PROCESS AUTOMATION—A USER’S PERSPECTIVE

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ISCOR VANDERBIJLPARK STEEL
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Abstract: Process automation systems are widely used within the steel industry. The increasing competitiveness of this industry creates significant challenges for owning process automation equipment. Cost pressures require that the cost of ownership and maintenance headcount be continually reduced. This is in contrast with a constant drive for higher levels of automation and a greater plant dependence on process automation technology. Achieving these seemingly divergent goals requires that process automation equipment be managed in an efficient and sustainable manner. To implement such a management system it is necessary to understand the trends and nature of the process automation industry and tailor a strategy to match the business requirements of the steel industry.

1. Introduction

One of the primary objectives of corporations today is to generate sustainable returns for their shareholders. To achieve this a business formulates strategies to position themselves such that they have a competitive advantage in their market. In the mining and metals industry, now more than ever before, process automation is one of the key enablers in achieving a sustainable competitive advantage.

In industries such as these, the core processes can be considered mature with improvements being evolutionary as opposed to revolutionary. Consequently, little opportunity for gaining competitive advantage through process changes exists. The steel industry is also extremely cost intensive, from an operational perspective, which places a limit on capital funds available. The funds that are available are hotly competed for. As a commodity the steel price is fixed externally through market forces. The current oversupply has depressed the steel price which has led to two effects; Firstly there is significant consolidation in the industry in an attempt to exert a greater influence on the steel price; Secondly countries have had to protect their steel industries through trade tariffs.

Under these conditions, companies in the steel industry must focus on achieving the following medium term objectives to improve their profitability:
Excel at cost reduction;
Increase manufacturing efficiency;
Improve quality;
Streamline manufacturing operations.

Process automation provides a comparatively cost effective means of achieving these targets by ensuring that production operations are performed consistently, leading to increased plant stability, which increases efficiencies, and reduces quality rejects. In addition to this, process automation provides tools for identifying and analysing manufacturing problems and optimising the manufacturing process through static and dynamic modelling as well as advanced process control solutions.

The process automation industry can be split into two broad fields, automation users and automation suppliers. Almost everyone is a user of process automation in one form or another. Process automation suppliers are those organisations whose primary business is the development and supply of automation hardware and software. Iscor's core business is the manufacturing of steel and although they possess the capability to develop automation systems, they are considered an automation user.

In this paper, the current trends and challenges in the process automation industry will be discussed. Following this a similar analysis will be done for the steel industry. These discussions will be used as the context within which the initiatives launched by Iscor Vanderbijlpark Steel to manage their process automation systems will be discussed.

2. Process Automation Systems

To create a common point of reference, it is necessary to clarify the author's understanding of Process Automation Systems (PAS). For the purposes of this discussion, PAS is defined as including all systems from the sensor level through to, but not including, Enterprise Resource Planning (ERP) systems. This continuum includes among others, process control systems, static and dynamic process models, manufacturing execution systems, plant centric information systems and finite capacity scheduling systems. A graphical representation of this definition is provided in Figure 1.
2.1. Process Automation Environment / Trends

For any manufacturing concern to realise the process automation promises, it is vital that the business’ approach to the development and use of this technology is managed such that it is utilized in an innovative and synergistic way. One of the critical success factors for achieving this is to understand the driving forces in the process automation industry and position the company accordingly.

The PAS industry is where the IT industry was around about 7 years ago in terms of lifecycle. We believe that the PAS industry is in its early to mid maturity stage. This is clear from the fact that the product offerings are becoming much less proprietary and more of a commodity, driving down the cost of the product. This, together with slow market growth, forces the industry into significant consolidation. Ultimately this leads to product offerings disappearing as a differentiator and process automation suppliers starting to focus on service provision as one of their main profit contributors.

The importance of realising that the current issues facing the PAS industry are, in many respects, similar to those the IT industry faced about 7 years ago is that there are a wealth of management systems and theory available that could be adapted to the management of the PAS environment. Other benefits include the opportunity to learn from their mistakes and getting a preview of the next wave of issues through witnessing their current concerns.

Typical examples of the systems and theory referred to above are listed below:
- SEI Capability maturity model
- COBIT model
- Architecture development methodologies

2.2. Process Automation Challenges

Users of process automation technology have a better understanding of the technology itself than they have of how to apply the technology to improve operations and reduce product variability. The strategic challenge for process automation organisations is to mature past their product focus. This maturing process will require a focus on adding bottom line value to the business through the leveraging of process automation technology, i.e. we need to become unconsciously competent in the technology and focus on adding tangible, quantifiable value through the solution.

