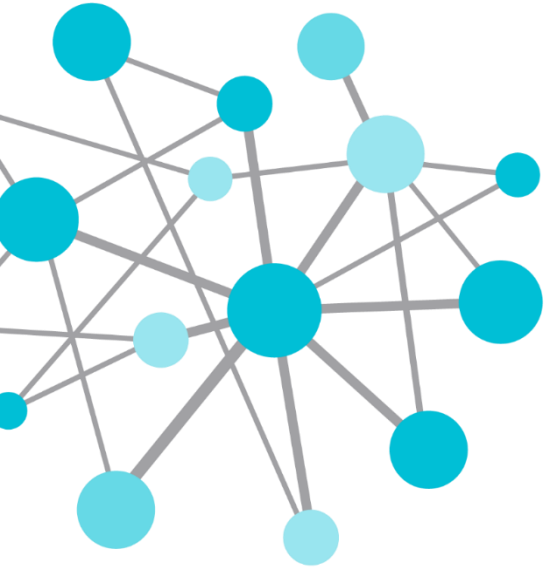
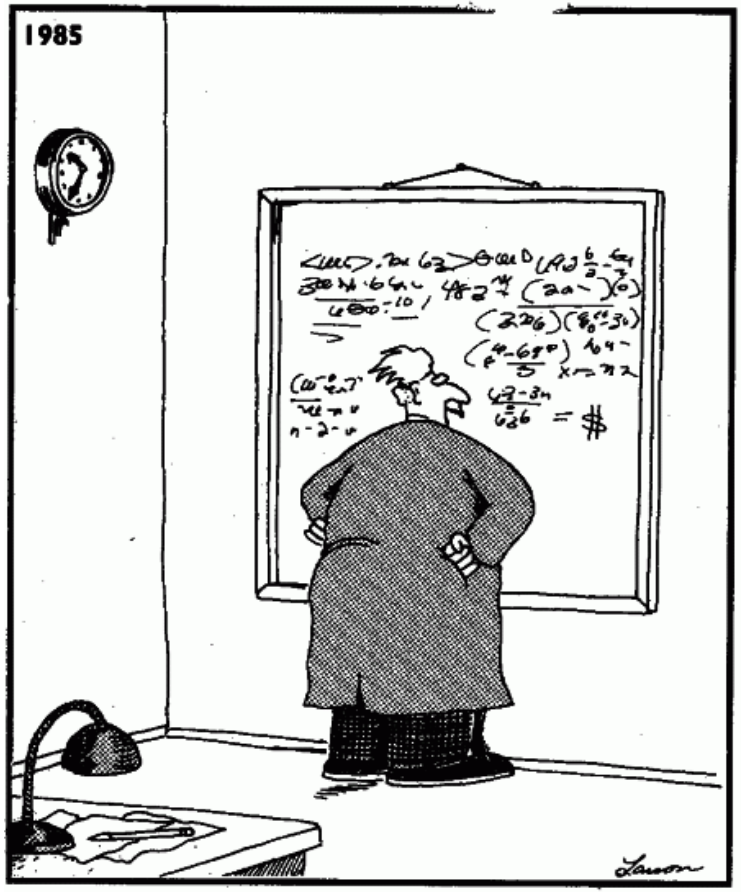


Troubleshooting Operational Aspects of Well Drilling and Completion Using the PI System

Presented by **Ales Soudek, Global Solutions Group**

Yung Wallace, Global Solutions Group



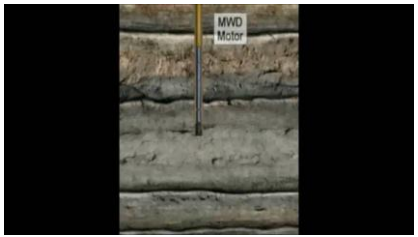
Einstein discovers that time is actually money.

Business Challenge

- High Cost - $80,000/d to $1,000,000/d
- Reduce Drilling/Completion Days
  - Drilling – 20 to 25 days
  - Completion – 50 to 70 days
- Current focus – Depth Based Analysis
- Compare Shifts, Crews, Drilling Outfits
- Noise in the Data

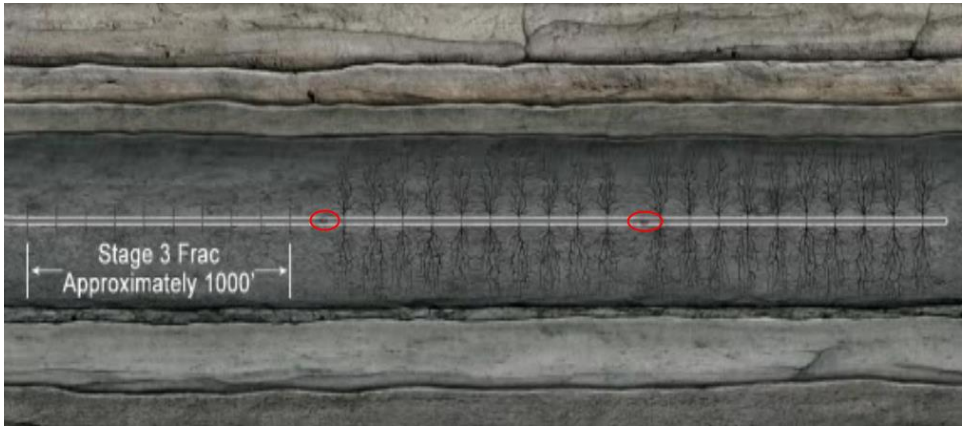
Background and Terminology

- Stick-Slip
- Rotating Drilling
- Sliding
- Tripping In/Out
- On/Off Bottom
- Other Types of Events …



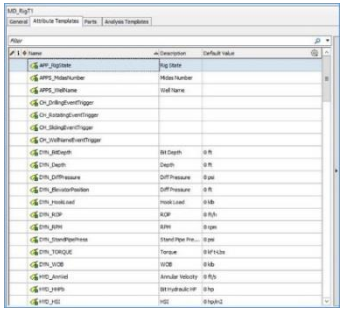
Completion - Fracking

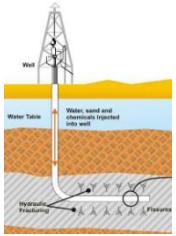
- Process
  - Blast
  - High Pressure Fluid
  - Plug
- Stages
  - Typically 1000 ft

