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Why Some APC Applications Lose Performance Over Time And How You Can Avoid It

Isadora S. Moreira*, Gustavo A. Neumann*
Artur T. M. Oliveira*

**Braskem S.A, Triunfo, Brazil,*
(e-mail: isadora.moreira, gustavo.neumann, artur.toledo@braskem.com)

Abstract: For a long time, companies in the Chemical Process Industry have turned to Advanced Process Control (APC) as a means to increase profitability and production capacity. Among the most widely used APC techniques is Model Predictive Control (MPC). Many service and software vendors have become knowledgeable in executing projects and delivering MPC applications throughout a diverse range of processes. The focus of this work is on what happens after project conclusion, when the project team is dismissed and the application is handed over to the customer operations.

It has been observed in practice that without proper maintenance, APC applications will tend to progressively lose their ability to capture benefits. This work will present how we developed a program aimed at sustaining the value of our APC applications. The program reflects our experience in supporting APC applications from multiple vendors installed in 11 different polymerization lines in seven different sites. It will be presented which steps were taken in building such program starting with the cause-effect analysis, where we identify the causes for application malfunction, going through the identification of stakeholders, key performance indicators and assignment of roles and responsibilities.

Although the outlined program was built based on the characteristics of the plants and APC applications found in the polymers business, it should be equally applicable to other industries. It is also interesting that the program does not depend on the choice of APC vendor.

Keywords: Advanced Process Control, Model Predictive Control, sustain value, performance, polymerization.

1. INTRODUCTION

The most common questions when APC applications lose performance are:

- What is the problem?
- Which is the simplest way to solve it?
- Which actions should be inside a sustain value program to prevent it?

In 2004 Brisk announced that previous studies indicated that only about a third of industrial controllers were achieving acceptable levels of performance. Indeed, nowadays, APC performance remains an issue.

To answer the questions mentioned above and develop a plan to mitigate the problems, it is necessary to follow a set of actions.

2. THE SUSTAIN VALUE PROGRAM

In order to devise a program aimed at sustaining the value of the APC applications we have followed a sequence of activities, as shown in Fig. 1.

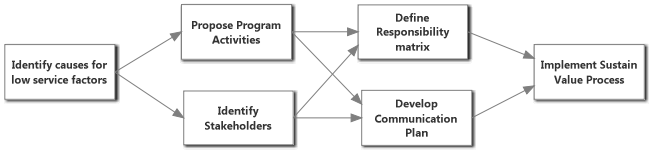

Fig. 1: Sequence of activities leading to the implementations of a Sustain Value process.

2.1 Why service factor declines over time?

Low service factors can be related to the equipments, to software or even to human aspects. Concerning to the application, we identify problems related to monitoring:

KPIs are not being calculated;

No model quality KPIs related;

Problems related to Performance:

Poorly tuned controllers;

Inadequate process models;

Software problems;

Problems related to Design:

Control Matrix is more complex than it should;

Problems with lab analysis timestamps;

Problems with lab analysis feedback;

System not designed for product transitions;

Problems related to Equipment:

Instrumentation problems;

Computer failure (servers, HMI);

Network failure;

Problems related to People:

Operators lack the necessary training;

He doesn't know how APC works;

He doesn't know how to run the application;

Lack of operator real time support;

Excessive judgement is required from the operator;

Operator doesn't know when he can turn controllers on;

Operator is reluctant to turn the controllers on when he doesn't know why they were turned off;

Operator doesn't trust the system;

Failure to report corrective measures have been taken;

Operator lacks experience with the system;

Problems related to Management:

Management of Change;

Process modifications;

New grades/recipes require model updating;

Staffing changes causing loss of knowledge;

Lack of visibility of the application benefits;

Results are poorly reported;

KPI calculations are complex and time consuming;

Lack of commitment;

Corrective actions take too long to be implemented;

Limited staffing dedicated to maintenance;

Problems are not efficiently diagnosed and reported to the APC engineers;

2.2 Who are stakeholders in this program?

Another important step is to define the stakeholders and their responsibilities. Table 1 gives reference of which should be stakeholders in each level of the organization.