3. Process Automation at Vanderbijlpark Steel

Process Automation has played a major role in the steel industry, as is the case at Vanderbijlpark Steel. In a lot of respects the authors believe that, Vanderbijlpark Steel has been a leader in this field.
3.1. The Process Automation Environment at an Integrated Steel Mill

Vanderbijlpark steel is the largest of four steel mills within the Iscor group. It produces approximately 2.9 million tons/year of flat steel products. To achieve this, the site consumes 25 000t of raw material, 11.9 million cubic metres of fuel gas and 6.28 GWh of electricity daily.

The works is comprised of thirty-three separate plants, making use of a total of 200 000 I/O. This I/O feeds a variety of process control systems that range from regulatory to completely discrete systems such as found on a cold mill. The response times of the processes vary from 23 hours for a coke oven to times of the order of milliseconds for a hot strip mill. Advanced control and mathematical models are extensively applied throughout the works.

The number of employees was reduced over the last 5-10 years from approximately 18 000 to the current level of 6 800. The PAS maintenance personnel were reduced in proportion. In many cases the reductions were made possible through higher levels of automation.

Vanderbijlpark Steel has installed, and working, examples of process automation equipment from most of the well known vendors. One of the key drivers of this degree of diversity was that, up until recently, product offerings were used as a differentiator by PAS suppliers. Consequently, only a limited degree of standardisation was possible.

3.2. The Process Automation Challenges at an Integrated Steel Mill

In a commodity industry such as steel making, production cost is the overriding concern. The resulting unwavering focus on cost creates a number of challenges for the process automation functions within such an organisation. Some of these are detailed below:

- With ever declining budgets, increasing installed base and higher support costs, maintenance of the installed PAS is becoming more and more difficult.
- The diversity of installed systems has a major cost impact in terms of the number of persons required to maintain them and the spares holding costs.
- The failure of a PAS system creates a major business risk as in most cases such a failure will result in a production interruption. This is not only true for process control systems. In many cases the degree of automation is so high, that without the availability of advanced control systems, the plant is unable to produce a quality product. The risk of this type of failure is increasing daily due to the limited capital available to replace legacy systems.
- The management style required to ensure maximum cost efficiency needs to be very well defined and disciplined. This type of environment stifles the creativity required to leverage PAS to create business value.
Seemingly in contrast to the above, significant pressure is brought to bear on all elements within a business to justify their existence by demonstrating the business benefit they generate. This is not a significant problem as PAS is a powerful bringer of business benefits; the downside is that all this occurs at an additional cost.

4. The PAS Paradox

The items discussed above present the difficulties associated with the owning and operating of process automation technology, but as mentioned in the previous section, PAS can be an important source of competitive advantage.

This gives rise to following paradox: While PAS can be a major source of business benefit, it can also result in spiralling costs and unacceptable business risk.

The question is how does one bring the benefits of technology to bear in a mature and declining industry, such as the steel industry.

The answer, we believe, lies in the management of process automation technology. If a company, active in a mature and declining industry, fails to manage their installed base, spiralling process automation costs and business risks could become an accelerating factor in their demise. On the other hand, if they fail to take advantages of developments in PAS they could lose their competitive edge with respect to their competition – ultimately also leading to their demise.

In the second part of this paper some of the techniques used at Vanderbijlpark Steel to manage the process automation environment will be presented.

5. Management of PAS at Vanderbijlpark Steel

In 1999, the PAS department and the management of PAS at Vanderbijlpark Steel were critically reassessed, primarily as part of a reengineering process. As part of this assessment, many of the factors presented in the previous sections were considered. The outcome of this process was a strategy for the department and an extensive redesign of functions and responsibilities. As presentation of the complete design is beyond the scope of this paper, only selected core elements will be discussed.

The resulting defensive and offensive strategies were the fortification of the PAS maintenance function and the stabilisation of the PAS environment. The stabilisation of the PAS environment included the following initiatives:

- Development of a technology strategy
- Supplier development
- Best practice application development
- Training
The remainder of this paper will concentrate on Iscor’s experiences with the development and implementation of a PAS technology strategy.

5.1. Technology Strategy

Technology can be defined as, “The knowledge and skills that lead to unique products and/or services which, in turn, leads to a competitive advantage if utilized in an innovative and synergistic way.” As can be seen from this, a technology strategy should focus on both technology (products) and on knowledge and skills.

