

OSIsoft, Sharepoint, VBA Harmony to Advance Operational Troubleshooting

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MHPS



Agenda

- MHPS Overview
- Challenge
- Organization Development
- Implementation
- Further Harmonization within the RMC
- Future Growth and Plans
- Questions and Takeaways

About Mitsubishi Hitachi Power Systems

- MHPS is an industry leader in power generation technology including Advanced Class Gas Turbine.
- The MHPS Remote Monitoring Center (RMC) is using the PI System to monitor its customers' power generation assets around the world.
- Connectivity is tailored for the specific requirements of the customer. The RMC monitors OEM and non-OEM equipment across turbine classes.
- MHPS is currently expanding to Total Plant Monitoring and improving process efficiency through automation is a strong focus.





Operations Overview

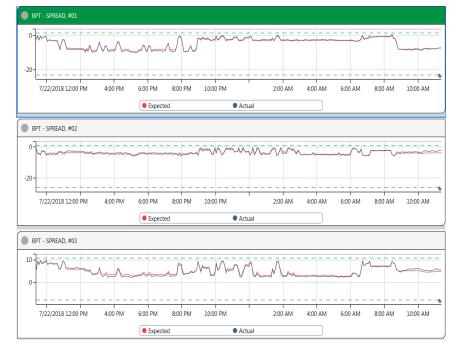
- 24-Hour OEM Support
- Real-Time Monitoring and Analysis with OSISoft PI
- Lessons-Learned Fleet Database
- Informative Operational Reports
- Alarm Management
- Web-Based Customer Portal for Remote Data Access



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Engineering Overview

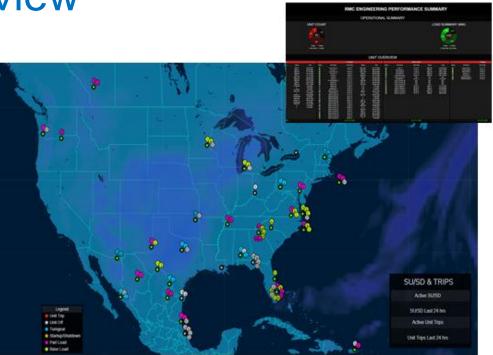
- 24-Hour OEM Engineering Support
- Predictive Analysis through Advanced
 Pattern Recognition software linked to
 OSISoft PI
- Performance & Reliability Optimization
- Controls, Combustion Dynamics,
 Vibration, and Operational
 Engineering Support





Development Overview

- Total Plant Monitoring Initiative
- Dashboard Development
- Quarterly Report Development
- Custom Coded Tools
- Software Evaluation
- AssetFramework Buildout





Automating Journal Entries

Start-up commences Macro based excel tools uses PI Datalink, and calls data from Sharepoint

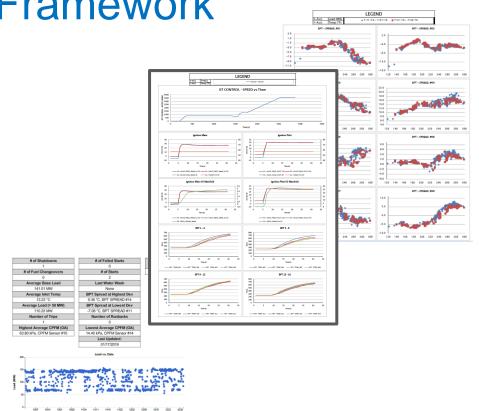
Userform Data pushed to Sharepoint, with a click of a button



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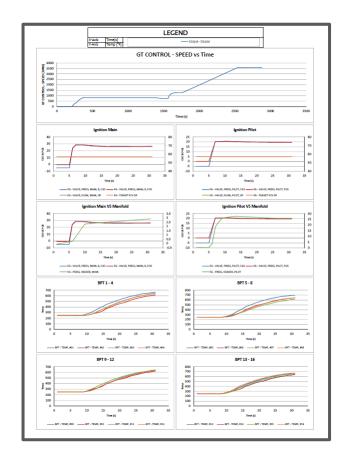
Conversion to AssetFramework

- With the addition of AssetFramework and the subsequent utilization with the RMC of that structure, the majority of our macro based tools were modified to use our AF Fleet structure.
- Custom tools that are built for RMC troubleshooting as well and tools that are created for other MHPS based groups reference this structure.



Pulling PI Data

- The startup comparison is an in house custom coded tool that uses Sharepoint information, and PI Datalink to review the profiles of start-ups.
- The RMC uses the tool to watch for degradation of components and to assist in the troubleshooting of failed starts.
- A portion of this tool automates the journal entries created by the operators.





