



The Death of a Spreadsheet – Streamlining Gas Turbine Operations and Maintenance Reporting

Presented by **Beatriz Blanco**
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Agenda

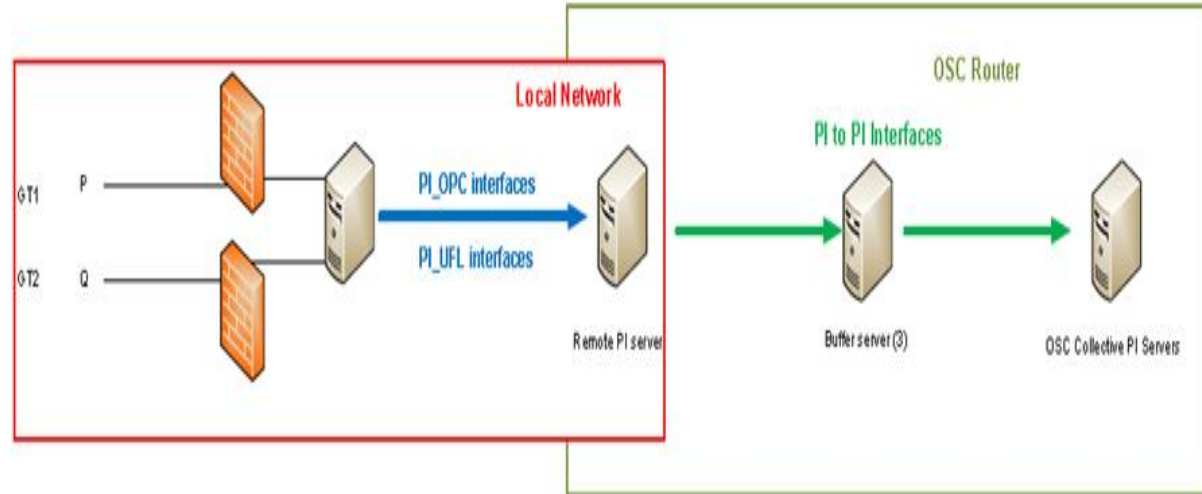
- About Mitsubishi Hitachi Power Systems America, Inc.
- Current PI System Configuration
- Need for Improving Report Efficiency
- Reporting Application
- Implementation Details
- Diminished Review Time, Editing and Conversion Efficiency
- Conclusion

About Mitsubishi Hitachi Power Systems America, Inc.

- MHPSA is an industry leader in gas turbine technology.
- The MHPSA Remote Monitoring Center (RMC) monitors 70+ gas turbines around the world using the PI System.
- Coupled with Asset Framework and Analytics, the RMC uses the PI System to drive R&D, mitigate potential issues, troubleshoot problems, and distribute reports for customers.

MHPSA PI Systems Configuration

- From P & Q Lines two main data sources configurations are used. The data from the P&Q line is first collected using these interfaces.
- This data is then transferred to the site/remote PI Server™, using either PI Interface for OPC or PI Interface for UFL.
- The data will then be transferred to Orlando Service Center collective PI Servers™ using PI to PI Interfaces located on Buffer servers.



MHPSA PI Systems Configuration


- Once on the OSC PI Servers™, the data is now available to users through various applications that include PI ProcessBook®, PI DataLink®, Asset Framework etc. Data is stored on archives with no time limit.
- The configuration of the data sources are different, but in each instance the data flows from the controller to the Orlando Service Center collective PI Servers™.
- The framework of the quarterly report was based on this data collection, as well as other tools that the RMC has developed.

