Success Story

Improved Efficiency and More Reliable Operations through the Use of Machine Learning Technology to Conduct Alarm Behavior and Alarm Action Analysis

BASF SE

Location: **Ludwigshafen am Rhein, Germany**
Completion: **November 2021**
Industry: **Specialty & Fine Chemical**

Executive Summary

BASF SE is a multinational company and one of the largest chemical producers. From its headquarters in Ludwigshafen, Germany, BASF oversees operations at subsidiaries and joint ventures in more than 80 countries and operates 6 integrated production sites and 390 other production sites in Europe, Asia, Australia, the Americas, and Africa. The company supplies products to customers in a wide variety of industries, in more than 190 countries, and its product portfolio is organized into six segments: chemicals, materials, industrial solutions, surface technologies, nutrition & care, and agricultural solutions.

The target facility selected for this project was a water treatment plant at the BASF Verbund site in Ludwigshafen. The solution that Yokogawa provided combines Alarm Behavior Analysis (ABA) and Procedure Analysis for SOP Optimization (e-SOP) technologies that provide insights into alarms and operator actions. They exceed the capabilities of conventional methods like alarm monitoring, and support improvements that are the first step toward the achievement of an autonomous plant.

The Challenges

BASF has been seeking not only to increase efficiency by ensuring the plants are operated in the best operating range, but also to have methodologies for a transfer of know-how to compensate the retirement of skilled plant personnel.

One of the customer's major expectations for this project was a correlation between the occurrence of an alarm and alarms that follow it (consequent alarms). Especially for new less experienced operators the analysis of consequent alarms allows a fast and deep understanding of the alarms and the process and helps the operator to perform the correct operator action.

BASF became interested in this solution by hearing about a case study that used this technology to improve plant efficiency.

To address BASF's challenges at the Ludwigshafen plant, Yokogawa took a different approach in which two solutions, ABA and e-SOP, were combined to improve manual operations in alarm behavior analysis. In the future, these two solutions that use machine learning technology to analyze DCS event logs could help BASF to realize a higher automation level and next step towards autonomous plants.

ABA overview

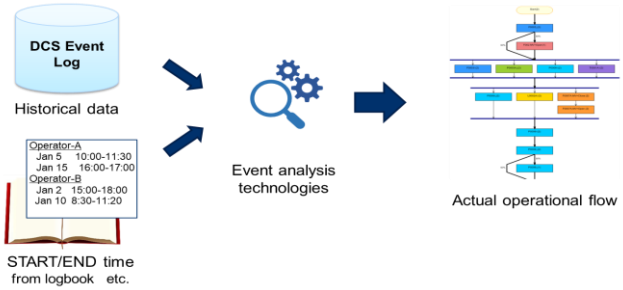
The Solutions

Through the course of this project, Yokogawa collected alarm and event log data from the DCS (Delta V).

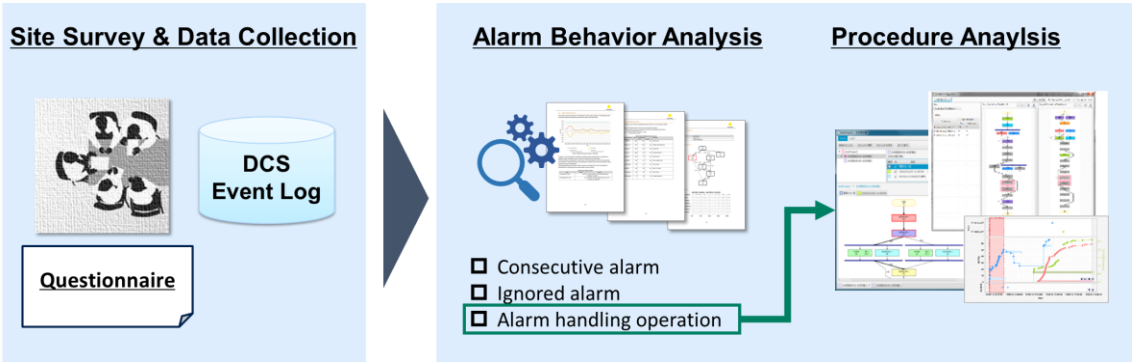
As a first step, after retrieving the DCS log data from the customer site, Yokogawa employed ABA to analyze the cause-and-effect relationship between alarms and operations (consecutive alarms, ignored alarms, alarm handling operations).

One of the characteristics of ABA is that it provides not only quantitative but also qualitative results that help to understand alarm behavior. It looks not only at how often two specific alarms occur, but also whether they are interrelated.

After the ABA analysis, Yokogawa made use of the e-SOP technology to analyze in detail all the actions (alarm handling operations) taken by operators after alarms were generated. The e-SOP solution could help to visualize DCS manual operations and identify the difference between SOP and actual operations taken by operators, also the difference in operation between different operators.



e-SOP (Procedure analysis) overview



Project overview

Customer Satisfaction

BASF was very satisfied with the results of the analysis.

The main results were as follows:

- Alarm behaviors and alarm handling operations were clearly visualized.
- The causal relationship between alarms and operations was identified and understood (something that was not possible using existing alarm monitoring tools).

This plant had been in operation for many years with experienced operators and had undergone operational improvements, and still the analysis produced further discoveries regarding options for standard operating procedures. To identify which operation is the best, we need to have another workshop with the customer. However, this finding is necessary to standardize a procedure. This insights for BASF would have been more complicated and time consuming to get with conventional methods.

Based on the findings, the alarm analysis could be improved and accelerated.

With this positive experience in mind, ABA / e-SOP has proven to be an effective tool.

Statements by staff at the BASF water treatment plant:

“An alarm monitoring tool is already available at BASF; however, the use of a cause & effect chart has been especially effective in improving this tool, allowing us to see the relationships between alarms and operator actions, which usually can be identified by an experienced colleague.”

“It has benefited me to see how alarms are connected to each other. As I only started working at BASF last year, this information has been an asset in my discussions with my more senior colleagues.”

“It has been very interesting to see the differences in the actions that individual operators take. This has been useful in helping us to improve the alarm setting and behavior which leads to a less stressed operator.”

“I’ve been working at this plant for 30 years, but I’ve learned new things and gained some helpful insights from this analysis.”

“One has to keep in mind that the cause-and-effect relation of the alarms are calculated by the timestamp of the occurring alarm. That timestamp depends on the priority-controlled processing of the controller in the DCS.”

For more Information and Contact
Alarm Behavior Analysis (ABA)
Procedure Analysis for SOP Optimization (e-SOP)

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