Advanced Data Analysis Environment with PI System on MHPS-TOMONI

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MHPS

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Agenda

1. MHPS-TOMONI Digital Solutions
2. Interactive Advanced Data Analysis
3. Demo
4. Conclusion

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1. MHPS-TOMONI Digital Solutions

MHPS Digital Solutions
TOMONI

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Our Background

MHPS At a glance

"Mitsubishi Heavy Industries x Hitachi"
Power plant equipment OEM / EPC contractor
The Prove of Engineering Excellence

20,000+ staffs

Over a century of experience in turbines & Boilers.

120+ years of solid background

1,000 Gas turbines,
2,600 Steam turbines
5,600 Boilers made

Headoffices in 17 countries with 48 group companies

2,000+ patents

- Service branches
- Remote Monitoring Centers
- Manufacturing sites

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MHPS-TOMONI™

MHPS Digital Solutions
TOMONI

A suite of digital solutions driven by user needs fueled by data analytics to make power plants digital.

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MHPS-TOMONI™

Bring in software experts to provide the best solution based on customer needs and priorities.

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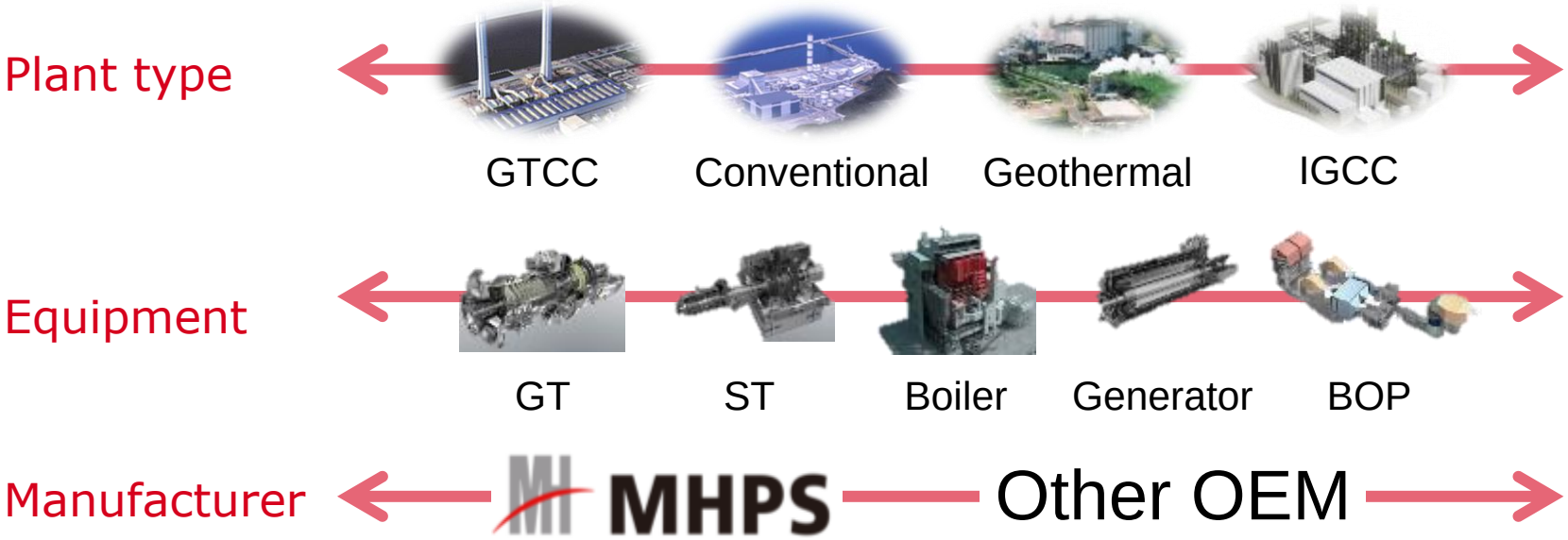
MHPS-TOMONI™ Scope and Deployment

MHPS-TOMONI™ covers the entire thermal power plant, regardless of fuel and original equipment manufacturer, and is being steadily deployed around the world.



