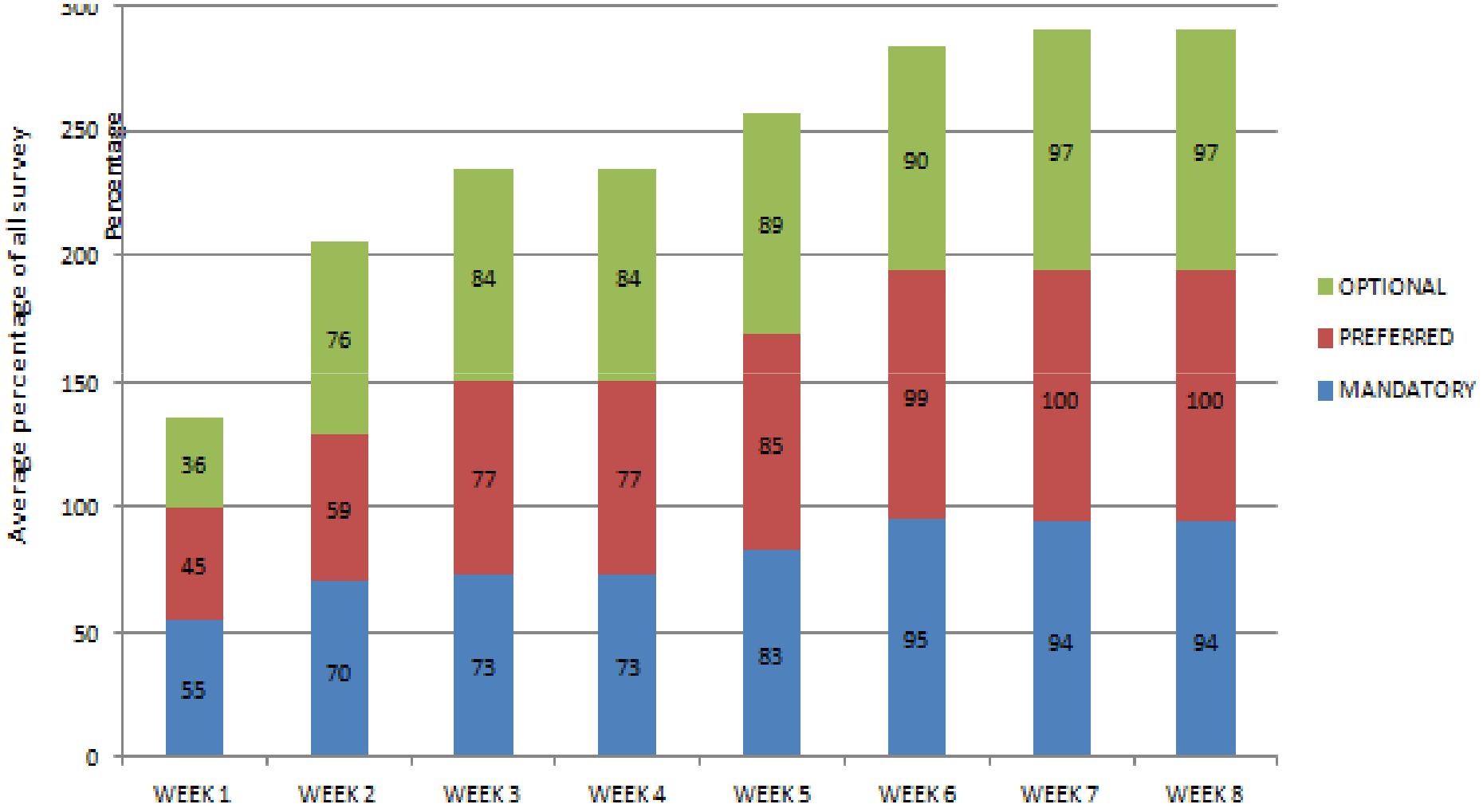
Mubadala Petroleum

No	Mandatory	2D	3D
1	Validated by	√	√
2	Validated date	√	√
3	Original File Location	√	√
4	Original File Name	√	√
5	Original Format Media	√	√
6	Year of Processing	√	√
7	Processing Company	√	√
8	Processing Type	√	√
9	Processing Output Phase	√	√
10	Polarity Type	√	√
11	SQ Survey Name	√	√
12	SQ Product Name	√	√
13	SQ Product Description	√	√
14	Seismic Archive Location	√	
15	SP/CDP Relationship	√	
16	Nav File	√	
17	CRS Nav File	√	
18	Source of Nav File	√	
19	Line Name	√	
20	Version	√	

