# Condition Based Maintenance & Smart Monitoring in the Frade FPSO with the PI System®

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# Agenda

- About Chevron
- CBM for Emergency Valves
- Smart Monitoring
- Summary
- Q&A


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# About Chevron

- **Second-largest integrated energy company** headquartered in the United States and among the largest corporations in the world based on market capitalization as of December 31, 2015.
- Global workforce consisting of approximately **61,500 employees**, including more than **3,300 service station employees.**
- Produced **2.594 million** net oil-equivalent barrels per day, with about **73 percent** of the volume outside the United States.
- OSIsoft EA customer since 2011.


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# Chevron Brazil – Projects Overview

- **Frade: Chevron (51%), Petrobras (30%), FJ (18%)**
- Papa-Terra: Chevron (37.5%), Petrobras (62.5%)
- Ceara CE-M-175: Chevron (50%) e Ecopetrol (50%)


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# Chevron's Frade Asset in Brazil

- Floating, Production, Storage and Offloading (FPSO) facility in Frade Field.
- Located 120km from the nearest Brazilian shoreline in the Northern of Campos Basin.
- It lies in water depth of about 3,700 feet (1,128 m).
- Capable of storing – 1,5 million barrels of oil and processing of 100,000 bopd.
- Compressing and treating 106 MMscfd of gas and injecting 150,000 bwpd of water.

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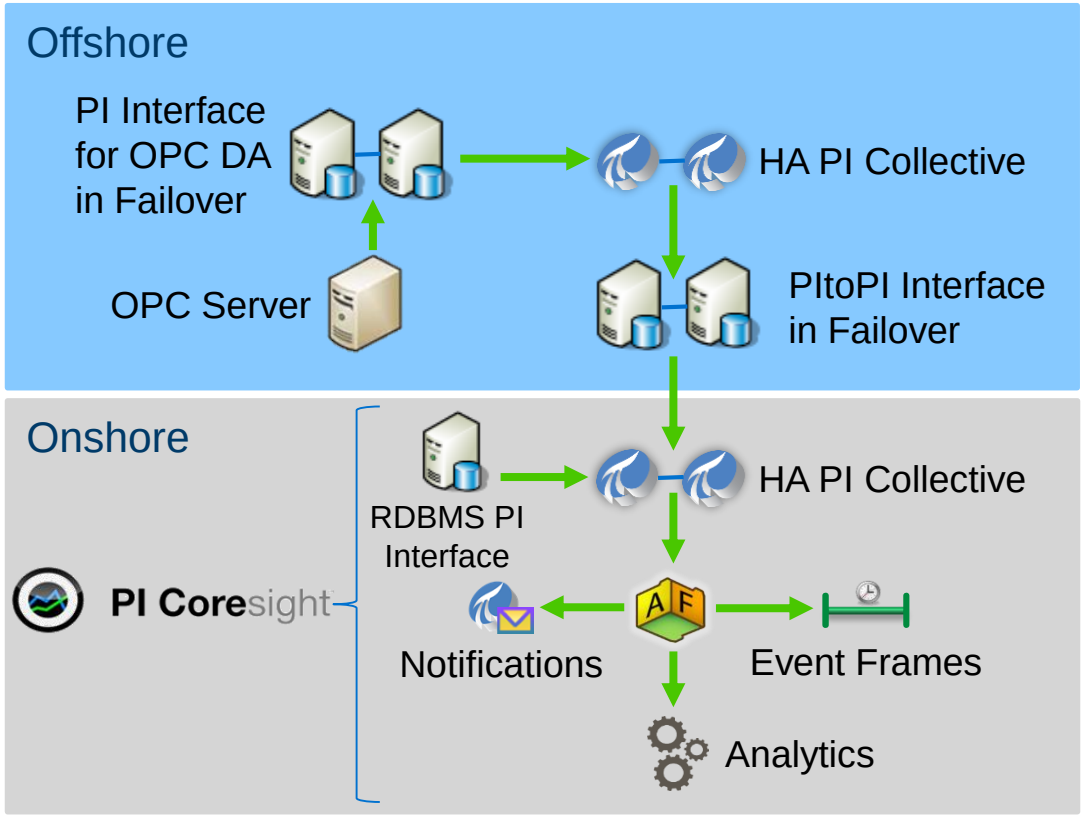
# Chevron Brazil – PI System Overview

- ~12.000 tags maped in the PI Data Archive (Onshore & Offshore);
- Over 1,300 assets and 150 templates in PI AF;
- More than 2,000 PI Asset Analytics running;
- 114 dashboards developed and published in PI Coresight™;
- Integration with other software databases.





