New technology has fast found its way into paper mills and the technology that controls the paper processes — something that we have welcomed with open arms as these technologies are helping us to visualize and improve the process.

For these modern systems it is important to realize that they come together with new challenges for maintenance throughout their lifecycle. A modern automation system is an evolving structure that has a continuous life cycle, and with correct maintenance can provide its users with the highest possible benefit at the lowest risk.

Along with ensuring high reliability, keeping an industrial automation system up-to-date will allow the user to easily take advantage of new and advanced technologies, without having to exchange the complete system.

**HISTORY OF THE INDUSTRIAL AUTOMATION SYSTEM**

Around 50 years ago, the first attempts were made to introduce microelectronics into automation technology, starting the era of modern solid-state controls in Industrial Automation. For the first 25 years, the market was determined by the supplier’s standards. The established suppliers developed and manufactured their systems from scratch, each supplier applying their own system philosophy and system architecture.

The second 25 years shows a clear change to a more open architecture. With increased need to understand the production processes better, the data available in the systems had to become more accessible. Data exchange between systems in horizontal (between multiple controls systems) and vertical (between control systems and mill management systems) direction became a necessity.
At the same time as the industry increased the need for process data, the available technology changed and with that the general philosophy of the industrial automation system. The Personal Computer (PC) started to dominate the scenery and opened the world of computers to the general public. Bill Gates and Paul Allen successfully developed and marketed user-friendly programs that run on Ed Roberts computer assembly kit, the Altair, and with that, the era of Windows was born.

In the late 90’s the focus of the industry for Industrial Automation was towards these PC’s and the Windows operating system. The visionaries promoted a common network backbone allowing all systems independent of supplier to interface seamlessly. This common system architecture was derived from the office automation, where such architecture was, and still is, common practice. Although there are slight deviations from this early vision, the main idea is in place. Intersystem communications have been standardized on standardized fieldbus and networking technology. Data storage, handling and visualization have been standardized on PC and Server Technology.

A LAYERED SYSTEM
The Industrial Automation system of this day and age consists of three main product layers, and each different layer with its own characteristics.

Layer 1 - I/O and Field Device Layer
The interface to the process, the Field layer, is based on hardware and communication compliant with Fieldbus standards. The trend is that this hardware is becoming more and more interchangeable among the different platforms.

Layer 2 - Control Layer
The control layer is the foundation of automation, based on purpose-built hardware, control and engineering software. In general, this layer is driven by the control application, resulting in the software not to be portable among the different platforms.

Layer 3 - Operator Interface and Data Management Layer
The 3rd and most standardized layer is the operations and data management layer. It’s this layer that brings “IT” into Industrial Automation and in most cases is based on the Microsoft Platform, common with business systems, and Custom off-the-shelf (COTS) client, server and network hardware.

Especially in this 3rd layer, the use of COTS technology has had a major effect on system capability and functionality, but also brings new challenges to the way we maintain a modern industrial automation system.

THE CHALLENGES OF MAINTAINING A MODERN INDUSTRIAL AUTOMATION SYSTEM
If we take a closer look at the three levels described previously, it can be concluded that each has its own characteristics and with that how we manage the maintenance of each:

- I/O and Field Device layer is based on Hardware and Communications that in most cases apply established (Fieldbus) standards, this enabling easy interchange among the different platforms. Configuration changes at this level are accompanied with a medium risk. The typical lifespan of the system components is 10-15 years.
- Control Layer consists of purpose-built hard and software, in most cases based on commercially available Central Processing Units (CPU) and Operating Systems (OS), in some cases embedded. In the control layer the custom built application software is housed. Changes at this layer are therefore of higher risk. The lifespan at this layer is in general 15-20 years.
- Operations and Information Management level is the most standardized throughout the industry from a hardware and software objective. The use of COTS hardware and software at this layer allows for easy expansion of functionality, but also has the shortest life-span, typically 4-6 years.

It is this last layer that brings the most challenges to the maintenance and service of a modern Industrial Automation System. To be able to insure a long term reliable platform, several aspects have to be addressed:
Increased complexity of the systems has lead to a change in the level of interaction. Where in the past the maintenance engineer could repair system parts at component level, increased complexity, reduced size and applied techniques, i.e. Surface Mounted Devices (SMD), in many cases only allow exchange of parts at printed circuit board (PCB) or even exchange at unit level.

With more and more COTS products being applied, industrial automation suppliers and users are confronted with new releases, which can cause compatibility issues.

Technology is evolving faster and faster with new functionality coming on-line in an increased pace. In order to benefit from today’s technology it is essential that the systems should be easily upgradeable.

From the aforementioned information we can conclude that maintaining a modern automation system is vastly different than in the past, when the focus was mainly on two areas, namely: modification and expansion of the application software and repair of system components. Maintaining the application is still a main focus area of a modern system. The repair of system components, however, is being replaced with exchanging at unit level and the need to keep systems up-to-date.

THE FOUR STEPS TO A SUCCESSFUL LIFE CYCLE MANAGEMENT

To be sure to get the maximum advantage of a modern automation system, one has to plan from the beginning. It’s not enough to purchase and install the system and then start thinking of how to maintain it. System Life Cycle Management starts at the beginning as the following four steps show:

- Set-up
- System Integration
- Software Management (Sentinel)
- Support (remote)

A good life-cycle management program starts when the system is planned — a system has to provide the mill with the correct functionality without compromising the upgradeability of the system at hand.

In a modern paper mill, different systems are required to communicate together (horizontal integration) as well as communication to the mill’s business systems (vertical integration). In many traditional mills, the required functionality is covered by a number of (stand-alone) systems. Upgrading one system can impact the overall picture, with unwanted side-effects. Integrated solutions, such as those offered by ABB, can be seen as one system, providing a clear and predictable upgrade path with minimal impact on communication links.

An important aspect of assuring system reliability is timely upgrades of the different system layers, especially layer 3 (operations and data management), which requires increased attention. The COTS hardware and software used at this layer typically has a life span of 4-6 years. Managing the impact on production and minimizing the costs of these upgrades is something that maintenance managers are often
confronted with. A program such as ABB’s Sentinel software management program allows users to easily evolve to the latest available software, insuring up-to-date systems that are current with the latest technology and easily expanded with new enhanced functionality.

In the case of a system defect, the system downtime can be reduced by making use of the remote support functionality that all ABB Industrial IT-based systems support. From remote support centers, experts can log into the systems, determine the defect, and instruct local mill personal what parts to exchange, reducing the time that is lost due to travel in a conventional on-site intervention. The remote support allows for continuous remote monitoring of the system, so that interventions can be made before failures actually affect the production process. For mills that provide their own maintenance, the remote support provides an on-line maintenance program, assisting users to perform optimal and timely preventive maintenance.

A RELIABLE EVOLVING SYSTEM

With the changing of the industrial automation system architecture, it is important to adapt a new way to maintain industrial automation systems. To insure the highest benefit at the lowest risk, one must manage the system life cycle actively, starting with the initial system setup creating the maximum functionality based on system standards and maximum integration. A good software management program supporting cost effective system upgrades, combined with the advantages of remote support, will ensure a reliable evolving system providing the highest benefit at the lowest risk and costs.

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