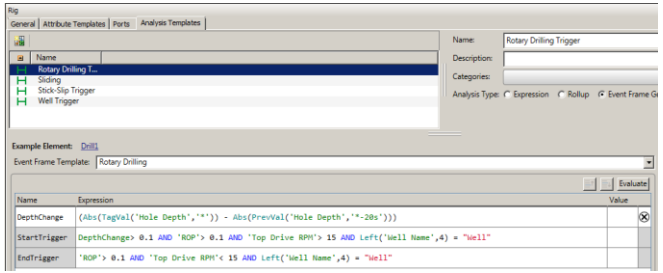


The Approach

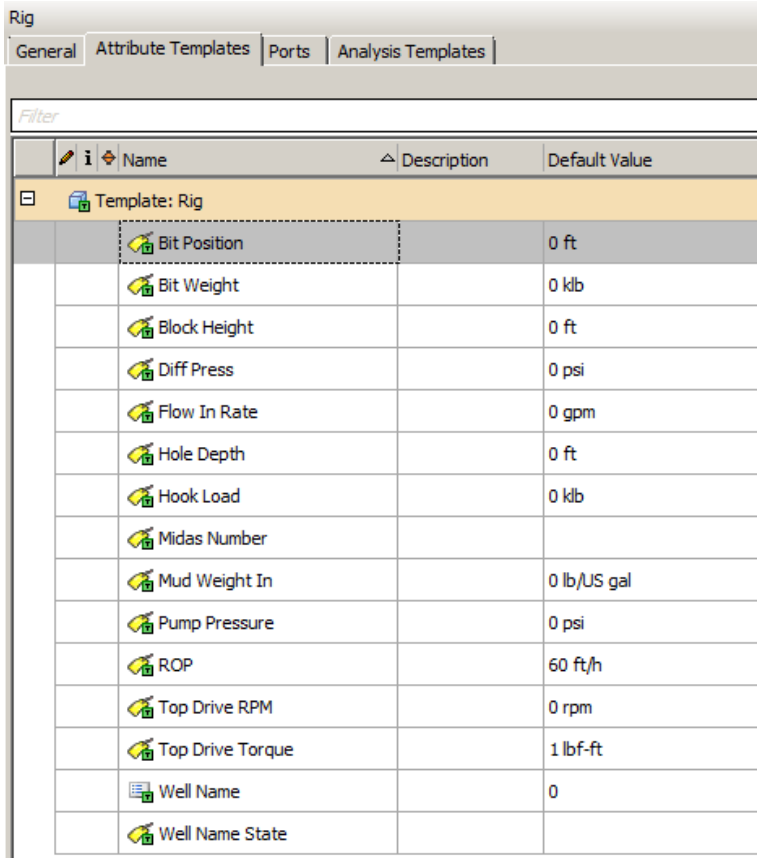
- PI AF Elements
  - Rigs
- PI Event Frames
  - Wells
- PI Asset Based Analytics
  - Triggers for Well Events



