Greetings from Division Director

Welcome to the third edition of the Mining and Metals Division Newsletter for 2017. Productivity is one of the key elements with prices of material declining. Therefore, adopting standards becomes a critical factor to reduce operational costs and become more productive. ISA has implemented several Standards across many industries (ISA 95-99-100), but in mining still, there is a challenge because OEM/OTM and mining companies have not agreed to implement standards initiatives (there are some cases). We invite all members of ISA to create an open discussion of how this industry can solve this issue. One important example of this is the article written in July/August 2017 edition of Intech magazine by Director-Elect, Bas MutSaers, about “Mining and IT-OT convergence”

Francisco Soto
Director
ISA Mining & Metals Division

Greetings from Newsletter Editor

Greetings! My name is Don Root and welcome to the third edition of the Mining and Metals Division Newsletter.

The technical article in this issue discusses the application of advanced process control in mining and metals. This is very timely information given the current conditions in the industry. The July/August edition of Intech also provides several articles that are insightful and applicable to our industry and is highly recommended.

Thank you for your interest in the ISA Mining & Metals Division.

Donald J Root, PE
Newsletter Editor
ISA Mining & Metals Division
Our Volunteer Leaders:

Director ......................... Francisco Soto
Director-elect ..................... Bas Mutsaers
Newsletter Editor .................... Donald J Root
WebMaster .......................... Ari Supomo
Section-Division Liaison ............. Carlos Mandolesi
Committee Members ................. Sandeep Vysvaraiu
                                      Michael Hughes
                                      David Howat
                                      Harry Sowieja
                                      Robert Zwick

Leader Biographies

Francisco Soto is the manager of a R & D center in Chile, with more than 13 years of experience developing and implementing innovation projects for international companies, and labs. Supporting technological spinoffs, technology transfer contracts and raising R&D contracts with companies in mining and oil & gas. Has worked with several mining companies on the development of innovation products and solutions. Holds a Bachelor’s degree in Business from Universidad Técnica Federico Santa Maria, Chile.

Bas Mutsaers is an innovative, results driven professional with extensive experience in setting and executing strategy, leading various high-performance teams in the areas of consulting, engineering and software development across the Natural Resources, Energy (up- mid and downstream), and Utilities industries. This has been achieved in APAC (ANZ Region), India and Europe. Over 15 years leveraging ISA standards like ISA95/ISA99 with a strong global network and deep experience analysing, selling, designing, building, testing, and deploying innovative industry-specific solutions. Leader of many Global complex migration and transformation projects and pursuits with strong solutions, systems, and business process capability. Leveraged ISA standards across domains of ERP, EAM, MES, and Industrial Automation achieving IT/OT convergence by leveraging the ever-growing data of Sensors, People and Technology across the entire value chain and applying it in BI and Analytics solutions.

Donald J Root, PE is a licensed professional electrical engineer with 33 years of experience in electrical power & control systems, mechanical design, and project management. He pioneered the use of PLCs in several industrial applications and is fully knowledgeable in US and international electrical codes that apply to environmentally-rated industrial locations areas. He is the author of magazine articles and book sections on the use of control systems and has been a guest instructor at Kansas State University. Don has seven years of P&L experience in a small high technology company and international experience executing projects in the People’s Republic of China, Thailand, Indonesia, The Philippines, Romania, Poland, Ecuador, Puerto Rico, and the Caribbean.

Ari Supomo has been in the process automation in the mining industry for all his professional life. Says Ari, “I joined ISA so that I can stay informed with the automation advancement. In addition, I can learn and apply automation best practices and standards from ISA to our mining sites. I believe there are great opportunities for the mining industry and companies to work and partner with ISA. My goal for the division is to improve the communication, participation, interaction and collaboration between ISA and mining society/community.”

Carlos Mandolesi is the owner of Sigmma Automation located in Brazil, with 24+ years’ experience in industrial automation and networks and now with a strong focus in Industrial Internet of Things. Experienced in large projects in mining, metals, oil & gas and biofuels including customers like VALE, Anglo American, Samarco and Petrobras. Carlos is ISA District 4 (South America) Vice President and was elected to be a member of ISA Executive Board.
FEATURED TECHNICAL ARTICLE
Applications and Benefits of Advanced Process Control in M&M
By Robert Zwick, M.A.Sc., P.Eng., M&M Executive Committee & Principal at Automan Controls, Inc.

