Compressor Shutdown Digital Transformation – Integrating the PI System to Maximo

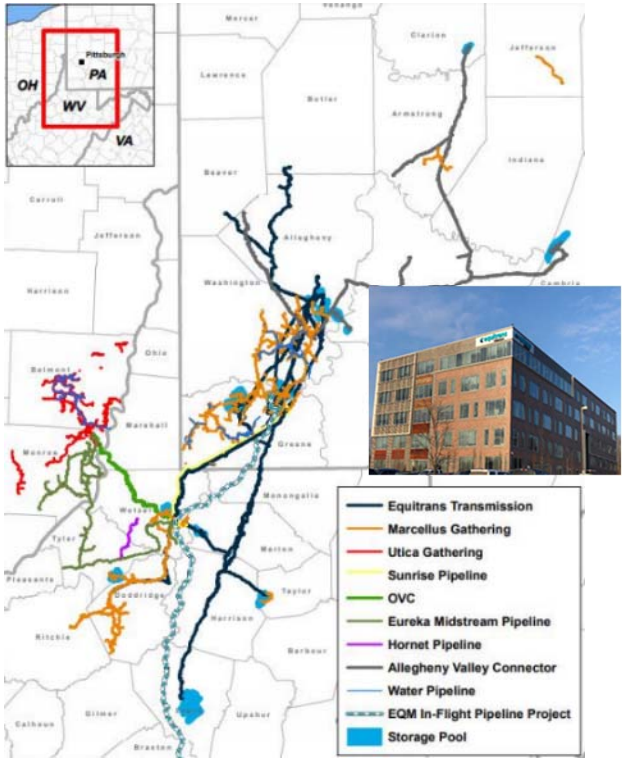
Nick Galizia, Jonathon Vincent, Matt Whiteman

Agenda

- Equitrans Company History
- Equitrans PI System Background
- Application of PI system to Compressor Shutdown Process
- Implementation Details
- PI System Capabilities Leveraged
- Lessons learned, results obtained & next steps

Equitrans Midstream Corporation (NYSE: ETRN)

- Premier natural gas midstream company in the Marcellus and Utica shale
- Operate both gathering & transmission assets
- 910 miles of high-pressure gathering pipeline
- 950-mile FERC-regulated interstate pipeline
- ~ 700,000 HP of Compression



Operations Intelligence System Journey

2015

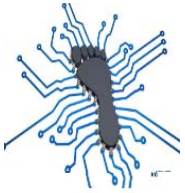
The Pilot (POC) – One Gathering Site

- Saturn Compressor Station
- 7 Engine/Compressor Units
- ~9,000 TAGS

2020

41 Compressor Stations

- 130 Engine/Compressor Units
- ~700k Horsepower
- 31 Gathering facilities
- 10 Transmission facilities
- Localized and centralized data collection



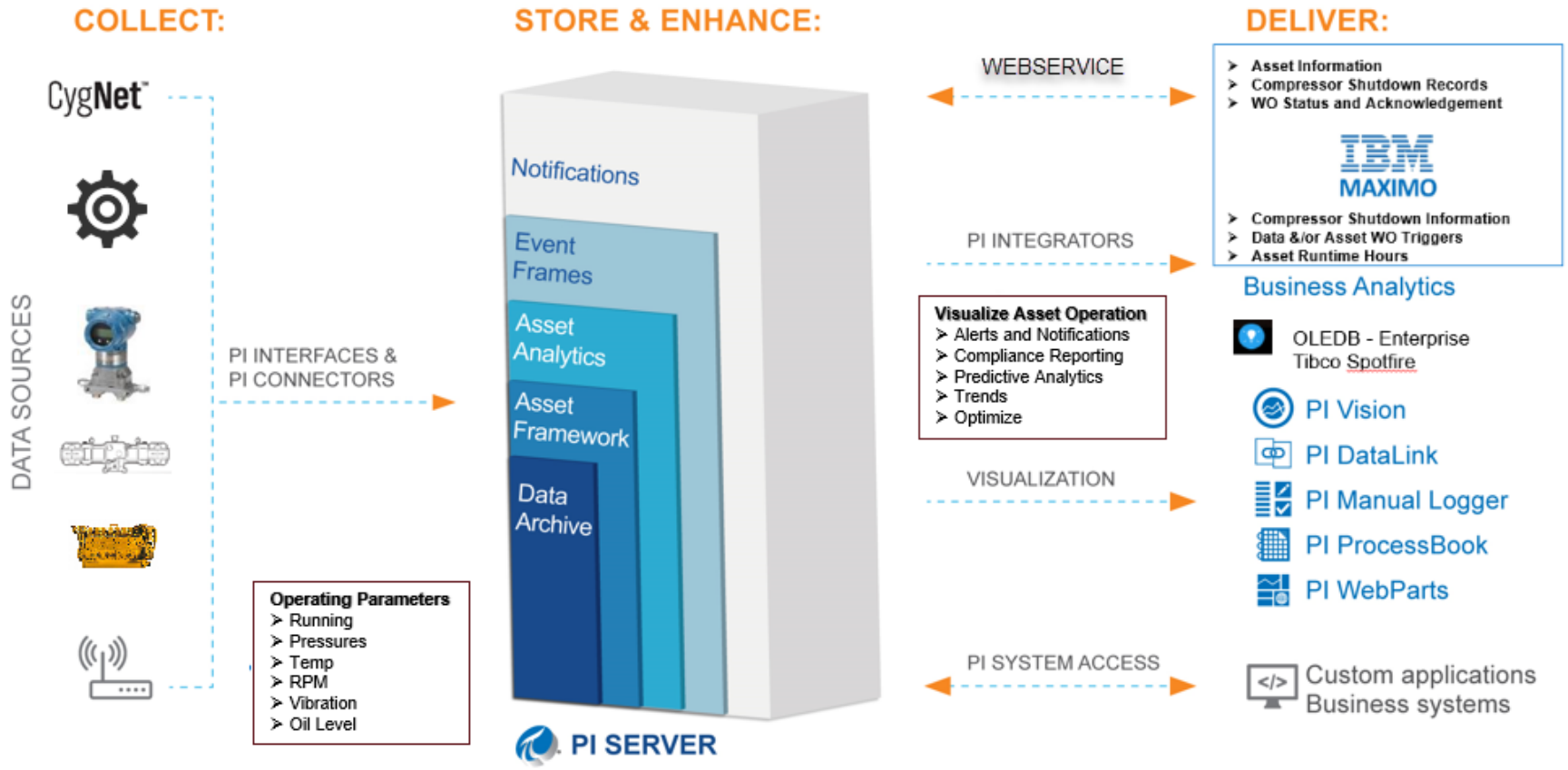
■ Reciprocating ■ Centrifugal

Key Points

More than 150,000 TAGS / sec

- 2,143 Analysis templates
- 39,036 Analyses **(16X)**
- 192 Element templates
- 5,959 Elements **(32X)**
- 1,167 Notification rule templates
- 19,357 Notifications **(16X)**
- 1.2+ MM Event Frames **(manage by exception)**
- **Supported by 2.5 FTE resources**
- **SME Enablement**

PI System Components



2020 PI System Initiatives Support Equitrans Priorities

Priorities:

- Support Equitrans Strategic Priorities
  - Act with Fiscal Discipline
  - Optimize Operations

Initiatives:

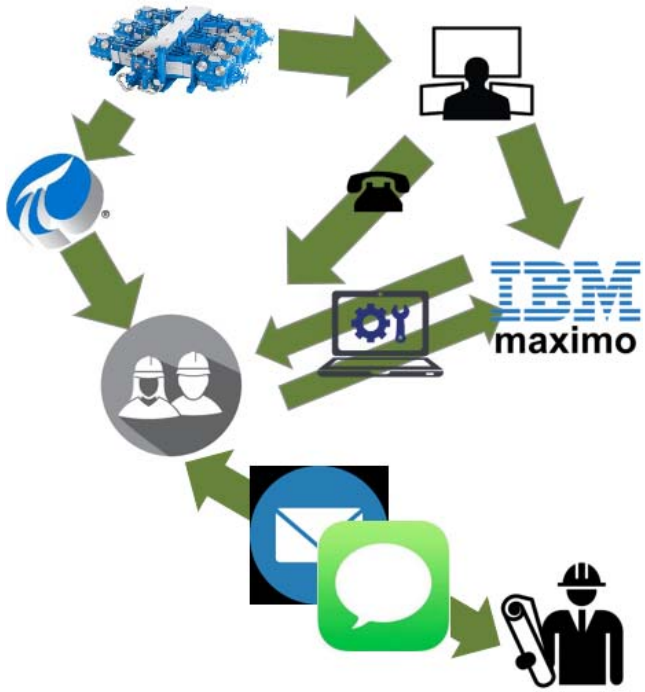
- New & legacy station PI implementation
- Compressor Shutdown Process
- Environmental Reporting
- Ultrasonic Meter Diagnosis
- Pigging Analysis

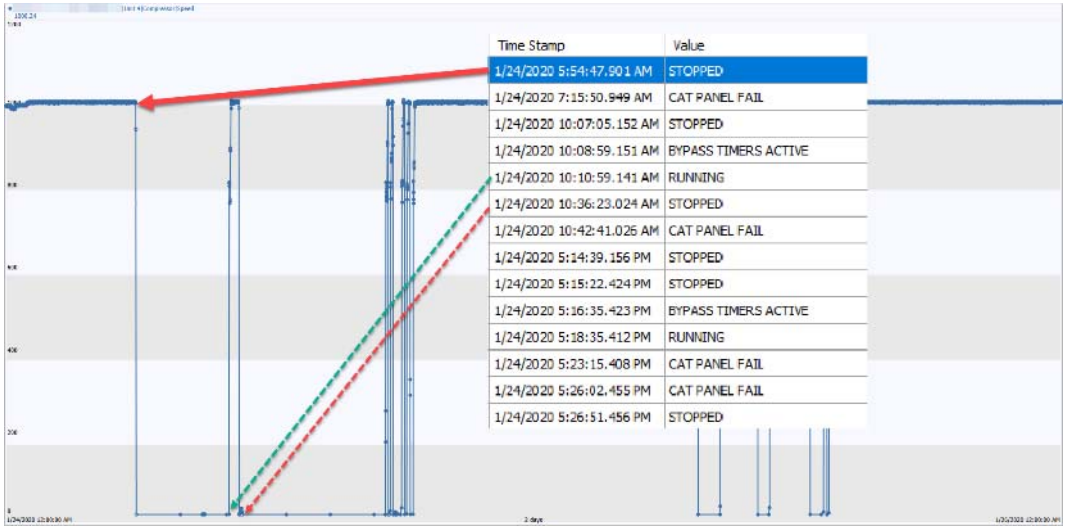
Digitally transform Equitrans business functions with a focus on efficiency by eliminating manual, redundant processes

What Happens When a Compressor Shuts Down?