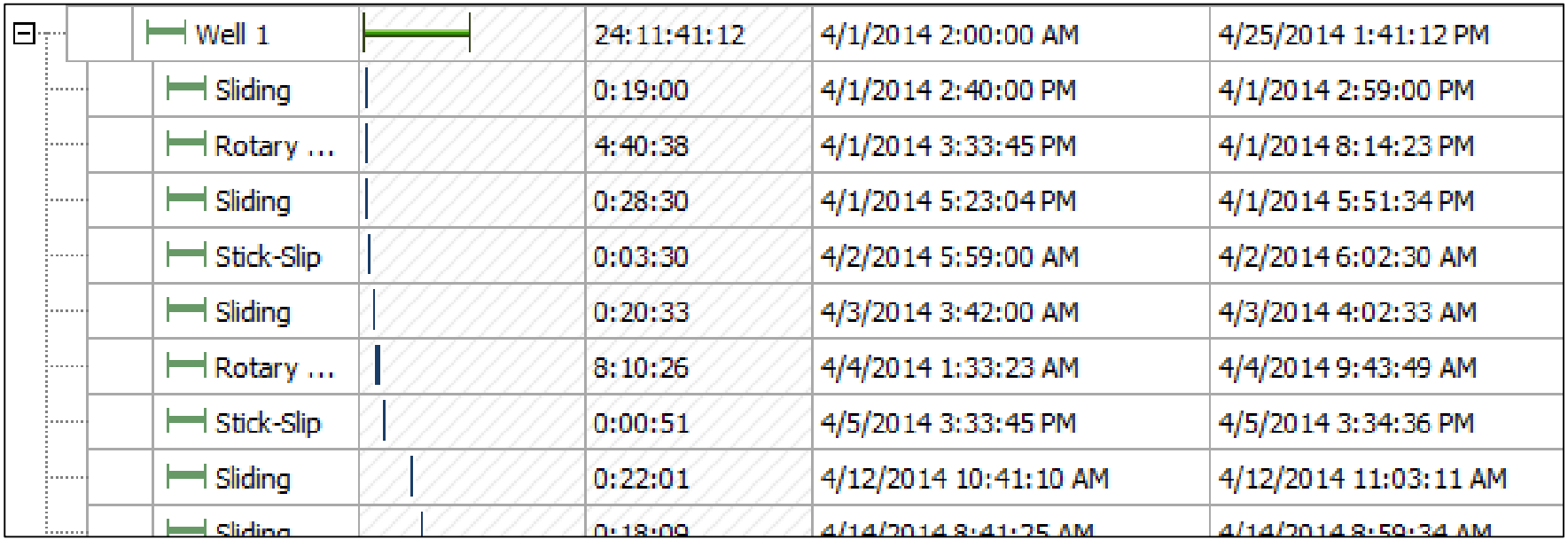




Step 1: *Model the Drilling Rigs*

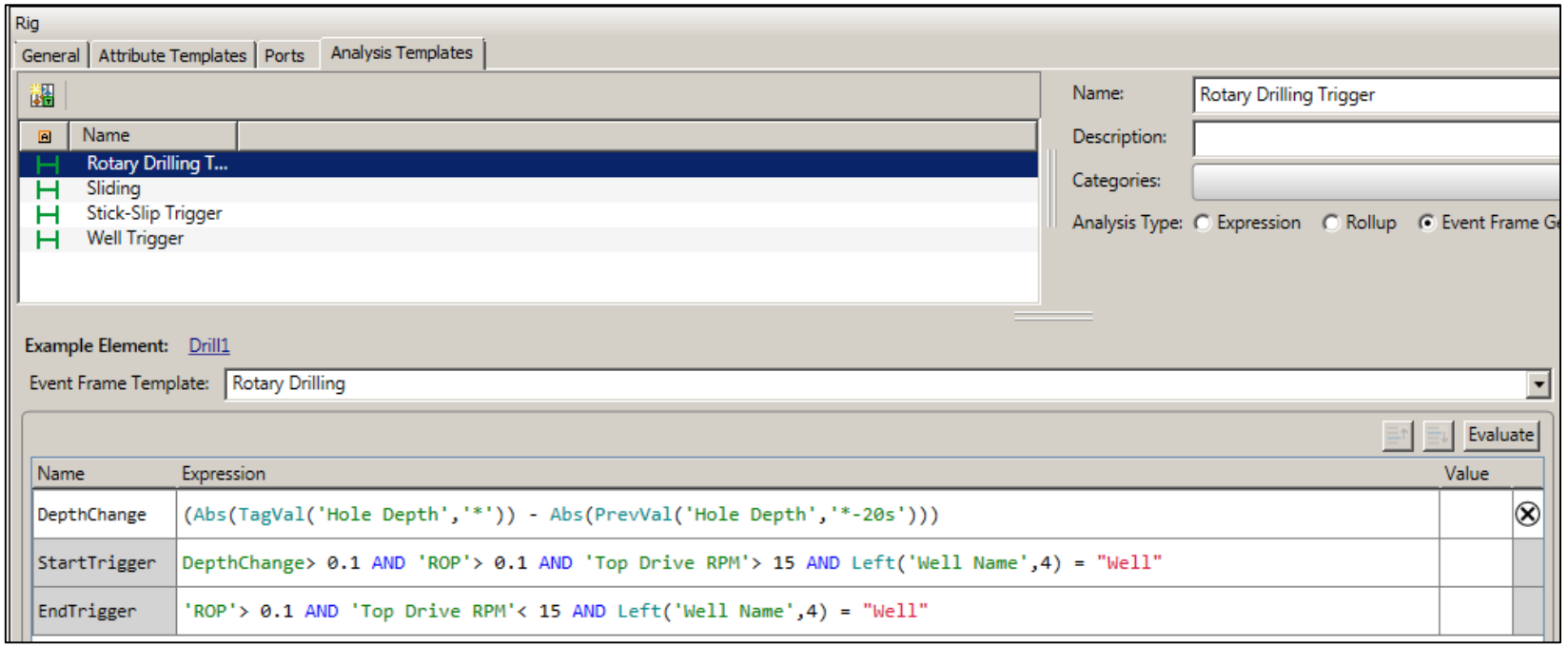


Step 2: *Define Critical Well Events*



Well 1	24:11:41:12	4/1/2014 2:00:00 AM	4/25/2014 1:41:12 PM
Sliding	0:19:00	4/1/2014 2:40:00 PM	4/1/2014 2:59:00 PM
Rotary ...	4:40:38	4/1/2014 3:33:45 PM	4/1/2014 8:14:23 PM
Sliding	0:28:30	4/1/2014 5:23:04 PM	4/1/2014 5:51:34 PM
Stick-Slip	0:03:30	4/2/2014 5:59:00 AM	4/2/2014 6:02:30 AM
Sliding	0:20:33	4/3/2014 3:42:00 AM	4/3/2014 4:02:33 AM
Rotary ...	8:10:26	4/4/2014 1:33:23 AM	4/4/2014 9:43:49 AM
Stick-Slip	0:00:51	4/5/2014 3:33:45 PM	4/5/2014 3:34:36 PM
Sliding	0:22:01	4/12/2014 10:41:10 AM	4/12/2014 11:03:11 AM
Sliding	0:18:09	4/14/2014 8:41:25 AM	4/14/2014 8:59:34 AM