Background
A technology has no value unless it can drive profits for the Mining and Metals operation. Process control can play a dominant role in driving the company bottom line. Every time an operator makes a set point change, it can affect the plant profitability. Today, determining whether the Operator decisions are good or bad has become increasingly complex due to many conflicting factors involved. Not only must traditional Operator objectives be met such as maximizing production and/or product quality, but now new factors have been introduced to the modern-day Operator. For instance, decisions around control set point changes now take into consideration minimizing energy consumption, minimizing water consumption, minimizing environmental impact and others. And all the while, attempting to maximize the plant profitability. One solution is to use advanced process control (APC). Modern-day APC solutions no longer makes this an insurmountable task for Mining and Metals operations to use.

What is Advanced Process Control
Advanced Process Control is a general term used to describe process control software that simultaneously controls multiple setpoints of a process. As shown in Figure 1, an APC is a supervisory control system that sits on top of the existing controls.

For an APC to work properly, firstly all the existing instrumentation, control elements and the control loops need to function correctly – i.e.; “the Foundation” needs to be in place. APC’s sit on top of this Foundation, reading process variables, and then simultaneously writing to multiple controller set points, with the software safely making optimum decisions based on pre-established operating constraints.

The software technology has progressed to the point where APC’s commonly use an optimizing engine to maximize profits for a broad range of given operating variables and constraints. Early APC adopters were found in the Oil and Gas industry during the 1960’s where significant bottom-line profitability was experienced and documented.

The technology has increasingly become more “mainstream” not only because of the recognized and fully-established benefits, but because costs have decreased due to improved control system OPC connectivity, lower software licensing costs and easier “off-the-shelf” implementations.

There are four types of process variables used in an APC:
• Controlled (CV) – where the process output is to be maintained at a specific setpoint
• Constraint (AV) – the process output which must be maintained within a specific range (takes precedence over target)
• Manipulated (MV) – which is the process input that is adjusted to maintain a controlled variable at setpoint or a constraint variable within limits
• Disturbance (DV) – the process input which may affect both controlled and constraint variables (feedforward)

The math behind what an APC uses can vary widely. APC is the “umbrella” term that encompasses several techniques, including:
• MPC or Model Predictive Control (the most commonly used technique)
• Neural networks
• Expert / rule based systems
• Fuzzy logic systems
• Genetic algorithms
• Non-linear / multivariable control
• Optimal / robust control

The choice of the math model (or combination thereof) would depend on the process itself. Other model choice considerations would be the ease of installation and the long-term maintenance requirements of the application. For a company with multiple sites and various process control systems (PCS), having a common APC platform helps with support, training, people movement, strategy sharing, and sustainability in general. There should also be within the organization an “owner” of the APC installation who ensures Operator usage of the APC is more than 80% utilization. Typically, it would be the plant process engineer or metallurgist. The ISA competency model for ownership of the APC is a good guideline to follow. For security reasons, PCS access is usually limited to process control staff and the third-party APC solution provider.

**How and Where APC is Used in Control Systems**
APC’s connect to existing control systems, typically at an ISA-95 standard Layer 2 or 3 of a control system architecture. An OPC server is typically used by the APC to ensure trouble-free reading of Layer 0 instruments and writing to Layer 0 control elements, being controlled through the Layer 1 controllers. The best APC software is compatible with any control system in use at the M&M facility. Best practice is to locate the APC application on a server within the secure control network and follows good standards for process network security per the ISA-99 standard:

Security considerations are important because the APC plays a direct role in the control system function. Any APC-related activity such as optimization, often use connectivity with the business network. This requires a secure connection to the “outside” world. It would also include monitoring APC performance and connectivity, reporting APC usage KPI’s, accessing system diagnostics, and remote access for support by specialists.