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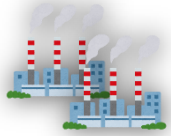
MHPS-TOMONI : Roadmap

Autonomous Operation



Advanced O&M

O&M Support

Monitoring

Higher Reliability

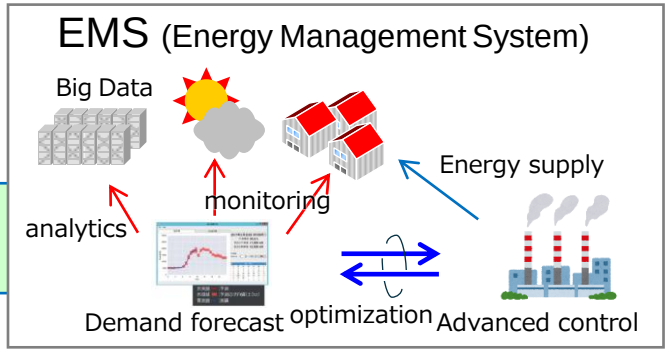
Shorter Outages

Extended Outage Intervals

Optimized Performance

Remote Operation

Optimize the overall fleet portfolio



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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MHPS-TOMONI architecture

AI CPFM

Auto Vlv. tuning

Boiler AI tuning

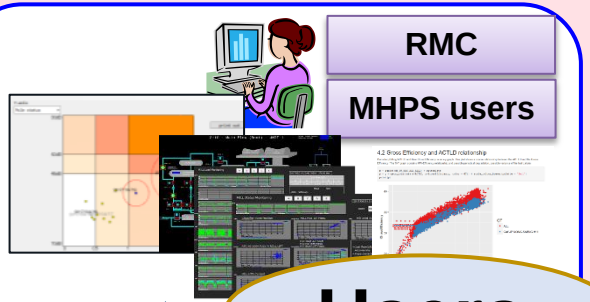
GT AI flow modulation

Edge application

SecureGW

Power plant

Edge



Users

KPI Analyst

Pre Act

Plant performance

GT parts lifetime

ST/GEN Predict.

Boiler diagnosis

Customer application

Internal application

PI System

OSIsoft.

Cloud

Microsoft Azure

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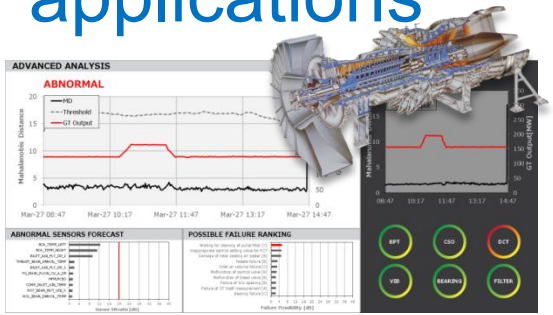
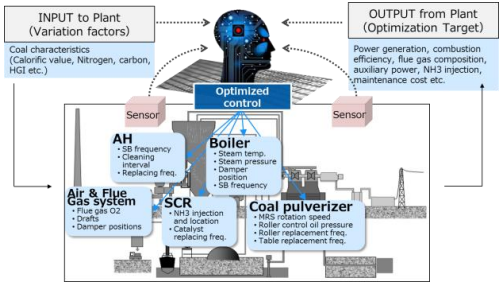
MHPS-TOMONI™ applications