Asset Shutdown Process (Integrate PI Event Frames with Maximo EAM System)

Previous Process





Time Stamp	Value
1/24/2020 5:54:47.901 AM	STOPPED
1/24/2020 7:15:50.949 AM	CAT PANEL FAIL
1/24/2020 10:07:05.152 AM	STOPPED
1/24/2020 10:08:59.151 AM	BYPASS TIMERS ACTIVE
1/24/2020 10:10:59.141 AM	RUNNING
1/24/2020 10:36:23.024 AM	STOPPED
1/24/2020 10:42:41.026 AM	CAT PANEL FAIL
1/24/2020 5:14:39.156 PM	STOPPED
1/24/2020 5:15:22.424 PM	STOPPED
1/24/2020 5:16:35.423 PM	BYPASS TIMERS ACTIVE
1/24/2020 5:18:35.412 PM	RUNNING
1/24/2020 5:23:15.408 PM	CAT PANEL FAIL
1/24/2020 5:26:02.455 PM	CAT PANEL FAIL
1/24/2020 5:26:51.456 PM	STOPPED

Challenges:

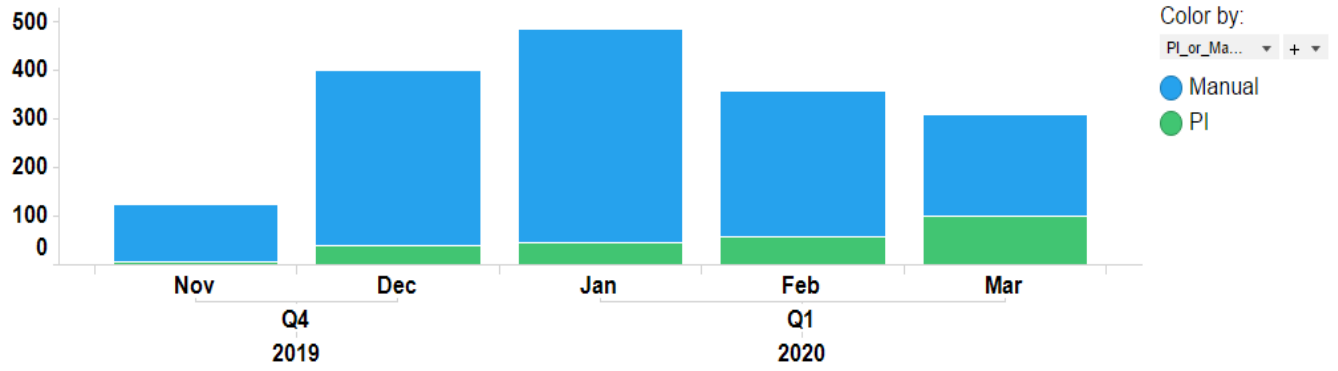
- Previous process was manual
- Did not leverage existing technology and PI System data
- Data inaccurate and subjective
- No hard link between Work Order Events and PI System data

Why Automate the Current Process?

>200 Units

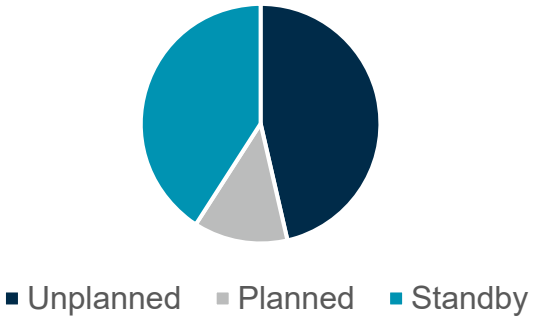
~700,000 Horsepower

70 Locations



- Equitrans manages > 5,000 compressor shutdowns per year
- Manually entered by gas control into Maximo for field to respond (est. 2,500 hours per year)
- Reliability team relies on good data to analyze shutdowns and perform corrective action

Shutdown Types

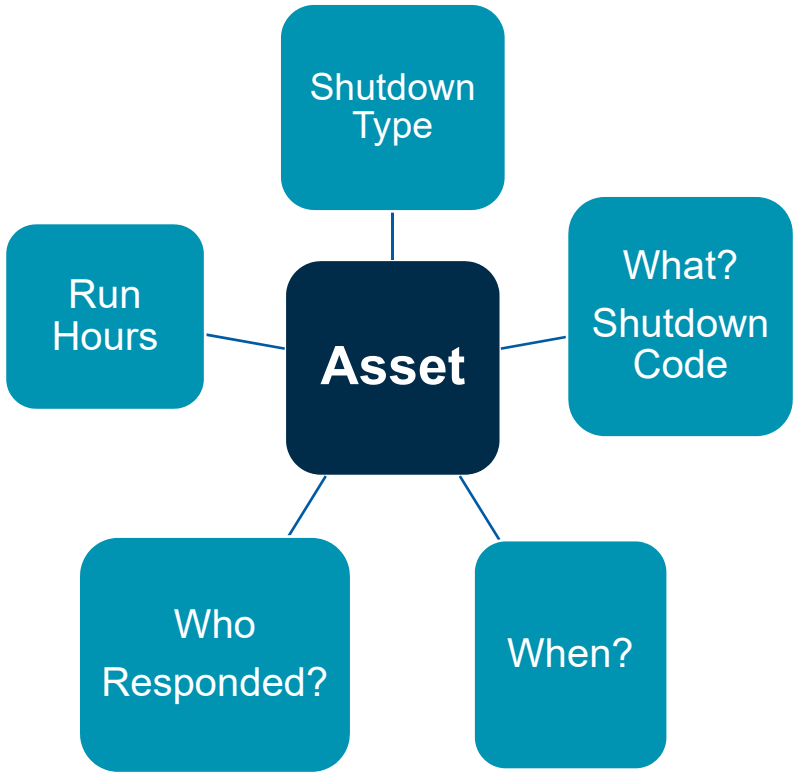


Approach Utilizing all Stakeholders & OSIsoft Tech Svs

Asset Shutdown Process (Integrate PI Event Frames with Maximo EAM System)

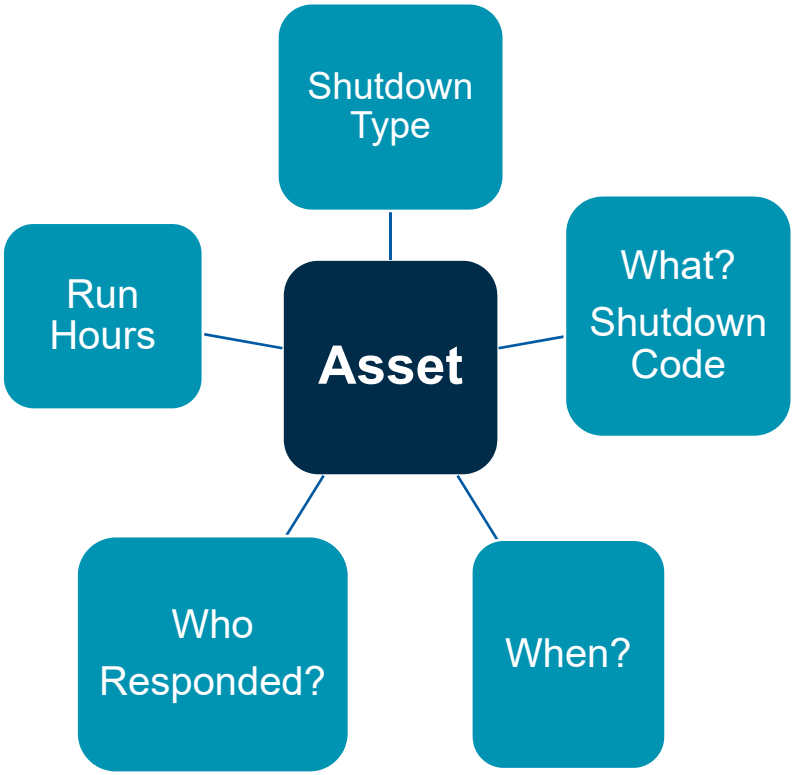
Investigate / Plan → **Collaborate (Feb 2019)** → **Test / Pilot Oct-Nov** → **Implement Nov – 2020**

What Information do we Need & Why Important?



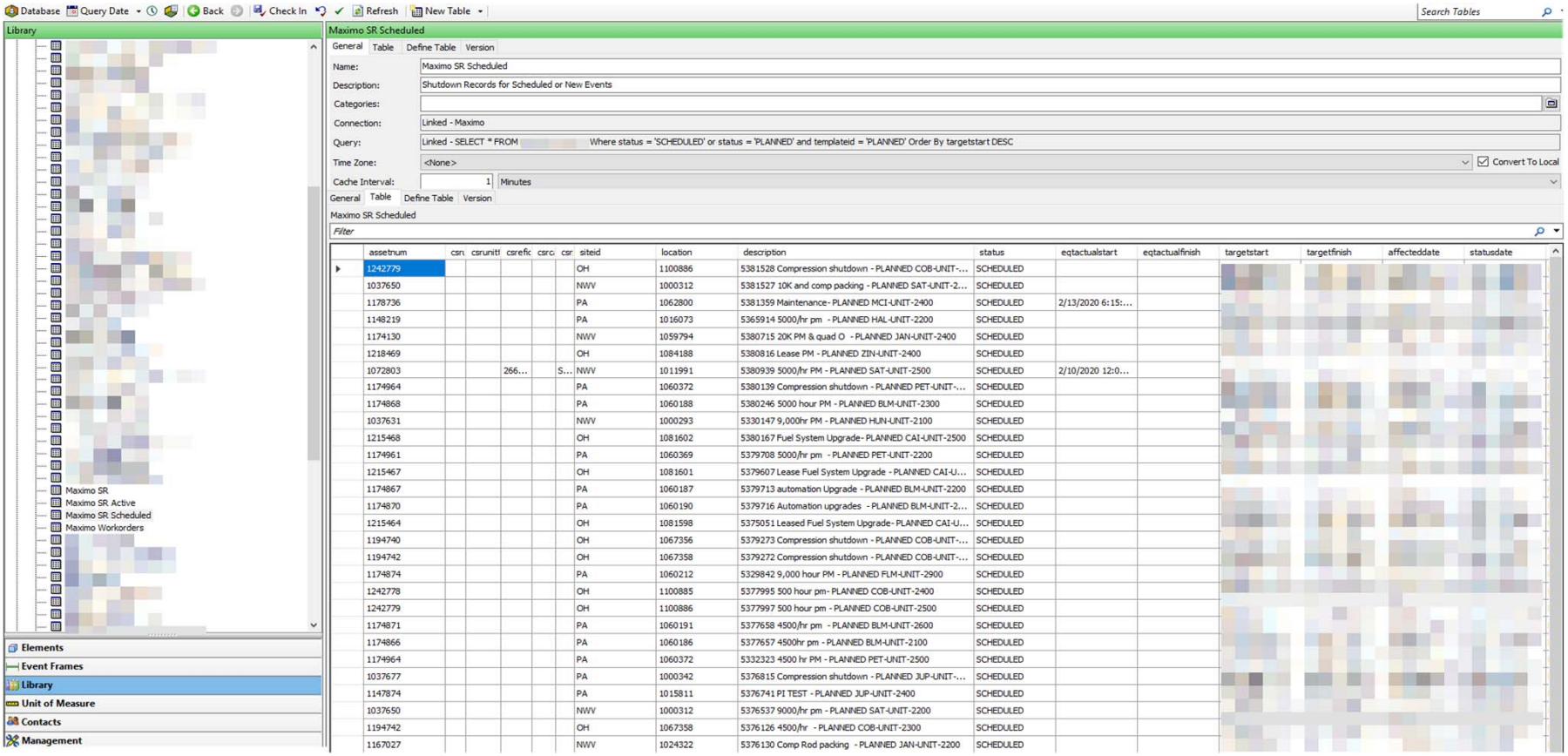
- Run hour data used for:
  - Environmental reporting
  - Maintenance scheduling
- Root cause analysis
- Codes and type used for root cause analysis
- Shutdown type used for contractual requirements

Where Could We Get the Information to Automate?