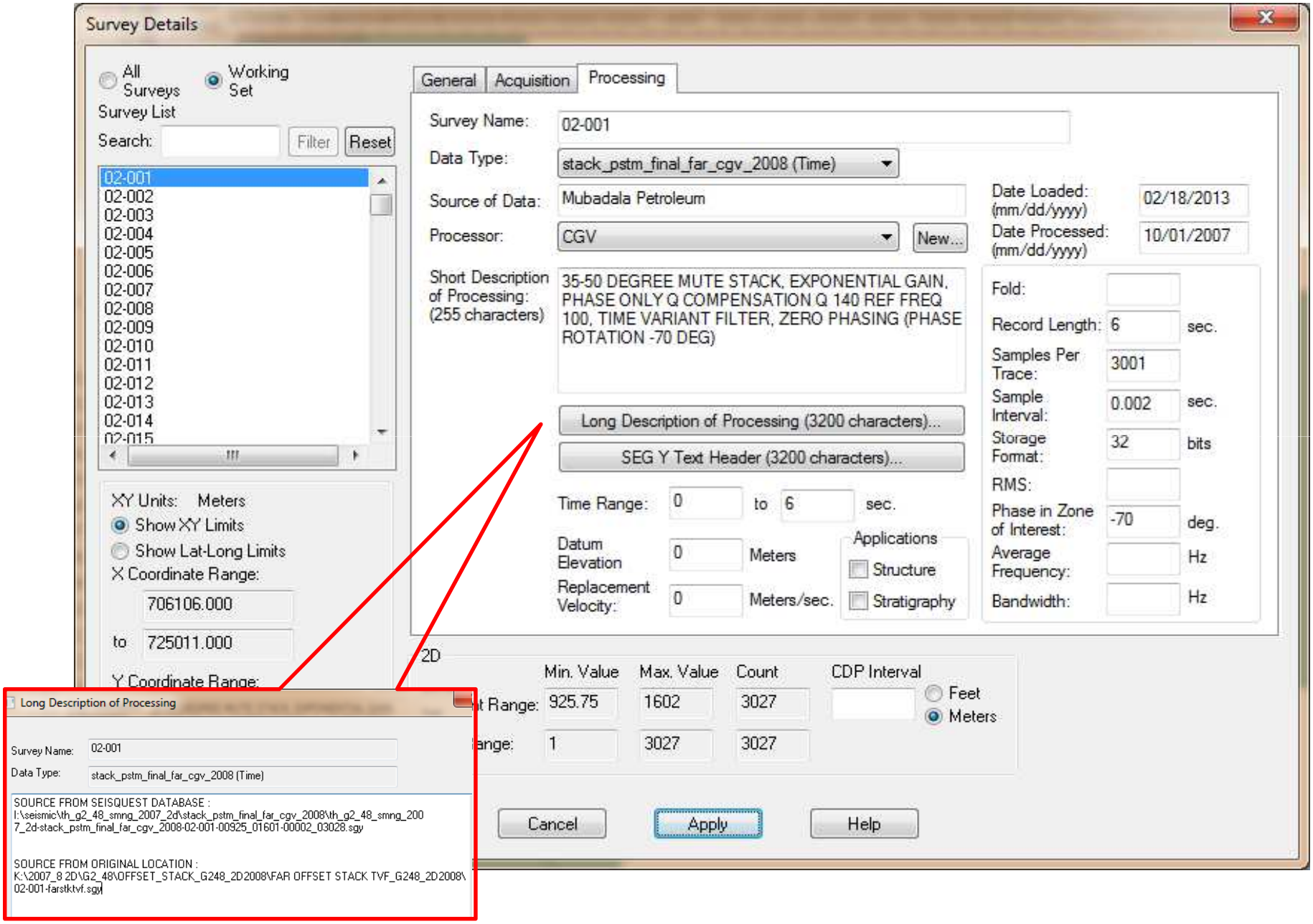
No	Prefered	2D	3D
1	Acquisition Date		√
2	Acquisition Year	√	√
3	Acquisition Contractor	√	√
4	Data Source	√	√
5	Total Live Trace Square	√	√
6	Total SEGY Size	√	√
7	Total Length Km	√	
8	Number of 2d Lines	√	
9	Number of Live Traces	√	√

No	Optional	2D	3D
1	Data Obtaining Method	√	√
		√	√
3	Country Area	√	√
4	Block	√	√
5	Original Survey Name	√	√
6	Source Type	√	√
7	Acquisition Sample Interval	√	√
8	Acquisition Record Length	√	√
9	Survey Environment	√	√
10	Geographic Area	√	√
11	Acquisition CRS	√	√
12	Seismic Acquisition Datum	√	√
13	SP Interval	√	√
14	Line Increment	√	√
15	Trace Increment	√	√
16	Spacing Between Lines	√	√
17	Spacing Between Traces	√	√
18	Attribute Seismic Type	√	√
19	Data File Format	√	√
20	Seismic Domain Type	√	√
21	Inline Byte Location	√	√
22	Trace Byte Location	√	√
23	Total Survey Area		√
24	Processing Record Length	√	√
25	Sample Format	√	√
26	Create By	√	√
27	Create Date	√	√
28	Inline Min	√	√
29	Inline Max	√	√
30	Xline Min	√	√
31	Xline Max	√	√
32	X Receiver Coord Byte Location	√	√
33	Y Receiver Coord Byte Location	√	√
34	Processing CRS	√	√
35	Coordinate Scalar	√	√
36	Sample Rate	√	√