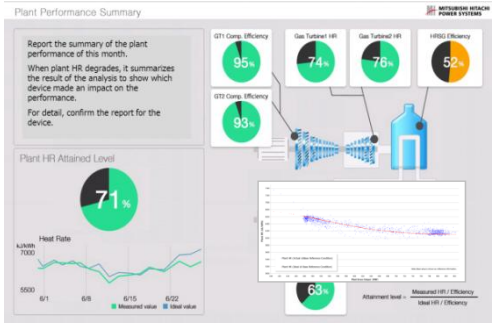
24/7 Remote monitoring center



Predictive analysis

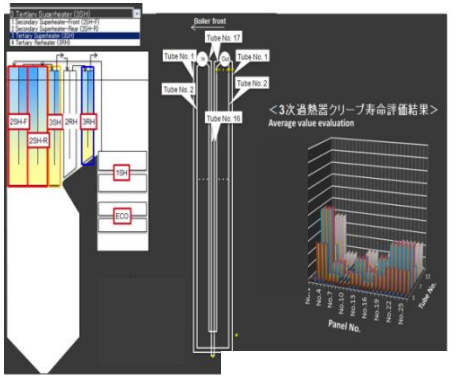


AI combustion tuning



Plant performance analysis

KPI Analyst



Boiler lifetime assessment

… and more

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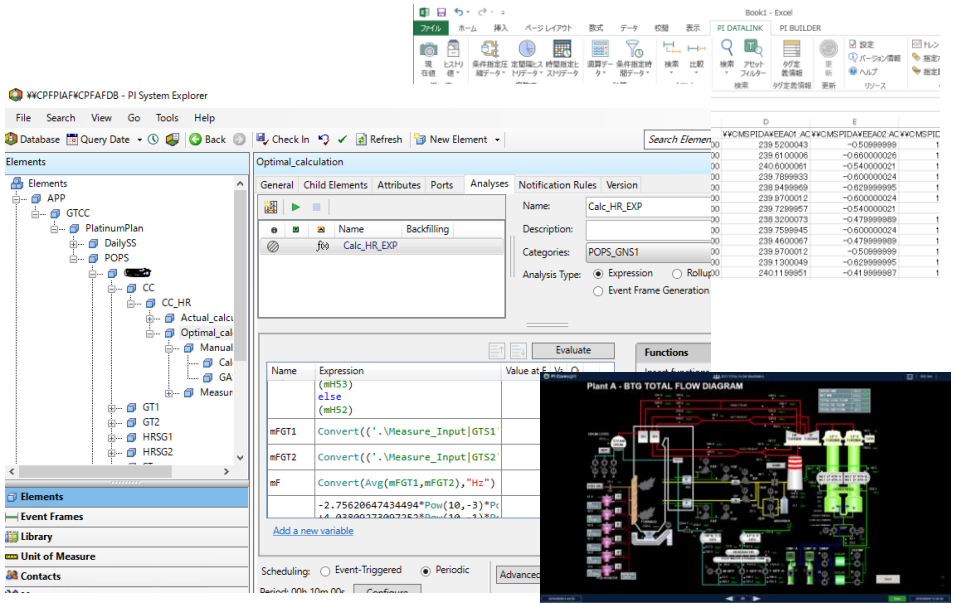
Important PI components

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



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We need more powerful tools !!

Calculation

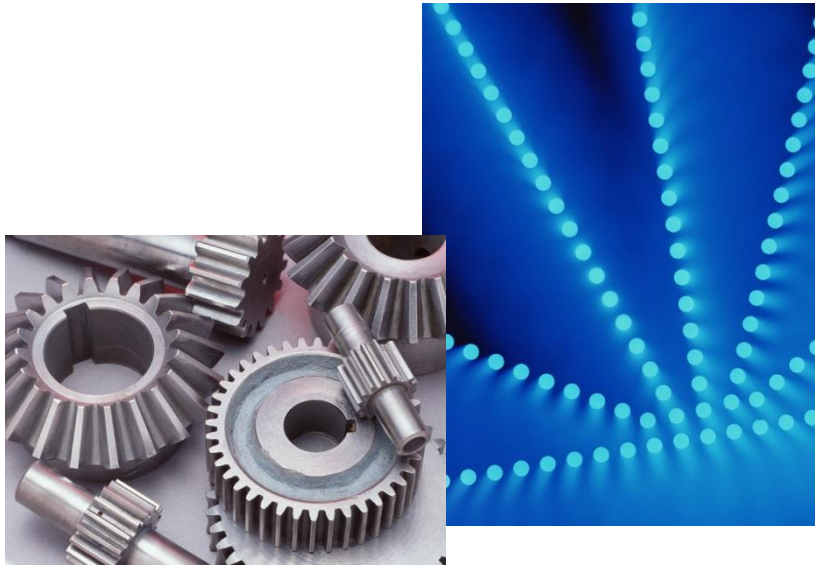
R, Python

AI/Machine learning

Visualization

Web based interactive framework

Easy to develop



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2. Interactive Advanced Data Analysis

MHPS Digital Solutions

TOMONI

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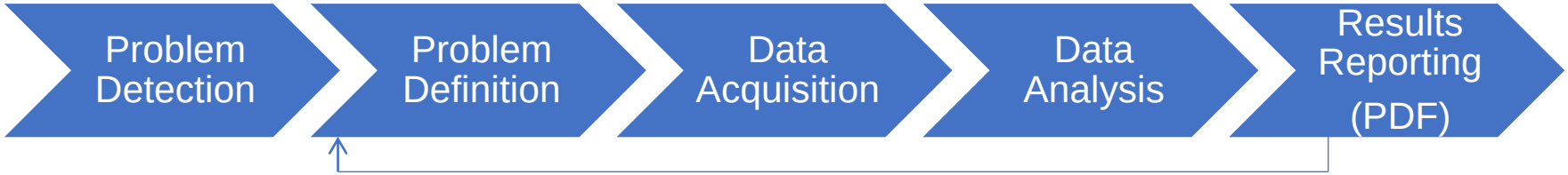
Change of Paradigm for Data Analysis Report