Step 3: *Discover Performance Problems*



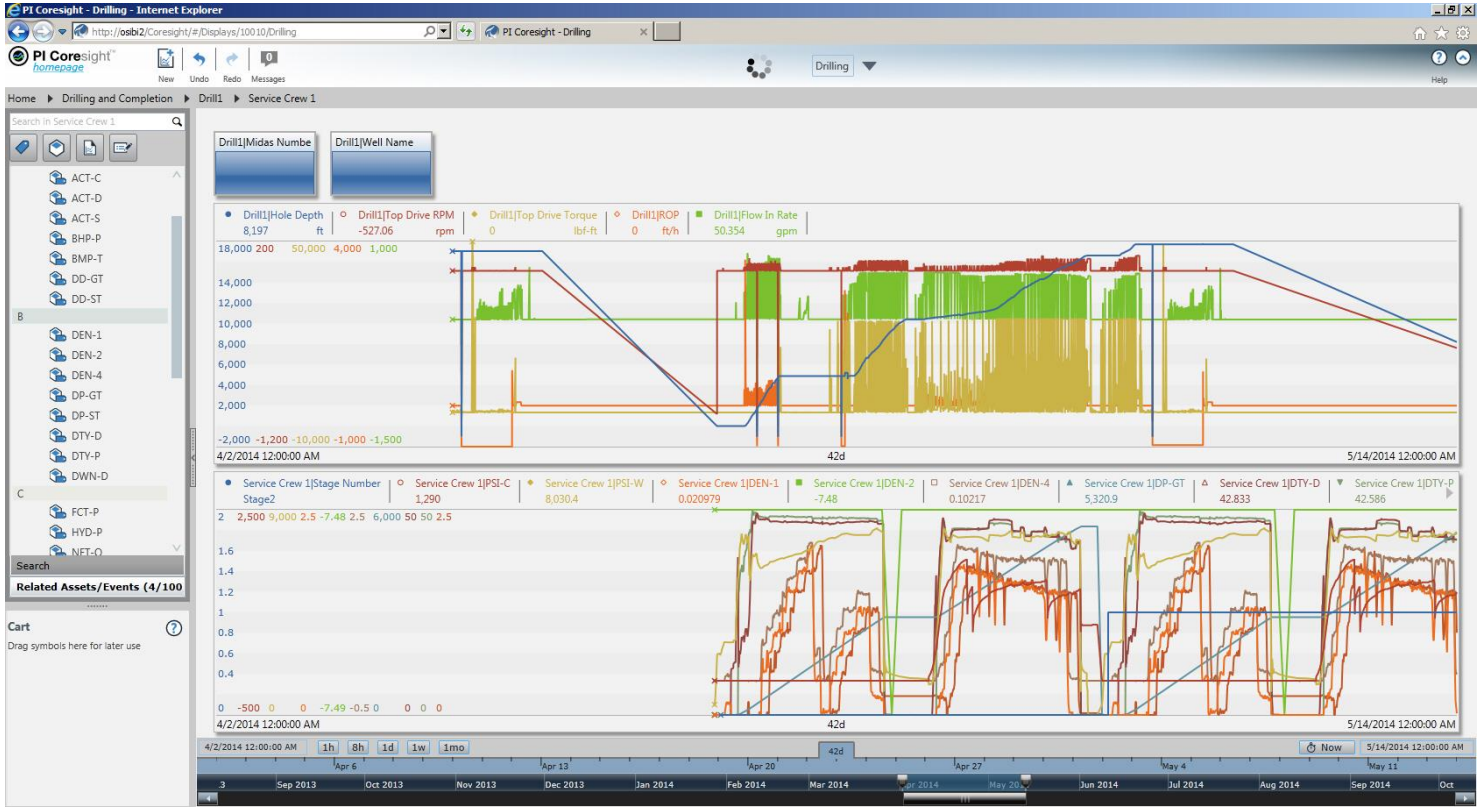
OSIsoft Products Used

- PI AF (2014)
- PI Asset Based Analytics
- PI Event Frames
- PI OLEDB Enterprise
- PI Coresight
- PI DataLink

Results

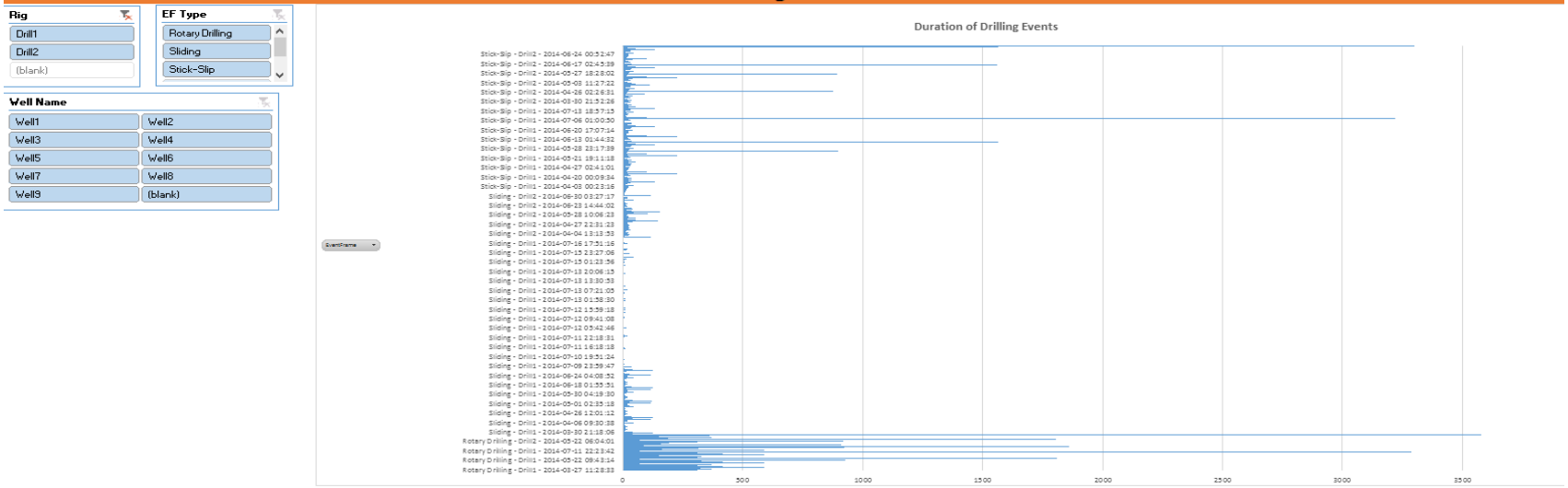
- Analyzing Results
  - PI Coresight
  - Microsoft PowerView
  - PI DataLink