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# CBM and Smart Monitoring in Frade FPSO with the PI System®

## COMPANY and GOAL

One of the world's leading oil producer wanted to **improve its Frade FPSO monitoring capability and information quality through the PI System®**.

Chevron

radix
Engineering and Software

## CHALLENGE

Reduce the maintenance cost and increase monitoring capability

- Perform real time and historical data analysis on the condition of the Emergency Valves
- Shift the monitoring philosophy to event driven

## SOLUTION

Implementation of PI System applications to automate the data analysis, event detection and notifications delivery

- Real time data analysis through Asset Analytics and Event Frames
- Custom Excel Report using PI AF SDK
- Web monitoring displays published in PI Coresight[tm]

## RESULTS

Emergency valves maintenance cost reduced and significant improvement on Operational Intelligence

- $350k investment saving on offshore system solution
- Potential $300k/year cost saving on third party monitoring solution
- 90% time reduction on intelligence gathering


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# Challenges: Emergency Valves Maintenance

Provide a solution that enables real time and historical data analysis on the condition of the Emergency Valves, allowing maintenance to be planned in advance according to the equipment condition.

## Previous Scenario:

- Preventive routines set in Computerized Maintenance Management System (CMMS) which required to have the asset integrity and guarantee the reliability verification;
- Equipment inspection was executed in all critical valves due to lack of equipment condition information;
- Implementing a solution in offshore systems implicate in costs and risks:
  - Complete production shutdown for ICSS full download;
  - Activity planning including comissioning hours, troubleshooting, contigency plans, engineering onshore support , AMS report...


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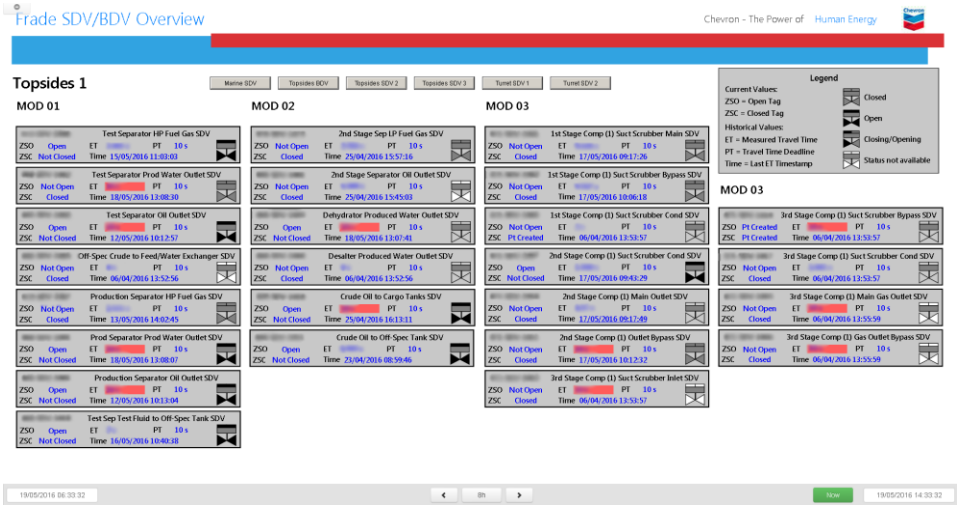
# Solution: Emergency Valves Maintenance

## Dashboards

- PI AF Element Template associated with a Symbol Template significantly reduced the application development and maintenance time;
- PI Asset Analytics enabled the calculation of complex status for multi-state symbols;
- Web publication in PI Coresight$^{tm}$ in a user friendly way.





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# Solution: Emergency Valves Maintenance

## Report

- Excel file with custom UI for searching and filtering data;
- Add-in implemented in C# using the .NET Framework and PI AF SDK;
- It can search directly for Event Frames or PI Data Archive tags and process the data to identify relevant events.

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# Summary: Emergency Valves Maintenance

## CHALLENGE

Provide a solution that enables real time and historical data analysis on the condition of the Emergency Valves, allowing maintenance to be planned in advance according to the equipment condition.

## SOLUTION

- PI AF Element Template and PI Asset Analytics to determine the complex status;
- Dashboards using Symbol Template associated with PI AF;
- Publication in PI Coresight[tm];
- Excel add-in to retrieve and process historical data for analysis and reporting;
- PI Event Frames to detect and present information with start and end conditions.

## RESULTS

- $350K investment saving on offshore system solution;
- Improved onshore surveillance capabilities;
- Improved the quality information used to plan and support the decision making on execute equipment inspection and intervention;
- Savings due to targeted inspection scope by performing condition based maintenance.