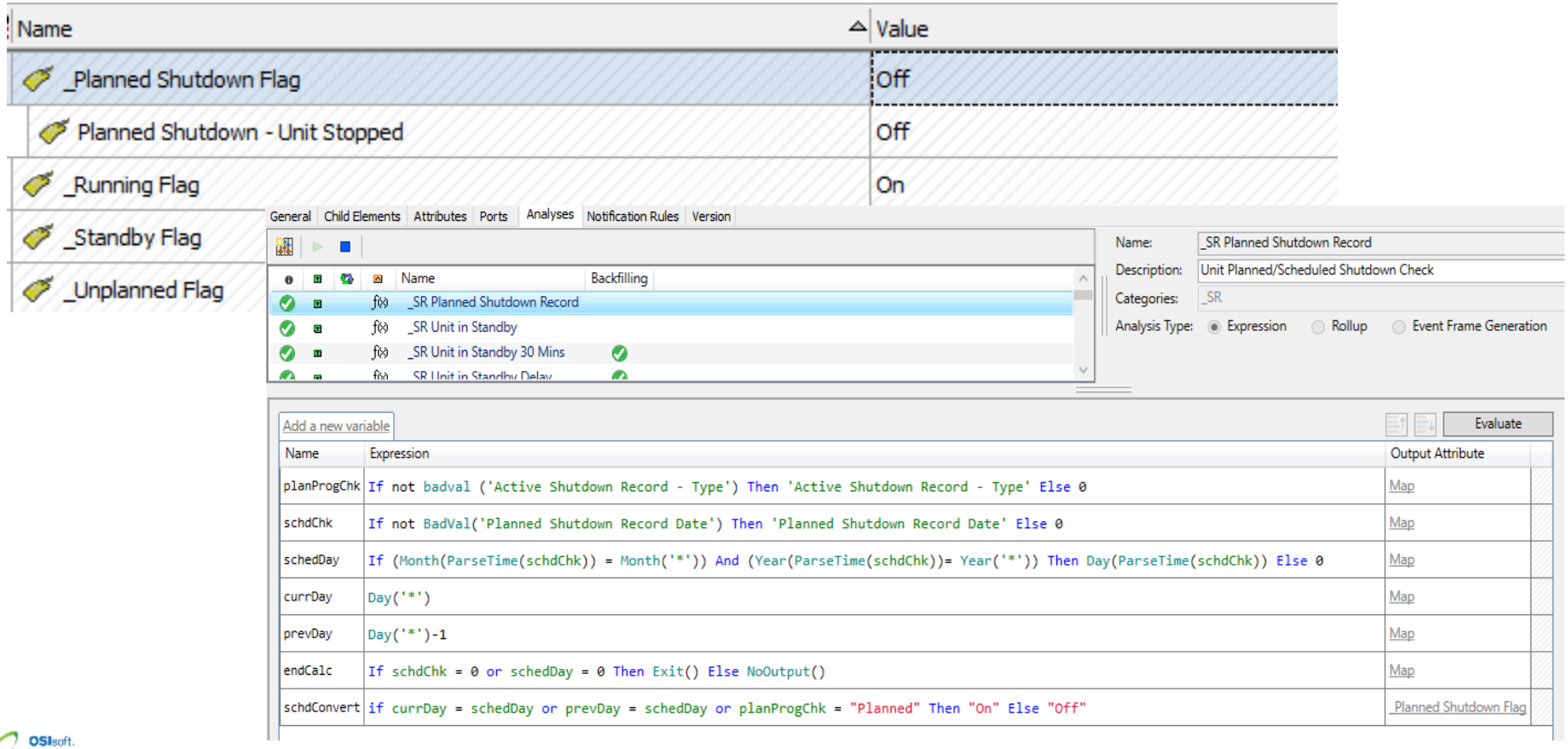


Data Type	Source	Method
Asset Info	Maximo	PI AF/SQL Table
Planned/Unplanned/ Standby	PLC, Maximo	PI Calculation (Flags)
Shutdown Code	PLC	PI Tag
When?	PLC	PI Event Frame
Responding Operator	Gas Control *Future automation planned*	Manual Entry in Maximo
Run Hours	PI Virtual Meter Tag	PI Event Frame

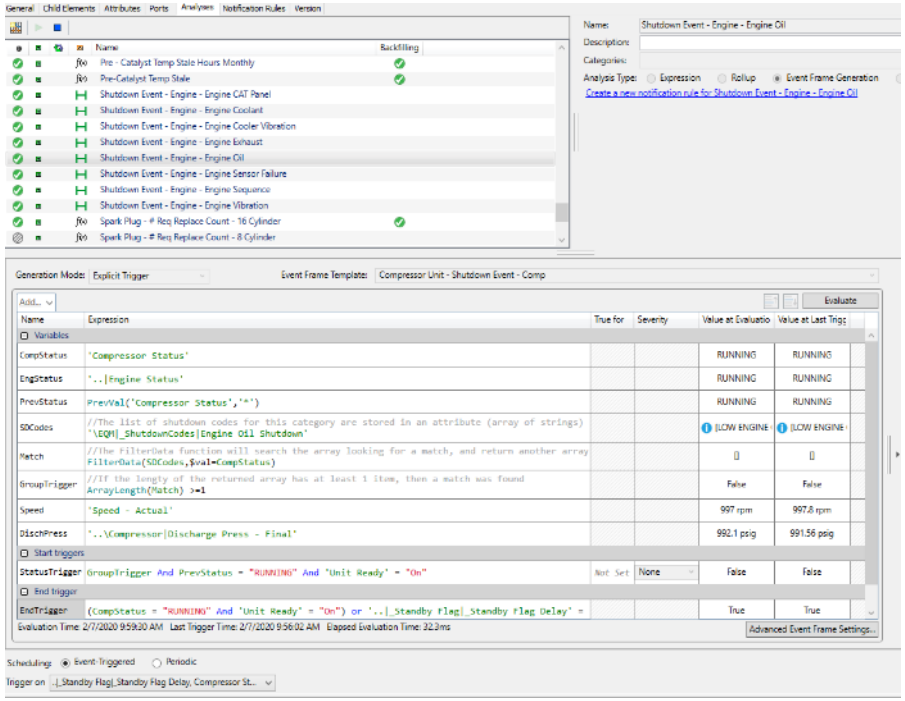
Planned Shutdowns from Maximo Table

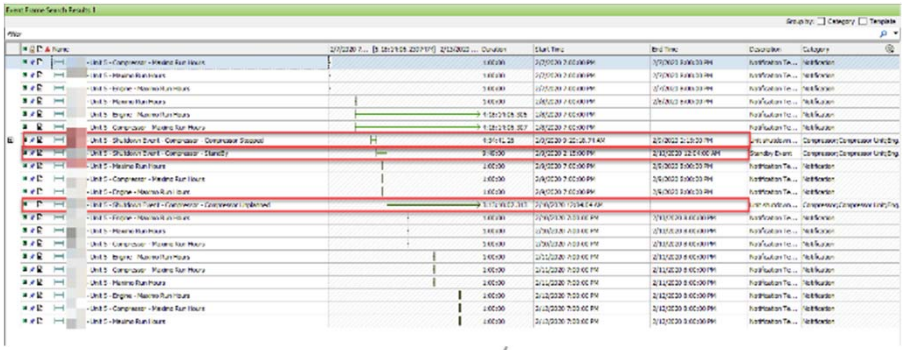


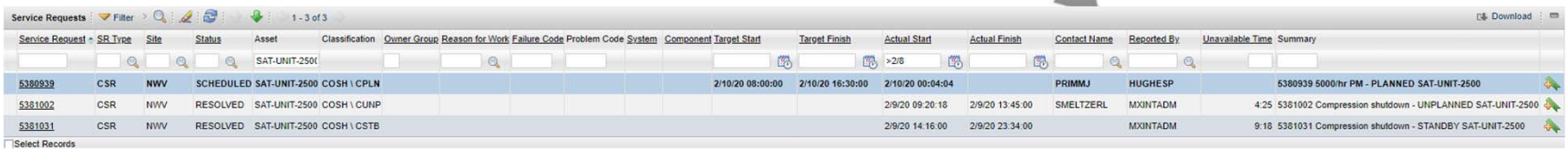
PI System Calculation to Determine Shutdown Flag