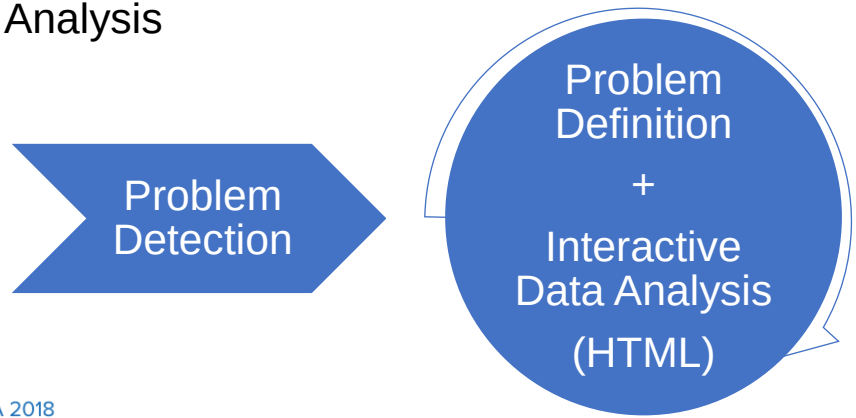
MHPS have shifted from Classical Data Analysis Report to Interactive Data Analysis.

Communication between issue owner and data scientists is improved.

Classic Data Analysis



Interactive Data Analysis



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Our Tools

Consistent PI historical data is leveraged by data analyst's tools like R and Python.

Mechanism is simple. Fast GUI implementation by short code.

Data Consistency ▶ Analyst's Tools ▶ Fast GUI implementation ▶ Interactive Analysis

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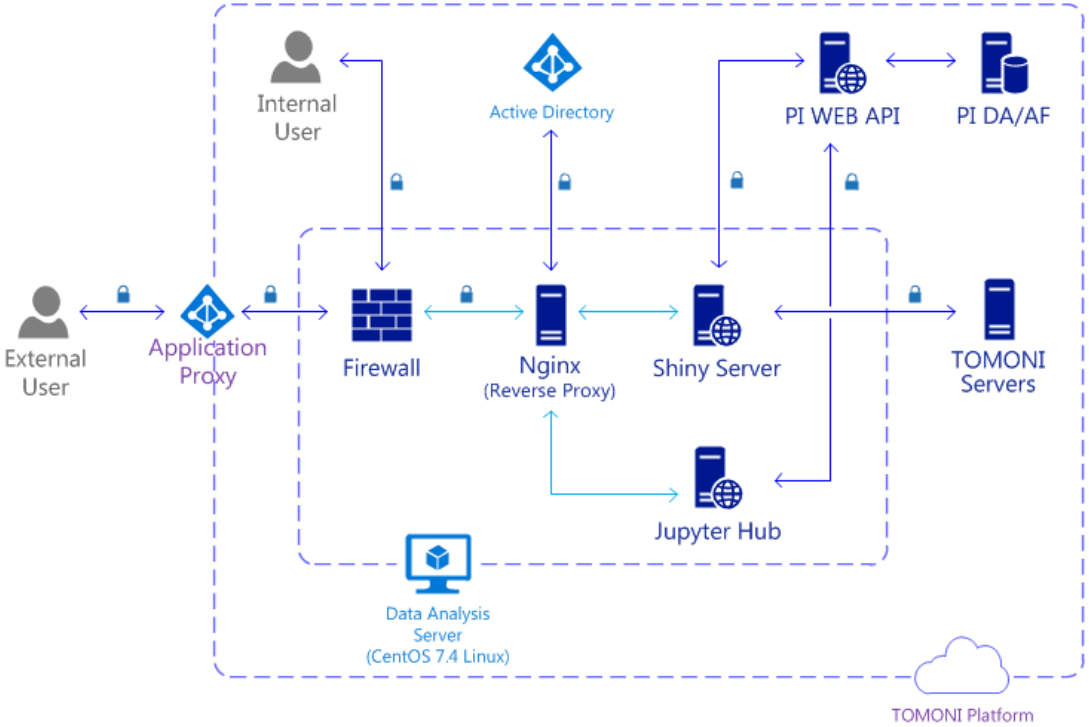
Data Analysis System Architecture

Connections between Data Analysis Server and outside servers are secured connections.

