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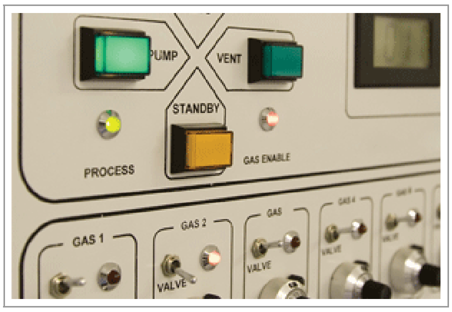
Web Exclusive

Intangible benefits of upgrading control technology

Intangible benefits are hidden jewels that do exist, and need to be accepted as valid

By Pamela K. Quillin, P.E.



Have you ever tried to justify upgrading old control room equipment to a Distributed Control System (DCS)?

In that process, have you been challenged to justify an upgrade, strictly on the basis of economic returns, in the face of maintaining an obsolete system?

Have you ever gotten dubious looks explaining or selling intangible benefits of upgrading to newer technology?

If you answered "Yes" to any or all of the questions above, you are not alone. Many of us have lived there. The following story highlights how intangible benefits of upgrading instrumentation and control equipment had huge returns.

The place

A silica plant in the U.S., built decades ago, was still running on 1960s vintage technology by the late 1990s. A number of projects were implemented piecemeal as is always the case with older operating plants due to the difficulty in obtaining capital. It was running so the prevailing perception was the plant was in no need of an upgrade. Engineering investigations soon proved otherwise in the dryer unit of this plant.

Geographical layout

The dryer unit is spread over many acres. The dryer building proper has eight floors and is over 10 stories in height. Product handling and processing equipment, valves for switching production, and the storage bins at the 10th floor, where each product is stored, are spread throughout this acreage.

There are two operators housed in the dryer building, who have all of the responsibility for production, testing, product switching, and quality control requirements in the unit. Since there was no control system, automation was nonexistent, thus climbing up and down the stairs in the building was a continuous task to maintain the process.

A number of valves had to be manually switched to line up product with the proper bin on the 10th floor. Product switching required an operator to climb to the bin's top to make a product switch. Often they would have to go back an hour later to make another switch as production and/or shipping requirements dictated. Most of the operators did not find the 10 flights of stairs easy or enjoyable to climb.

The control room is located on the second level, where several filter wheels are housed. These are the heart of the dryer operation. This gives a firm sense of the number of stairs climbed daily by many operators to switch products, control, and generally keep the unit running smoothly.

Old control equipment

Controllers were manual loaders and pneumatic and electronic single loop controllers. All were locally and panel board mounted. There were still quite a few locally mounted controllers and a handful mounted on the panel board.

There were a number of push buttons and strip chart recorders mounted on the panel board. The strip

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charts were “used” by management to “track” unit performance.

Operators frequently changed setpoints on local controllers then returned to the panel board controls to monitor the change.

Operational issues

Product storage and alignment:

- Products and bins were often improperly aligned causing rework or scrap.
- Climbing 10 flights of stairs is arduous, thus not conducive to maintaining focus on the task at hand.
- Emergency switching delayed due to operator not being available due to other operational duties.

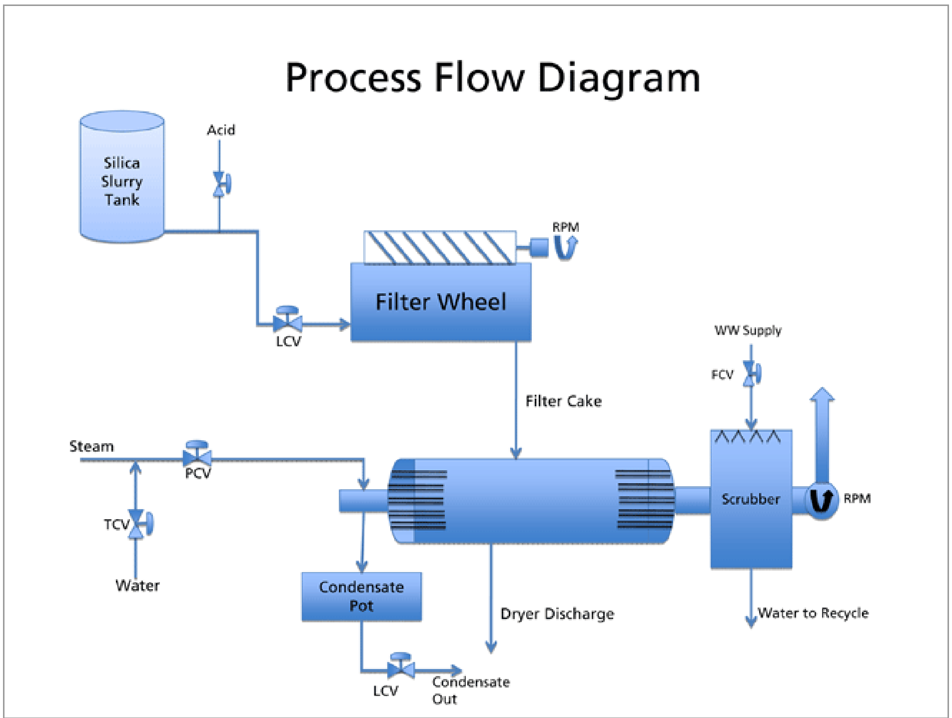
Steam system control:

- The steam system is a critical part of the dryer process as it impacts product quality.
- Indications for the steam controllers were located on the dryer’s panel board in the control room.
- Temperature and pressure controllers were under the ownership of the furnace operator in an adjacent area, which is a quarter of a mile away.
- The steam pressure and temperature controllers were located at grade level near the dryer’s unit perimeter, thus not easily adjusted by the furnace operator.
- Adjustments to the controller took time due to its field location and the responsibilities of the furnace operator. It often took the furnace operator 15 to 20 minutes to reach the controllers and change the steam system setpoints, when requested by the dryer operator.
- During steam system upsets, the furnace operator was required to stay at the local controllers, for long time periods, until the upset was stabilized, thereby keeping him from the furnace control room and other responsibilities.
- During an upset in the furnace area, the furnace operator’s top priority was to maintain furnace operation. This left the dryer operation in an unstable mode or shutdown and at the mercy of the rest of the plant.

Quality control:

- There were quality issues due to poor control over many of the parameters including moisture and pH.
- There was no common database to perform Statistical Quality Control (SQC) and Statistical Process Control (SPC) studies.
- Management had too few windows into the process to optimally manage their business with the old controls and instrumentation.
- Operations did not have an accurate “picture” of the process in real time; consequently, they did not see the subtle changes in the process affecting quality.

Due to disparate controls, lack of controls, lack of automation, lack of operator graphics, and the large territory covered to produce silica products, the operators often felt as though they were running the unit blindly. The operators faced many difficulties, which added to the stress of producing quality products.



The sell

After doing several projects in the silica dryer unit, it became more apparent the silica plant would benefit from a DCS, and not just any DCS. They needed the same platform the rest of the plant standardized on. The silica plant is part of a larger facility, thus shares utilities with other units such as the steam system. The selling process began, but even my own chain of command bluntly said I would fail because the silica plant would never buy it. More specifically, the product team leader would never buy it.

One-time data entry was a key initiative at the time, as was portability of data to the business leaders in the company. All DCSs were linked electronically and various data monitored by employees across the spectrum. Critical parameters in one unit impacting other units were ported via communication links to all units that needed them. Often this data was used in configuration of control strategies. This ability had vastly improved quality, productivity, and safety in other units. Therefore, it stood to reason the silica plant would benefit in similar ways.

The dryer Foreman was not familiar with DCSs nor was his product team leader. Ideas brought forward to bring all field devices into a DCS were foreign to them. It took a couple of months to convince the foreman of the right path to pursue. It also took project successes and hard work to gain his confidence. Once gained, we approached his product team leader, and the selling process began again.

The product team leader had many questions, and all were answered. Each time he would contemplate for a few months then request another meeting to ask more questions. Necessary resources based upon the questions posed were supplied. Most of the time, I provided all of the answers but other times I pulled in the system salesman. He needed to sell himself as well the company behind him.

Often the team leader looked dubiously at various people, as if incredulous that a DCS could solve so many problems for so little cost. These were new ideas to him. Although, a few times I checked my own forehead for a mystical "third eye." Tangible benefits were easily discussed, but the intangible benefits were not. By that time, I knew intangible benefits played a bigger role than management dreamed. However, since they were intangible, there was no proof and nothing solid to discuss. They had to trust experience on the intangible benefits from previous projects.

Ultimately, the entire selling process took a year and a half to two years. They needed to understand the payback completely, as well as the DCS.

The tangible ROI and payback

The only solid costs to justify the project were based on scrap. The soft issues were improvements to ease the difficulty of running the unit for the operators, i.e., elimination of trips up 10 decks and back down, elimination of all field controls, and a window into all aspects of the process through new and more instrumentation.