PI Coresight



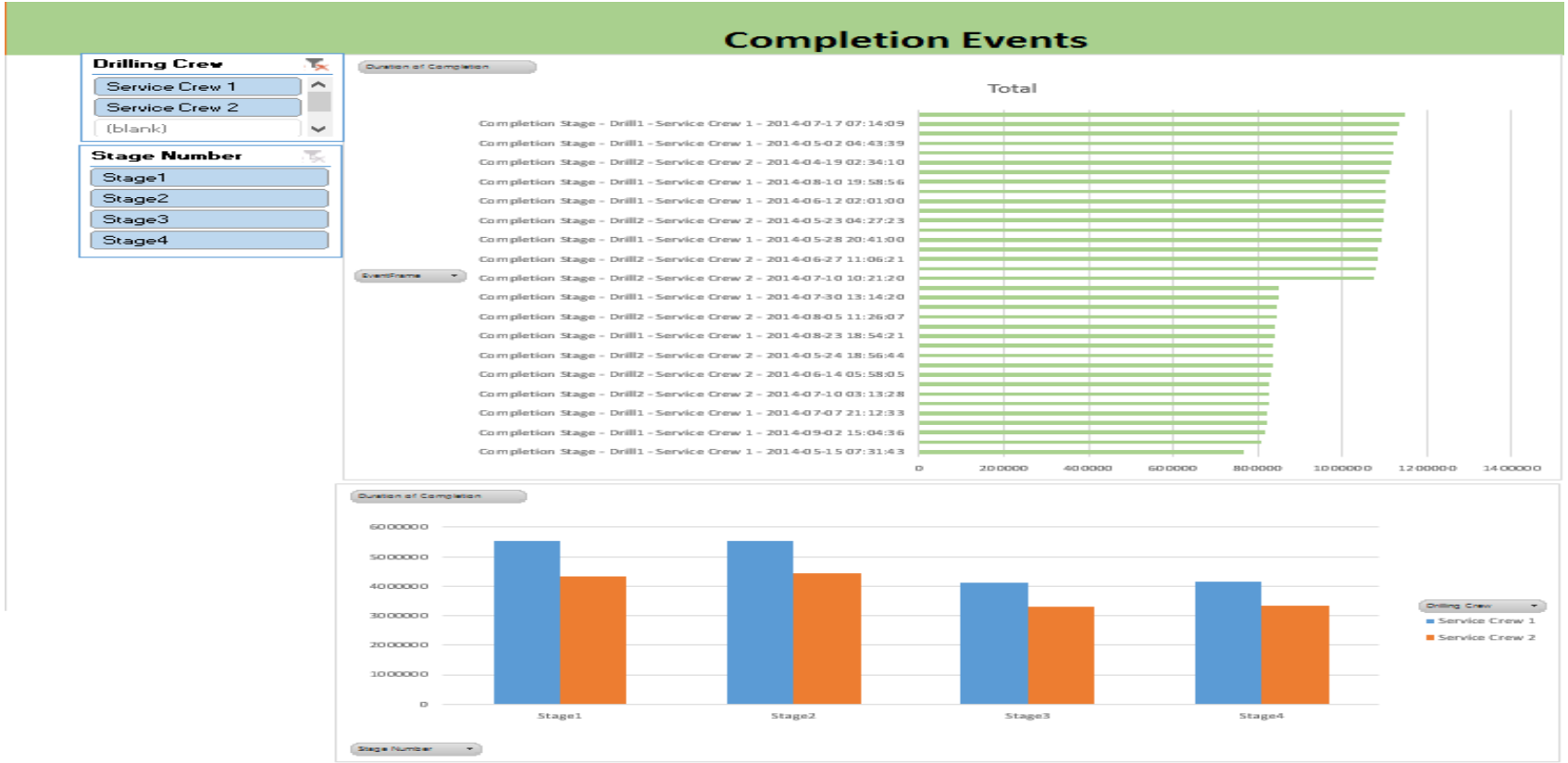
Overview of Drilling Events

Drilling Events

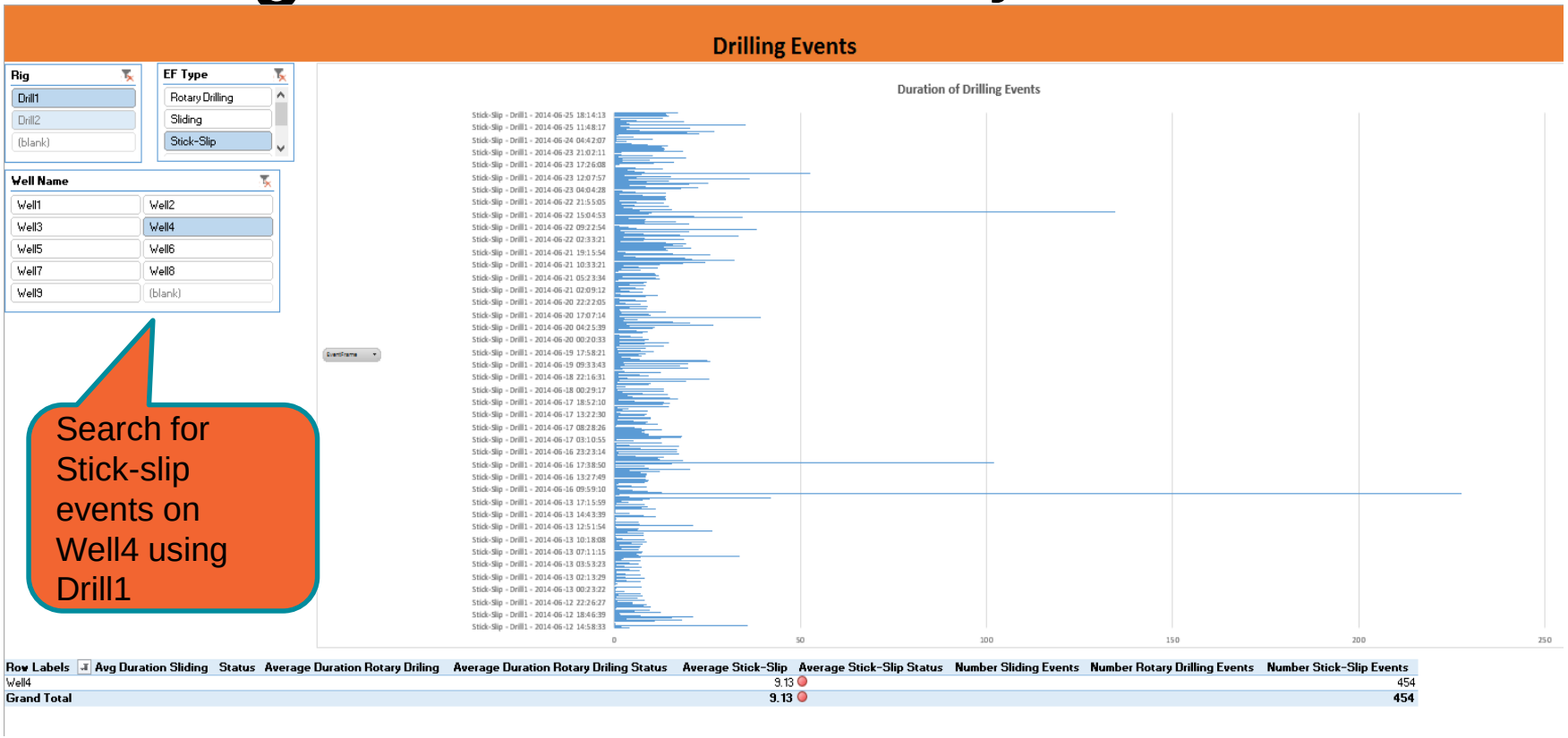


Row Labels	Avg Duration Sliding	Status	Average Duration Rotary Drilling	Average Duration Rotary Drilling Status	Average Stick-Slip	Average Stick-Slip Status	Number Sliding Events	Number Rotary Drilling Events	Number Stick-Slip Events
Well1	4.7		72.7		8.13		375	102	439
Well2	4.69		70.82		8.31		407	106	448
Well3	4.84		97.74		14.6		333	104	456
Well4	4.71		70.35		9.13		361	98	454
Well5	0.88		99.7		16.14		3425	106	460
Well6	6.03		77.41		5.43		181	77	114
Well7	7.76		60.71		10.67		236	91	423
Well8	8.25		95.89		14.48		221	98	461
Well9	4.22		110.91		19.29		381	104	455
(blank)	1.58						1		
Grand Total	**2.76**		**84.61**		**12.5**		**5921**	**886**	**3710**