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# Challenges: Smart Monitoring & Notifications

Increase the engineering team efficiency on monitoring by shifting the applications approach from displaying unprocessed data to analyzed information, detecting and notifying events in real time.

## Previous Scenario:

- Status of measurements in relation to critical control limits (LL, L, H, HH) were unknown in real time for onshore engineers;
- No KPI automated calculations for Control Loops;
- Hydrate monitoring information was spread across different systems and calculated manually in spreadsheets;
- No automated event detection or notification to onshore team;
- No aggregate status per production tree based on its measurements;
- The visualization displays didn't have calculated multi-state color representation.


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# Solution: Smart  Monitoring & Notifications

- PI AF Asset Analytics automated KPIs for control loops and real time status calculation that requires complex equations;
- Imported data from other systems via PI RDBMS Interface;
- PI Event Frames implementation to detect critical limits bypass and undesired operating conditions;
- PI Notifications alert the engineers whenever critical event detection occur;
- Dashboards published in PI Coresight$^{tm}$  to present detailed information in user friendly interface.


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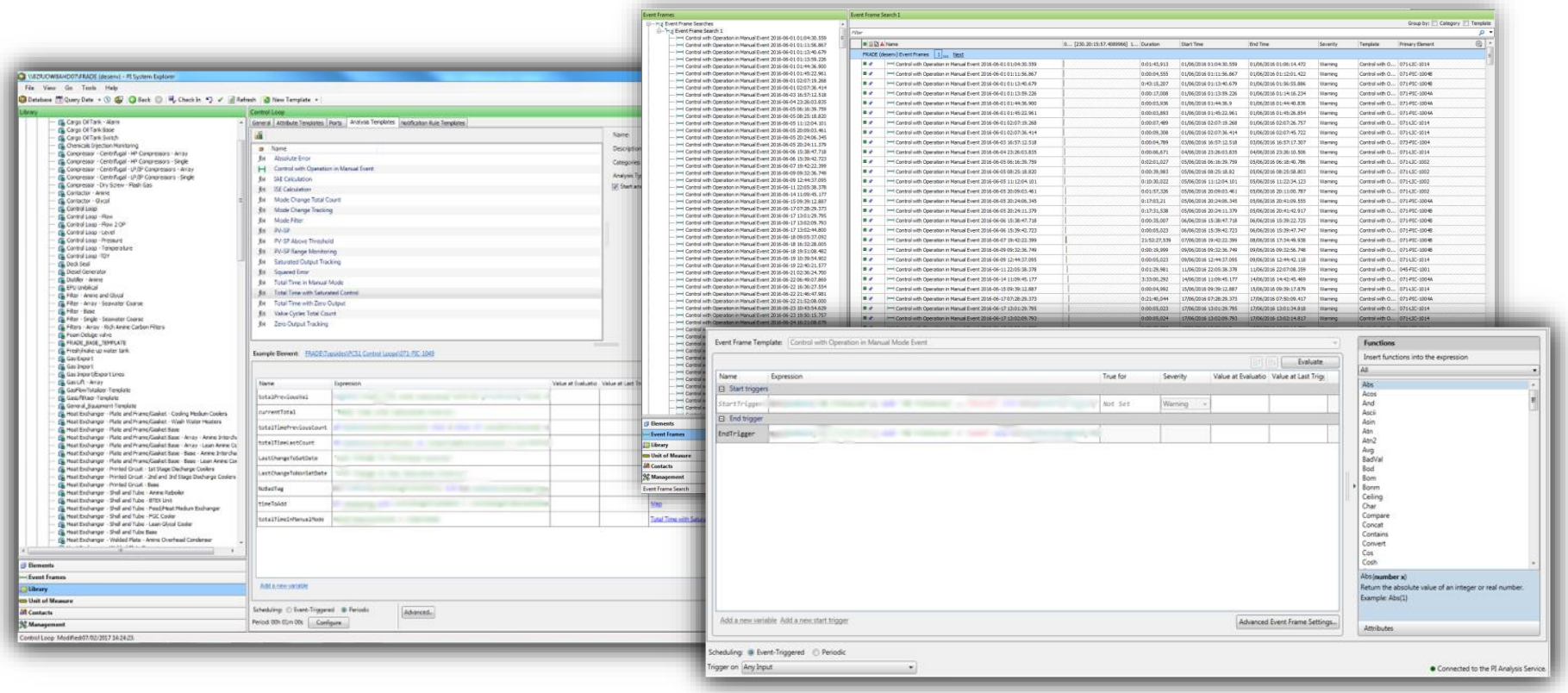
# Smart Monitoring Applications – Analytics & Events