**Benefits of APC in your Mining and Metals (M&M) projects**
For the Mining and Metals industry, APC’s have been successfully implemented with documented benefits of guaranteed production improvement. Depending on the project size and complexity, installed costs of APC projects range between $200k – $500k with returns on investment of 1 year or less. In the M&M industry these kinds of ROI’s exist for applications such as:
• SAG and ball mill grinding
• Washing and finishing circuits
• Flotation circuits
• Roasters and other pyrometallurgical processes
• High-Pressure leach and other hydrometallurgical processes
• Cement processing and lime kilns

Typical APC projects can take between 6 – 10 months to complete and commission. APC and optimization can improve operating profit margins in 4 ways:

i. Higher production rates with documented improvements typically from 3% to 5% – by pushing against constraints.

ii. Lower raw material, energy usage per unit of product and emissions with documented improvements typically from 3% to 5% – by pushing against constraints.

iii. Lower product losses & rework – by reducing quality variability with documented improvements typically from 10% to 20%.
iv. Improved maintenance costs such as reduced refractory consumption with documented improvements typically from 10% to 20%.

**Approach in Justifying APC**

Justifying an APC is done by establishing process variability of key process variables (CV’s) for the manipulated variables MV’s. And then an estimate is made on the reduction in key CV variability – it’s typically a reduction in one-half to one standard deviation. Establishment of DV’s or feedforward variables and AV’s or process constraints, will determine the limits on what would be the potential change in the new setpoint.

Justification is developed by predicting the potential process variability reduction and then the corresponding potential change in setpoint based on the Specification Limit constraint. This is nicely shown in Figure 3:

![Figure 3 Setpoint can be changed after process variability is decreased](image)

- Random influences create a normal CV variation.
- Advanced control can reduce the standard deviation of a performance variable typically by up to a half.
- Then, moving the set point an amount equal to the reduction in initial standard deviation or to the constraint limit, it will yield economic benefits with no degradation of product quality.
- Based on a newly-established set-point, an economic justification can be made to project expected benefits.

Economic justification is calculated by computing the expected change in 3 basic components for the operation unit run time (RT):

**Change in Production Rate (PR) and Product Value (PV)**

\[
( \text{PR}_{\text{new}} \times \text{RT}_{\text{new}} \times \text{PV}_{\text{new}} ) - ( \text{PR}_{\text{old}} \times \text{RT}_{\text{old}} \times \text{PV}_{\text{old}} )
\]

**Improvement in Energy Efficiency (EE) and Energy Cost (EC)**

\[
( \text{PR}_{\text{old}} \times \text{EE}_{\text{old}} \times \text{RT}_{\text{old}} \times \text{EC}_{\text{old}} ) - ( \text{PR}_{\text{new}} \times \text{EE}_{\text{new}} \times \text{RT}_{\text{new}} \times \text{EC}_{\text{new}} )
\]

**Improvement in production Feed Rate (FR) and Product Yield (PY)**

\[
( \text{FR}_{\text{old}} \times \text{RT}_{\text{old}} \times \text{PY}_{\text{old}} ) - ( \text{FR}_{\text{new}} \times \text{RT}_{\text{new}} \times \text{PY}_{\text{new}} )
\]

**APC’s are a great opportunity for the M&M Industry**

In summary, APC’s are becoming increasingly common-place with the Mining and Metals industry. This is due to decrease in project capital cost, relatively fast commissioning times of less than two months (and without plant interruption), along with recognized and proven increase to plant profitability. Most the major automation companies have proven APC solutions and most are built on similar technology platforms. APC applications are no longer development projects and now can be characterized as using well-established control engineering methodology.

APC software has become increasingly easy to use and with many modern-day features. Best in class developments in APC software now include
• Modern and intuitive User Interfaces, tag-building, data management and easy-to-use historian
• Secure and integrated OPC connection tools into the control network
• Capability to interface with other business systems for optimization and “big data” integration
• Auto-model build capability
• Customizable models to support unique process behavior
• Integration with first principles dynamic models
• Improved performance monitoring

Figure 4 Modern-day APC software now have an excellent User Interface following ISA 101 standard
Photo with permission from Schneider Electric SimSci APC

A well-run APC project always starts with a well-defined scope and an up-front establishment of project deliverables. In some cases, those deliverables can even be guaranteed by the vendor. A key factor for success with any APC project installation is good support by automation company, along with their experience in the APC end-use application. APC applications truly are a technology of value and can drive profits for the Mining and Metals operation!

