MHPS-TOMONI: Cloud Based Plant Data Monitoring and Analysis Platform

Presented by Hiroyasu Ishigaki
Agenda

1. MHPS-TOMONI Digital Solutions
2. MHPS-TOMONI Cloud/Edge System
3. Cyber security on MHPS-TOMONI
4. User environment and PI development
5. Red carpet incubation program
6. Conclusion
Part 1
MHPS-TOMONI Digital Solutions
1-1. Our Background

MHPS At a glance

Power plant equipment OEM / EPC contractor

The Prove of Engineering Excellence

- 2,000+ patents
- Over a century of experience in turbines & Boilers.
- 20,000+ staffs
- 120+ years of solid background
- Headoffices in 17 countries with 48 group companies
- 1,000 Gas turbines,
  2,600 Steam turbines
  5,600 Boilers made
- 2,000+ patents
1-2. MHPS-TOMONI : The Concept

TOMONI means “Together” in Japanese. It represents MHPS’s bold move to revolutionize ICT solution for thermal power industries, together with our customers.

We aim at transforming businesses and leading digitalized industries with advanced technologies, decades of O&M knowhow and profound plant knowledge.

Through partnership, we ensure customer satisfaction with strategic development to expand mutual benefits in a sustainable way.
1-3. MHPS-TOMONI : Roadmap

Autonomous Operation

Advanced O&M

O&M Support

Monitoring

- Autonomous Operation
- Advanced O&M
- O&M Support
- Monitoring

- Optimize the overall fleet portfolio
- Remote Operation
- Optimized Performance
- Extended Outage Intervals
- Shorter Outages
- Higher Reliability

EMS (Energy Management System)

- Big Data analytics
- Energy supply
- Demand forecast optimization
- Advanced control

- Advanced Remote Monitoring
- Automated Boiler Combustion Tuning
- Global Service Center (Philippines)
- Remote monitoring and O&M support
- Predictive Analytics by diagnostics of motor current

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1-4. MHPS Remote Monitoring Center

Our Remote Monitoring Centers are first step for MHPS ICT solutions

Takasago RMC (Japan) 1999-

Orlando RMC (USA) 2001-

Alabang RMC (Philippine) 2016-
1-5. Strong relationships for MHPS-TOMONI

We have selected best in class technologies

MHPS ICT uses common platform for greater flexibility and security

Collaboration with customers identify new ways to solve problems
Part 2
MHPS-TOMONI Cloud/Edge System
2-1. MHPS-TOMONI System overview

MHPS Digital Solutions

TOMONI

SecureGW

PI I/F

Netmation

SecureGW

HTTPS I/F

Netmation

IP-VPN

Internet

VPN

Microsoft Azure

MS data center

KPI monitor

AI tools

Analytics

Optimization

Cloud simulator

Customer

PI to PI

Web access

Customer

Remote access

Data sharing

SharePoint

IoT suite

XenApp

Web Server

MHPS Orlando PI System

Philippine GSC

MHPS-E

MHPS Japan

Web Server

HTTPS I/F

MHPS Orlando PI System

Philippine GSC

MHPS-E

MHPS Japan

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Netmation
2-2. MHPS-TOMONI Cloud System in detail

- **Plant**
  - Internet
  - Plant DMZ
  - Customer DMZ
  - Point Site DMZ

- **Customer**
  - Internet
  - Multi cloud DMZ
  - Company internal DMZ

- **RMC**
  - Internet
  - Multi cloud DMZ

- **User / Analyst**
  - Internet
  - Plant DMZ
  - XenApp Environment
    - XenApp Standard user
    - XenApp Developer
    - XenApp Administrator

- **Developer**
  - Internet
  - Plant DMZ

- **Base services**
  - Citrix Cloud
  - Automation
  - Online Management Suite
  - Azure Active Directory

- **Connection**
  - Active Directory

- **Service platform**
  - Production
  - Staging
  - Development
  - Web application

- **WAF**
  - (Application Firewall)
2-3. Edge System – data collection

Based on data volume, we have several options to transmit data to Cloud.

HTTPS on Internet: Low volume
PI OPC Interface on IP-VPN/Internet VPN: Middle volume
PI to PI Interface on IP-VPN: High volume
2-4. Edge System – plant performance enhancer

Not only collecting data, also enhancing plant performance

MHPS-TOMONI Cloud

MHPS-TOMONI Edge Enabler

Plant DCS

Power Plant

Heat rate recovery

CC efficiency
Part 3
Cyber security on MHPS-TOMONI
3-1. Cyber security on cloud

Monitor and prevention of cyber attack using advanced Azure tools

Developer
- Virtual desktop
- Multi factor authentication
  - No data/logic on local PC

Customer
- Prevent illegal login
  - Inside connect: Firewall, VPN
  - Outside connect: Firewall, VPN

Hacker
- No data/logic on local PC
- Multi factor authentication

Other cloud
- Virtual desktop
- Multi factor authentication
- Security management: ISO/IEC27017, NIST 800-53

VPN and firewalls
3-2. Various cyber security tools provided by Azure

Operations Management Suite (OMS)

Security Center

Log Analytics

To achieve high security level which we hardly obtain by ourselves on premise system with reasonable cost.
3-3. Cyber security on edge

Netmation Secure Gateway
- One way data diode equivalent secure communication with asymmetric data lines to realize flexible data access
- Secure SSL/TLS communication with server/client digital certification
Part 4
User environment and PI development
4-1. Remote application environment