PI Event Frames Drive Shutdown Records in Maximo

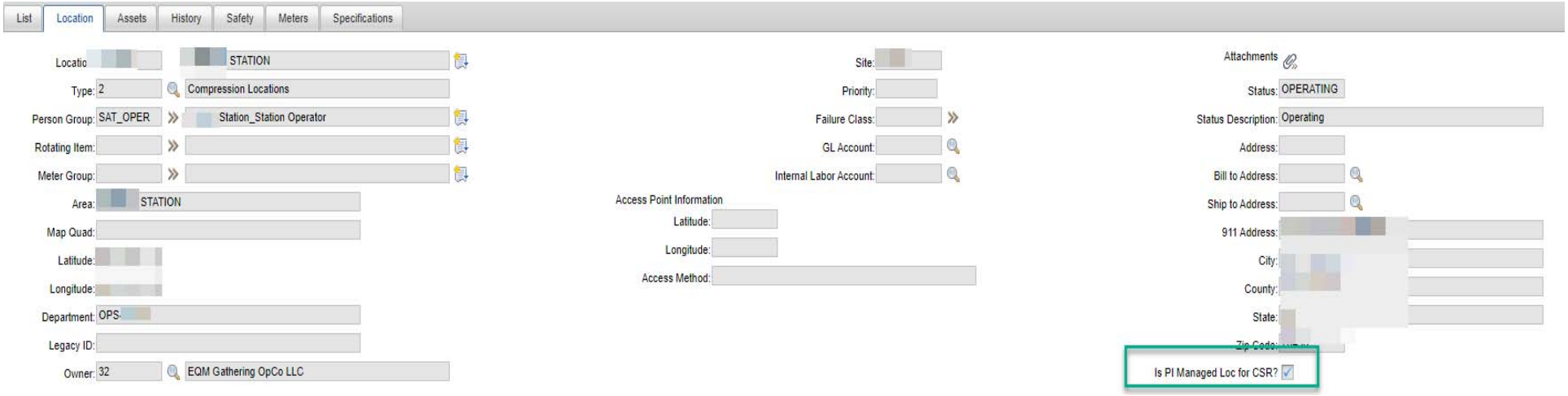






Maximo Integration

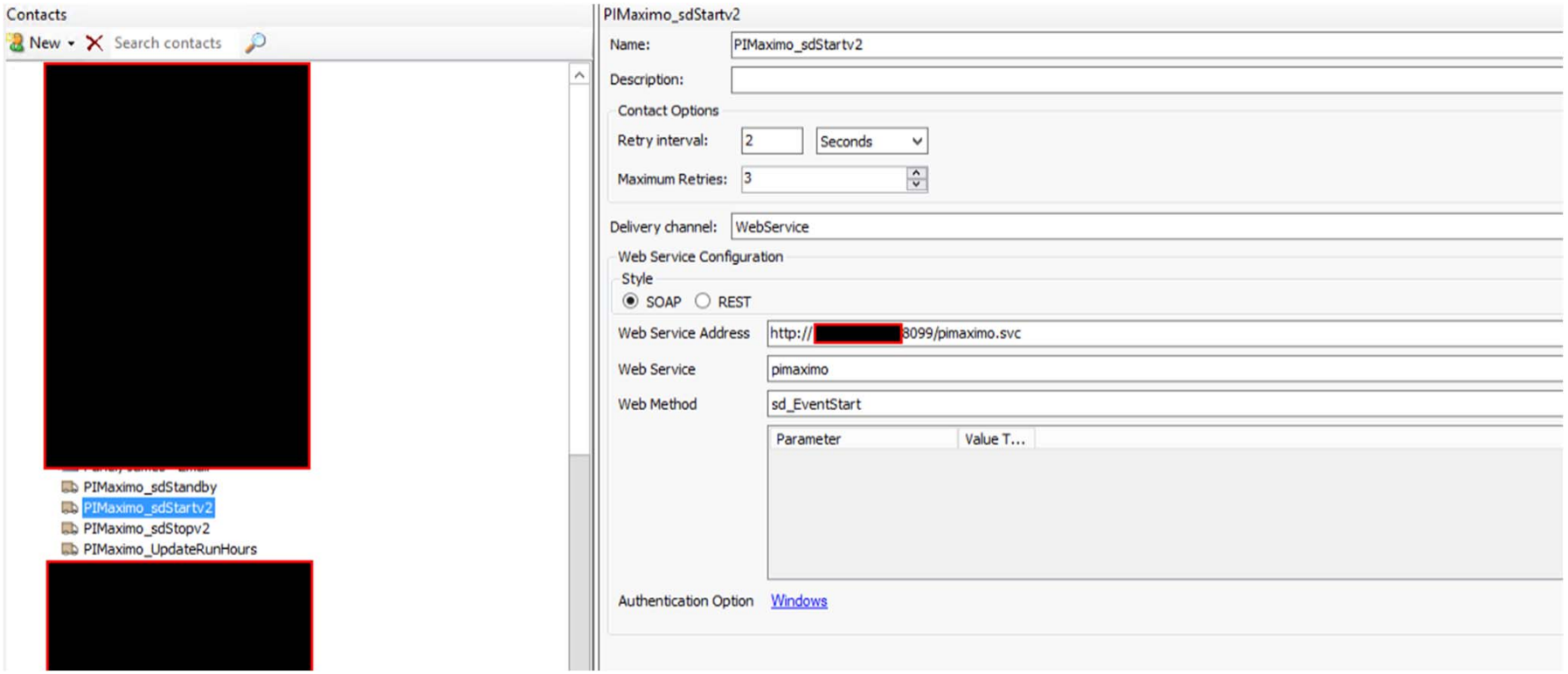
- Maximo integration framework using interface table method
- Checkbox added at "Station Location" which drives integration for shutdowns and run hours



PI System To Maximo Integration Via Delivery Endpoint

- Out of the box functionality with PI AF Notifications
- Ability to trigger data flow upon event frame generation
- SOAP or REST Webservice
  - Simple Object Access Protocol (SOAP)
  - Representational State Transfer (REST)
  - Webservice must be developed using .NET or other supported development platform.

PI System To Maximo Integration Via Delivery Endpoint



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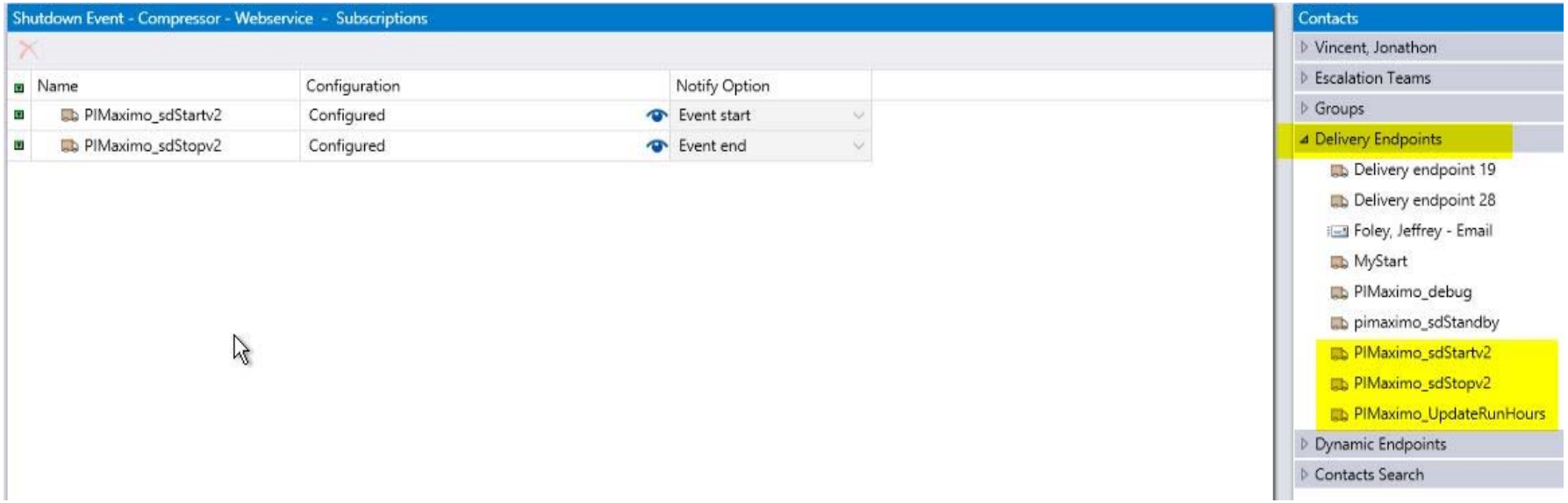

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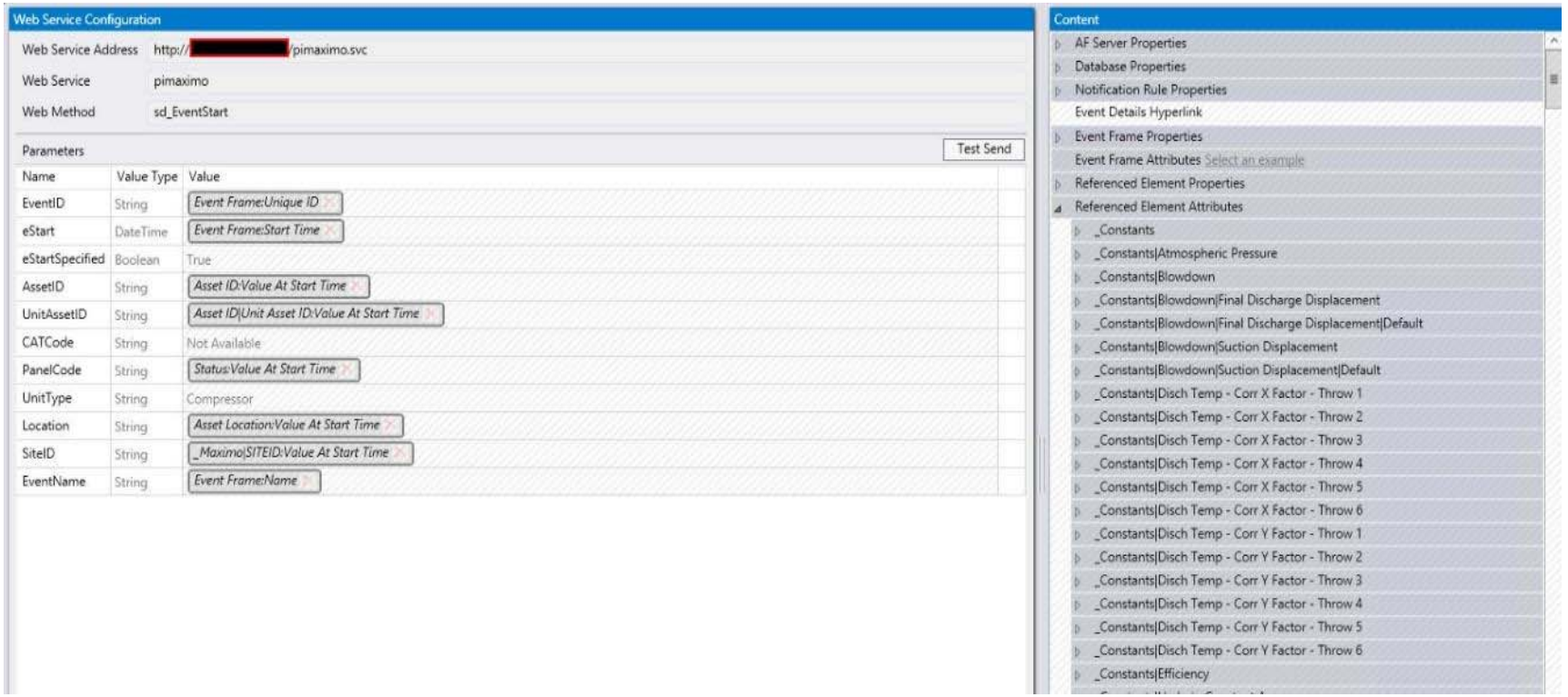
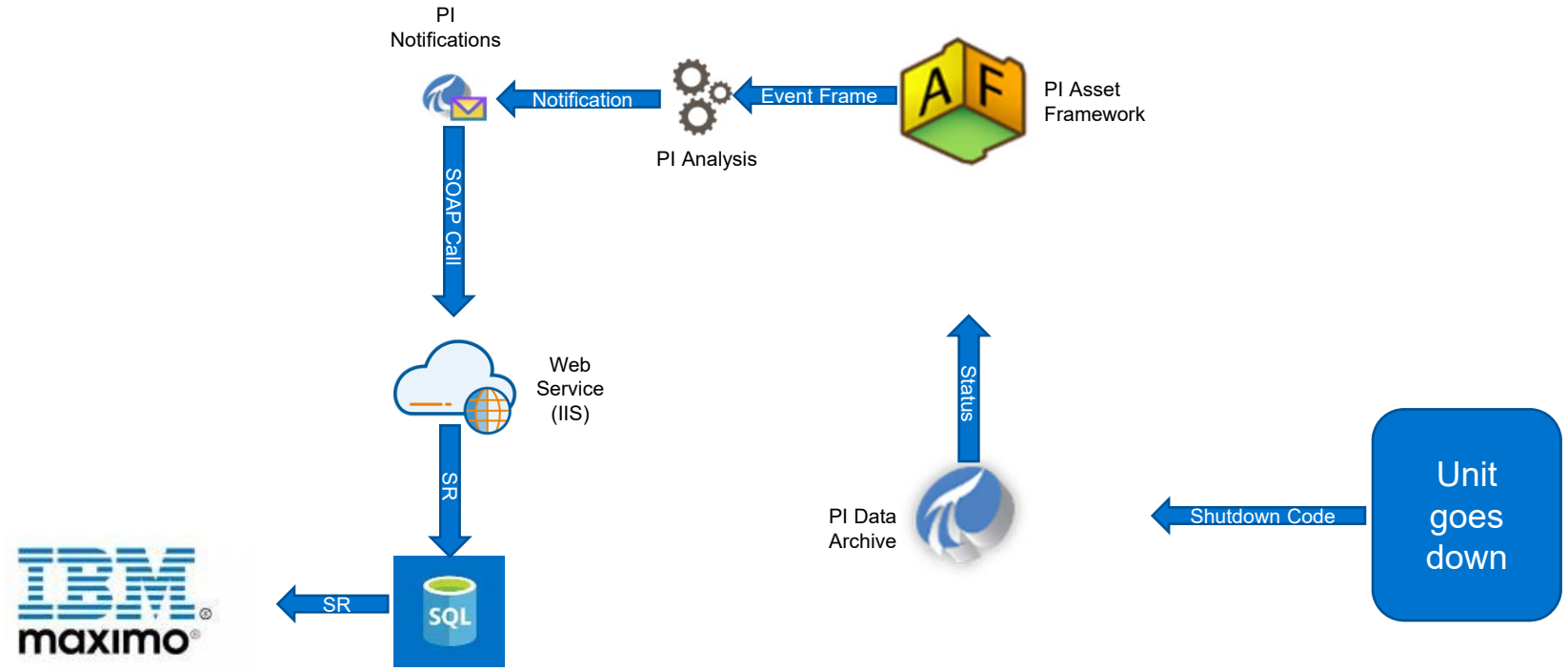