Overview of Completion Events



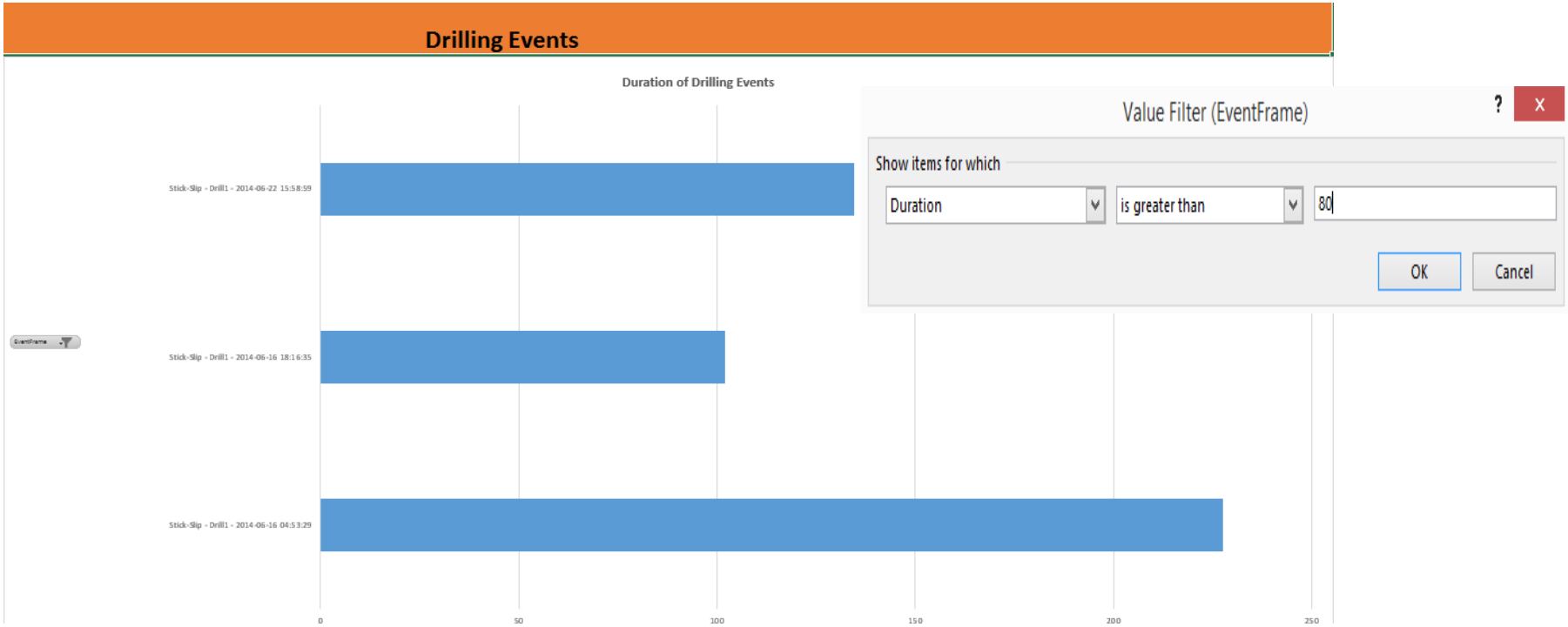
Drilling Event – Ad hoc Analysis



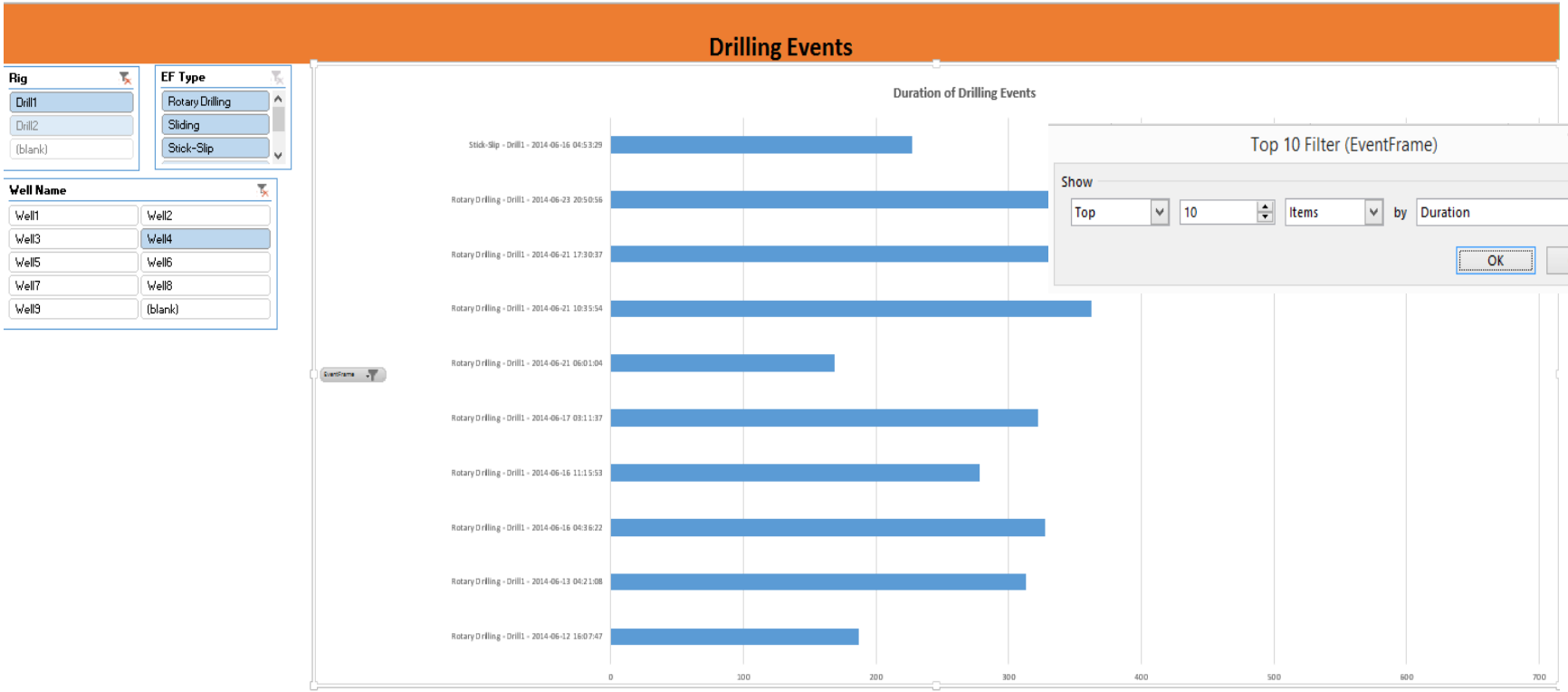
Search for Stick-slip events on Well4 using Drill1

Row Labels	Avg Duration Sliding	Status	Average Duration Rotary Driling	Average Duration Rotary Driling Status	Average Stick-Slip	Average Stick-Slip Status	Number Sliding Events	Number Rotary Drilling Events	Number Stick-Slip Events
Well4					9.13				454
Grand Total					**9.13**				**454**