MHPSA PI Systems RMC Developed Tools

- The RMC has created Tools utilizing PI DataLink® and Asset Framework that include the following:
 - » Start Up/Shutdown Comparisons
 - » Start Up/Shutdown Parameters Data Pulls
 - » 3 Day vs 10 Day Comparisons
 - » Swirl Analysis Tool
 - » Daily Chart Builder
 - » Quarterly Reports

Quarterly Reports for Customers

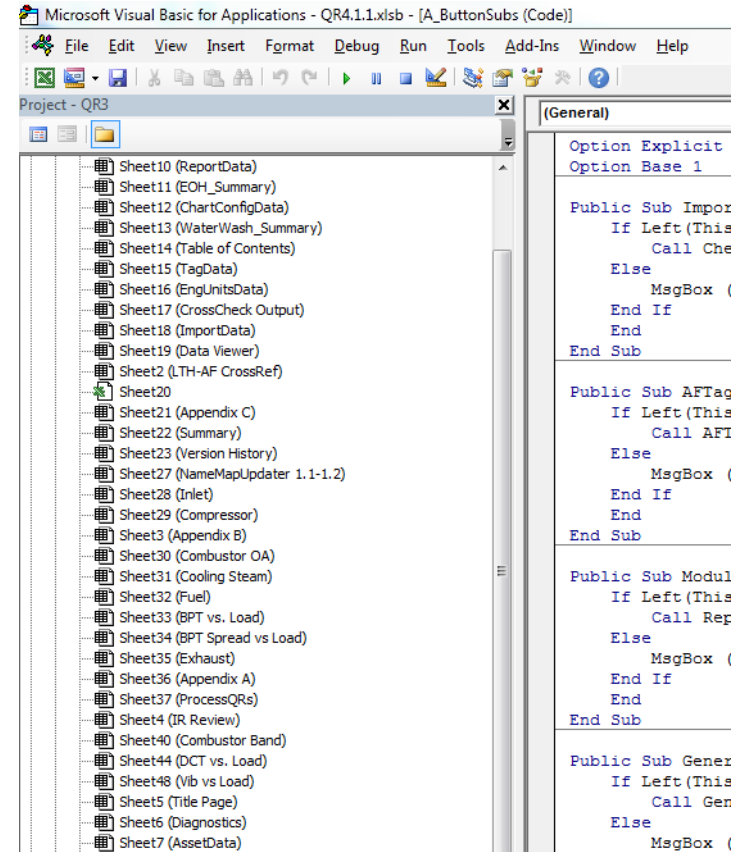
- The Quarterly Reports provide segmented comparison data of the gas turbine's major systems, along with a summary of issues being tracked for an individual site.
- The reports provide the ability to keep the customer up to date on all long term and short term trends and issues.
- The original reporting tool was created using VBA and Macros in Excel.

Prepared NAME	Technical Information		
Reviewed NAME	To:	SITE NAME	
Approved NAME	Subject:	MHPSA Remote Monitoring Center Quarterly Operations Report	
	Date:	10/1/2016 - 1/1/2017	
	Abstract:	This report describes the results of monitoring for Quarter 4 from Saturday, October 1, 2016 to Sunday, January 1, 2017	
COPY	Category:		
	() Recommendation	(X)	Technical Report
	() MHI Question	()	Information
	() Reply to Technical Inquiry		
	Reply:		
	() Required	(X)	Not Required
		Rev	Issue Date
		0	Jan 4, 2017

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Quarterly Reports for Customers

- These macros often failed, were difficult to troubleshoot, and the reports were difficult to modify.
- New unit additions to the existing Excel spreadsheets were time-consuming, and inputs necessary for the macros to run were easily missed, causing failure.
- With every revision, several inputs needed to be adjusted and likely failures occurred.