A technology strategy defines a firm’s approach to the development and use of equipment architectures and personnel skills. The following discussion will present Vanderbijlpark Steel’s consideration of a technology strategy.

5.1.1. High Level Architecture Plans

The first step in managing the PAS technology should be the development the ideal architecture for PAS in your business by considering the required system functionalities as well as business and technological constraints. The purpose of this high-level architecture is to:

- Locate the required functions within the technical architecture
- Decide on the core technologies required in the architecture
- Ensure integration between different components
- Consider the approach towards the maintenance of the different components.

A simple example of a high level architecture plan is shown in Figure 2.

One of the first things one realises when approaching the PAS technology landscape from this perspective is that the architecture consists of several distinctly different technologies. This is a key realisation as one soon comes to understand that these distinct technologies have to be managed differently because they are normally at different stages in their lifecycle. Some of the typical technologies one would find in a PAS architecture includes normal PLC and DCS controllers, the SCADA and real time historian type technologies, advanced process control applications, static and dynamic process models as well as pure IT technologies. Each of these technologies mentioned here are at a different stage of technological development and needs to be managed differently.

An example of the application of this is the replacement of a process computer. Traditionally these computers include a wide variety of functions such as a historian, an information system and process models. When one considers the high level architecture it is clear that these functions should no longer reside within the same hardware.

To illustrate the segmentation and unique management of the different technologies one only has to consider the process model and information system technologies. The process
models represent metallurgical knowledge that has been captured in software. These models can only be obtained from steel technology companies and are usually very expensive, due to the licensing of the expertise encapsulated in them. In the case of the information systems, the functionality is generic, relatively low cost and widely available. The lifecycle of the process models is probably of the order of 10 years as steel making is a mature technology. The lifecycle of the information system is most likely less than 5 years. If these two items are combined in the same solution, the mismatch in lifecycles will result in one of the functionalities being sub-optimised.

![Diagram of a typical high-level process automation system architecture]

**Figure 2 A typical high-level process automation system architecture**

### 5.1.2. Standardisation of Equipment

Once the distinct technologies in the architecture have been identified, it is necessary to consider the cost of ownership of these technologies. In order to manage the cost of ownership of PAS technologies the authors believe that it is important to reduce the diversity of suppliers one has in each of these technology segments.

It is important to understand that this is normally a very emotionally charged decision to implement due to differing and very passionate brand loyalty among line maintenance personnel. An aggressive standardisation program is cardinal to the management of cost of ownership as well as to the ability to provide the expected service to the user. To ensure successful implementation of a standardisation strategy, both internal and external stakeholders must be considered.

The most important internal stakeholders are the line maintenance personnel. If one fails to get buy-in for this strategy from them, they will find a way to prove why the selected brand will not work on their plant. On the external side, one of the key risks is that as it
becomes clear that a business is adopting an equipment standard, the suppliers not selected immediately start to under quote to try and maintain an installed base. In this respect it is very important to understand that only about 30% of the cost of owning that technology is incurred in the project acquisition phase and up to 70% of the total cost of ownership of PAS solutions originates post implementation, i.e. after commissioning.

When choosing a supplier on which to standardise, Iscor decided not to use the conventional, “best of breed,” analysis as this is a very time consuming process and usually results in a significant fragmentation in suppliers. The results of such an analysis are also usually only valid at a certain point in time. The approach recommended by Iscor is to find one or two large suppliers that cover 80% of the products required within a technology grouping, such as process control. It was found that in any market, there were usually three major players that dominated the top three spots for a particular product. For some products a supplier would have the best product offering and in others, he would not. It was seldom found that the product offering dropped totally out of the top five. The ranking would only change, over time, depending on who had the most recent release.

Through following the above approach, the authors learned that there are exceptions to any rule which must be managed as such. They should not be allowed to dictate the norm. Typically, in the steel industry, the bulk of the plants can be controlled by PLC type technology, but there are specific exceptions such as the high speed rolling applications found at the hot strip mill and tandem cold mills, which require a very niche technology application to function correctly.

In adopting a strategy like this, it is important to understand the obstacles that your detractors could use to derail the implementation of this strategy. The typical that were experienced at Vanderbijlpark Steel were:

- Cost to retrain personnel in new technology
- Cost of holding spares
- The potential of uncontrolled price increases by the chosen supplier.

Through diligent management and negotiation with the chosen suppliers, these issues can be resolved amicably.