Overview of Integration Process



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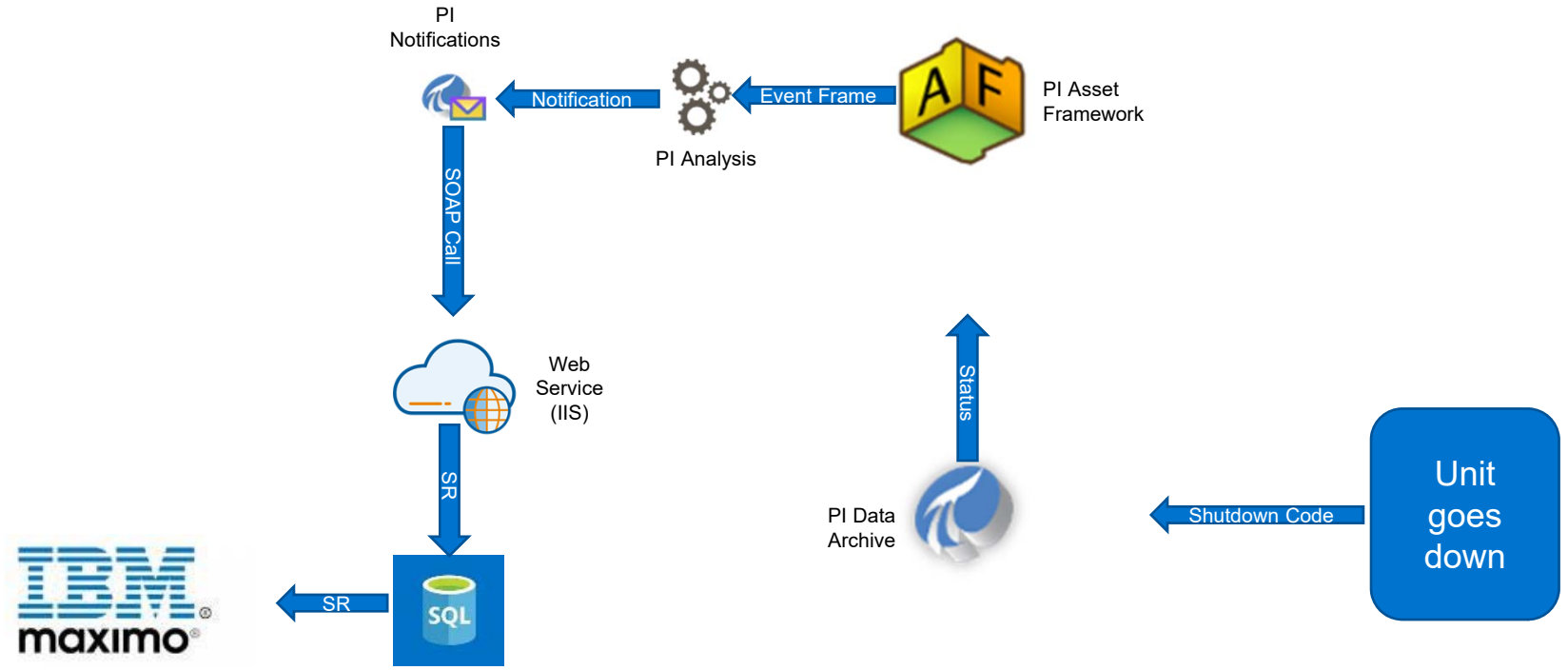

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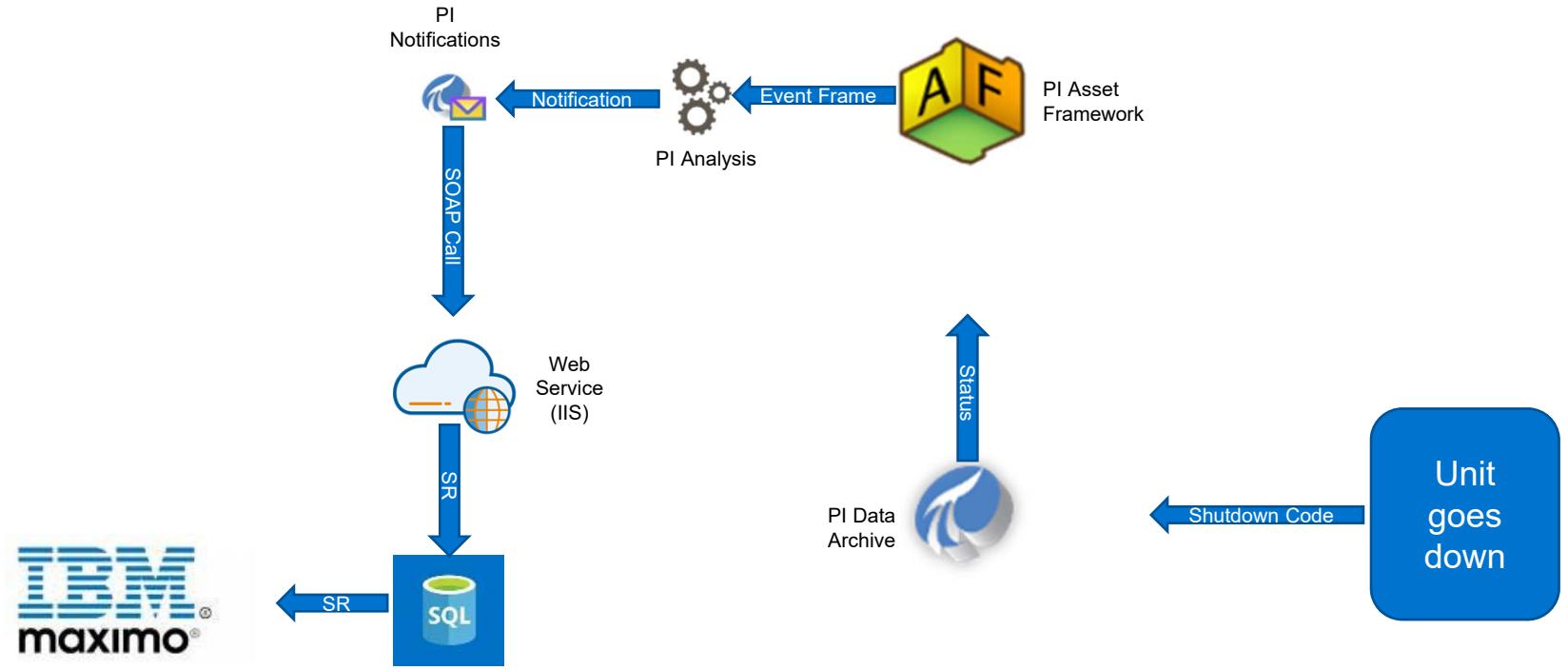

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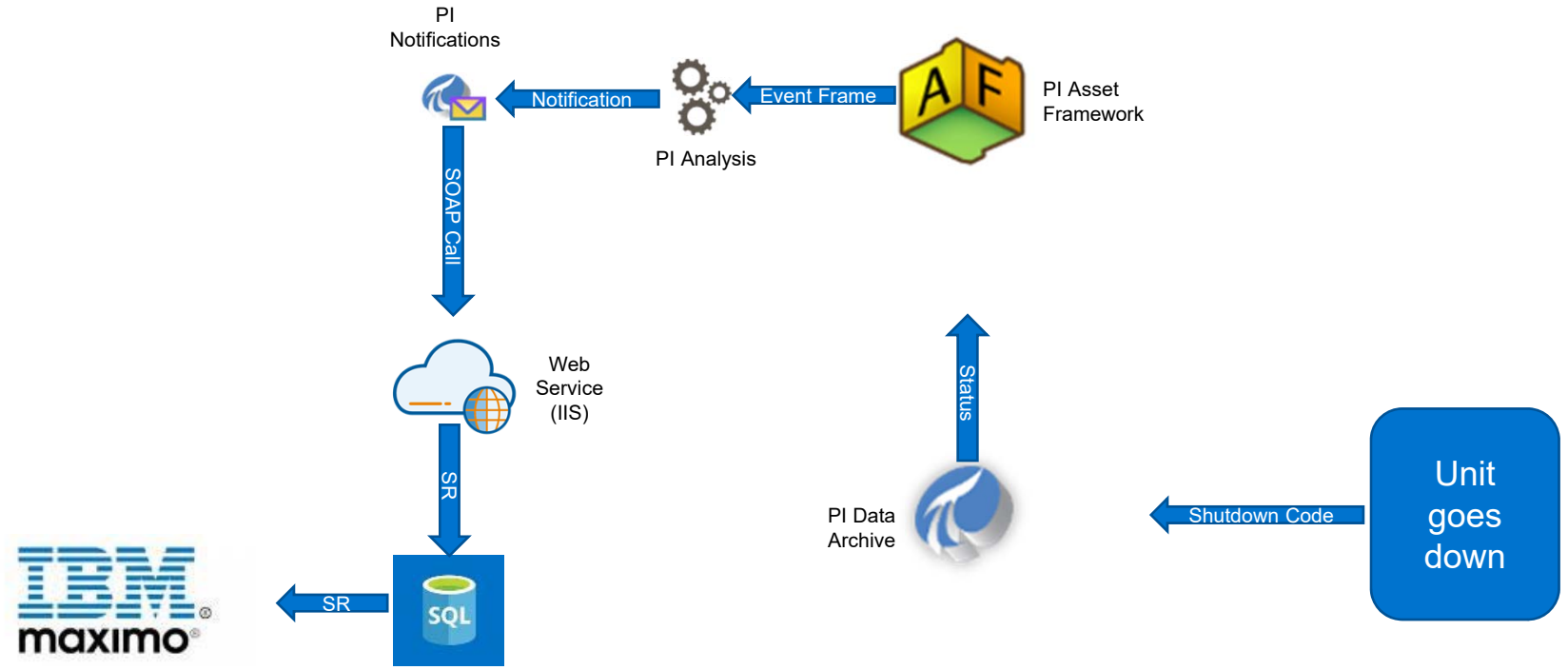