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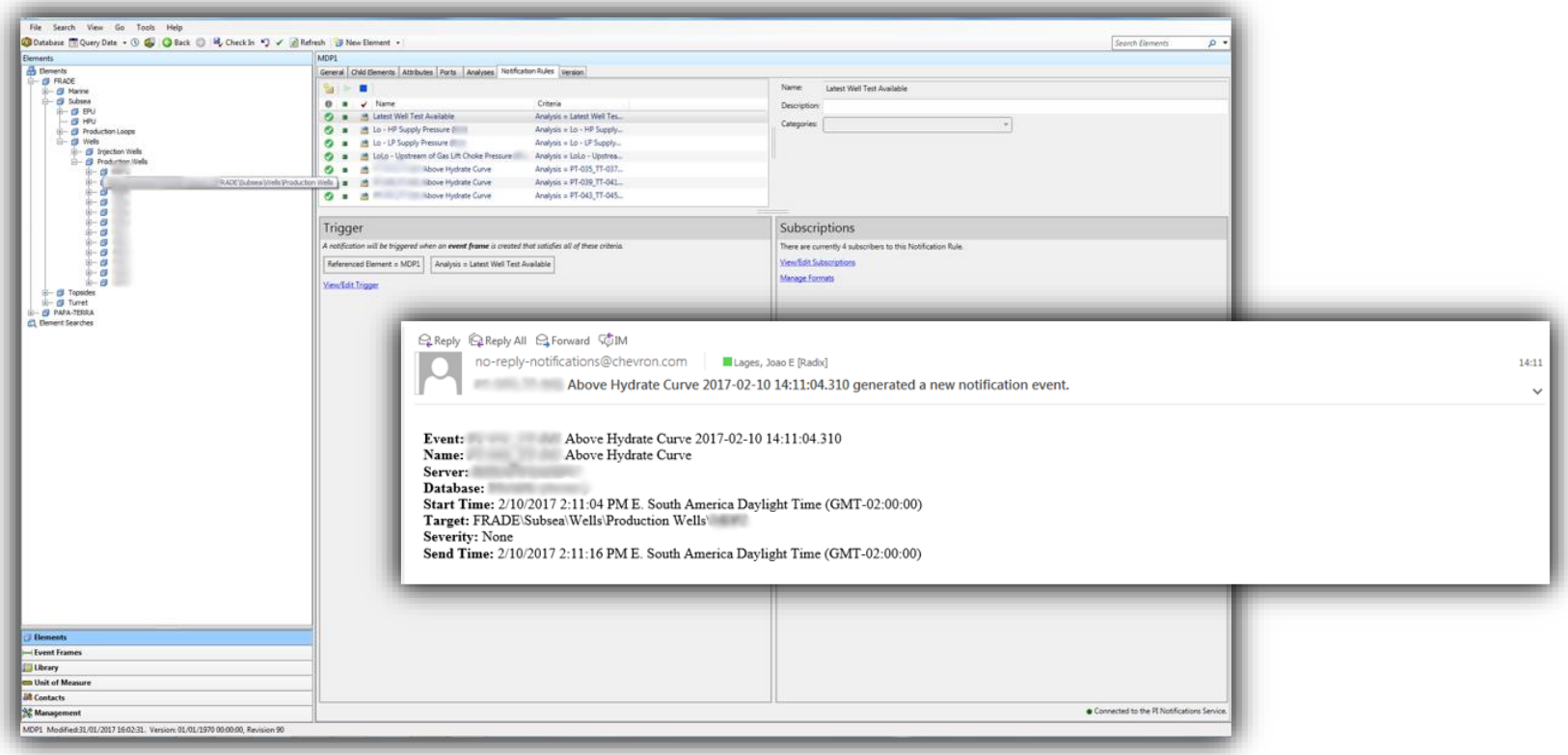
# Smart Monitoring Applications – PI Notifications