Pulling PI Data

Project - VBAProject	X (General)
	nCol = TagRng.Count
	wsa.Range("d7").Value = nCol
🗄 🍇 atpvbaen.xls (ATPVBAEN.XLAM)	On Error GoTo ErrHandler1:
🗄 😻 Solver (SOLVER.XLAM)	
🗄 😻 VBAProject (FLEETAOH.xlsm)	Advabbing PI Data using the small commands and pushing it into a 9m2 appay
B & VBAProject (FUNCRES.XLAM)	This grabs PIArray with datetime stamp with the first tag the 1 before server string means show timestamp
E 😸 VBAProject (StartUpSSAuto.xlsb)	'TagRng(1) means you are taking the only the first item from the tag range
Microsoft Excel Objects	PIArr = Application.Run("PISampDat", TagRng(1), stime, etime, inter, 1, AFwsa)
🕀 🧰 Forms	asa.Range("dll:e" & UBound(PIArr) + 10) = PIArr
😑 📇 Modules	ssa.Range("d5") = UBound(PIArr) Erri releaite
- 🚜 All_Run	240 For $M = 2$ To nCol
- 🕰 Alt_Run_All	ErrNumber 2 = 0
- 🚓 Arrange_Charts	ntags = TagRng.Count
Calculations	If TagRng (M) <> 0 Then
- 🖧 Chart_Compare	
Data_Add	On Error GoTo ErrHandler2:
- 🕰 Filter	PIArr2 = Application.Run("PISampDat", TagRng(M), stime, etime, inter, 0, AFwsa)
- 🖧 Journal_Lookup	<pre>wsa.Range(wsa.Cells(SR, M + SC), wsa.Cells(UBound(PIArr2) + SR - 1, M + 4)) = PIArr2</pre>
	End If FrrHandler2End:
- 🚜 Module2	330 Next
- 🖧 Overall_BPT	Next Side Next
Overall_BPT_Swirls	INCA C
Overall_Combustor	Exit Sub
- Cooling_Steam	
- 🚓 Overall_DCT	ErrHandler1:
😪 Overall_Exhaust	
- Cverall_Fuel_Gas	If ErrNumber = 2 Then
Overall_Fuel_Gas_Vlv	Resume ErrHandler1End
Overall Fuel Oil	Else
- Coverall_Fuel_Oil_Vlv	

 Automatically pulls data using PI Datalink and references Asset Framework attributes so that it can be used across the fleet.



Referencing Asset Framework

😧 \\piaf\RMC - PI System Explorer							
File Search View Go Tools Help			•				
😫 Database 🛅 Query Date 🔍 🥥 🌍 Back 💿 🔩 🤇		🖄 Refresh 👕 New Element 🖄 New Attribute					
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FUEL GAS GENERATOR GI IGV		🎺 врто2	1156.1 °F				
		🎺 вртоз	1163.5 °F				
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Library Unit of Measure		🎺 BPT10	1158.1 °F				
🚨 Contacts	_		v				

 The tool uses the attribute name and path so that the only input the operators needs to make is the selection of the unit in which they are doing the evaluation.

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Transferring PI Data to Userform

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oject - VBAProject	X	General)	▼ DataGrab_Click_Startu
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- 🚜 Filter		Application.ScreenUpdating = False	
Legend_Creator		'Turn Calculate to Manual	
K Module1		Application.Calculation = xlCalculationManual	
Module2			
- 🖑 Overall BPT		'Clear Clipboard	
Overall_BPT_Swirls		Application.CutCopyMode = False	
Overall_Combustor			
- Overall Cooling Steam		Call unfilterall	
Overall Exhaust		Set wsDataUnit1 = Worksheets("Data Unit 1")	
Verall_Exitatist		Set wsDataUnit2 = Worksheets("Data Unit 2")	
		Set wsDataUnit3 = Worksheets("Data Unit 3")	
Overall_Fuel_Gas_Vlv		Set wsUnitInfo = Worksheets("UnitInfo")	
		Set wsTitlePage = Worksheets("Title Page")	
		wsUnitInfo.Range("Q15").Value = 2 'Cancel Code	
- 🖧 Overall_Inlet		wsUnitInfo.Range("Q16").Value = 3 '# of Units	
- 🖧 Overall_Summary		UnitNum = 3	
Overall_Valve		nCol = 108	
Overall_Vib_vs_Load		' Load DoAll Form	
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Recalculate		Do Until wsUnitInfo.Range("Q15") = 0	
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• The parameters that are required for the startup entry are read and placed into the userform automatically.