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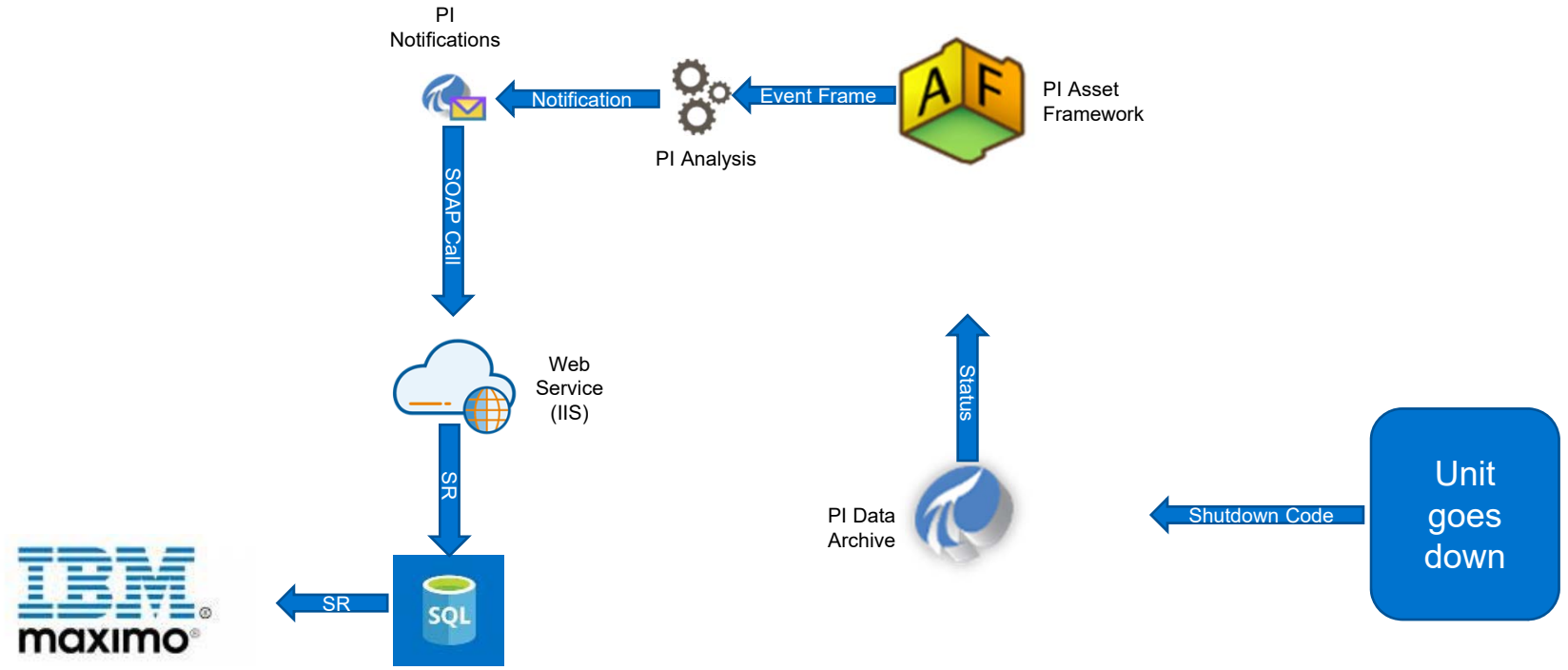

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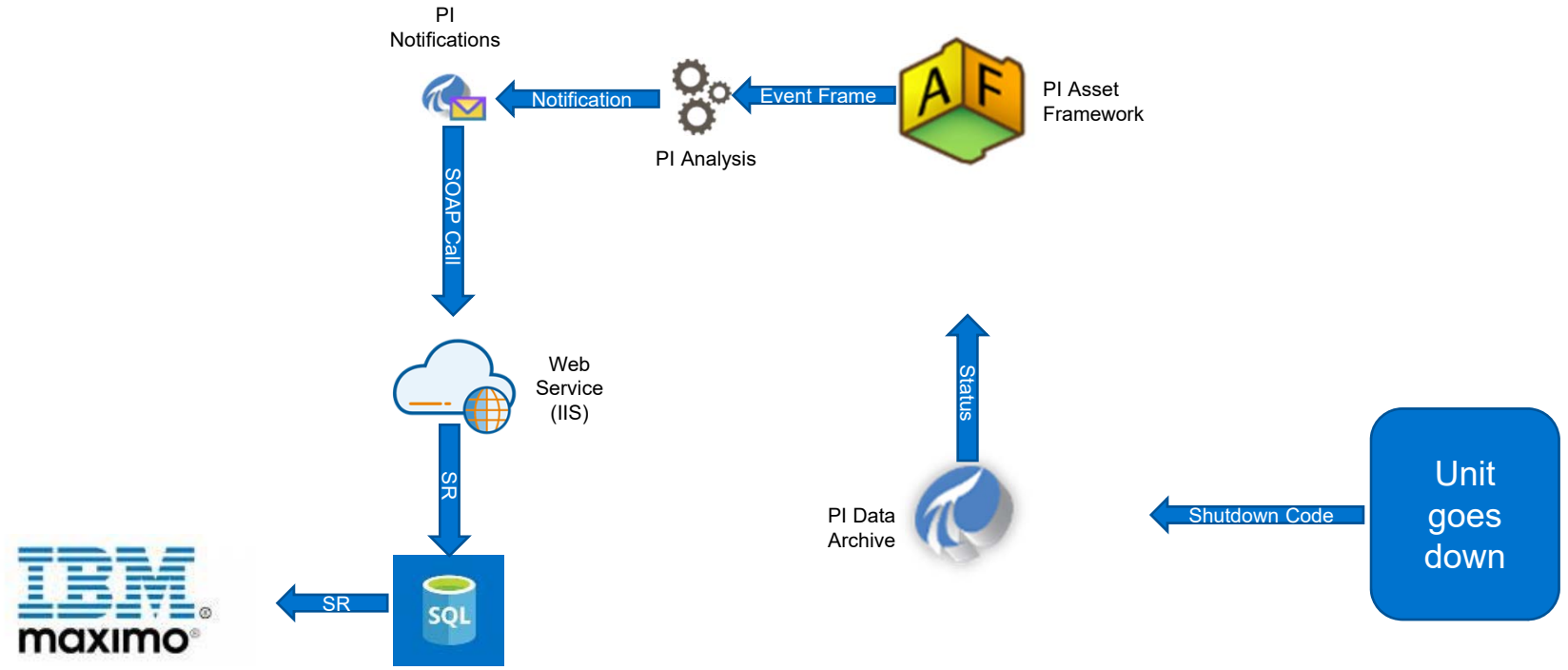

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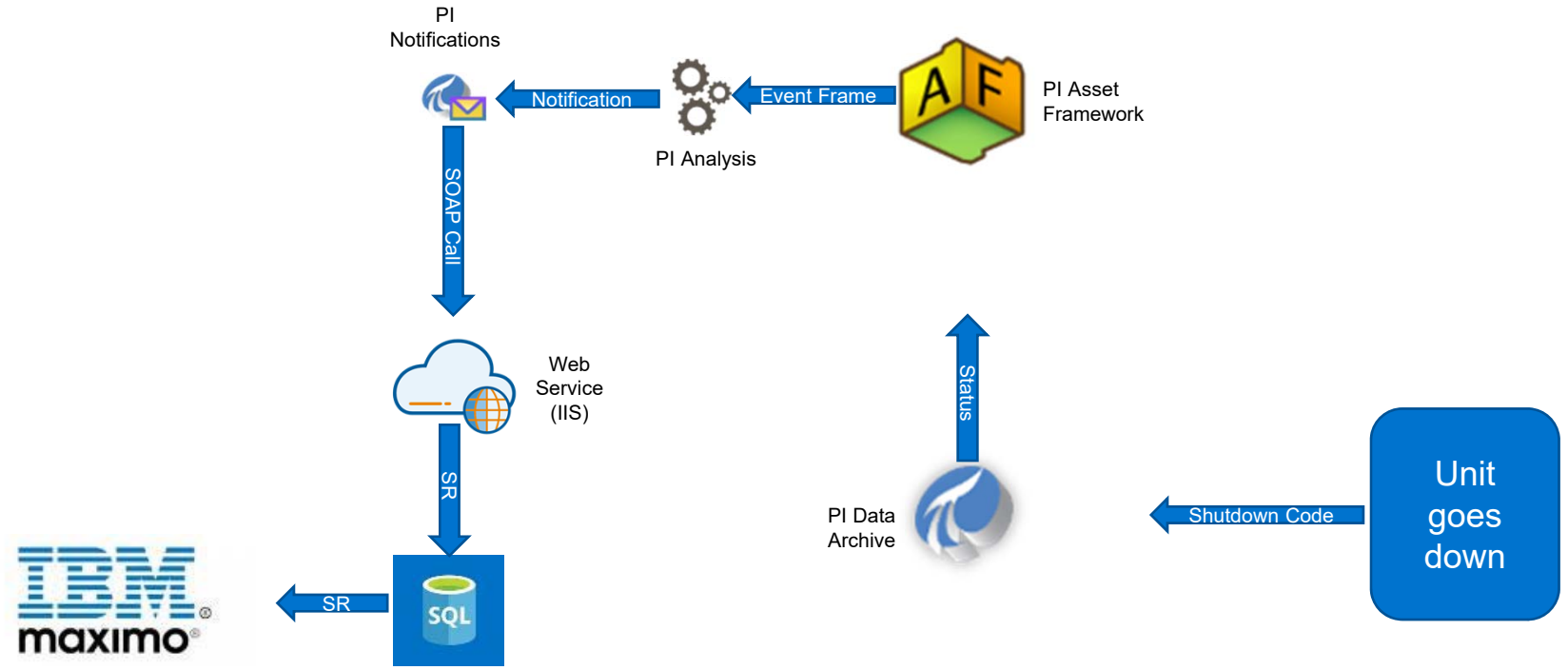

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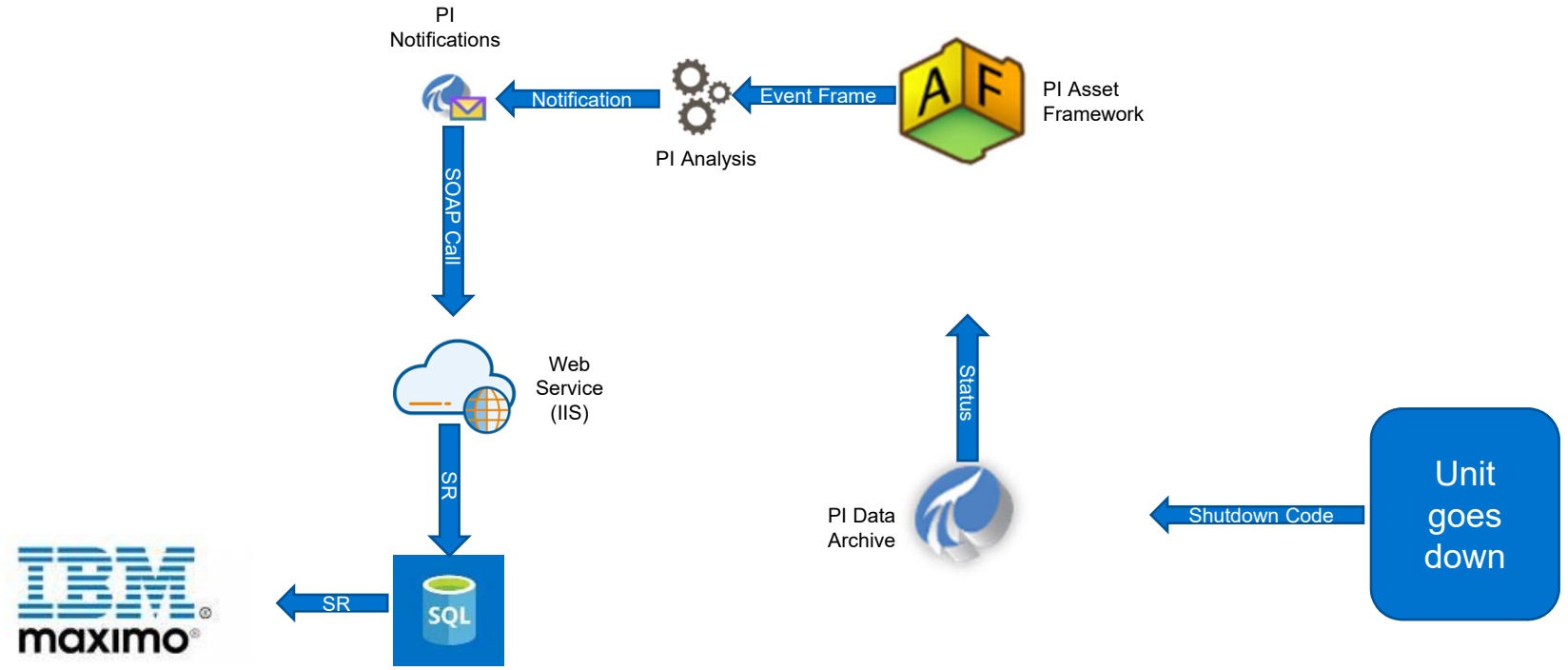