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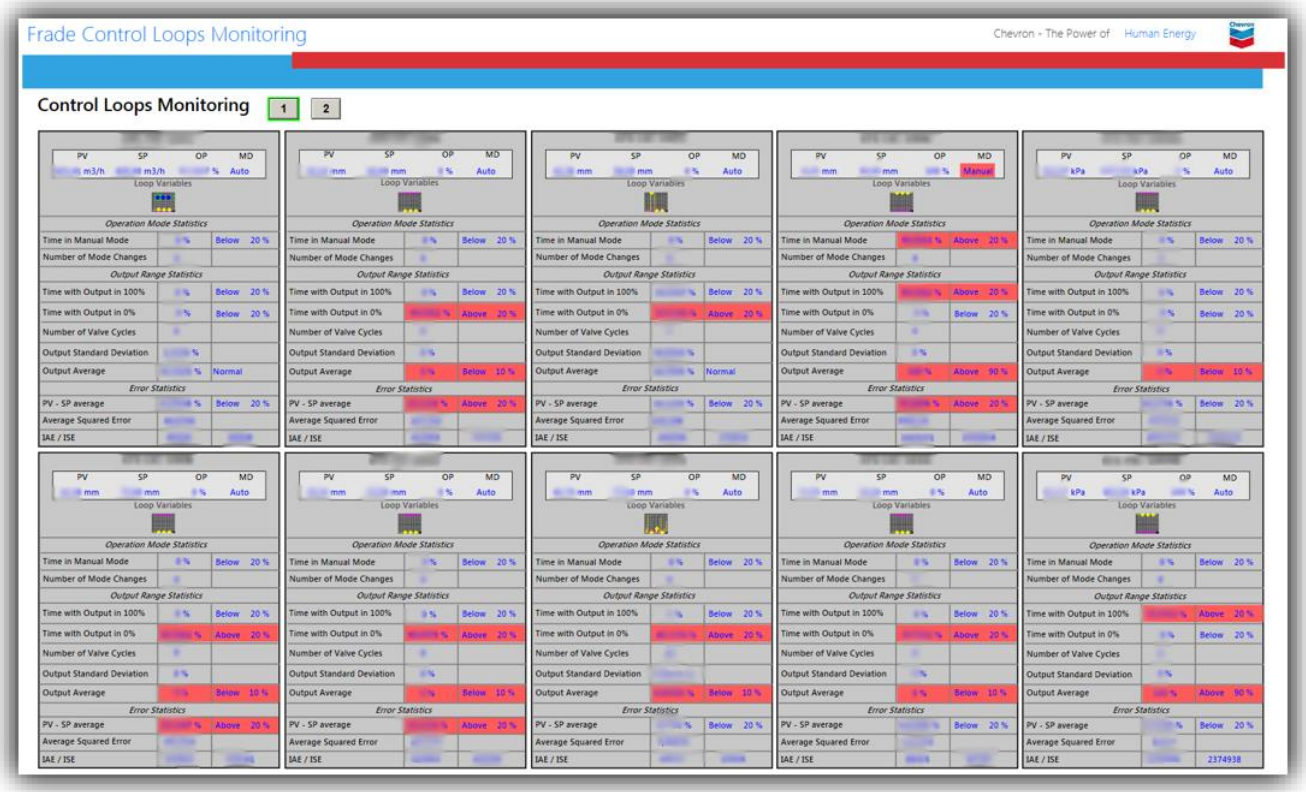
# Control Loops KPI - Dashboards





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# Production Tree Management Status - Dashboards

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# Summary: Smart Monitoring & Notifications

| CHALLENGE | SOLUTION | RESULTS |
| --- | --- | --- |
| • Increase the engineering team efficiency on monitoring by shifting the applications approach from displaying unprocessed data to analyzed information, detecting and notifying events in real time. | • PI AF Asset Analytics to transform raw data into actionable intelligence;<br>• PI Event Frames to detect critical limits bypass;<br>• PI Notifications to alert engineers;<br>• PI Coresight dashboards published to present detailed information in user friendly interface. | • Potential $300k/year cost saving on third party control loops monitoring solution;<br>• Decreased intelligence gathering effort by 90%;<br>• Aggregate status per Production Tree;<br>• Significantly reduced response time. |


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# Next Steps and Future Plans

- Expand Reactive Monitoring application for others control loops;
- Expand CBM applications to other assets, such as Compressors & Filters;
- Automate more event detections through Event Frames;
- Increase and enhance the PI Notifications usage;
- Implement the predictive analytics for CBM applications.


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# Benefits: PI System® Tools

- **Better Governance Model:**
  - Increased the effectiveness of support and maintenance;
  - Reduction of hours spent on creating new dashboards;
- **System Integrator**
- **Data Infrastructure**:
  - Single Data Source;
  - Better Relational Structure;
  - Better Data Analysis;

- **System Standardization and Optimization**


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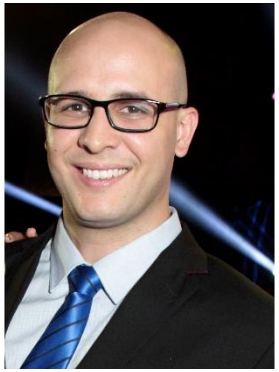


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# Questions

Please wait for the **microphone** before asking your questions

State your **name & company**

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감사합니다

谢谢

Danke

Merci

Gracias

# Thank You

ありがとう

Спасибо

Obrigado


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