Improving AVEVA™ PI System™ data reliability: A multi-layered approach

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What are we talking about here?

Defining some terms and setting the scope

• Context: time-series data in AVEVA PI System

• “Data reliability,” “data quality,” or “data integrity”?

Accuracy
Is the data free from errors or misinformation?

Completeness
Did we get all the data?

Timeliness
Did the data arrive on time?
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**Accuracy**
Are there bad values or out of range values?

**Completeness**
Are there data gaps or flatlines?

**Timeliness**
Did the data arrive on time?
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**Accuracy**
Are there bad values or out of range values?

**Completeness**
Are there data gaps or flatlines?

**Timeliness**
Is the data stale?
Why do we care about this topic?

Testimonials from AVEVA PI System administrators and business owners

- AVEVA PI System data feeds rollups for our corporate dashboards
- The data needs to be accurate
- AVEVA PI System is critical to monitoring our operations
- Users complain loudly when it’s stale or bad
- Our modeling applications are sensitive to bad quality data
- We need to keep AVEVA PI System data as clean as possible.
Goals & approaches

• Main goals:
  o Protect against issues that negatively impact data reliability
  o Identify and report issues as soon as possible
  o Not concerned with data cleansing or profiling

• Approaches
  o Governance and change management
  o High availability architectures
  o System monitoring
  o Monitoring of individual “tag health”
Data governance
Data quality and governance

Process and governance approaches

• Document and follow processes for changes to source systems and AVEVA PI System.

• Communication and collaboration are key.

• Data quality & governance - best practices (PI World 2019 San Francisco)

What is Data Quality?

Objective

- Accessibility
- Appropriate amount of data
- Completeness
- Concise
- Consistent
- Accuracy / Free-of-Error
- Interpretability
- Security / Auditable
- Timeliness

Subjective

- Believability
- Ease of Manipulation
- Objectivity
- Relevancy
- Reputability
- Understandability
- Unique / Value-Added


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High availability (HA) architecture
High availability

PI Interface Failover Pair

Primary PI Interface Node

Backup PI Interface Node

Identical data

Primary PI Interface Node

Backup PI Interface Node

Buffered identical data

Metadata synchronization

Secondary PI Data Archive Server

Primary PI Data Archive Server

 Archived, compressed data

Data Source

PI Data Archive Collective

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AVEVA adapter failover: On-premises

Client-side failover

Failover modes:
- Hot
- Warm
- Cold

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AVEVA adapter failover: Cloud

Client-side failover

Remote assets, sensors, & IIoT devices

Data Source

AVEVA Connect
AVEVA Data Hub
Failover Endpoint

Failover modes:
- Hot
- Warm
- Cold

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Client-side and server-side failover for AVEVA PI Server and AVEVA™ Data Hub

**Supported failover endpoints**

- AVEVA PI Server
- AVEVA Data Hub via AVEVA™ Connect

**Client and server failover modes:**
- Hot
- Warm
- Cold

**Diagram:**

- **Primary** and **Secondary** data sources are connected to **AVEVA adapters**.
- **Client failover service** is available between **Primary** and **Secondary** AVEVA adapters.
- **Client-side and server-side failover** for AVEVA PI Server and AVEVA™ Data Hub.
System monitoring
Hundreds of instances of connectors and interfaces can require around-the-clock observation.

**Problems and challenges**

- Tracking and monitoring
- Quality degradation
- Limited insight and visualization
Manage software deployments at scale with AVEVA™ Edge Management
With AVEVA Edge Management, we can now monitor
System monitoring with AF & asset analytics: PSM

AVEVA PI System status monitoring from AVEVA PI System technical adoption services

- The AVEVA PI System monitoring service offering includes AF templates to help with monitoring at several levels.
- Leverages data from Perfmon, Ping, & TCP Response Interfaces.
- Example:
  - Server and component monitoring help minimize impact of wide outages (many tags).
    - Examples: poor service health, low I/O Rate, queuing data, and network issues.
  - Watchdog tags: key tags that can help identify data source or interface issues.
    - Stale or flatline data.

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PSM: Identify & alert

Event frames

Add Context
- Reason attribute
- Annotations
- Acknowledgement
Notifications

Event: PSMR01 - Data Archive Historical Data Corrupted Archives 2021-05-07 17:54
Start Time: 5/7/2021 15:54:16 PM Coordinated Universal Time (GMT-06:00:00)
Severity: Minor

The PI Archive Subsystem has detected archive corruption. One or more historical archive files are currently corrupted. These archives need to be reprocessed to fix the issue. You can access the list of archives from PI SAFET -> Operations -> Archives. Look at the Corrupt column to know which archives are corrupted.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Value at Event Frame Start Time</th>
<th>Value at Email Send Time</th>
<th>Expected Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI Archive Subsystem_Corrupt</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Archives Count</td>
<td>1</td>
<td>0</td>
<td>0, there should not be any corrupted archives</td>
</tr>
<tr>
<td>PI Archive Subsystem_Archiving Flag</td>
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<td></td>
<td></td>
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<tr>
<td>Average Archive Write Rate</td>
<td>306.6</td>
<td>306.1</td>
<td>=&gt;0</td>
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<tr>
<td>PI Archive Subsystem_Failed Archive</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>SHF Flag</td>
<td></td>
<td></td>
<td></td>
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*Value at Event Frame Start Time can be different than Value at Email Send Time if this is a close email, or if there is a delay sending the notification email and the value has changed.