A two-factor authentication is used to control access to TOMONI & Data Analysis Server.



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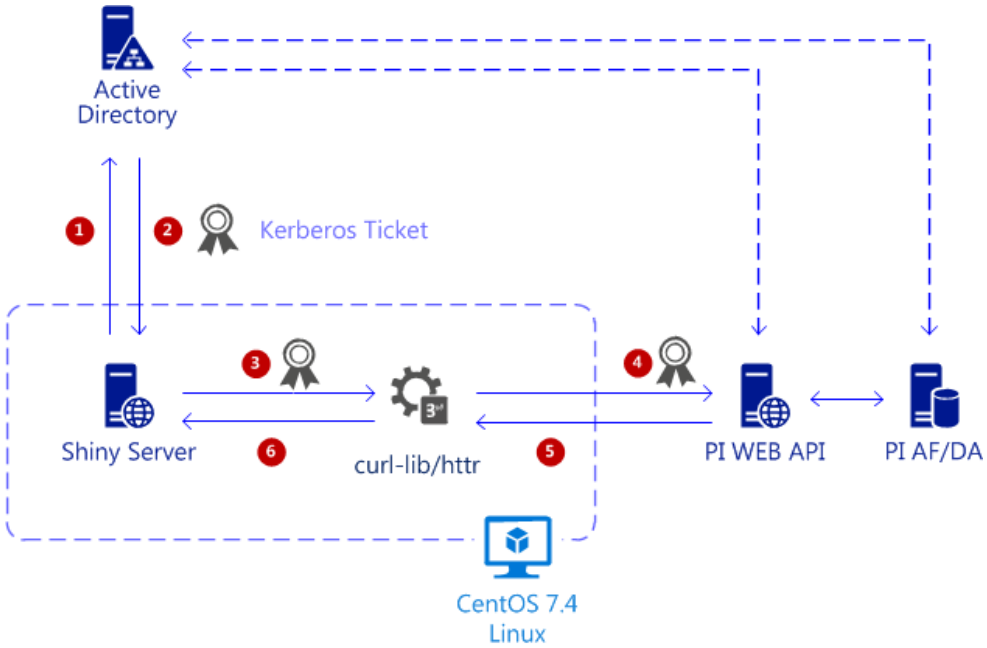
Integration between Shiny Server and PI System

Shiny applications access PI data using PI Web API.

Security is hardened by using Kerberos instead of plain user / password.



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Fast GUI implementation with Customized Logic - Shiny

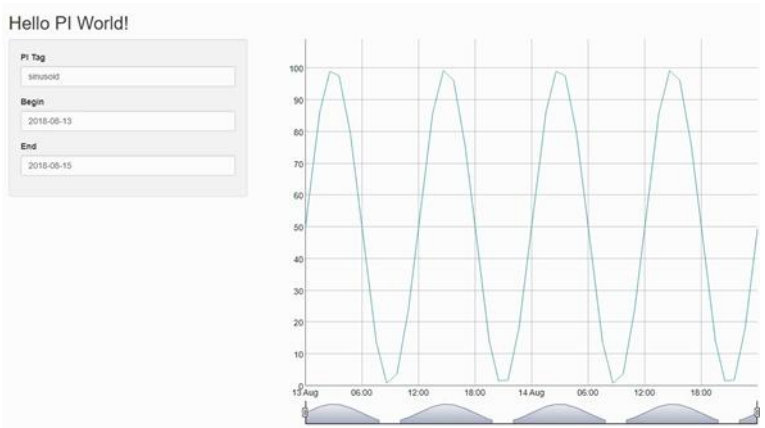
Shiny applications access PI data using PI Web API.