Some of the benefits achievable through technology standardisation are:

- Increased buying power
- A proven technology solution prior to project implementation
- Managed risk in terms of integration
- Mobility of personnel
- Successful implementations easily duplicated in similar plants
- Facilitates moving beyond a product focus to concentrate on using technology in an innovative manner to create a competitive advantage for the business

5.1.3. Rationalisation of Hardware and Software
Even after choosing a specific supplier, it is important to understand that within a supplier’s product range there is normally a wide range of products to choose from. If not managed, this could lessen identified benefits of standardisation. It is therefore important that the next step must be one where the specific model in the supplier’s product range is identified and that the introduction of a new range or version be strictly managed from that time onwards.

5.1.4. Migration Plans

When one has decided on a high level architecture, standardised, and rationalised the equipment contained in the architecture the next step is to develop a plan for how to move from your current situation to the planned architecture. Due to the cost sensitiveness of the steel industry and the consequent limitations on capital, this is very rarely a case of simply replacing the old disparate technologies with the new standardised equipment and architecture.

What is required is a thorough examination of each plant on the site to obtain a clear picture of precisely how the current architecture looks. Through mapping the changes required to migrate the current architecture to the desired architecture, any gaps in the current systems can be identified. It is then a question of assigning these gaps to projects already on the capital plans. Through diligent portfolio and programme management all new implementations can be exploited to progress towards the achievement of the planned architecture.

5.1.5. Skills

Due to the ever-increasing pressure of cost containment and reduction, the real maintenance budget and resources available for supporting a constantly expanding PAS installed base is shrinking. This implies that there are fewer resources maintaining more equipment. The trend away from lifelong employment also drives employee turnover and consequently skills loss.

Under these conditions one of the few levers a technical manager has at his disposal to counteract this trend is to ensure that the equipment and software comprising a process automation system is standardised. This will ensure that the learning curve for new employees is drastically reduced. Constant exposure to the same equipment and applications also serves to reinforce the skill level of existing employees.

Improved skill levels result in shorter turnaround times on fault identification and resolution. This leads to better plant availability, higher process stability and higher returns.

In the final analysis it is clear that while it is a long and difficult road this strategy in the end leads to lower cost, but more importantly also better plant availability. This is true
because the maintenance personnel now only have to be familiar with one set of technologies and can focus on what is wrong and not on how the technology works.

6. Conclusion

In a commodity industry such as the steel industry, where prices are set externally, profitability can be influenced through improving cost, efficiency and quality. Businesses such as these are leveraging process automation technology for improvements in their competitive position.

In order to exploit the benefits of process automation technology in an efficient and sustainable manner, it is important that a business understands the forces driving the PAS industry. If one considers the current climate in the PAS industry, it appears to be undergoing similar events as were experienced in the IT industry. This similarity can be exploited to provide a preview of the future industry trends and to provide access to a wealth of IT knowledge and systems that will be applicable to the PAS industry with only minor modifications.

The greatest challenge for the PAS industry is to shift from its product or technology focus to one of providing business benefit through PAS technology.

This is especially relevant in the steel industry where cost driven reductions in manpower are driving increased levels of automation. The average age of automation systems is also increasing at a high rate. These factors propose a risk to the steel industry, as many of their processes are deeply dependent on ageing PAS systems that must be maintained by an ever-decreasing number of persons.

It soon became clear that Vanderbijlpark Steel would have to fundamentally change the manner in which they manage PAS technology if they were to obtain the benefits promised by PAS systems while mitigating the creeping cost and business risks associated with owning PAS technology.

The implementation of a technology strategy formed part of a set of initiatives focussed on reforming the way in which technology is managed within Vanderbijlpark Steel. One of the underlying premises was that it is important to understand that there are a number of distinct technologies that are applied in a typical PAS implementation. These technologies need to be separated and managed differently to ensure that the optimum business benefit is realised.

Standardisation is being applied as a powerful means of reducing the cost of ownership while maintaining and improving the level of service to the business with regard to PAS technology.

In a cost driven business such as the steel industry it is critical to systematically manage the ownership and procurement of PAS technology to enable the business to enjoy the
competitive benefits of the this technology while maintaining a downward trend on the cost of ownership curve.

Acknowledgements

The authors wish to acknowledge the following sources of information which have, over time, been a catalyst in the formulation of many of the points of view expressed in this paper.

- AMR Research
- ARC Advisory Group
- Meta Group
- Software Engineering Institute

References