The screenshot shows the Microsoft Visual Basic for Applications environment. The title bar reads "Microsoft Visual Basic for Applications - QR4.1.1.xlsb - [A_ButtonSubs (Code)]". The menu bar includes File, Edit, View, Insert, Format, Debug, Run, Tools, Add-Ins, Window, and Help. The Project Explorer on the left shows a project named "Project - QR3" containing a list of sheets: Sheet10 (ReportData), Sheet11 (EOH_Summary), Sheet12 (ChartConfigData), Sheet13 (WaterWash_Summary), Sheet14 (Table of Contents), Sheet15 (TagData), Sheet16 (EngUnitsData), Sheet17 (CrossCheck Output), Sheet18 (ImportData), Sheet19 (Data Viewer), Sheet2 (LTH-AF CrossRef), Sheet20, Sheet21 (Appendix C), Sheet22 (Summary), Sheet23 (Version History), Sheet27 (NameMapUpdater 1.1-1.2), Sheet28 (Inlet), Sheet29 (Compressor), Sheet3 (Appendix B), Sheet30 (Combustor OA), Sheet31 (Cooling Steam), Sheet32 (Fuel), Sheet33 (BPT vs. Load), Sheet34 (BPT Spread vs Load), Sheet35 (Exhaust), Sheet36 (Appendix A), Sheet37 (ProcessQRs), Sheet4 (IR Review), Sheet40 (Combustor Band), Sheet44 (DCT vs. Load), Sheet48 (Vib vs Load), Sheet5 (Title Page), Sheet6 (Diagnostics), and Sheet7 (AssetData). The Properties Window on the right shows the (General) tab with the following code:

```
Option Explicit
Option Base 1

Public Sub ImportData
    If Left(ThisWorkbook.Name, 10) = "ImportData" Then
        Call MsgBox("Import Data")
    End If
End Sub

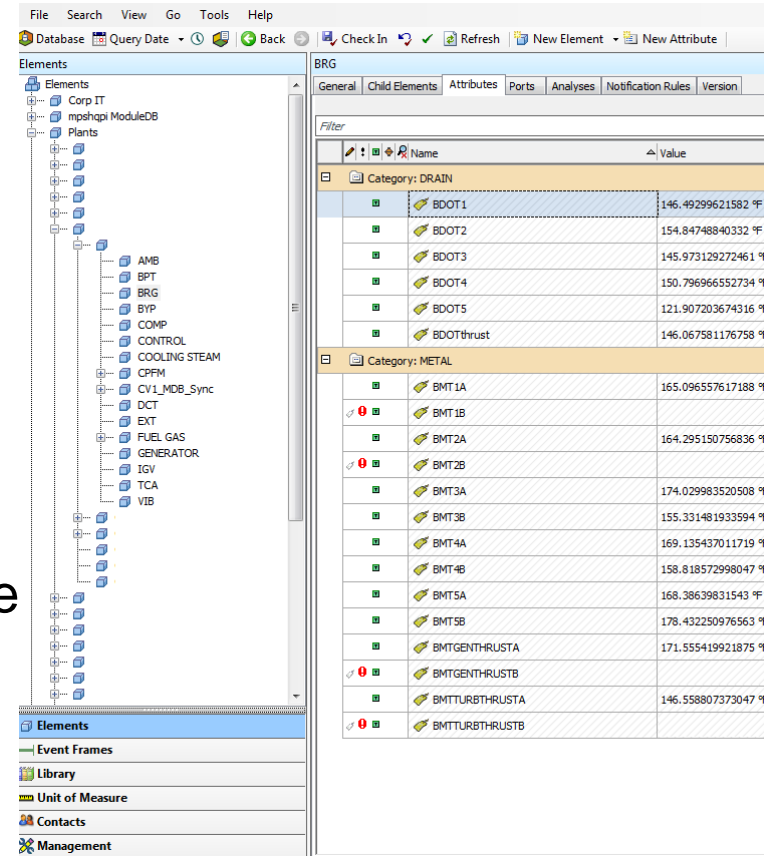
Public Sub AFTag
    If Left(ThisWorkbook.Name, 10) = "AFTag" Then
        Call AFTag
    Else
        Call MsgBox("AFTag")
    End If
End Sub

Public Sub Module
    If Left(ThisWorkbook.Name, 10) = "Module" Then
        Call Reg
    Else
        Call MsgBox("Module")
    End If
End Sub

Public Sub Generate
    If Left(ThisWorkbook.Name, 10) = "Generate" Then
        Call Gen
    Else
        Call MsgBox("Generate")
    End If
End Sub
```


Quarterly Reports for Customers

- Two attempts were made to re-vamp the reporting tool.
- Both products utilized our current Asset Framework structure.
- Each plant is divided into major systems, and templates are created based on frame size, units of measure, and special systems.