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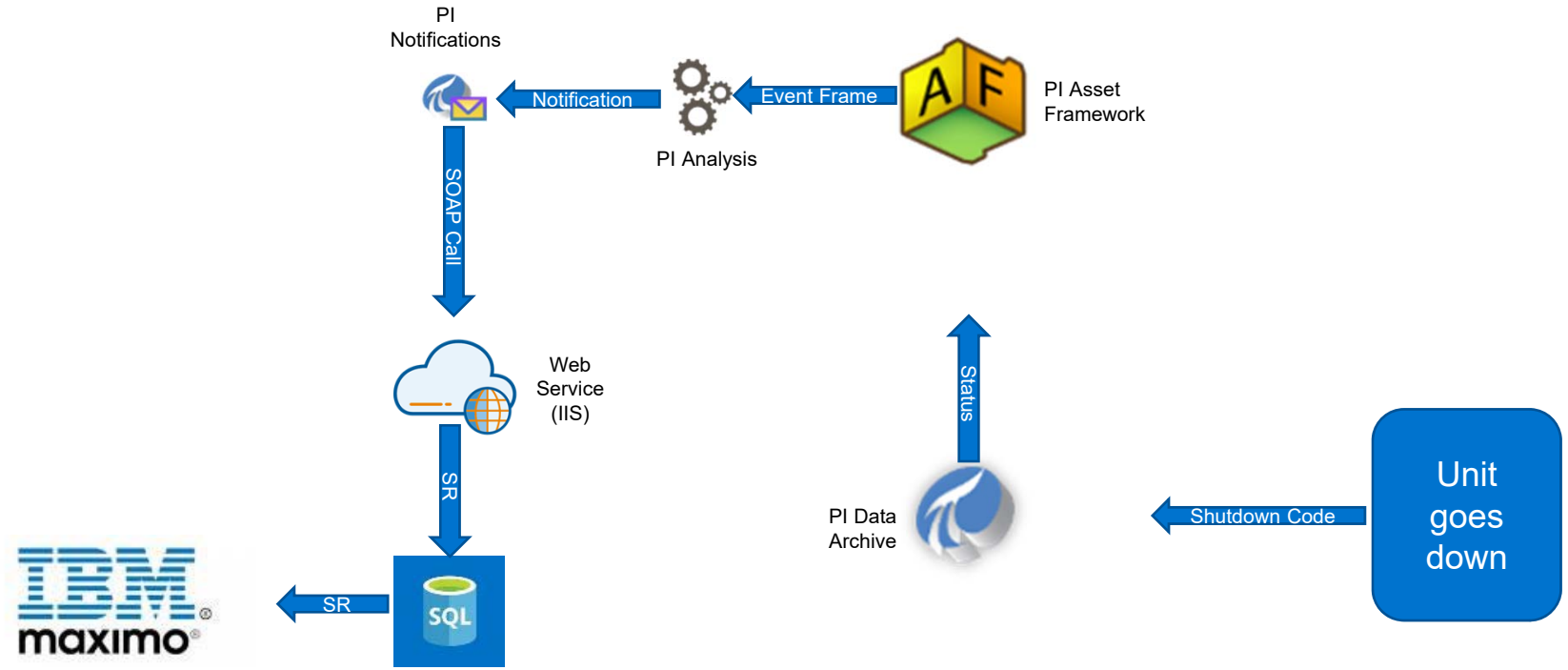

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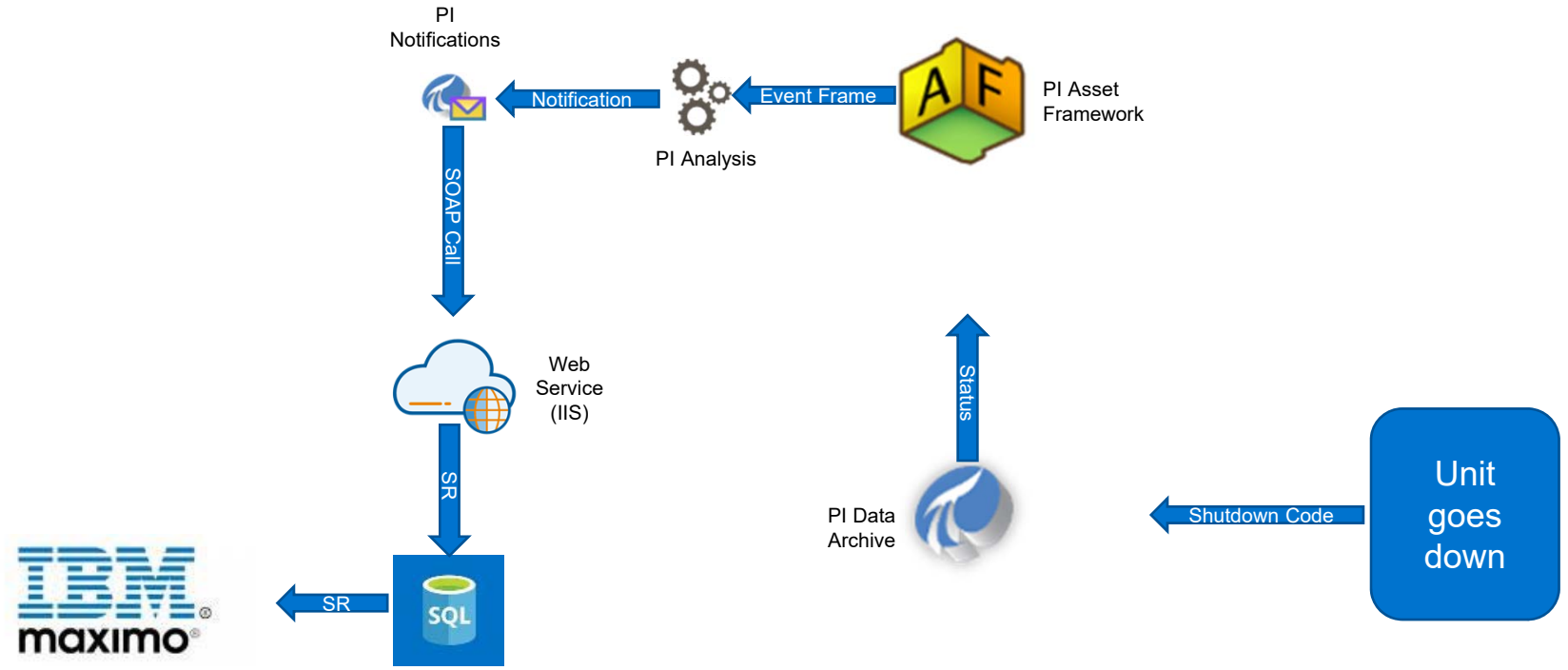

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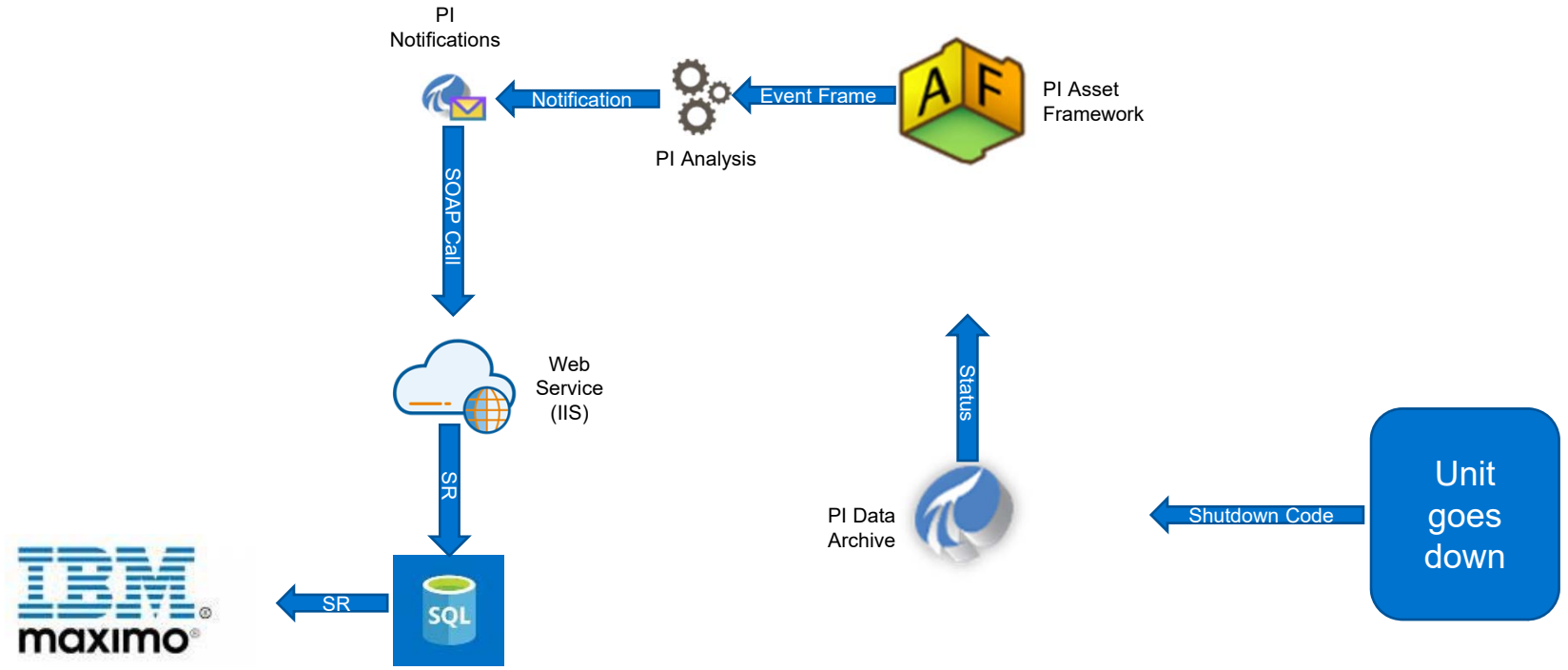

