Improvement Leader Development Program for Driving Improvement Activities

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Improvement activities with a quick return on investment are attracting attention to increase global competitiveness. The leaders who facilitate such activities must have extensive knowledge and experience, and yet there are fewer opportunities to obtain these in modernized plants. Yokogawa has developed the Improvement Leader Development Program to train such leaders, in which participants learn about improvement methodologies and know-how through virtual on-the-job training with a dynamic simulator. This report describes the outline and objectives of the Improvement Leader Development Program.

INTRODUCTION

In recent years, safety and profitability have become ever more important in the process industry due to fierce global competition. Greater emphasis is being placed on highly efficient plant operation for reducing the increasing energy bill.

In these circumstances, improvement activities with a quicker return on investment are attracting attention. To promote these improvement activities, thorough knowledge and extensive experience are required, including identifying problems in one’s own plant, understanding the latest industry standards, acquiring improvement methodologies and learning how to make the best use of the tools provided by vendors. At present, however, due to the retirement of experienced staff and personnel reengineering, there are insufficient improvement leaders who can facilitate such improvement activities.

Yokogawa has developed the Improvement Leader Development Program to train such leaders in customers by fully utilizing our capabilities. In this program, participants can learn about improvement methodologies and know-how required as a leader not only from lectures but also through virtual on-the-job exercises using a dynamic simulator. This paper introduces the courses prepared for the Improvement Leader Development Program.

BACKGROUND

Probably the most effective way to develop an improvement leader is On-the-Job Training (OJT) through a variety of experiences. However, the development of such leaders is becoming difficult because of fewer opportunities for OJT and personnel streamlining in developed countries, and limited supply of qualified personnel in developing countries.

The increasing complexity of production processes requires improvement leaders who have not only expertise in their own area of responsibility but also thorough knowledge of the entire plant, the latest standards in the industry, and sometimes best practices in different industries. In addition, an organizational silo, which is commonly observed in plant operation today, is considered to be one of the obstacles to the development of improvement leaders.

A virtual plant on a desktop would provide not only an operator training environment but a good opportunity for OJT of operational improvements. For example, task force team members from various departments could repeatedly learn improvement methodologies using a virtual plant by getting together around a table and discussing without disturbing actual plant operations. Participants could also learn team

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Improvement Leader Development Program for Driving Improvement Activities

work through this training experience of sharing awareness about improvements, issues to be improved, and methods of implementing the improvements. Leadership on how to organize team members focusing on the issue could also be learnt. Furthermore, a workshop gives a good opportunity to meet participants from other industries as well as to learn about the latest industry standards. In addition, it is also effective for plant staff of new plants as training for their coming assignment.

Yokogawa has developed the Improvement Leader Development Program to provide best practices for solving issues and nurturing improvement leaders.

**IMPROVEMENT LEADER DEVELOPMENT PROGRAM**

The Improvement Leader Development Program (hereinafter referred to as “this program”) offers an environment in which virtual on-the-job training can be conducted at a desk using a dynamic process simulator.

This program is designed to develop an ability to solve real issues by lectures and practices using a virtual plant. First, participants learn about best practices for solving problems in a lecture with reference to a wide range of laws, regulations, guidelines, and industry standards necessary for improving operations. Next, they learn how to effectively utilize various tools, and then repeatedly and immediately implement various practices learnt into the virtual plant and confirm the results of implemented measures.

By experiencing a series of problem-solving practices, participants acquire the knowledge and confidence required for improvement leaders.

**Features**

This program is intended for participants to learn not how to use various products and tools, but to give practice on improvements based on the Six Sigma DMAIC (Define, Measure, Analyze, Improve, and Control), which is a famous quality control method. DMAIC has been developed based on the PDCA (Plan, Do, Check, Action) cycle, which is a famous Japanese quality control method. PDCA and DMAIC differ in that PDCA was developed to support individuals and bottom-up quality control activities at site, whereas DMAIC is designed for management leadership activities for identifying and removing causes of defects in manufacturing processes involved in both management and site operators. The DMAIC procedure enables sharing of awareness of the improvement throughout the plant, and improvement procedures can be standardized for every employee.

This program also offers a way to utilize tools for improvement. At first, the background and functions of tools are taught in lectures using a textbook. Then, using a sample problem, participants are asked to apply the tools to a virtual plant. Thus, participants can apply actual tools to approach their own issues.

**Training Environment**

The training environment of this program involves two PCs, one for a process simulator and another for a control system (DCS), or otherwise a single PC in which two virtual PCs are configured constituting both a process simulator and a control system. Figure 1 shows an example of the training environment.

![Virtual plant and DCS PC](image)

**Figure 1 Overview of the training environment**

The specifications of a virtual refinery plant for this training are described in Table 1 and its process flow in Figure 2. This virtual plant can dynamically simulate various operation modes such as start-up and crude switching. Thus the participants can experience the dynamic movements of plant behavior. In addition, using its mal-operation function, it can generate abnormal situations and can be utilized for verifying the design of an alarm system mentioned later.