Drilling Event – Search based on Duration

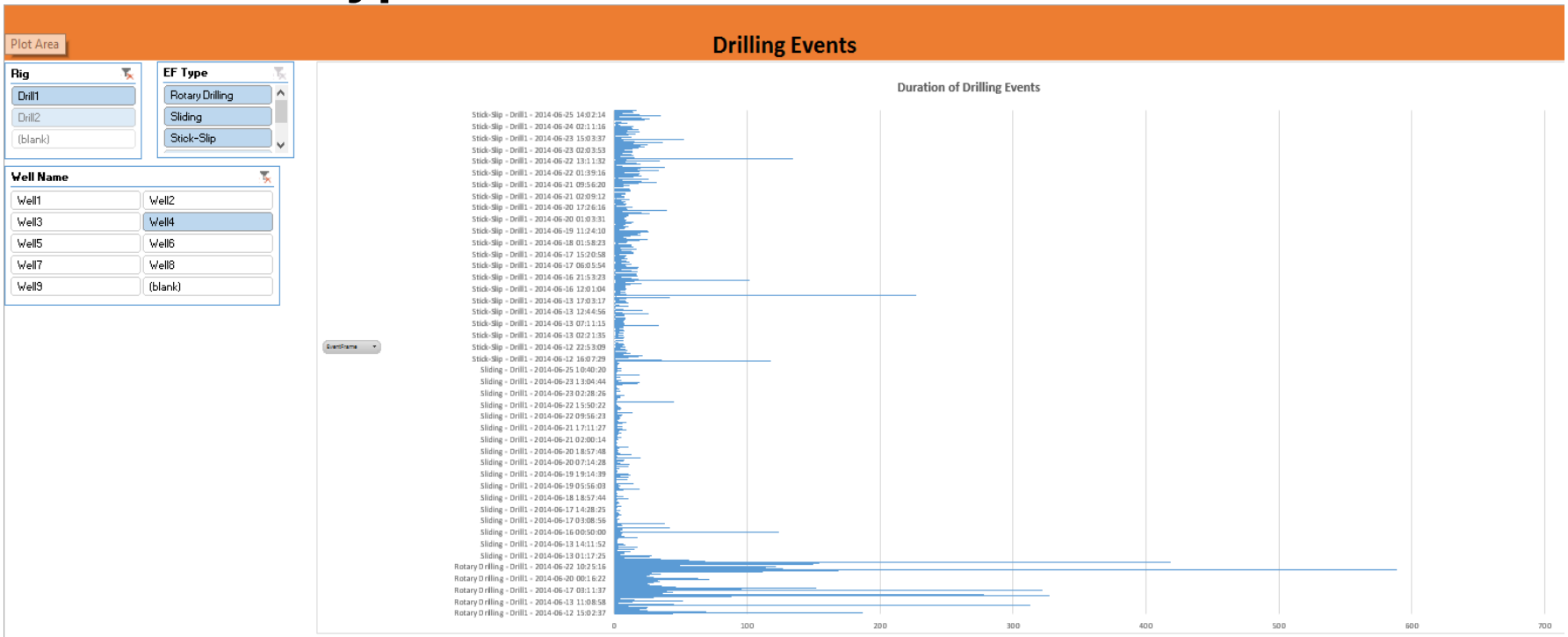


Drilling Event – Search based on top 10 events



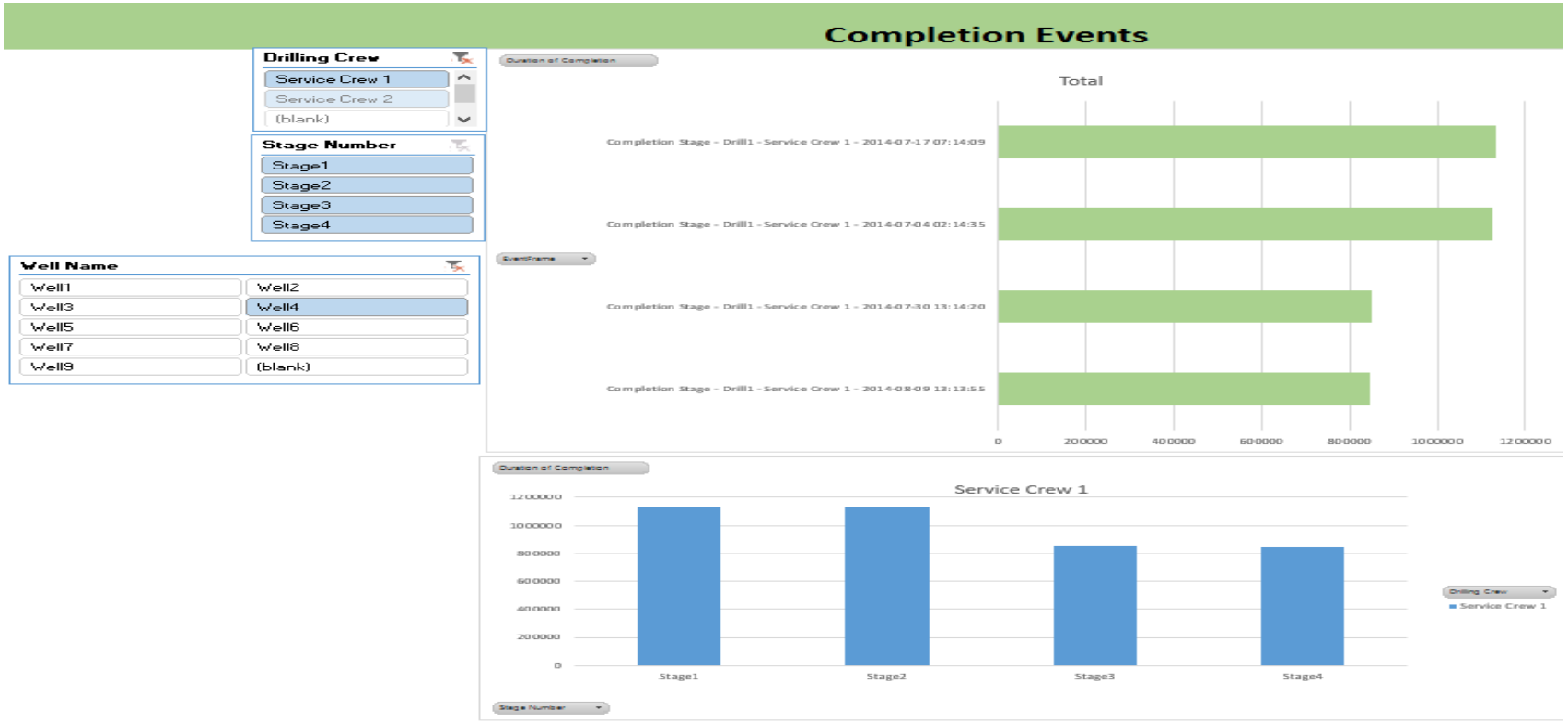
Row Labels	Avg Duration Sliding	Status	Average Duration Rotary Drilling	Average Duration Rotary Drilling Status	Average Stick-Slip	Average Stick-Slip Status	Number Sliding Events	Number Rotary Drilling Events	Number Stick-Slip Events
Well4	4.71		70.35		9.13		361	98	454
Grand Total	**4.71**		**70.35**		**9.13**		**361**	**98**	**454**