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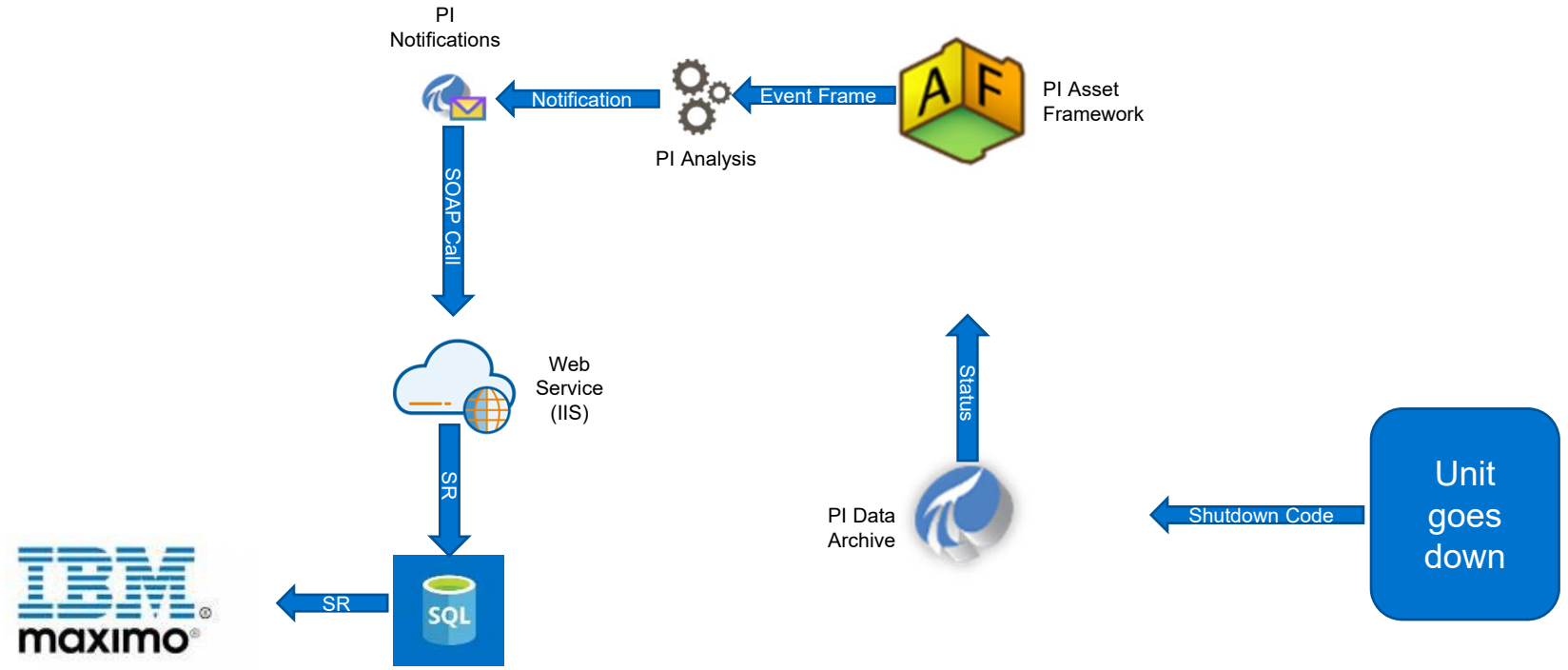
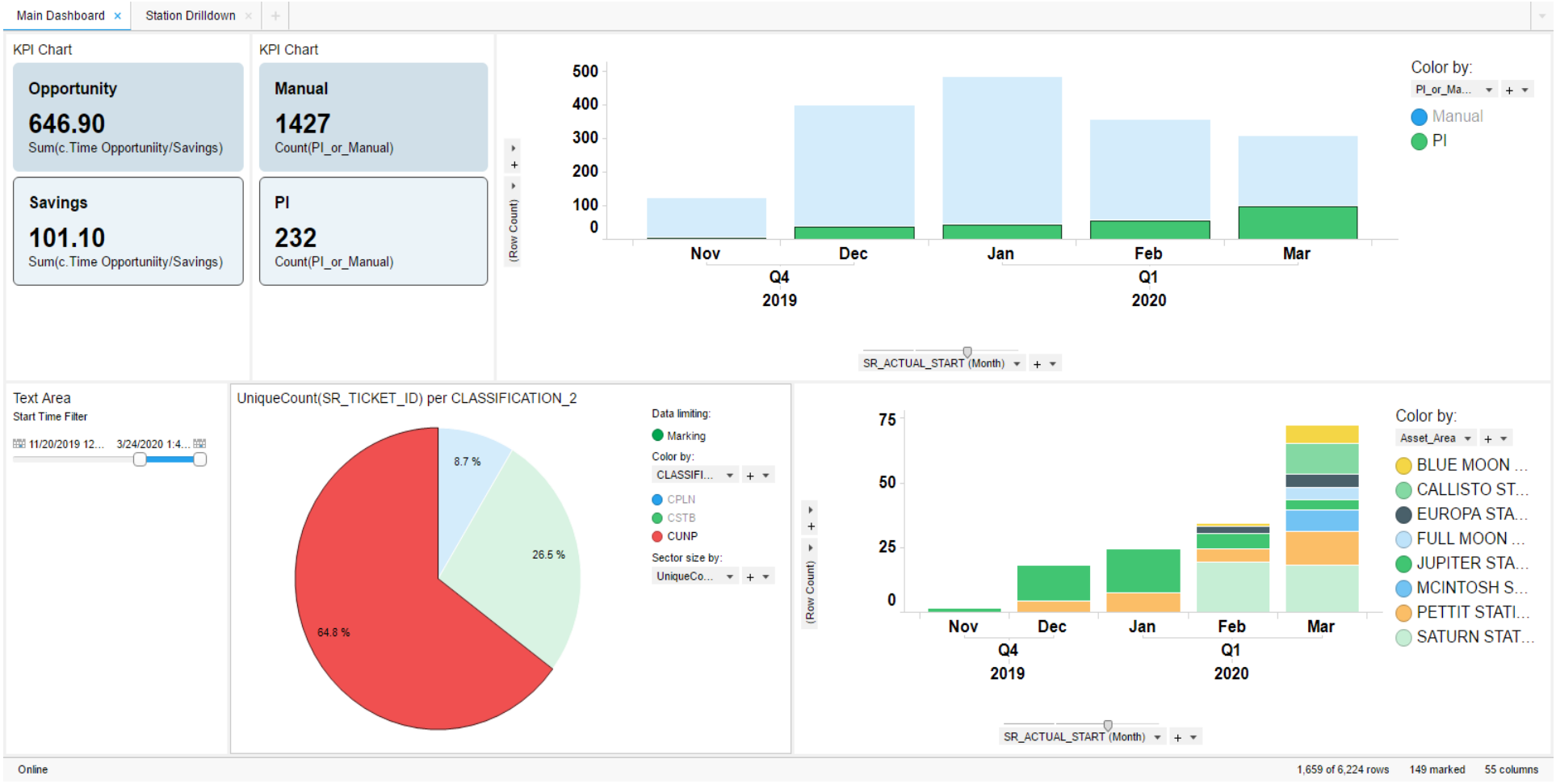




Challenges and Complications

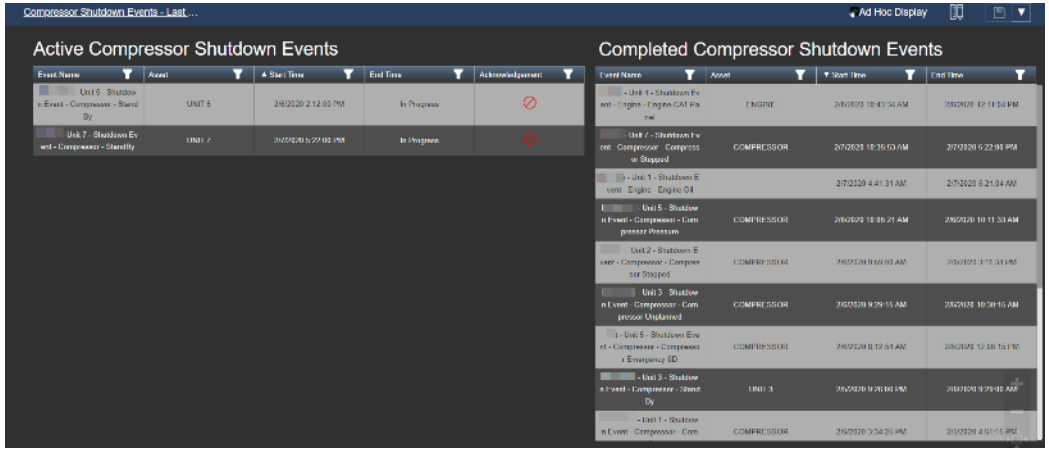
- Need to run both manual and new process
- Don’t break existing reporting
- Culture Change – Subjective process to automated process
  - Training, Reinforcement, Communication

Compressor Shutdown Events - Last ...

Event Name	Asset	▼ Start Time	End Time
Saturn - Unit 4 - Shutdown Event - Engine - Engine CAT Panel	ENGINE	2/8/2020 10:43:34 AM	In Progress
Saturn - Unit 7 - Shutdown Event - Compressor - Standby	UNIT 7	2/7/2020 5:22:00 PM	In Progress
Saturn - Unit 7 - Shutdown Event - Compressor - Compressor Stopped	COMPRESSOR	2/7/2020 10:35:53 AM	2/7/2020 5:22:00 PM
Europa - Unit 1 - Shutdown Event - Engine - Engine Oil		2/7/2020 4:41:31 AM	2/7/2020 6:21:04 AM
BlueMoon - Unit 5 - Shutdown Event - Compressor - Standby	UNIT 5	2/6/2020 2:12:00 PM	In Progress
BlueMoon - Unit 5 - Shutdown Event - Compressor - Compressor Pressure	COMPRESSOR	2/6/2020 10:06:21 AM	2/6/2020 10:11:33 AM
Jupiter - Unit 2 - Shutdown Event - Compressor - Compressor Stopped	COMPRESSOR	2/6/2020 9:59:00 AM	2/6/2020 3:11:34 PM
BlueMoon - Unit 3 - Shutdown Event - Compressor - Compressor Unplanned	COMPRESSOR	2/6/2020 9:29:15 AM	2/6/2020 10:30:15 AM

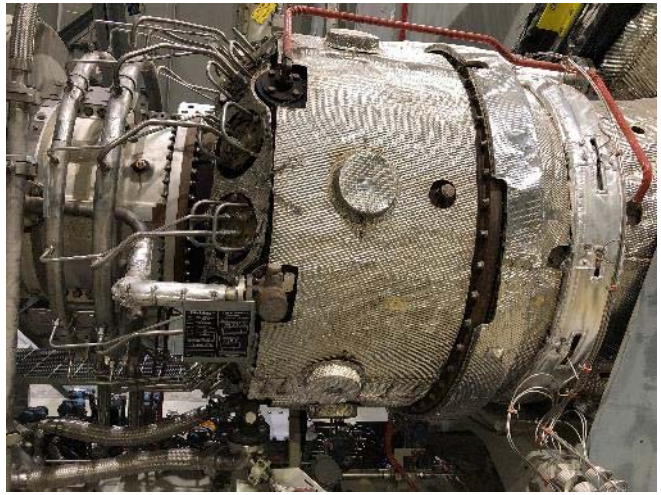
Lessons Learned

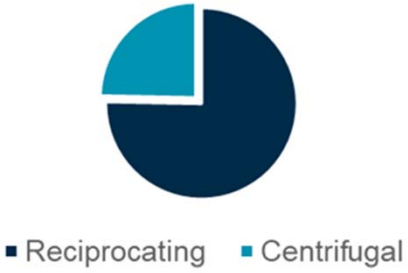
- Benefit to gas control underestimated
- Email and texts are tough habits to break – work order documentation important
- Communicate, Communicate, Communicate
- Try to eliminate legacy processes
- Utilize PI tools & dashboards to monitor process
- Don’t try to get it 100% right the first time (Agile)



Next Steps

- Continue to roll out to more stations (12 down, 28 to go)
- Continue to refine logic for shutdown classification
- Configure process for Turbines (Centrifugal) Compression





Compressor Shutdown Digital Transformation

equitrans Midstream

CHALLENGES

- Over 5,000 shutdowns managed per year across the fleet
- Non-standardized procedures & somewhat subjective process

SOLUTION

- Utilized PI AF, PI Event Frames, PI Notification, Webservice and Maximo Integration to automate compressor shutdown process

BENEFITS

- Standardized, consistent process across Operations
- Reliable Shutdown Data
- Eliminated ~100 hours of Gas Control administrative time
- Improved understanding of shutdowns to enhance ability to prevent

"The Compressor Shutdown Process will help us to digitally transform our operations and supports our objectives of optimizing operations and acting with fiscal discipline."

Speaker Information

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