Tracking Safety Instrumented System Performance with Process Data

Safety Lifecycle Manager

Conformance to IEC61511

MANGAN Software Solutions

Tracking Safety Instrumented System Performance with Process Data

SLM® Safety Lifecycle Manager

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1 Abstract

By leveraging the power of real-world device event data and incorporating that data into a Safety Instrumented System (SIS) Safety Lifecycle Management (SLM) software, plant operations and maintenance teams can gain powerful insights into the performance of their Safety Instrumented Systems (SISs) while responding quickly to maintenance issues. Integration between the systems automates the manual processes of gathering critical data surrounding SISs and simplifies the data exchange surrounding test frequencies, test results, spurious trips, automated event tracking, and overall plant safety. There are many means of accessing and reporting on this real-world and even real-time data. If the SLM software has integration capabilities with open interfaces and flexibility, users can quickly define and integrate this time-series data stream into Key Performance Indicators (KPIs), report views, test events, and notifications. This complete end-to-end integration of data allows you to gain a more complete picture of how to maintain and operate a safer and more efficient plant.

2 Performance Data Collection

SLM software is capable of providing its users high value data on the performance of plant protective systems through an Operate-Maintain Module. Operate-Maintain is capable of reporting on key performance indicators such as:

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- Testing records and management of testing due dates
- Evaluation of Device performance over time to provide a powerful prior use basis and allow the user to incorporate actual Device failure rate data into Probability of Failure on Demand calculations. This can allow testing intervals for Protective Functions such as Safety Instrumented Systems (SIFs) to be extended beyond the intervals that may have been established based upon public or semi-public data
- Assessment of the overall performance of Protective Functions including evaluation of Demand Rates and Failure Rates versus those assumed in the Safety Requirements Specifications (SRS). This can lead to early identification of Protective Functions that have excessive demands placed upon them and allow for identification of the causes
- Bypasses of Protective Functions can be monitored over time to identify Functions that are being bypassed more than they should be or remain in Bypass for extended periods of time.
- KPIs can be automatically and continuously generated and presented to Site Operations, Maintenance and Process Safety Personnel with little effort to obtain the data.

Realization of these benefits requires that performance data for Protective Functions and Devices used to implement those functions be entered into the SLM software promptly and routinely.

This is often a significant obstacle as there are diverse personnel involved in capturing and entering the Event data for such things as Demands, Failures, Bypasses, etc. and getting a complete picture can be organizationally challenging.

One method of addressing the problem of getting reliable manual Event data entry is to maximize the amount of data that can be collected automatically. In modern Process Control Systems and SISs this can be handled effectively through standard processes that are available with these systems. This involves making the Event data available to Process Historians where it can be readily collected and recorded by the SLM software.

At the SIS level, detection of Events of interest should be programmed into the SIS and made available to the Basic Process Controls Systems (BPCS) and Historians. This includes programming to identify common Events such as:

- Demands upon the SIFs and other auxiliary functions generated by the SIS logic
- Capture of the source of Demands, whether from a Process demand (e.g. a Low Flow) or a Manual Demand such as a shutdown button
- Feedback and monitoring of final device command vs. state and capturing Events where a final element may not have responded as expected
- Monitoring of Inputs and generating status data for Events such as Device Failures, Deviations in voting inputs, etc.
- Identification of when Inputs or Outputs associated with Protective Functions have been Bypassed or Overridden

3 The Value of Reliable Event Data

When the detection of the above types of Events are programmed into a SIS or BPCS, the Status or Alarm tags can be built into the BPCS displays available to the Operators and also made available to Process Historians.

Typically, Cyber Security considerations make direct access to BPCS data by an outside application unacceptable. However, most modern control system implementations include a data historian that accesses Process data in a secure manner and also has Business Network facing functionality that allows for many users at the Business Network level to access the data.

The following sections of this paper identify methods to make Event Data available to the SLM software so the Events can be automatically captured in the Operate-Maintain Event Records and be used to evaluate and report on Protective Function and individual Device performance and KPIs. The net result is a vastly improved management of Protective Systems for Process Safety, faster identification and resolution of performance problems with resulting improvements in Protective Safety Function Reliability, and reduction in costs associated with testing, maintenance and false trips.

4 Process Data Integration

Real-world data can be represented in many forms. This can be from a variety of sources including proprietary DCS Data protocols and Data Bus communications. The majority of these systems conform to a common language and protocol stack called OPC. OPC today comes in 2 varieties, OPC Classic which exposes individual services for Data Access (DA), Alarms & Events (AE), and Historical Data Access (HDA). The second is a modern implementation that provides these same data services within a single interconnected and secure protocol called OPC Universal Architecture (UA). It is on this standard OPC UA that the SLM software integrates with real-world data streams.

The SLM software connects to OPC UA systems using an intermediate application service; we can call it the SLM OPC UA Service for this white paper. This service can reside on a dedicated OPC Server, the SLM software Data Server, or a Separate Server acting as a DMZ or data Gateway. This service maintains a local configuration of OPC UA Servers, scheduled and subscription events, and Tag/IO Address points that are being monitored.

The SLM OPC UA Service is initiated based on either a defined subscribed event (Expression of a Tag Value evaluates to True) or a defined scheduled interval reached (Once a Day, Every Hour, Every Minute, etc.). The SLM OPC UA Service collects the defined tag values when initiated and transfers them to the SLM OPC Data Staging Tables for analysis.

From these Staging tables a SLM OPC Import Adapter is configured to analyze, manipulate, and/or aggregate the data for analytics or import into SLM Object Events. This configuration can apply data rules and manipulation of data using SLM Application Scripting or data can be preprocessed at the application database level using Stored Procedures, views, and transforms.