MetaData as a Project Tracking Tool

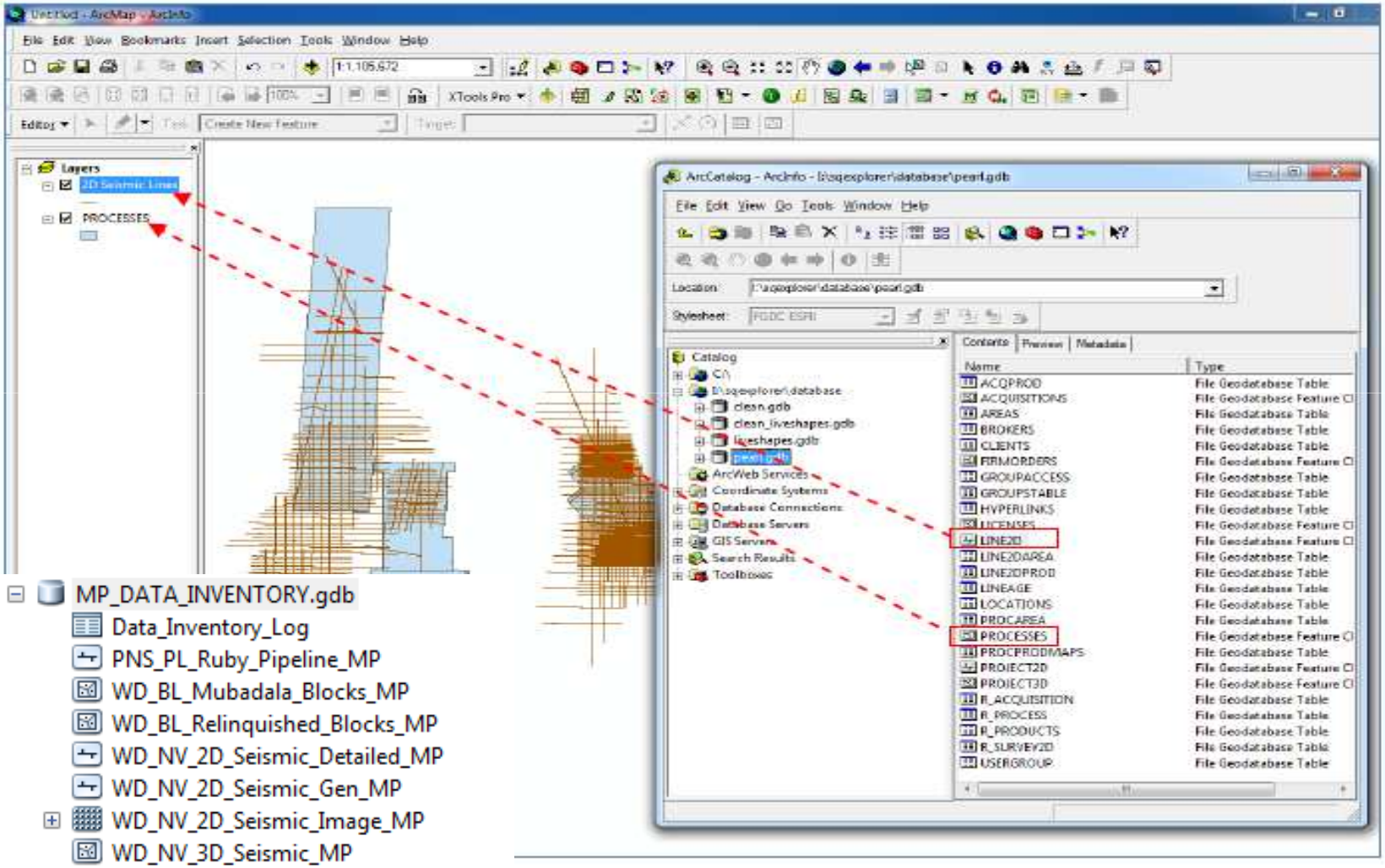


MetaData Population in System of Record



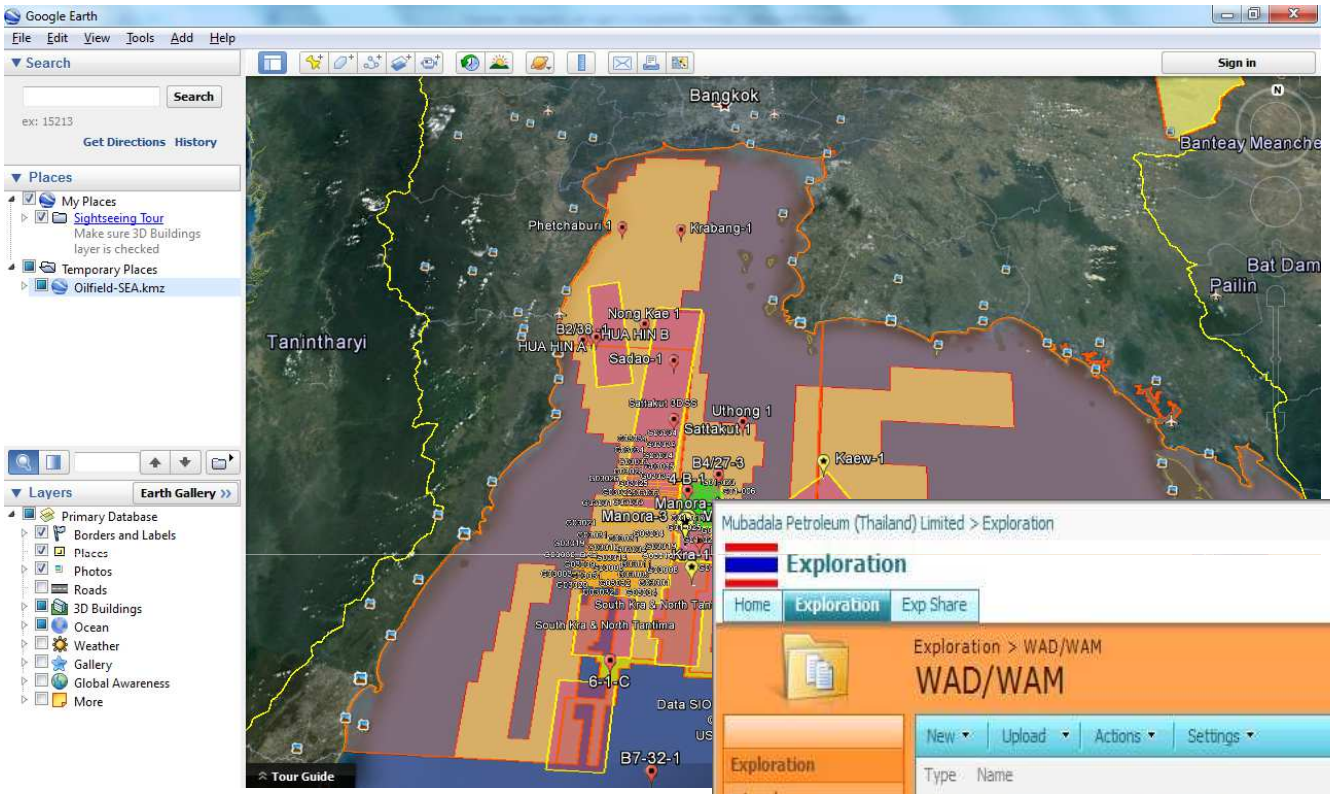
Delivery in ESRI Maps

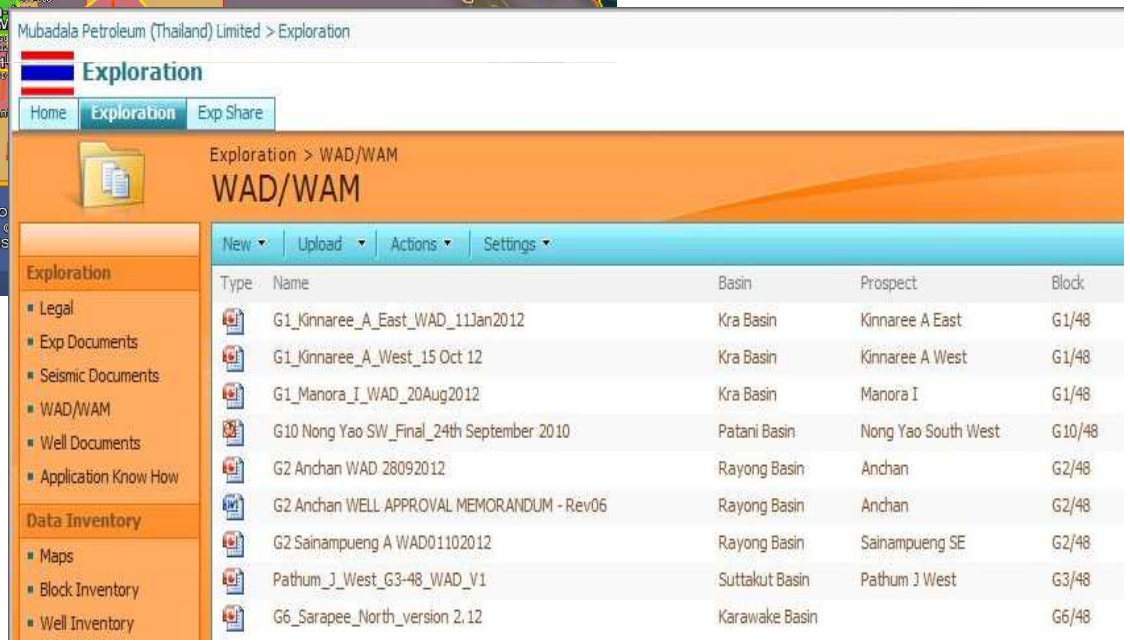
Mubadala Petroleum



- MP_DATA_INVENTORY.gdb
  - Data_Inventory_Log
  - PNS_PL_Ruby_Pipeline_MP
  - WD_BL_Mubadala_Blocks_MP
  - WD_BL_Relinquished_Blocks_MP
  - WD_NV_2D_Seismic_Detailed_MP
  - WD_NV_2D_Seismic_Gen_MP
  - WD_NV_2D_Seismic_Image_MP
  - WD_NV_3D_Seismic_MP
  - WD_WL_Data_Completeness_MP
  - WD_WL_Well_Data_Inventory_MP
  - WD_WL_Well_Data_Presence_MP