Security is hardened by using Kerberos instead of plain user / password.

```
library(shiny)
library(dygraphs)
library(piwebapi)
library(xts)

server <- shinyServer(
    function(input, output) {
        output$dygraphsPlot <- renderDygraph({
            ### Secured access to PI System ###
            piWebApiService <- piwebapi$new("https://piserver.diasysnetmation.com/piwebapi/",
                                            TRUE, NULL, NULL, FALSE, FALSE)
            res <- piWebApiService$data$getInterpolatedValues(paste0("pi:\\\\SERVERDA\\", input$tagId),
                                                              startTime = format(input$dateBegin),
                                                              endTime = format(input$dateEnd), interval = "60s")
            ### Type formatting ###
            res$timestamp <- as.POSIXct(res$timestamp, format="%Y-%m-%dT%H:%M:%S", tz='GMT')
            res <- xts(res, order.by = res$timestamp)
            ### Plot drawing ###
            dygraph(res[,2:2]) %>% dyOptions(includeZero = TRUE) %>% dyRangeSelector()
        })
    }
)

ui <- fluidPage(
    titlePanel("Hello PI World!"),
    sidebarLayout(
        sidebarPanel(
            textInput("tagId", label = "PI Tag", value = "sinusoid"),
            dateInput("dateBegin", label = "Begin", value = (Sys.Date() - 7)),
            dateInput("dateEnd", label = "End", value = Sys.Date())
        ),
        mainPanel(
            dygraphOutput("dygraphsPlot", width = "100%", height = "640px")
        )
    )
)
### Shiny Application Ready ###
shinyApp(ui = ui, server = server, options = list(host = "0.0.0.0"))
```



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                                                              endTime = format(input$dateEnd), interval = "60s")

            ### Type formatting ###
            res$timestamp <- as.POSIXct(res$ti
            res <- xts(res, ord
            ### Pi
```

```
piWebApiService <- piwebapi$new(
                            "https://piserver.diasysnetmation.com/piwebapi/",
                            TRUE, NULL, NULL, FALSE, FALSE)

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                   paste0("pi:\\\\SERVERDA\\", input$tagId),
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```


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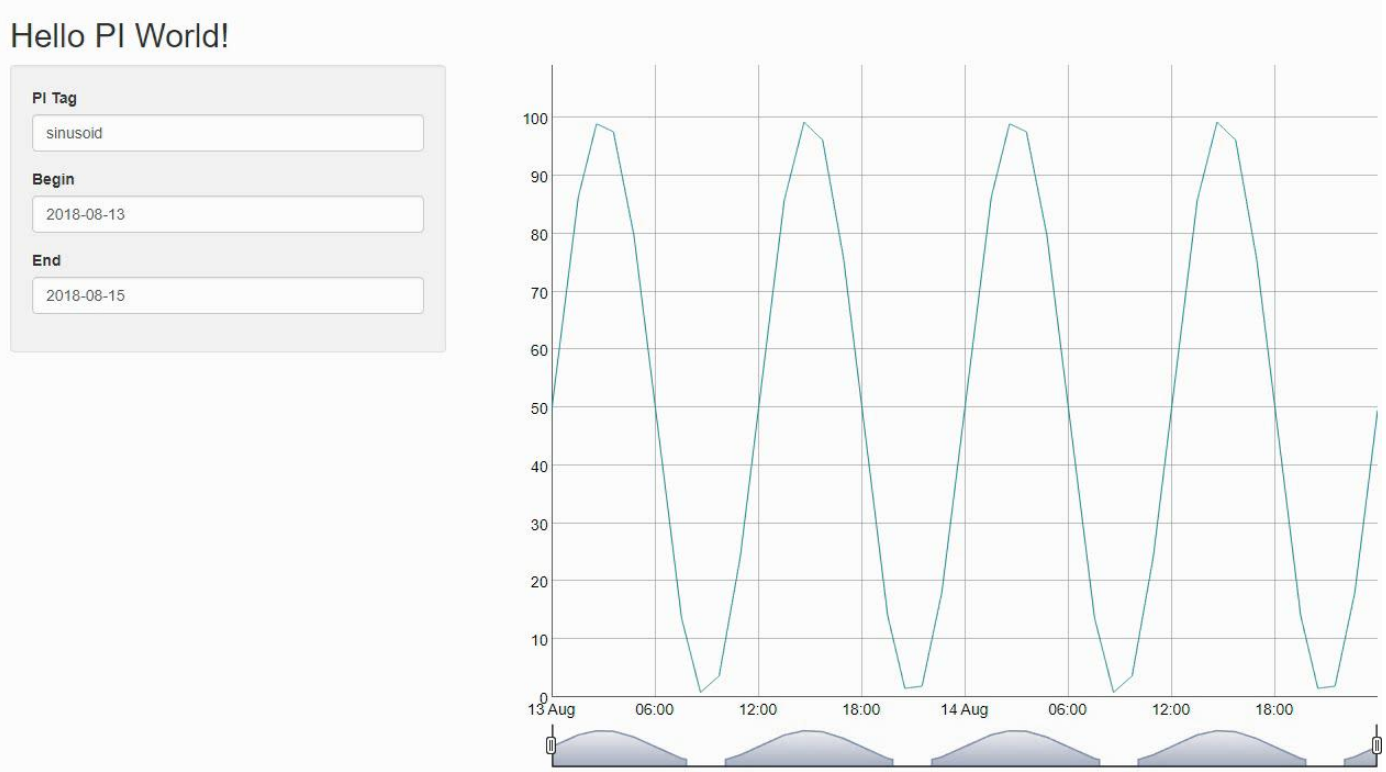
Fast GUI implementation with Customized Logic - Shiny