5 Data Analysis and Reporting

Real-world data analysis and reporting can encompass many areas of the safety lifecycle. These areas include a wide range of safety and safety related functions that may be tracked within a SLM software tool:

- Alarm Events
- Spurious Trips
- Maintenance Events

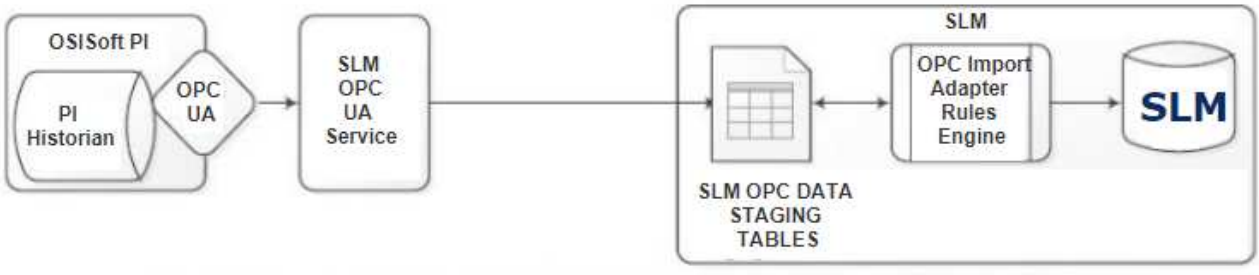

Figure 1: Integration Example of OSISoft PI to SLM using OPC HDA Service

- Maintenance Events
- Test Events
- Demand Events
- Discreet Command or Function Failures

Data collected is first organized and in some cases cataloged, using aggregate data stores. This allows for a roll-up of data, which can be easily reported and used within calculations. These catalogs and aggregate data stores are built as part of an Import Adapter configuration within the SLM software.

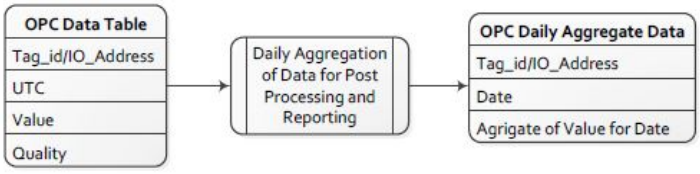

Figure 2: Example Using Daily Aggregation Tasks to Allow for Post Processing and Reporting

With this organized data the SLM software can leverage internal links within the data to provide reporting and analysis overlays as well as notifications of events. Examples of this are leveraging real-world events such as overlaying the total number of trips correlated with the number of test or maintenance reported trips for a given facility or for a specific device. This can provide a very simple way of understanding test intervals and instrumentation Proven in Use statistics.

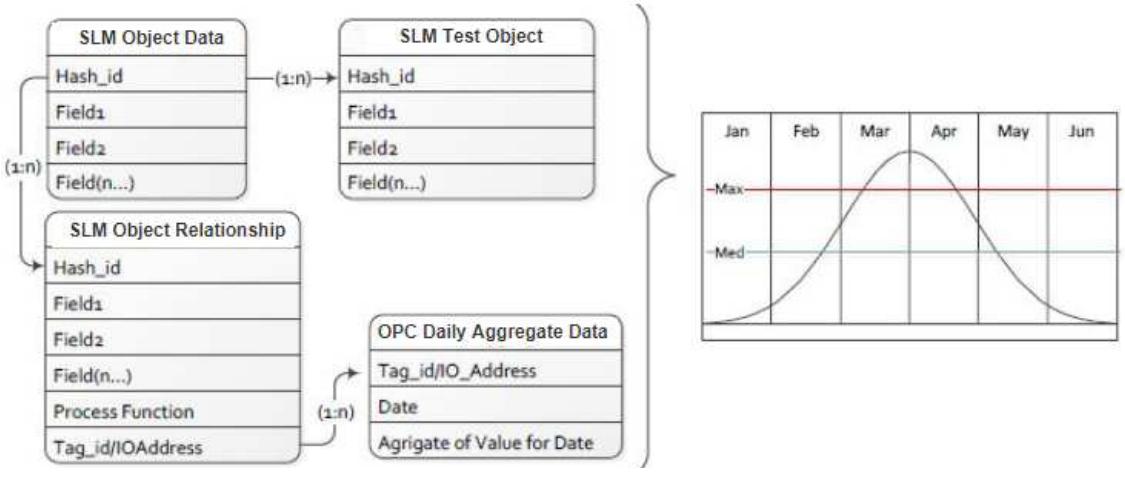

Figure 3: Example Combining Aggregate Data and Test Object Data to Deliver Analytics

6 Conclusion

SLM software can leverage real-world plant data to augment manual data entry processes, with automated event identification and analytics to assist in safety performance identification across the entire plant. Incorporating this level of data and near real-time data streams is made simpler using a SLM software with a flexible open architecture and Import Adapter modules, and can lead to a safer and more efficient plant.

***JEREMY LUCAS**: As Chief Technical Officer for Mangan Software Solutions (MSS), Jeremy Lucas is responsible for leading the architecture, design, development and data intelligence teams, as well as, promoting MSS through technical evangelism and consultancy. Jeremy has been leading teams developing software and system architectures in the Oil & Gas and Life Science Industries for the past 25 years. Prior to his current role at MSS, Jeremy spent 15 years providing innovation and technology solutions that helped drive efficiency and cost savings to Mangan Inc.'s clients and industry portfolio.*