The screenshot displays a software interface with a hierarchical tree on the left and a data table on the right. The tree shows a structure under 'Elements' with sub-items like 'Corp IT', 'mposhgl ModuleDB', and 'Plants'. The table on the right is titled 'BRG' and has columns for 'Name' and 'Value'. It is divided into two categories: 'DRAIN' and 'METAL'.

Category: DRAIN	
BDOT1	146.49299621582 °F
BDOT2	154.84748840332 °F
BDOT3	145.973129272461 °F
BDOT4	150.796966552734 °F
BDOT5	121.907203674316 °F
BDOTthrust	146.067581176758 °F
Category: METAL	
BMT1A	165.096557617188 °F
BMT1B	
BMT2A	164.295150756836 °F
BMT2B	
BMT3A	174.029983520508 °F
BMT3B	155.331481933594 °F
BMT4A	169.135437011719 °F
BMT4B	158.818572998047 °F
BMT5A	168.38639831543 °F
BMT5B	178.432250976563 °F
BMTGENTHRUSTA	171.555419921875 °F
BMTGENTHRUSTB	
BMTTURBHRUSTA	146.558807373047 °F
BMTTURBHRUSTB	

Earlier Attempt at New Quarterly Reporting Tool

- First new tool used Microsoft SQL Server Reporting Services (SSRS)
- Data imported from upon report generation
 - From Asset Framework (AF) using PI OLEDB Enterprise
 - From Sharepoint using built in querying tools
- Subscriptions scheduled to save reports as PDF documents
- Problems
 - Charts generated as images and could not be easily edited or annotated
 - Any document changes required annotating the PDF and then “printing” to a new PDF to flatten the document
 - Manual exporting of many reports independent of subscription
 - Limited to features and calculations that SSRS provides
 - Bugs in SSRS that could not be fixed

New Quarterly Report Tool Requirements

- Customer requirements
 - Chart annotation and editing before exporting
 - Workflow management
 - Bulk exporting of reports
 - More intuitive user interface with quicker response
- Developer requirements
 - Ability to add new features without SSRS limitations

Solution

- Metadata stored in SQL Server configuration table
- Import raw data to an intermediate database
 - Stores calculation results
 - Stores annotations and chart edits
 - Stores workflow information
- Build a web application to interact with the intermediate database
 - Easy to customize visually
 - Access to many JavaScript libraries
 - Can create custom controls and dialog boxes for any custom feature requests

Technology Used

- Import of Raw Data to Intermediate Database
 - C# application built to import data and crunch numbers
 - PI data imported using PI OLEDB Enterprise
 - Sharepoint and SQL Server imported using .NET libraries
 - Intermediate data storage in MongoDB
- Data and report frontend in a web app viewed in a web browser
 - Deployed to an IIS web server
 - Web application built in Angular 2 using Material Design styles
 - Custom charts built in D3.js
- Report output to PDF using wkhtmltopdf