Userform

- The final product: A userform that automatically pulls the relevant PI Data via a function that uses PI Datalink, communicates with Sharepoint to pull the related unit issues, and allows for notes to be entered
- With the push of a button publishes all aggregated data to Sharepoint

Startup Parameters					
Entry Type	Start Up Summary	Start Up Conditions: Ambient = 74.0°F			
Entry_Date	12/3/2018	T1C = 79.2%			
Entry_Time	12:06	Peak BPT Ave = 1062.0°F @ 1879.4 RPM T1C @ Flame ON = 76.9°F FG Temp @ Flame ON = 115.8°F FG Supply Press @ Flame ON = 565.59 Disc Cavity Temperature: DC2 = 462.0°F DC3 = 461.3°F DC4 = 448.7°F Highest Vibrations: 1st Critical = BR2Y: @ 3.152mils @ 1175 RPM 2nd Critical = BR2Y: @ 4.493mils @ 2403 RPM			
Work Shift	Day				
Operator	OPERATOR NAME				
Unit	UNIT				
Fuel Type	Fuel Gas				
Unit Roll_Date	12/3/2018				
Unit Roll_Time	11:24	BPT's at FSNL			
Flame On_Date	12/3/2018	Actual Low = BPT #2 @ 582.32 Actual High = BPT #13 @ 694.73 Spread Low = BPT #2 @ -33.99			
Flame On_Time	11:46	Spread High = BPT #5 @ 21.17%			
FSNL_Date	12/3/2018				
FSNL_Time	12:03				
Breaker Closed_Date	12/3/2018				
Breaker Closed_Time	12:06				
Notes	Operation Notes Entered Here	<i></i>			
Issue Tracker Status	C Created C Updated C	Referenced C No Issue # Needed			
7593 DCT 7146 BPT 9 5380 (A-CI 5354 CPFN 5156 Main	¹⁴ Erratic Behavior #2 RS Erratic (Bad Quality Indication Bread #05 Alarn HL. FO Operation PFM) Pressure Sensor Abnormal Low 1 PS#4 ABN LOW SENSTIVITY A PCV Deviation Shutdown/Startup H 1A, 1B, 2A, 2B erratic activity, bad in	Sensitivity #12			
	1				



Pushing data back to Sharepoint

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roject - VBAProject 🗙	CommandButton3					
	<pre>Dim list As String Dim UnitId As String Dim UserId As Double Dim JSON As String Dim nodeList As MSXML2.IXMLDOMNodeList Dim entryType As String Dim nodeList1 As MSXML2.IXMLDOMNodeList If InStr(TextBox1.Text, Chr(34)) <= 0 And InStr(TextBox1.Text, Chr(39)) <= 0 Then entryType = ComboBox1.Value list = "/Journal" server = "https://rmc.mhpowersystems.com/rmcteam/crm/_vti_bin/listdata.svc" & list Set objXML = CreateObject("MSXML2.DOMDocument") If entryType = "Start Up Summary" Then userLookup = "https://rmc.mhpowersystems.com/rmcteam/crm/_vti_bin/listdata.svc/Ur Set objHTTP = CreateObject("MSXML2.ServerXMLHTTP.6.0") objHTTP.Open "GET", unitLookup, False, "MPSA\rmcsvc", "DOnOtaccess!" objHTTP.send (sendJson) objXML.LoadXML (objHTTP.responseText) Set nodeList = objXML.getElementsByTagName("d:Id") UnitId = nodeList.Item(0).Text objHTTP.send(sendJson) objHTTP.send(sendJson)</pre>					

 JSON is used to transmit the structured data to the Sharepoint site.

Improving Journal Entry Efficiency

List Tools Items List									
Version History	Attach File	Alert Me •	Workflows Approve/Reject	I Like Tags & Notes					
Manage	Actions	Share & Track	Workflows	Tags and Notes					
3/21/2019 15:17 D	Jay	_			Count= 780 Gas Turbine	501G1	Start Up Summary	8051; 7748;	WC28 generated a Vibration No.2Y Bearing High alarr during the start-up sequence as a result of the following peak value exceeding the 5.0 Mils alarm setpoint:
								BRG 2Y = 6.406 Mils \oplus 1170 RPM Bearings 2X and 3Y continues to display "Bad" Indication.	
									Disc Cavity Temperatures #02(L & R) and #04DS continues to display "Bad" indication.
3/21/2019 12:07 D	Jay				Gas Turbine	M501G1	Start Up Summary	6378; 8097	DCT #02 LS continues to display erratic behavior. BMT 3A continues to show Bad Quality. BPT Spread #10 ~10F decrease, porfile shift change, BPT Spread #01 ~14F increase, possible new profile
									shift
3/21/2019 11:07 D	bay				Gas Turbine	M501G1	Start Up Summary		None
3/21/2019 10:00 N	light				Gas Turbine	M501G1	Start Up Summary	7133	DCT #02 LS continues to display a value of -300°F.
3/21/2019 9:06 Night				Gas Turbine	M501G1	Start Up Summary	7801; 8051;	WC2B generated a Vibration No.2Y Bearing High alar during the start-up sequence as a result of the following peak value exceeding the 5.0 Mils alarm setpoint:	
							0050	BRG 2Y = 6.0363 Mils @ 1167 RPM	
								Bearings 2X and 3Y continues to display "Bad" indication.	
									Disc Cavity Temperatures #02LS, #02RS and #04DS continues to display "Bad" indication.
3/21/2019 9:06 N	light				Gas Turbine	M501G1	Start Up Summary	7718	RAC LS continues to display "Bad" indication.
2/20/2010 22-24 N	llaht	_			Gae Turbloe	WSOIEC	Start Un		Due to loss of data feed, all times provided by the