Virtual desktop
Menu

Development environment
Visual Studio

PI ProcessBook

Ticket-driven Project management

Excel Data-link

Data-link

1. Remote application environment
2. Virtual desktop
3. Menu
4. Development environment
5. Visual Studio
6. PI ProcessBook
7. Ticket-driven Project management
8. Excel Data-link
4-2. Important PI system components

Calculation / Visualization

- PI Asset Framework
  Handling multiple power plants with structure/templates

- PI ProcessBook / PI DataLink
  Data visualization, easy, rich functionality

- PI Vision
  Easy, Ad-hoc, mobility visualization

- PI AF Analytics
  Various data analysis including Heat rate, equipment efficiency
4-3. Important PI system components

Data interface
- PI AF SDK / PI OLEDB IF / PI Web API
Data interface for various development environment / languages
C#, Java, R

- PI Interface
Interface with various equipment and data sources
PI to PI, PI OPC, PI UFL
4-4. Development flow for plant application

Application development is step by step.
Small start, then detail and generalizing

Idea → Datalink Excel VBA → PI AF

PI AF Analytics → C#, R

PI Process book → PI Vision

Web Application Framework
4-5. Application examples

Visualization using PI ProcessBook

- Parts life assessment
- Plant performance monitor
- Degradation analysis
- Maintenance guidance
4-5. Application example (Performance monitor)

Calculation with Asset Analytics

Visualization with PI Processbook / PI Vision

Calculation with Excel/Datalink

Store as Excel visualized report
4-6. Application examples

Visualization as Web Application

KPI monitoring

Predictive analytics with root cause analysis
4-6. Application example (Abnormality detection)

Early abnormality detection technology identifies sensors indicating abnormal values.

Example: BPT Abnormality detection

BPT fluctuation is within the threshold but MT method can detect abnormality

Abnormal signal detection

Root cause pattern matching
Part 5
Red Carpet Incubation Program
Red Carpet Incubation Program (RCIP)

A key element of RCIP is the **PI Integrator for Microsoft Azure** that automatically cleans, prepares and transmits PI System data, context and insights to the Microsoft Cloud Platform, which facilitates a rapid operationalization of IoT analytics.

https://partner.microsoft.com/en-us/case-studies/osisoft

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Red Carpet Incubation Program

The Red Carpet Incubation Program (RCIP), a comprehensive collaboration between OSIsoft and Microsoft, is designed to reduce the burden of data preparation by adding contextualization and insights from OSIsoft’s PI System to support Industry 4.0 initiatives related to using Azure-based Internet of Things (IoT) and AI solutions.

https://partner.microsoft.com/en-us/case-studies/osisoft
OSIsoft | Microsoft Red Carpet Incubation Program (RCIP)

**Discovery**
- Define use case & value proposition
- Setup system access
- Identify relevant data
- Setup IoT Analytics Workbench
- Install PI Integrator for Microsoft
- Install Cortana Intelligence

**Exploration**
- Generate hypothesis with SME
- Create data model & view
- Run experiments in Azure ML
- Analyze results
- Update hypothesis & iterate

**Operationalization**
- Store predictions in PI System
- See predictions in PI Vision
- Slice and dice data in Power BI
- Present results to stakeholders
- Train and handover

Diagram:
- **Discovery** steps:
  - Define use case & value proposition
  - Setup system access
  - Identify relevant data
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- **Exploration** steps:
  - Generate hypothesis with SME
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  - Store predictions in PI System
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  - Train and handover

Roles:
- Business Sponsor
- IT Architect
- PI Admin
- Data Scientist
- SME
- Operator
- Business User
Red Carpet Incubation Program - Result

Microsoft Azure Machine Learning
Cloud based machine learning analytics service

- PI System
- + Data Factory
- SQL Data Warehouse
- ML Studio / Create Model
- Azure Machine Learning
- Web API / Use Model
Part 6
Conclusion
6-1. Conclusion

- MHPS-TOMONI: Power Plant Digital Services
- Combining Azure cloud and PI System
- High level security
- Quick development
- Data analysis and visualization
- Advanced tool such as Azure Machine Learning

Digital Transformation with data and cloud
6-2. Future tasks

- Cyber Security on Azure PaaS / SaaS (currently using IaaS)
- Asset Analytics capability (more complex calculation, better editor)
- PI Web API performance
- Calculating and storing statistical data
- PI system / Azure integration support for customer
MHPS-TOMONI: Cloud Based Plant Data Monitoring and Analysis Platform

COMPANY and GOAL
MHPS is a power plant equipment OEM/EPC and wanted to provide best services for customers to improve power plant operation and maintenance.

CHALLENGE
How to create application/service platform which is secure and accessible from anywhere.
- World wide engineers/sales/customers
- Huge plant data
- Various requirements
- Cyber security

SOLUTION
Implement application/service platform using PI system on Azure cloud
- Asset Analytics
- PI Processbook / PI Vision
- PI AF SDK / PI Web API
- Azure tools / MS Datacenter
- Azure ML suite

RESULTS
Rapid, efficient and secure platform to provide best services for our customers
- Scalable
- Flexible
- Secure
- Accessible
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Questions

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감사합니다
Danke
Merci
谢 谢
Gracias
ありがとう
Спасибо
Obrigado