Further references:
1. ISA-95, Enterprise-Control System Integration. https://www.isa.org/isa95/

About the Author:
Robert (Rob) Zwick is President of Automan Controls Inc.; an Operations Technology (OT) company that provides the full range of engineering and management services on industrial control systems, automation technology, and process control applications. Rob’s specialty is in heavy industry such as mining, metals, utilities and pulp & paper; with over 30 years of experience associated with capital projects, plant operations and maintenance. Expertise includes working on plant processing strategies, development of long-term modernization strategies, corporate capital justification, vendor contract negotiations, DCS/PLC migration, and industrial control system management.

Automan Controls is a company that provides services on added-value process control projects – advanced process control (APC), alarm management, process control loop monitoring, operator training simulators, process network information systems, process network security, mobile operator interfaces, wireless instrumentation, and wireless infrastructure for process control purposes.
A new and different direction for ISA

By Steven W. Pflantz PE, 2017 ISA Society President

The classic definition of insanity is to keep doing the same things you have been doing and expecting different results. At some point, you have to nudge things along in an attempt to affect a change and move in a positive direction.

Last month, ISA’s Executive Board decided it was time to change what we were doing. The first step of that was to part ways with long-time ISA CEO and Executive Director Pat Gouhin. People immediately came to the conclusion that the move was prompted by some type of fault or wrong-doing. In this case, there was none of that. We just needed something different.

If I can offer an analogy, think of a sports team whose coach has a history of being a really good coach, but his current team can't quite win the championship. The team hires a new coach. They click and do well. The previous coach goes to another team who also has great success. This was a situation where a change was needed in order to embark on another path toward growth and improvement.

What undoubtedly happens is that the first change precipitates many more changes, some small and some big. Everyone takes notice of what happened and they undertake a little soul searching, step up their game, and generally get in the mode of what can we do better or do differently.

The world of the automation professional is changing daily, affected by rapidly evolving and emerging new technologies and solutions that need to be applied in creative new ways. It's essential that the Society evolve and adapt in tangent with this changing environment.

It's critical that ISA become more relevant and attractive to a younger generation. We need a steady influx of bright new minds in order to grow and meet the challenges of the future. Like parents who must adapt to communicate with and meet the needs of their growing children, ISA must adjust to a dynamic marketplace and to the expectations, demands and cultural underpinnings of today’s and tomorrow’s automation professionals.

For example, ISA’s roots lie in the process industries, mainly petrochemical-based operations. That's an important strength, but there are other industry sectors out there that can readily and easily leverage and apply our treasure chest of intellectual property and expertise. There are many opportunities to secure new members and customers if we are willing to think outside the box.

As I've written numerous times in my columns, change can be uncomfortable and downright scary. We tend to associate change as a negative, but it does not have to be. I ask that we all look for the positives during this change and continue to do great things for ISA. Let us build on a great past for an even greater future.

I want you to know that I and the ISA Board know that we're blessed to have such a great staff and great volunteer leaders, members, customers and partners. With your support and commitment to ISA, we will work together to achieve even greater success in the future.

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About the ISA Mining/Metals Division
The Mining & Metals Industries Division (MMID) is one of ISA Technical Divisions. Its goal is to support and advance its members who are working and/or interested in the mining and metal industries. MMID focuses on leveraging automation functionality and technology solution to enhance mining processes and metal production.

Who is best served by this division? Professionals concerned with economically and environmentally sound practices as related to the extraction of metal ores, coal, cement, sand, gravel, and other minerals and the handling, separation, processing, fabrication, related processes, and research and development for the production of finished mineral or metal products. It also covers the Iron and Steel Making industry, Aluminum Processing and other light metals and the production and manufacturing of metals products.