- Year to date we have close to 800 starts across the fleet
- Time of manual entries for start summaries drastically dropped, and continued focus on automation is key for our ever expanding fleet

Other Integration of OSISoft PI Data



Dashboard Under Development



PIAF connection with Python

import sys
sys.path.append('C:\\Program Files
(x86)\\PIPC\\AF\\PublicAssemblies\\4.0\\'
import clr
clr.AddReference('OSIsoft.AFSDK')
from OSIsoft import AF

```
system_name = "piaf"
target_database_name = "RMC"
plants element name = "Plants"
```

```
MySystem = AF.PISystems().get_Item(system_name)
databases = MySystem.Databases
target_database = databases.get_Item(target_database_name)
plant_elements =
target_database.get_Elements().get_Item(plants_element_name).get_
Elements()
```

- The connection to PIAF with python is handled by the OSIsoft AF SDK
- The python package needed is the 'clr' package in order to add the reference to AF SDK this will allow you to import the OSIsoft AF dll as a python package inheriting all of the AF Database functionalities

Getting Information from an Element

 Once an element is accessed you can get the name of the element by using the get_Name() function

self._plant_name = self._plant_element.get_Name()

 To access all attributes in an element you can use the get_Attributes() function

self._plant_element.get_Attributes()

 To get the value of an attribute use the GetValue() function [this returns a AF Value object] then this object can use its own get_Value() function to return the raw value of the attribute

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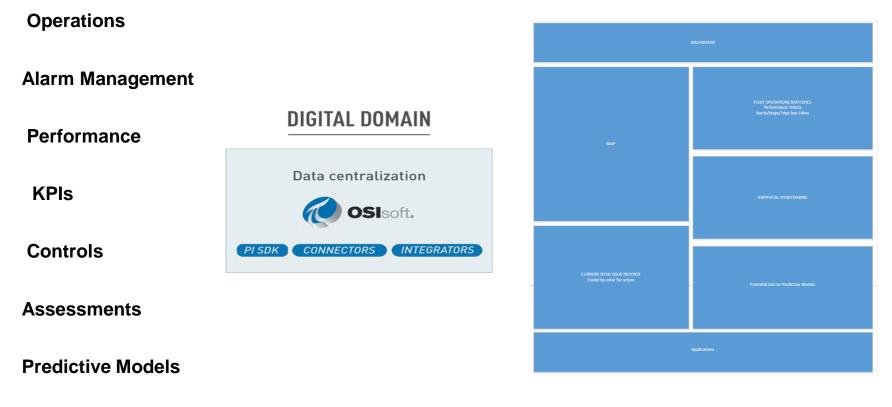
Getting Information from an Element



- Any values within a PIAF database can be accessed with the functionality noted in the previous slides.
- Once you are connected to the database, the values are all basically broken down into elements and attributes where you just need to find the relationship of child elements of a parent object until you route to the attribute that contains the value you are looking for.



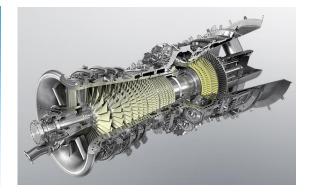
Total Plant Initiative



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Mitsubishi Hitachi Power Systems

Leveraging the PI System to Advance Troubleshooting Techniques and Process Efficiencies



CHALLENGE

Adapting to the demand of digital transformation and the optimization of the use of the data, and the exponential growth of the RMC

- Evolving Customers
- Expanding expectations to total plant and non-OEM equipment
- · Expansion of monitored fleet

SOLUTION

Use standardization of Asset Framework, and communication, to development tools to for process improvement

- Automation of startup process
 evaluation
- Automation of entry to journal
- Future Dashboard currently being used and in development

RESULTS

Reduction of journal entry time, reduction of time for evaluation of startups, improved root cause analysis

MHPS is currently expanding capabilities to offer Total Plant Monitoring and developing in house applications for troubleshooting and performance evaluation

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Contact Information



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Questions?

Please remember

Please wait for the **microphone**

State your name & company