Drilling Event – Calculate the average duration for each event type



Row Labels	Avg Duration Sliding	Status	Average Duration Rotary Driling	Average Duration Rotary Driling Status	Average Stick-Slip	Average Stick-Slip Status	Number Sliding Events	Number Rotary Drilling Events	Number Stick-Slip Events
Well4	4.71		70.35		9.13		361	98	454
Grand Total	**4.71**		**70.35**		**9.13**		**361**	**98**	**454**

Completion Event – Search for completion events on a Well

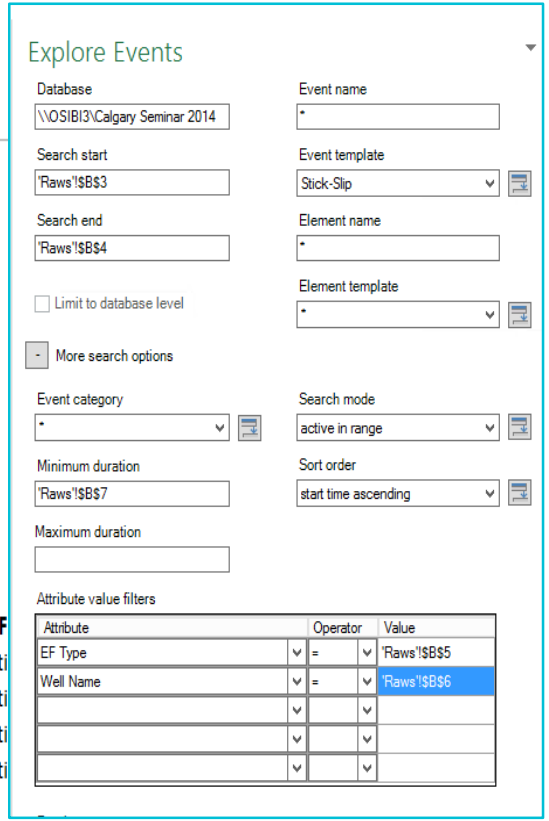


PI DataLink

Sample Drilling Report

Start Time	*-500d
End Time	*
EF Type	Stick-Slip
Well Name	Well3
Duration	5

Event name	Start time	End time	Duration	Event template	Primary element	EF Type	Drilling Crew	EF
Stick-Slip - Drill1 - 2014-06-03 16:01:	03-Jun-14 16:01:15	05-Jun-14 23:02:27	2 7:01:12	Stick-Slip	Drill1	Stick-Slip	Service Crev	Sti
Stick-Slip - Drill1 - 2014-06-02 00:48:	02-Jun-14 00:48:27	03-Jun-14 02:55:19	1 2:06:52	Stick-Slip	Drill1	Stick-Slip	Service Crev	Sti
Stick-Slip - Drill1 - 2014-05-26 21:39:	26-May-14 21:39:18	27-May-14 12:35:38	0 14:56:20	Stick-Slip	Drill1	Stick-Slip	Service Crev	Sti
Stick-Slip - Drill1 - 2014-05-22 14:31:	22-May-14 14:31:13	24-May-14 20:07:28	2 5:36:15	Stick-Slip	Drill1	Stick-Slip	Service Crev	Sti



Future Plans

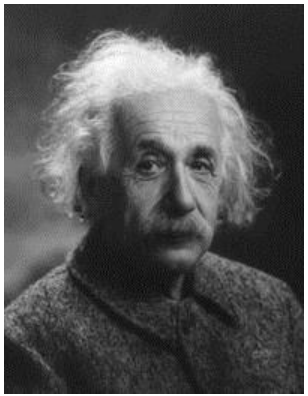
- Expand PI Event Frames Template
- Expand Analyses
- Create Performance KPIs

Conclusion

- Ability to Analyze Operations
  - Event Frames
  - Analytics
  - BI Tools
- Shorten time for Drilling and Completions

Word to the Wise

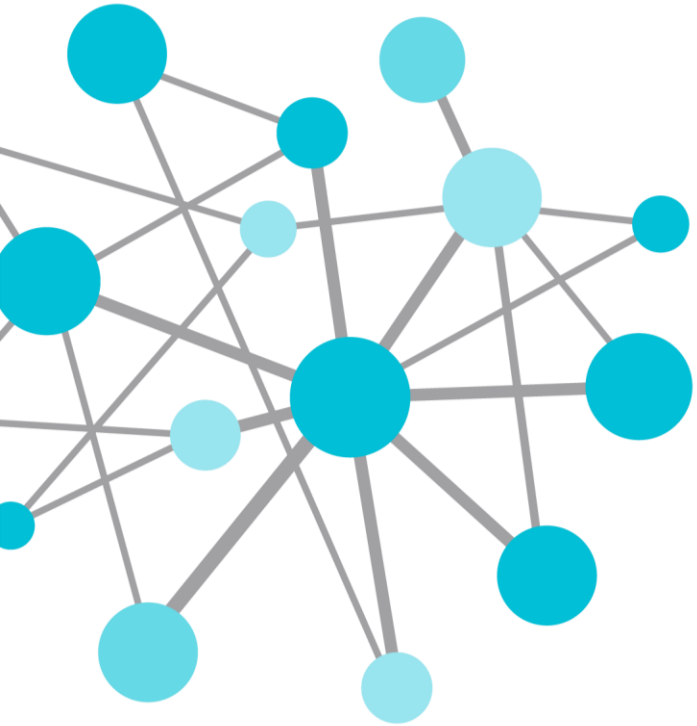
"Everything should be made as simple as possible, but not simpler."



Questions

Please wait for the microphone before asking your question

Please state your name and your company



THANK YOU

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