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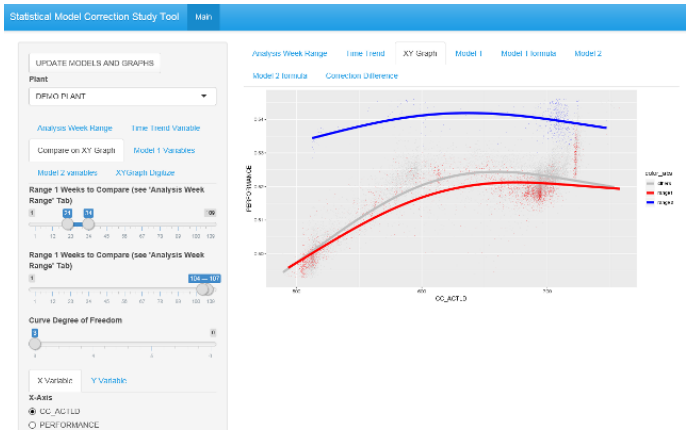
Example: Comparison of Plant Performance

The user can choose and shift the sampled data to compare plant performance between before and after upgrade event occur. Easy curve fitting and external effect removal is easy using statistic model.



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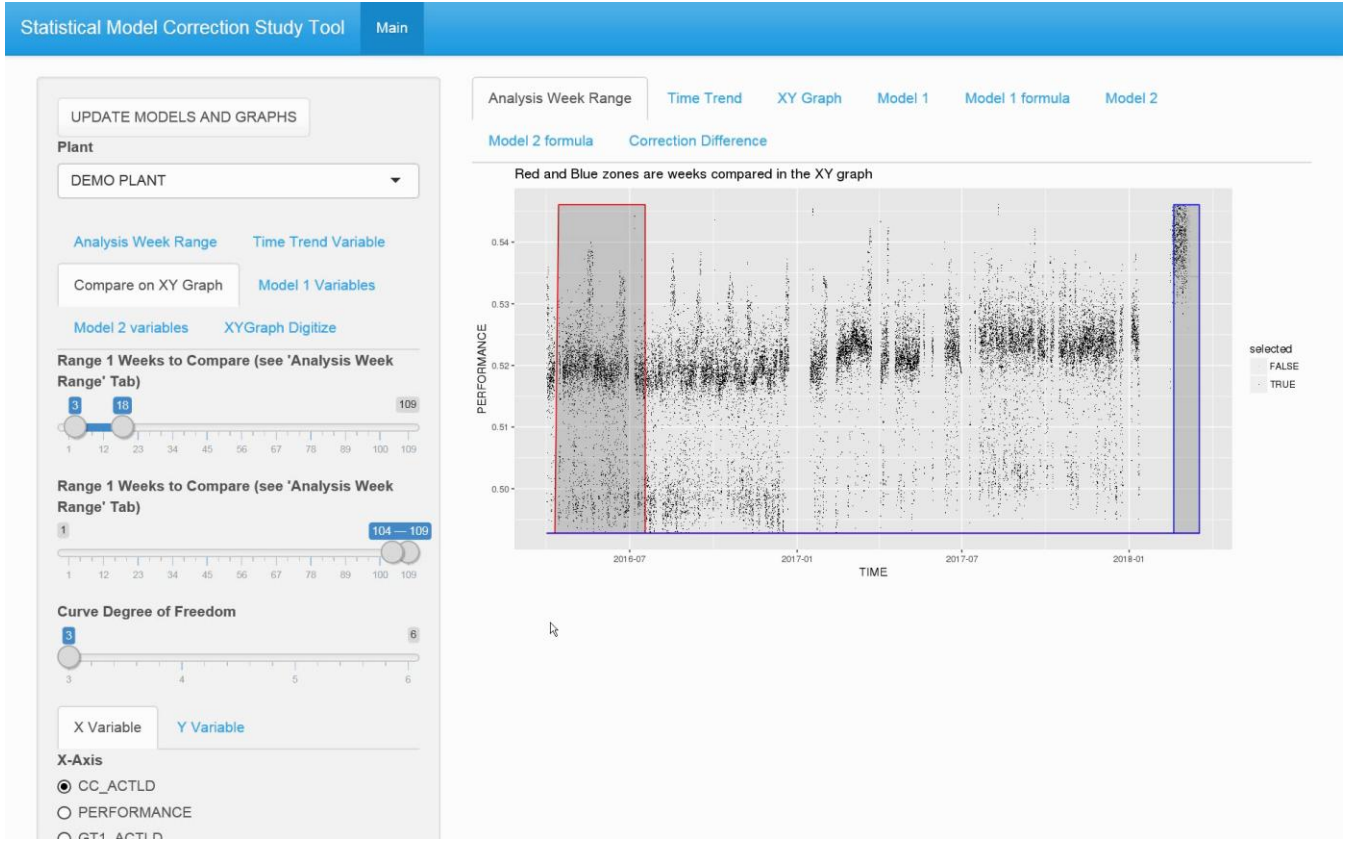
Video Demo