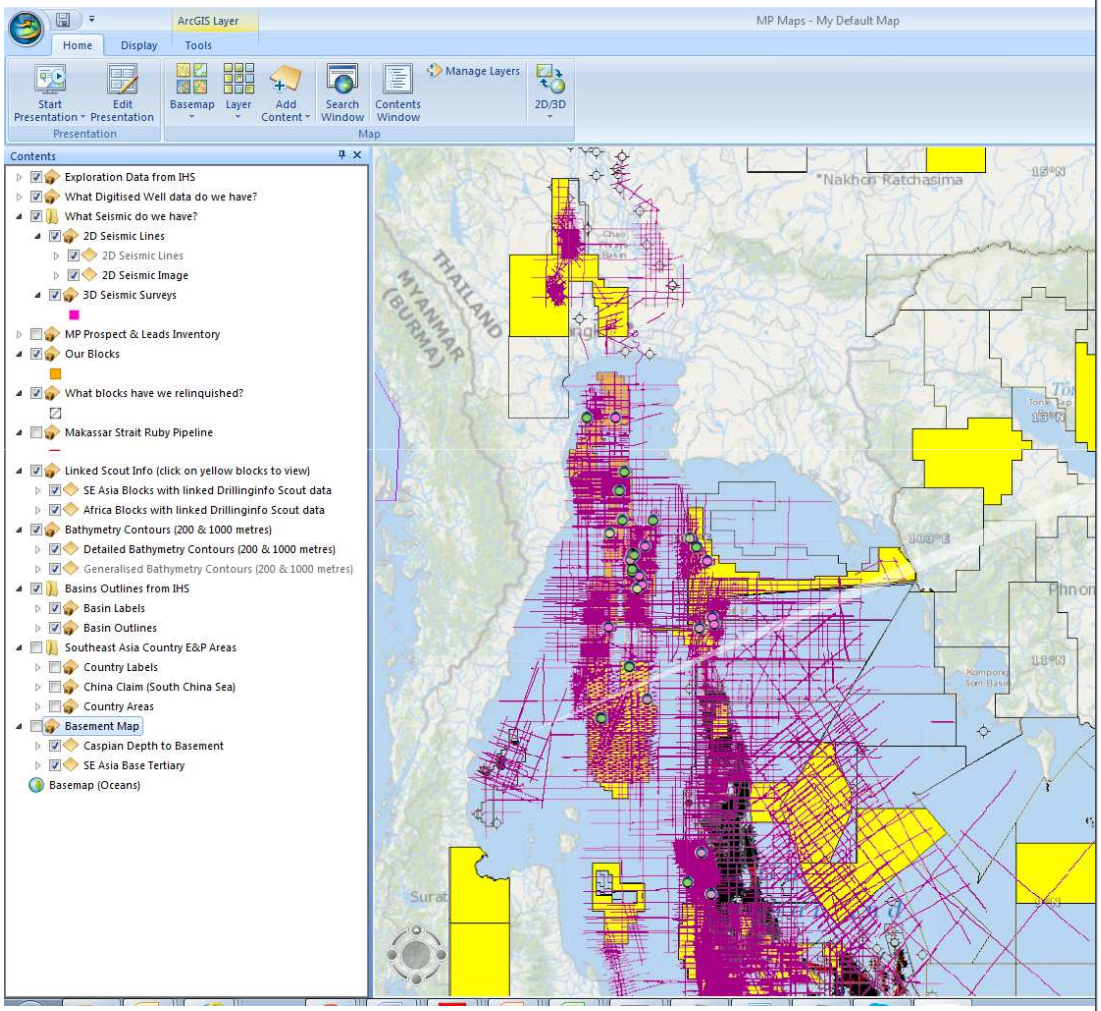
Delivery Across Multiple Platforms





Linked to managed folder structures

Metadata on a Map



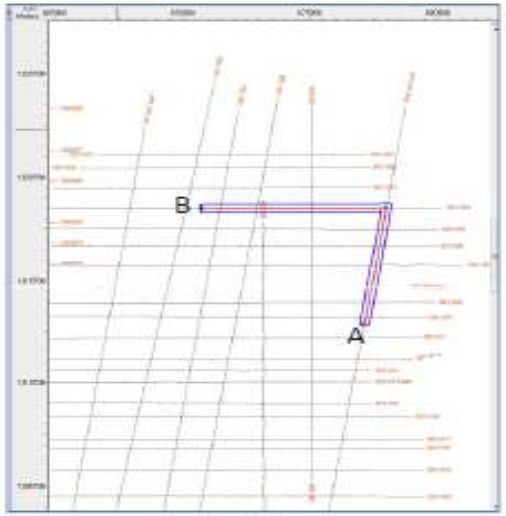
02-064

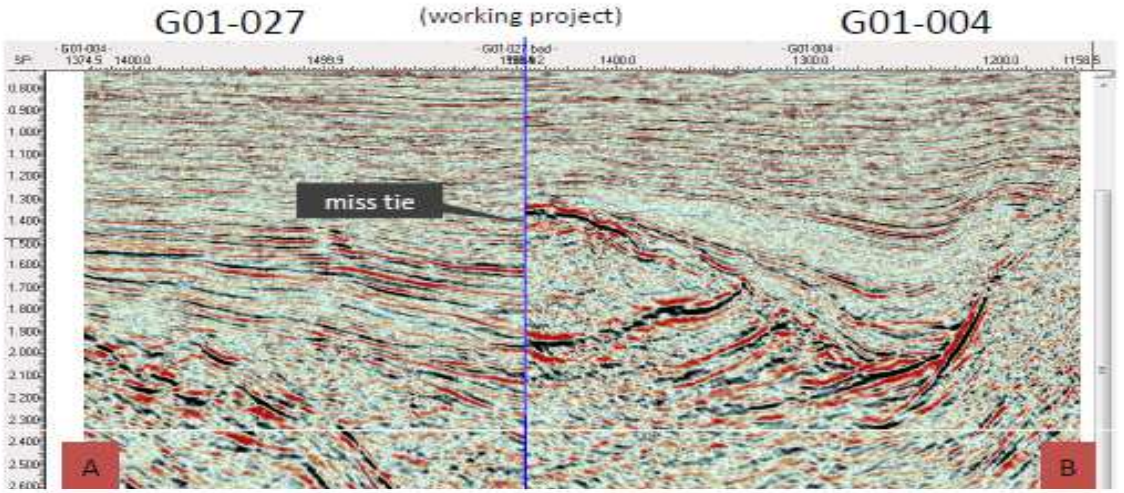
02-064	
SHAPE	Polyline
Survey Name	th_g2_48_smng_2007_2d
LINENAME	02-064
Preferred Flag	TRUE
SHAPE_Length	0.238727
Block	G2/48
Number_of_2D_Lines	144
First SP	1881
Last SP	921
Number_of_Live_Traces	4163
Acquisition_Company	Geostreamer
Validated_by	Sherry Pambayuning
Validated_date	February 2013
Original_Format_Media	DVD
Total_Length_Km	26.018385
Company name	Mubadala Petroleum
Survey Year	2007
Source of Navigation File	dump from SEGY trace header
Source Type	G. Guns & HGS Sleeve Guns
Shotpoint Interval (m)	25
Acquisition Record Length (msec)	6144
Acquisition CRS	WGS 1984 UTM 47N
Created by	Alliance Geotechnical Services
Created _ Date	December 2012
Seismic Archive Location	
Acquisition Year	2007
Seismic Acquisition Datum	Mean Sea Level
Acquisition Sample Rate (ms)	1
Remarks	

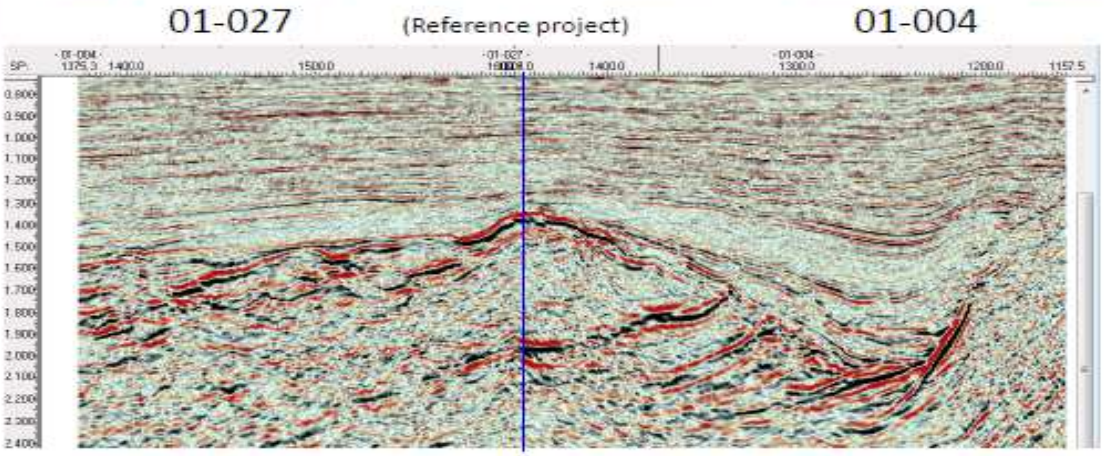
Business Case 1:
“I’ve got the wrong data”