Table 1: Sustain value program stakeholders

Operational Level	**Tactical Level**	**Strategic Level**
Automation Engineers (Systems) Automation Engineers (AT) Automation Engineers (APC) Automation Intern Automation Contracts Manager	Automation Managers Automation Coordinators Automation Senior Advisors	Automation Director
Production Engineer Operators and Shift Supervisors Operations Technician	Production Coordinators Production Managers	Industrial Managers Industrial Director
Process Engineer	Process Engineering Coordinators	
Maintenance Engineer	Maintenance Coordinators	

2.3 Proposed activities

Some routine and occasional activities are necessary to maintain a high service factor.

Governance is the term used to describe the creation and enforcement of your processes, policies and standards. There are two components - defining good processes and enforcing them.

Implementing good project management practices requires some level of governance. The governance is typically applied by the manager of the project and the sponsor. These managers don't need to be involved in every detail of the project. However, there are a number of areas where they need to be involved to make sure the project is progressing as it should.

An action item is work that requires follow-up execution. By their nature, action items normally cannot be planned for in advance. They arise on an ad-hoc basis during meetings or as a by-product of working on something else. An action item is assigned because there is not enough knowledge, expertise or time to resolve the item at the time it originally surfaced.

In many cases, action items are trivial in nature, but in other cases they can require substantial work to complete. Action items need to be assigned, worked on later and completed. If they are not going to be completed, they should not be called action items. Instead, simply note that the item will not be followed up on. Examples of action items include forwarding specific information to someone, arranging a meeting and providing a quick estimate on a piece of work.

Sometimes an action item is established to investigate an area where there may be a potential problem. Because of this, action items are sometimes mixed in with issues. However, this is not right, because an action item should not be confused with an issue. An issue is a problem which will have a detrimental impact on the project if left unresolved. An action item may lead to the discovery of an issue or a risk (a potential issue in the future) but the action item itself is not an issue.

The following items compose a procedure developed to help stakeholders to reach the intended service factor.

Preparation – there some actions that can be performed after MPC is installed:

Make sure KPIs are defined;

Review methods used for benefits calculations;

Define how reporting and tracking of application issues will be executed;

Provide a dedicated HMI for the application;

Automate KPI calculations;

Install visible management panels in the control rooms;

Create a systematic procedure of knowledge management that encourages knowledge sharing;

Include APC requirements in the career development plan of panel operators;

Standardize performance follow-up reports (format, frequency, distribution);

Implement the Communication Plan;

Define individual and collective goals;

Build operator-focused tools to support the activities they'll have to execute;

Define scope and quality criteria for support contracts;

Routine – Some actions must regular, to avoid gradual service factor decay without stakeholders know it.

Verify application status (daily);

Issue follow-up reports (monthly);

Update visible management panel (monthly);

Follow-up meeting, including process, production, operations, automation and maintenance teams (monthly);

Follow-up on reported issues (monthly);

Prepare/update training material (annual);

Train operators, shift supervisors and production engineers (annual);

Audit application (annual);

Occasional – Report when application presents problems or hardware and software undergo modifications.

Report issues;

Diagnose application problems;

Adjust base layer controller tuning;

Adjust MPC controller tuning;

Add new MVs or CVs to the MPC controllers;

Update existing models;

Hardware upgrade;

Software upgrade;

DCS configuration;

PIMS configuration;

LIMS interface configuration;

The set of actions listed above compose as efficient APC sustain value program. Good interaction between stakeholders, knowledge of the application and continuous attention to the program are important keys of success.

According to Friedman (1997), for sustained economic return, there is still no alternative to good engineering, dedicated maintenance and lots of attention to details.

6. CONCLUSIONS

The major contribution of this paper is to put together information about low service factor problems and propose a methodology to eliminate or mitigate these problems.

A set of problems related to low service factor was presented. To prevent these events it is necessary to invest time and constant effort as shown in proposed activities of sustain value program.

In addition, it is important the stakeholders to know that APC is not just about the project, but about a whole program and it necessary time and attention of everyone.

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