**Table 1 Specifications of the virtual plant**

<table>
<thead>
<tr>
<th>Type and capacity of the plant</th>
<th>Abnormal events embedded in the model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Distillation Unit</td>
<td>- Pump trip</td>
</tr>
<tr>
<td>Capacity: 100,000 BPD $^*$ (680 kL/H)</td>
<td>- Control valve sticking</td>
</tr>
<tr>
<td>Crude: Light/39.3 API $^*$ (Murban)</td>
<td>- Air blower stall</td>
</tr>
<tr>
<td>Products:</td>
<td>- Heavy/30.8 API $^*$ (Gulf of Suez)</td>
</tr>
<tr>
<td>Liquefied Petroleum Gas (LPG), Whole Naphtha, Kerosene, Light Gas Oil (LGO), Heavy Gas Oil (HGO), Reduced Crude</td>
<td>- Furnace fuel gas termination</td>
</tr>
<tr>
<td>Number of Tags: 141 (42 Analog Outputs)</td>
<td>- Stripping steam termination</td>
</tr>
<tr>
<td></td>
<td>- Exapilot operation efficiency improvement package software</td>
</tr>
<tr>
<td></td>
<td>- Exaplog event analysis package software</td>
</tr>
<tr>
<td></td>
<td>- AAASuite alarm rationalization assistance package software</td>
</tr>
<tr>
<td></td>
<td>- CAMS for HIS $^*$</td>
</tr>
<tr>
<td></td>
<td>- PID tuning tool</td>
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</tbody>
</table>

$^*$1: Barrels per day

$^*$2: A unit of specific gravity of crude oil and petroleum products defined by the American Petroleum Institute
Procedural operations usually consist of both manual operations and automatic operations. The Standard Operational Procedure (SOP) is prepared for procedural operations such as starting up and shutting down equipment or a plant, switching the line-up before and after cleaning of a unit, and changing the grade of products. However, SOP is not detailed enough for actual operations and a plant is often operated based on the know-how of skilled operators. Such know-how is difficult to transfer into documents and a plant operated in a different manner by an operator. If such implicit knowledge could be transformed to explicit knowledge, procedural operations could be standardized and automated. This would make it possible not only to transfer veterans’ skills to the next generation of operators but also to improve
the safety and productivity.

Therefore, it is important how to extract key operation parameters, i.e. know-how, from skilled operators in line with the SOP and to automate the procedure as much as possible. In other words, it is vital to clarify how qualitative know-how owned by skilled operators can be transformed to quantitative contents. For example, if we can identify the limit to the increase of temperature in a chemical reaction, the procedure for raising the temperature can be automated by monitoring the reactor conditions.

In this course, participants learn, from the SOP on changing the process feed rate of the virtual plant, how to extract key operation parameters necessary for automation, how to implement them into the Exapilot operation efficiency improvement package, which is a procedural automation software package, and how to implement it into the virtual plant.

By using a simulator, the operations automated using Exapilot can be compared with those actually operated manually. This proves how Exapilot can improve the operation by minimizing upsets and/or minimizing the transition period.

- PID Loop Controllability Improvement course (Regulatory Control Stabilization)

PID controllers are an important factor for safe and stable operation. When a process or operating procedure is modified, PID controllers must be re-tuned immediately and optimally. In addition, when advanced process control (APC) is introduced for higher level of control, the regulatory level of PID controllers must be retuned to obtain the maximum effect of the APC introduction.

However, PID controllers are often left untuned even though optimum tuning is necessary. To optimally tune a PID controller, it is necessary to choose an appropriate tuning method comparing various methods and their merits and demerits.

Methods of tuning PID parameters are classified into the trial-and-error method and the modeling method that uses a dynamic model identified from operation data.

In the PID Loop Controllability Improvement course, participants learn the basic theory of each method through sample exercises, and then actually apply the tuning methodology to a loop of poor controllability (such as a temperature-to-flow cascade loop) in the virtual plant. Through those exercises, performance differences between before tuning, manual tuning and model based tuning can be identified. For model identification, a plant test to obtain a step response is carried out. However, in some cases, process noises bury a step response. Special considerations and techniques will be taught to identify the dynamic model under such conditions.

Participants can experience identifying the model and tuning PID parameters under almost the same conditions as an actual plant in a noisy environment by utilizing the simulation model.

Through these exercises, participants can learn everything from the basics of PID parameters to the best practice of selecting the optimum PID parameters including model identification of a PID loop. For identifying the model and optimizing the PID parameters, a special tuning software tool is used for convenience in plant use.

RESULTS AND EVALUATION

This program has been offered in Japan and Southeast Asian countries, and 20 customers from 10 Japanese companies and 23 customers from nine Southeast Asian companies participated in the program in the first year after it started. This program is scheduled to be deployed in other areas of the world.

Some typical feedback from participants in this program is as follows.

- “Designing the right alarm system was somewhat difficult for me, but I mostly understood it through this program. Now, I can utilize this experience for improving our plant operation.” (Mr. Masaaki Tanaka, Oita Chemical Co., Ltd.)
- “Learned the basic concept of alarm management, with a systematic approach. Course inspires us for plant improvement.” (Teijin Polycarbonate Singapore Pte Ltd, Mr. VT Suresh)

Summarizing these appraisals, it can be concluded that this program is well designed as intended.

CONCLUSION

This paper introduced the Improvement Leader Development Program that was developed to train improvement leaders by offering opportunities to acquire a variety of knowledge and experiences required for such leaders.

To achieve the VigilantPlant, operational excellence and a variety of knowledge and know-how are required. Hereafter, we will enhance the range of courses to suit customers’ needs.

REFERENCES


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