Mubadala Petroleum

Seismic composite



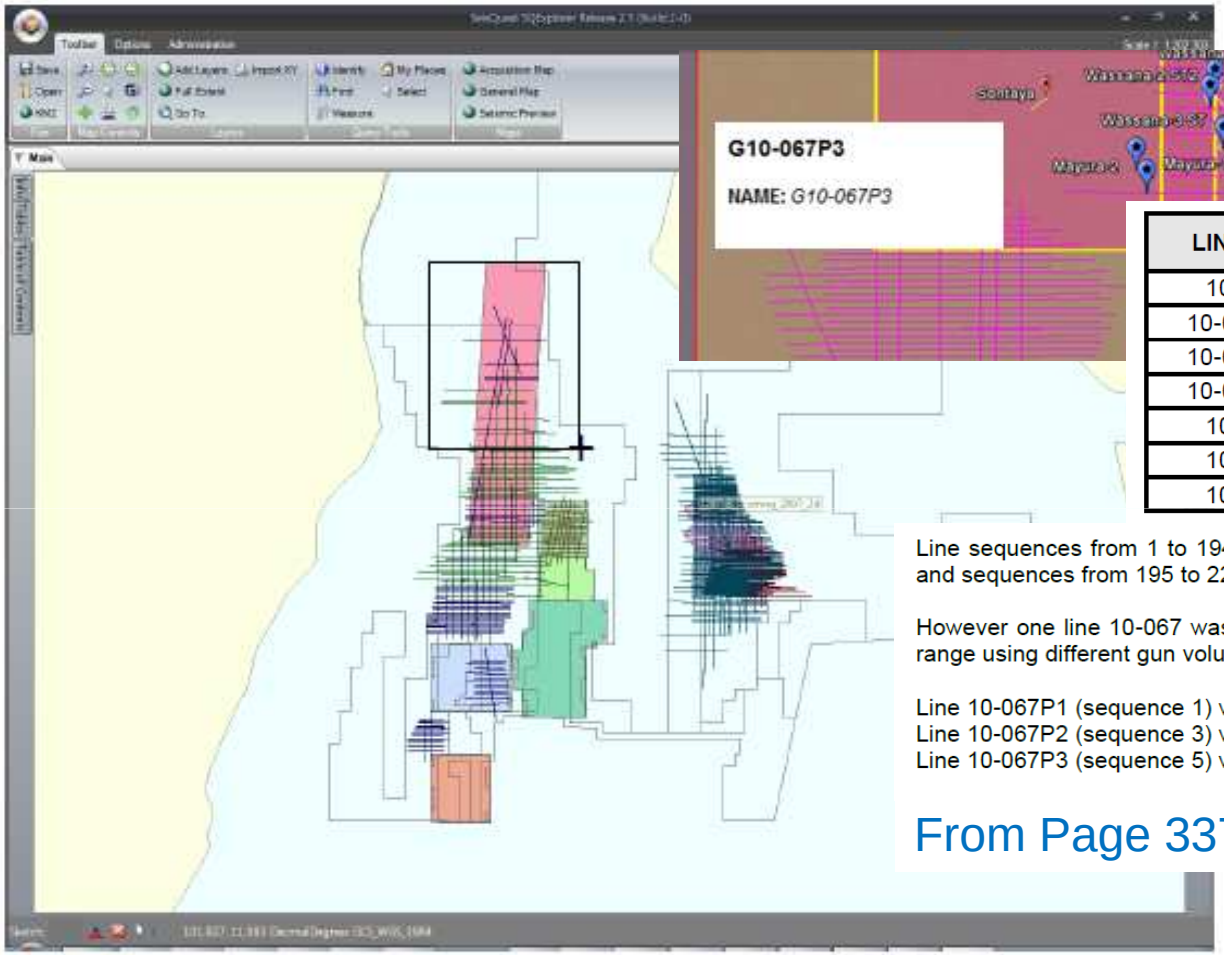




Notes added to a QC Reference Project in Workstation Format

Business Case 2:
“Why are there three versions of this line”

Mubadala Petroleum



LINE NO.	SHOTPOINT RANGE	CDP RANGE
10-066	1001 – 1930	2 – 4040
10-067-P1	1821 – 921	2 – 3924
10-067-P2	1821 – 921	2 – 3924
10-067-P3	1821 – 921	2 – 3924
10-068	1001 – 1857	2 – 3748
10-069	1744 – 921	2 – 3616
10-070	1001 – 1530	2 – 2440

Line sequences from 1 to 194 were recorded using a gun volume of 3800 cubic inches and sequences from 195 to 227 were recorded using a gun volume of 2850 cubic inches.

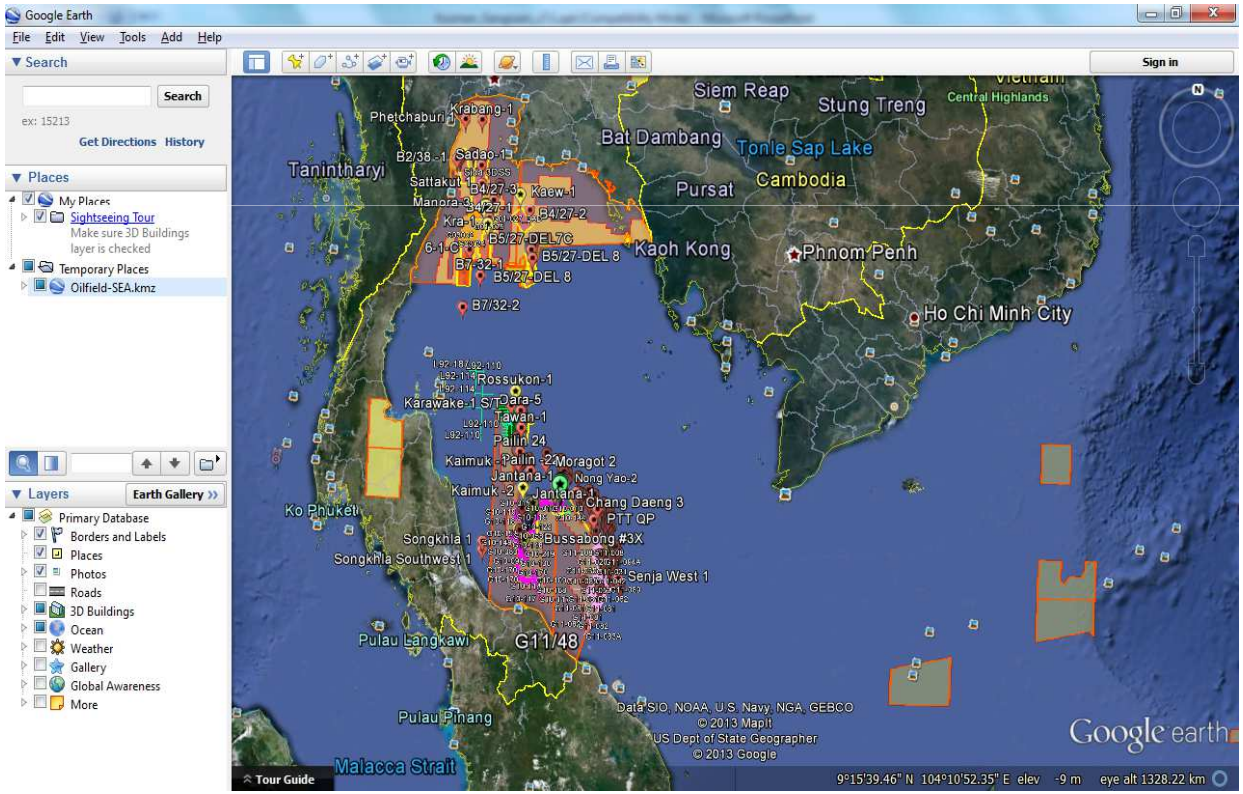
However one line 10-067 was recorded three times at the same location and shot-point range using different gun volumes as follows:

Line 10-067P1 (sequence 1) was recorded using gun volume of 3800 cubic inches.
Line 10-067P2 (sequence 3) was recorded using gun volume of 2850 cubic inches.
Line 10-067P3 (sequence 5) was recorded using gun volume of 1900 cubic inches.

From Page 337 of the pdf processing report

Business Case 3: Amplitude Balance and MisTie Analysis

Key modern set of surveys
High level of confidence
Use as a baseline



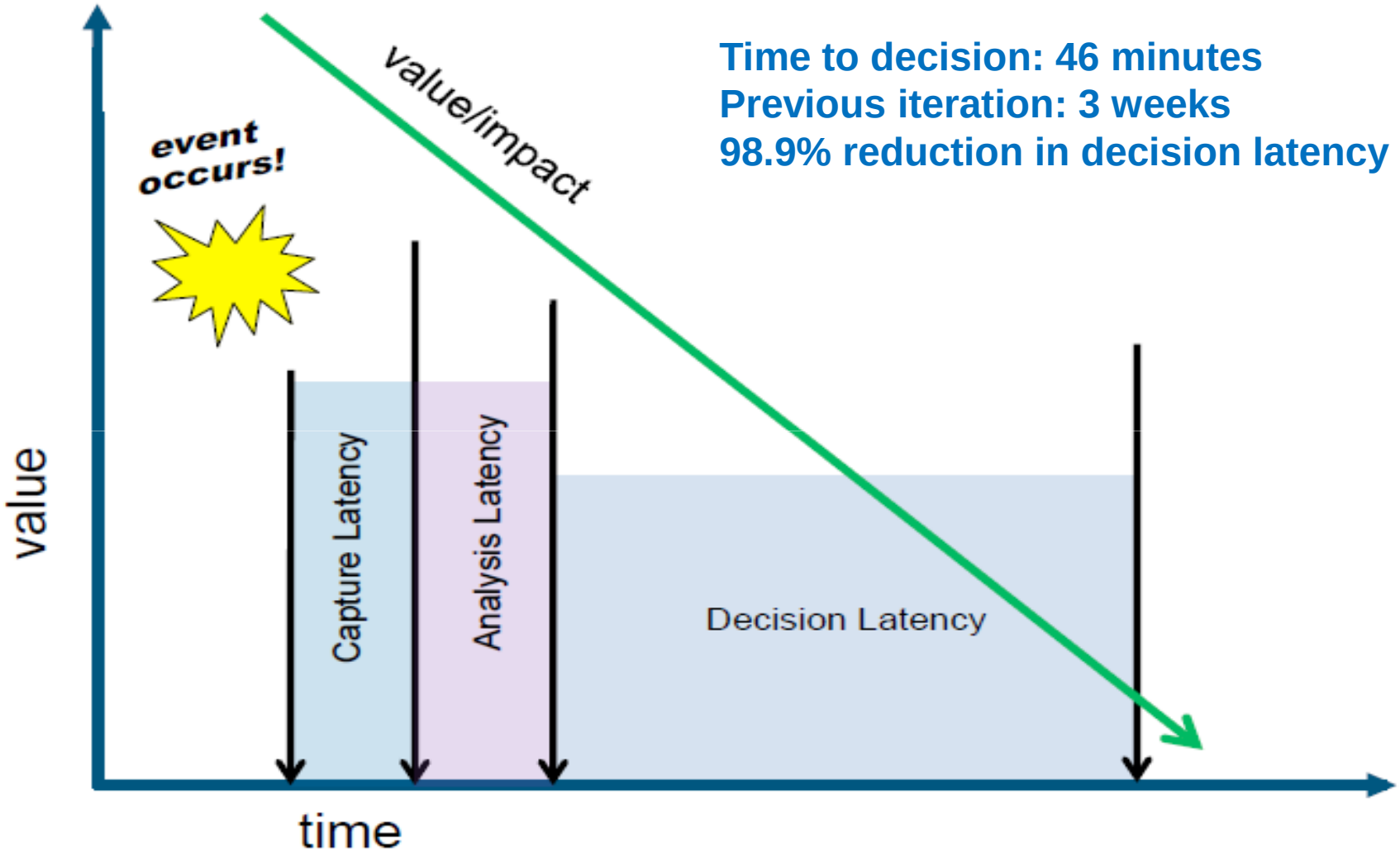
Expanded Scope:

Geographic AOI to entire Gulf of Thailand

Processing to Pre-Stack

Vintage to Pre-2007

Decision Latency



Time to decision: 46 minutes
Previous iteration: 3 weeks
98.9% reduction in decision latency

The Importance of Standards and UOM: A Tale of Three Centuries

Swedish warship "Vasa"

Sunk, 1628

Cause: Failure to recognize difference between Swedish feet and Amsterdam feet

The Swedish warship Vasa, when it was launched in 1628, was the most powerfully armed warship in the world. Unfortunately, her maiden voyage lasted only 20 minutes and less than a mile as she capsized, drowning 30 of her crew. After a recent three year program in Stockholm of measurements and inspection of four measuring rulers used by workmen constructing the ship, it was determined that two of the rulers were in ***Swedish feet***, containing twelve inches, and the other two in ***Amsterdam feet***, with eleven inches to a foot. Since carpenters worked on opposite sides of the ship, there was heavier structure on the port side of the hull than on the starboard, causing the ship to heel over. Fortunately "Vasa" sank in cold waters that preserved her timbers for over three centuries so we could learn from this tragic mistake. But did we?
http://www.pri.org/stories/science/swedish-preservationists-document-likely-cause-of-sinking-of-ancient-sailing-ship-8606.html
http://www.infra.kth.se/geo/publications/theses/EX-0704.pdf

