Control Loop Monitoring and Performance Management

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Agenda

• SLOVNAFT and MOL GROUP
• Control Loop Monitoring - Theory
• Data Mining
• On-site Monitoring
• Applications and use case / How the PI System was applied?
• Implementation in the PI System
• How the challenge has been solved by using other tools
• Results and business impact
• Implementation reports
• Conclusion
MOL Group

- MOL Group is an integrated, international oil and gas company, headquartered in Budapest, Hungary
- Active in over 30 countries
- International workforce of over 25,000 people
- Track record of more than 100 years in the industry
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Actual data (2017)
- Oil processing: 5.6 mn t/a
- Key products:
  - Motor fuels: 4.4 mn t/a
  - Plastics: 406 kt /a
  - Chemicals: 118 kt /a

Employees: 2389 + 1046 (in filling stations)
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Control Loop Monitoring

- Idea is to detect degradations of control performance
- Identify and rectify the root-causes of control system problems
- Results of control problems, which can decrease the level of automation:
  - Unsafe, unstable, uneconomical manner, producing off-spec products, consuming more energy, losing profit making opportunities...
Control Loop Monitoring

• This is a continuous activity which should cover discrepancy between desired mode and actual mode (by operators).

• Based on the findings, our team is in charge of implementing changes. As we want to highlight this resolution and to take corrective actions, we need to have an on-line monitoring system.
Flow Chart

LM – Loop Monitoring
PHD – Data Source (Honeywell)
MOC – Management of Change
Data Mining

- Before starting the “Loop Monitoring” we do data mining (getting appreciated data from available sources: Asset management or controller export)
Data Mining – Input Report (PI DataLink)
On-site Monitoring

• After we prepared this input report, we went to the production and discussed the problematic loops (FALSE in previous slide) with operations.

• Based on these discussions, we categorised the findings.
# On-site Monitoring - Categories

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
<th>Current MODE</th>
<th>New NMOD</th>
<th>Condition</th>
<th>Selector</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>SATD_FC211</td>
<td>UPOŘÁDENA VODA ZO SIETE DO T26</td>
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<td>FALSE</td>
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<tr>
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<tr>
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<tr>
<td>SATD_FC239</td>
<td>BCR2 DD R1/1.2</td>
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<td>OK</td>
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<td>False</td>
</tr>
<tr>
<td>SATD_FC247</td>
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<td>False</td>
</tr>
<tr>
<td>SATD_FC273</td>
<td>Prietok pracek-vody do CB15</td>
<td>AUTO</td>
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<td>FALSE</td>
<td>False</td>
</tr>
<tr>
<td>SATD_FC281</td>
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<tr>
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<td>False</td>
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<tr>
<td>SATD_TC132</td>
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</tr>
</tbody>
</table>
Resolution of the findings

• After defining the report, we created extended reports and started the second round of this activity.

• In order to support this activity, a good online visualisation tool is necessary. We decided to use the PI System for implementation of this application.
Why the PI System has been selected?

• This system was already working in the refinery

• Good consistency of the data which we need

• We defined one source of truth

• Good development environment
Motivation for on-line monitoring

To create a tool for visibility of control related problems: operational, instrumentation, tuning etc.
Motivation for on-line monitoring

But... previous slide is the actual implemented solution and there was a very long path to come to this point.
Why we used PI AF?

• To define good structure of data (PI System Explorer)
  • Database\Application\Unit (T)\Loop (T)
• For using of specific calculations (conditions / selectors / APC)
Why we used PI AF?

• As all necessary data are based on the templates we can simply generate dashboards.
• Detail displays are “Element / Asset Relative” – only one display for all loops from selected template.
PI as a tool for implementation of CLPM

For the implementation of Control Loop Performance Management (CLPM) – Loop Monitoring application, we used the following tools:

• In the first step MS Excel and VBA – PI DataLink
• PI AF Server (for connection we are using PI System Explorer)
• PI OLEDB (which is executing the logic implemented in SQL)
• PI ProcessBook / PI Vision
• MS PowerShell
Development of the SQL Application

For generation of dashboard data (list of loops etc.) we used SQL Tables connected to PI System via PI OLEDB interface.
PI OLEDB Enterprise

PI AF Tables contain SQL scripts which have been generated and debuged in PI SQL Commander.
Automatic Refresh

We developed application for some production units as a pilot using Import Tables. Import Table cannot be set to reload data in PI System Explorer automatically. For this, we used MS PowerShell script using PI AF SDK at first.
Automatic Refresh

This script is being executed during the night and it takes about 12 minutes (for 8 production units). This is big difference in comparison to the old excel tool (developed in VBA) which took a couple of hours for same amount of loops. This script is executed on the server as a scheduled task.
Pros vs. Cons

- **Pros**
  - Fast response
  - Data availability for all users
  - Possible modifications of screens (Ad Hoc displays)
  - Template based solution
  - Possible to generate reports and export them to *.csv or *.xml, from predefined screens

- **Cons**
  - Many different tools have to be used
  - Longer time for development and debugging
  - No automatic updates of the tables (has to be started from external environment)
Implementation of findings

• Complete the implementation reports in cooperation with other departments
  • analysis of problems for non-desired modes
  • solution proposal of the first step
  • definition of criteria for individual solution

• Initialisation of assignment of a new MOC (Corrective Action) and operative orders based on common rules
Findings (Types of corrective actions)

- NewNMODE (change NMODE)
- Maintenance (trouble with instrumentation or other HW components)
- Conditions (setting and agreeing conditions for correct statistics for LM) – implemented as a calculation in PI System Explorer
- Selection (setting and agreeing selectors for correct statistics for LM) – implemented as a calculation in PI System Explorer
- Technology (the changes in the technology process)
- Cancellation (cancellation of the control loop or some of its elements)
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CONTROL LOOP MONITORING AND PERFORMANCE MANAGEMENT

**CHALLENGE**

Is to increase the level of automation on the production with a monitoring of desired mode of control loops, based on which we want to define corrective actions.

- For online monitoring we can decrease the time to make data available.
- With using other solution we consume a lot of time.

**SOLUTION**

Integration of PI Tools (PI AF, PI OLEDB, PI Vision) into one logical part which can provide in a user friendly way fast access to requested data.

- This was a cooperation between local IT and Process Information and Automation departments.
- To be aligned, we had to split the work tasks between Automation and IT.

**RESULTS**

An application which we can use to increase level of automation by identifying problems in production.

- The tool make data available in few seconds instead of hours.
- The tool should be used by production for checking the production status.
Next steps...

- Integration with whole Refinery Information System,
- Add monitoring and management of ESD functions based on IEC 61511,
- Add calculation of statistics and control quality,
- Development of full Information System of Control System with monitoring of Network, ESD and DCS, Loops, Safety Functions etc.
Next steps... (ISCS)
Speaker

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