Quarterly Reports Lookup

Reports Admin

Year: 2017 Quarter: Q1 SEARCH

Unit	Reviewer	Approver	Status	DOWNLOAD PDF
No reports were found				

Made by DST Controls

Quarterly Reports Generation

Reports Admin

Year: 2016 Quarter: Q1 SEARCH

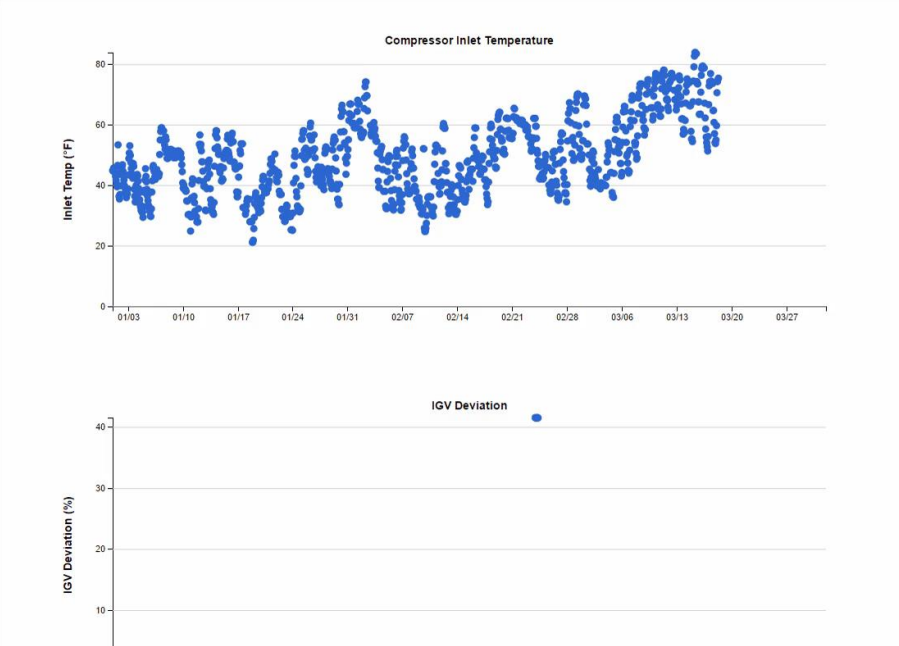
<input type="checkbox"/>	Asset	Status	Created	GENERATE REPORTS
<input type="checkbox"/>	Unit A	Not Generated		
<input type="checkbox"/>	Unit B	Not Generated		
<input type="checkbox"/>	Unit C	Not Generated		
<input type="checkbox"/>	Unit D	Not Generated		

Quarterly Reports Data Annotations

Asset 2

PREPARED PREVIEW DOWNLOAD

- Cover Page
- Table of Contents
- Summary
- IR Review
- Inlet
- Compressor
- Combustor OA
- Combustor Band
- Cooling Steam
- Fuel
- DCT vs Load
- BPT vs Load
- BPT Spread vs Load
- Exhaust
- Vib vs Load
- Appendix A
- Appendix B



Quarterly Reports PDF Export

Reports Admin

Year: 2016 Quarter: Q1 [SEARCH](#)

<input type="checkbox"/>	Unit	Reviewer	Approver	Status	DOWNLOAD PDF
<input type="checkbox"/>	Unit 1	Alan Kenyon		Reviewed	VIEW
<input type="checkbox"/>	Unit 2			Generated	VIEW

Using PI Data, Asset Framework, and PI OLEDB Enterprise to Streamline GT Reporting

COMPANY and GOAL

MHPSA monitors 70+ gas turbines and wanted to reduce the time it took to create, modify, and annotate reports, and minimize troubleshooting time.



CHALLENGE

Finding the most efficient user friendly interactive reporting tool that utilized both the PI System and Sharepoint

SOLUTION

MHPSA collaborated with DST Controls to create a self contained application that incorporated all the data sources required.

- Engineers can quickly annotate current and resolved issues, and identify and resolve potential problems.

RESULTS

Engineering review time decreased by 25% . Report creation and printing time decreased by 50%.

- Effectively streamlined the process to reduce the overall number of hours spent on total package for reporting to allow quicker reactions to potential issues.

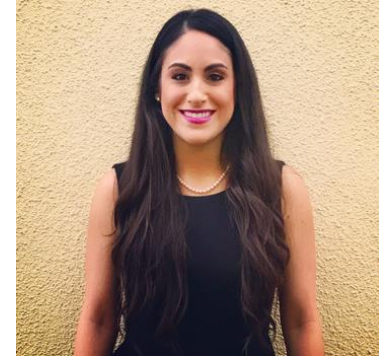
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Questions

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State your **name & company**

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감사합니다

谢谢

Danke

Merci

Gracias

Thank You

ありがとう

Спасибо

Obrigado

Custom applications using BI tools to create reporting,
streamlines the entire process.