Athletic Record Disqualification
NCAA, 1983
Cause: Failure to recognize difference between Metric and Imperial units

Air Canada Flight 143
"Dead Stick" landing , 1983
Cause: Failure to recognize difference between Liters and Kilograms

Korean Air MD-11 crash
8 deaths, 37 injuries, 1999
Cause: Failure to recognize difference between Feet and Meters

1983: University of Houston sophomore track star Carol Lewis (younger sister of Olympic star Carl Lewis) makes what appears to be a record-breaking long jump at the NCAA Men's and Women's Indoor Track Championship, in Pontiac, Michigan. However, officials hosting the games did not use ***metric*** tapes to record the distance and to be considered official, college sports track and field measurements must be measured in metric, and cannot be converted to metric after the event.
[Source: American National Metric Council Metric Reporter, May 1983.]

1983: Air Canada Flight 143 runs out of fuel halfway through its flight from Montreal to Edmonton. Fuel loading teams failed to recognize the difference between the ***liters*** measured in the tanks by the recently adopted metric system, and the pilot's calculation of the fuel requirement in ***kilograms***.
www.casa.gov.au/fsa/2003/jul/22-27.pdf
http://www.iasa.com.au/folders/Safety_Issues/others/GimliGlider.html

1999: Korean Air cargo flight 6316 receives clearance to climb to 1500 ***metres***. After climbing to 4500 feet and receiving two faulty confirmations from his first officer that the required altitude should be 1500 ***feet***, the pilot determines the aircraft is 3000 feet too high and puts the aircraft into a rapid descent which the crew is unable to recover from.
http://aviation-safety.net/database/record.php?id=19990415-0

NASA Mars Climate Orbiter
Total Loss, 1999
Cause: Failure to recognize difference between Pound-Feet and Newtons

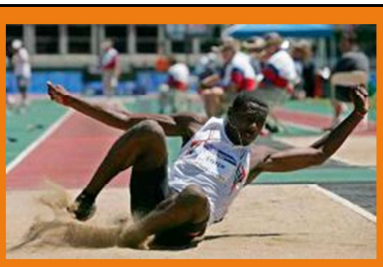
Escape of 250 Kilogram Tortoise
Los Angeles Zoo, 2001
Cause: Failure to recognize difference between Kilograms and Pounds

Shipment of Wild Rice to Japan
Elimination of Company Profit, 2001
Cause: Failure to recognize difference between Pounds and Kilograms

1999: NASA space scientists watch remote telemetry as the Mars Climate Orbiter attempts to enter into an orbit around the Red Planet as part of a new program of interplanetary exploration. A sudden loss of communication indicates a major problem, and a later investigation determines that the cause of the failure was an error in transfer of information between a spacecraft team in Colorado and a mission navigation team in California. One team used English units of ***Feet and Pounds*** while the other used metric units of ***Newtons***, causing the spacecraft to enter the Martian atmosphere at an improperly low altitude and disintegrate.
http://mars.jpl.nasa.gov/msp98/news/mco990930.html
ftp://ftp.hq.nasa.gov/pub/pao/reports/1999/MCO_report.pdf

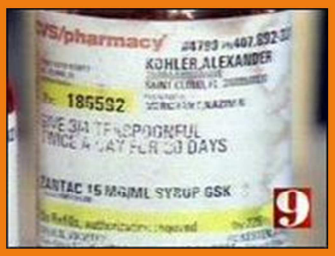
2001: Clarence the Los Angeles Zoo's 75-year-old Galapagos is newly ensconsed in an enclosure built for an animal that weighs in at "about 250". They think ***pounds***. Upon arrival, the zookeepers note "he's the size of a coffee table" and appears to weigh a lot more than 250. The first night in his new enclosure, he pushes over the fence poles and is discovered on a nearby lawn. He is moved to an enclosure with concrete poles built for a 250 ***kilogram*** animal.
http://articles.latimes.com/2001/feb/09/local/me-23253

2001: An exporter in the U.S. sells a shipment of wild rice to a Japanese customer, quoted at 39 cents a ***pound***, but thinking the quote was for 39 cents per ***kilogram***. To cultivate a long-term business relationship, both parties end up losing money on the deal.
http://www.bizjournals.com/eastbay/stories/2001/07/09/focus3.html



Athletic Record Disqualification
Olympics, 2004
Cause: Failure to recognize difference between Feet and Meters

Tokyo Disneyland roller coaster
Derailment, 2004
Cause: Failure to recognize difference between English and Metric units



Zantac Overdose
Child Safety Risk, 2005
Cause: Failure to recognize difference between Teaspoons and Milliliters

2004: Long jumper Melvin Lister is eliminated in the qualifying round of the Olympics after a sub-par performance. He blames the loss on officials' refusal to allow him to use his ***feet and inches*** measuring tape to set his running speed and approach. His teammate Walter Davis advances with a tape in both feet and ***meters***, saying "you've got to come prepared".
http://articles.latimes.com/2004/aug/21/sports/sp-olytrack21

2004: An axle breaks on a roller coaster at Tokyo Disneyland, causing a derailment. Parts were ordered in ***English*** specifications instead of the ***Metric*** units that had been adopted 9 years earlier.
http://chemwiki.ucdavis.edu/Analytical_Chemistry/Quantifying_Nature/Case_Studies%3A_Metric%2F%2FEnglish_Conversion_Errors

2005: A pharmacy in Florida fills a prescription for liquid Zantac with instructions to give three-quarters of a ***teaspoon*** twice a day. At a doctor appointment a month later, the mother of the patient discovers it should have been three-quarters of a ***milliliter***, leading her to overdose her child by four times.
http://www.wftv.com/news/news/pharmacy-makes-another-potentially-dangerous-presc/nD9mP/

So, over three and half centuries of costly and sometimes deadly mistakes, and we still cannot manage to include UOM metadata with our specifications?