Troubleshooting steps:
- The preferred way to reprocess archives is to use the online reprocessing capability in PI SAFET. More information can be found here:
  - [Online Archives reprocessing](#)
- If the online reprocessing cannot be used then the offline archive utility (psarch) must be used.
  - Offline reprocessing [23474958]

Link to this event in PI Viewer: Event Details hyperlink

Element Path: /users/psarchive/psarchive (example) /PSCH00/PSR01/PSR01 - Data Archive

Notification Rules: Archive Corruption Alert

Notifications
PSM: Identify & alert

Event: PSRv01 - Data Archive Historical_Data_Corrupted_Archives 2021-05-07 17:54
Start Time: 5/7/2021 5:54:16 PM Coordinated Universal Time (GMT-07:00)
Severity: Minor

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<tr>
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<td>0</td>
</tr>
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<td>PI Archive Subsystem_ArhcivingFlag</td>
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<td>1</td>
<td>0</td>
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<tr>
<td>Average Archive Write Rate</td>
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<td>0.56</td>
<td>0.56</td>
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<tr>
<td>PI Archive Subsystem_FailedArchiveSnackBarFlag</td>
<td>0</td>
<td>0</td>
<td>0</td>
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Troubleshooting steps:
- The preferred way to reprocess archives is to use the online reprocessing capability in PI Suite. More information can be found here: [Online reprocessing](#).
- If the online reprocessing cannot be used then the offline archive utility (inpsrchx) must be used. [Offline reprocessing](#).

Link to this event in PI Vision: [Event Details](#).

Element Path: [Unclassified](#)
Notification Rules: Archive Corruption Alert

Reprocessing an archive

**Procedure**
1. Open PI Suite, choose Operations -> Archives. If you have drop down corrup archive rules, PI Suite prompts you to reprocess them.
PSM: Identify, alert, visualize
Tag-level monitoring
Monitoring tags with AF & asset analytics

• Extension of the PSM watchdog tag methodology
• Typically used for a subset of critical tags
• Scalability considerations:
  • Load on PI Analysis Service
  • Follow Asset Analytics Best Practices for better scaling.
  • Determine practicality of Notifications and design accordingly.
• Published customer examples:
  • Monitoring Data Quality with Asset Analytics (PW2018)
  • Better Data Quality for Better Data Science with the PI System (PW2018)
Tag monitoring: Bulk reporting & analysis methodology

1. Low frequency, periodic queries of many tags
2. Output lists of tags with relevant data/context
3. Store and distribute output to AVEVA PI System admins/analysts
4. Consume lists with reporting/visualization tools
Bulk method: The simplest approach

Stale and bad points plug-in in PI SMT

- Run manually by system admin
- Output to CSV file
- Consume CSV with Excel
Bulk method: A more automated approach

Run script(s) on a schedule using AVEVA PI System developer technologies

Developer technologies

• Most typical: PI AF SDK
  o .NET app
  o Called from Powershell

• Older: piconfig (.bat files)

• Other possibilities:
  o Powershell Tools for the PI System
  o (sqlcmd or SQL Server) + PI SQL linked server

Scheduling options

• Windows Task Scheduler
• Other 3rd party tools
• SQL Server Agent (If using SQL Server)
Bulk method: A more automated approach

Output tag list(s)

Low frequency, periodic queries of many tags

Output lists of tags with relevant data/context

Example output options

• CSV files
• SQL tables
• PI tags for summary values
  • Example: stale tag count
Bulk method: A more automated approach

Store and distribute output to AVEVA PI System admins and/or analysts

Low frequency, periodic queries of many tags

Output lists of tags with relevant data/context

Store and distribute output

Example distribution options
- Share folder
- Notifications attachment or link
- SQL table
Bulk method: A more automated approach

Visualize and analyze the data

- Low frequency, periodic queries of many tags
- Output lists of tags with relevant data/context
- Store and distribute output
- Reporting/visualization tools

Example reporting options
- Excel
  - Filters
  - Pivot table/chart
- BI tools
  - Slice and dice on dimensions like failure type, point source, interface machine name, etc.
- AVEVA™ PI Vision™ dashboards
  - Summary values written to PI points
  - AF elements
Bulk Method: Reporting

Simple example in Excel with pivot table and chart
To Summarize

• Presented methods to help increase AVEVA PI System data reliability
• Suggested approaches:
  
  **Better governance and change management**

  **Use of high availability architectures**

  **System-level monitoring**

  **Tag-level monitoring**
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Questions?

Please wait for the microphone.
State your name and company.

Please remember to...

Navigate to this session in the mobile app to complete the survey.

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