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In the future…

- Data analysis for all! Let's empower our engineers with data literacy!
- Continuous training to get more out of our data.

PI Web API could…

- Implement claim based authentication for PI Web API for R/Python. (Eg.: Oauth)
- Return data frames from PI Web API with adequate data types.
- Improve caching for repeated queries.

Transformation with data and cloud

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Mitsubishi Hitachi Power Systems

ADVANCED DATA ANALYSIS ENVIRONMENT WITH PI SYSTEM ON MHPS-TOMONI

CHALLENGE

Build interactive applications with advanced data analysis within a short time

- Difficult to obtain data from field
- Multiple programming languages / Multiple programmers needed

SOLUTION

Access PI System using PI Web API in R and developing web application using Shiny package

- PI System in the cloud provides real time data
- PI Web API interfaces with the programming language of your choice
- One programming language from data extraction to web application

RESULTS

Time to deploy interactive data analysis application reduced from 2 months to 2 days

- Application development needs one person instead of three (Field Engineer, Data Scientist, Web Developer)
- Improved communication between issue owner and data scientist

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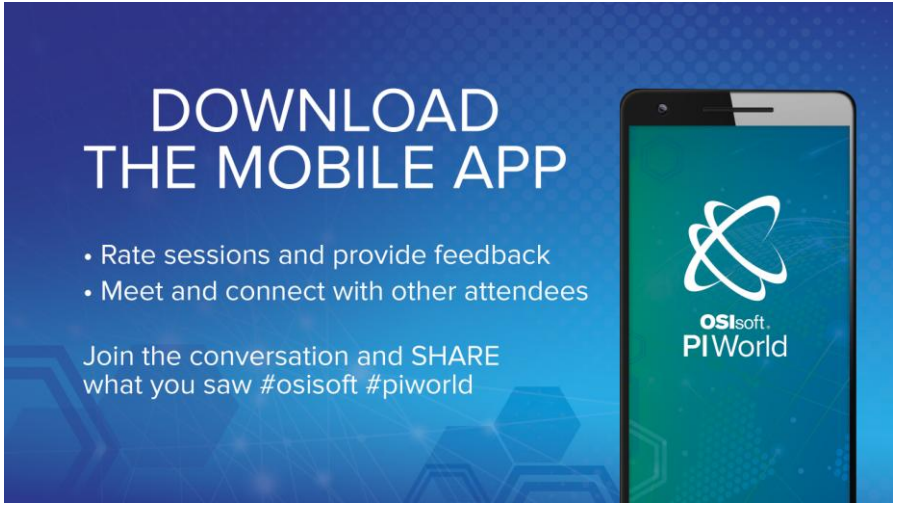
Questions?

Please wait for the **microphone**

State your **name & company**

Please rate this session in the mobile app!



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