Scrap due to misalignment was the only hard data from which to economically justify investing in a new DCS. Misalignment produced visible results, thus had a paper trail to follow, with hard numbers from quantity scrapped to landfill costs.

Rework occurred, but costs were harder to obtain due to the nature of the unit and its ability to absorb non-compliant material into the process for rework. It never reached the shipping department, thus was not accounted for as "rework." That is, rework left no paper trail. This turned out to be one of the intangibles that benefitted from a new DCS.

Consequently, hard numbers on misalignment were easily obtained but gave operations management heartburn due to the perceived low ROI for the project. Each project needed at least a 27-33% ROI or a one and a half year payback. Based upon the cost of a scrapped ton of finished product and $400/ton to landfill the scrap, this project would barely meet those hurdles. Indeed, it would take 22 to 24 months to meet a 27-33% ROI. The payback would be 18 months. The "perceived" payback was near two and a half to three years. There was no basis for this perception, but it was the "instinct" of the team leader, which explains some of his dubious glances. He was convinced they could improve on their own through their operators and the scrap data was somewhat inaccurate.

The average age of the entire facility was mid-to late 50s, at that time. However, all of the dryer operators were well below that average age. They were at their peak. Performance was not going to improve through the operators. Often management is very optimistic about performance and its ability to get huge returns with no capital expenditures.

The soft issues, to ease operator difficulty, were not enough to provoke the investment either. In other areas of the plant, some small capital projects were implemented to ease operations' duties. That was not the mindset of this product team leader in the silica plant.

The scale of the project was kept to a starter-sized system with the intent to grow it as capital became available. The project was approved. Scrap costs due to misalignment were estimated at most to be $168,000 per year. This elicited strange looks from management, but that was an estimate using the least quantities from all data. Management never desires to admit the real numbers. Project costs were estimated to be $250,000, which they viewed with some degree of skepticism.

Ultimately, they did not want to spend the money, but their need to replace an obsolete PLC and persistence won.

The ROI of the intangibles

During the project, the decision was made to roll the entire unit to the DCS, ballooning the cost of the project from $250,000 to $750,000. The original project economics suddenly flew out the window. But the intangible benefits rescued all of us.

Installation of the DCS enabled automation throughout the process. Critical process variables were finally brought into the control room. These had huge returns for this unit.

Scrapping product due to bin misalignment went to zero, which reduced costs by $168, 000 annually. Automation of transporting product to the proper bin eliminated the need for land filling. It also eliminated the paper work burden on shipping and operations.

With automation of the transport system of product to the proper bin came the flexibility to ship emergency orders, since many customers adopted just-in-time inventory during its heyday. If an emergency order was being shipped, an empty bin could be utilized for other production runs. This eliminated the occurrences of trucks and rail cars being sent out with incomplete loads or missing shipping completely. Emergency orders were no longer an operations nightmare to fill. This greatly enhanced customer support and optimized shipping container usage.

How much is a reduction in start-up time worth to your business? Bringing a dryer up to steady state for in spec product is time consuming and costly. Automation of this unit also decreased the start-up time by more than 20%. If your customer has an emergency order to fill, how long does he want to wait for in spec product? 12 to 16 hours? Or is eight to 11 hours better? This also reduced the amount of out of spec product that had to be reworked during start up of a dryer resulting in an annual savings of $480,000.

Product switching was much easier through automation. This is another tremendous asset to provide the best customer service.

With the 1960s vintage controls, no one had a good window in the process including quality control. Strips were difficult to gather data with accuracy and accurate time stamps; consequently, the charts were not used. There was no common database of process variables from which to perform calculations and monitor the processes performance.

A common database enabled SPC charts, which increased quality significantly. Variations in some process variables were reduced to well within +/- 0.5%. SPC alone would not have achieved this result; however, SPC coupled with better controls and instrumentation did achieve this result.

All unit variables were presented to operators on workstations, which led to many creative ideas to solve their own problems. They saw variations in the process and began controlling much better. With the improved quality of critical process variables came the retention of customers through customer audits. How important are your customers?

The steam controls on the DCS also made a huge impact on another unit, which is very temperature dependent and uses the same steam header. Steam savings were $120,000 annually through better control on the DCS.

Estimated rework consumed 20-25% of the process time at a cost of $50/ton. The cost per ton is manpower for material handling, bags used for recycling, and an occasional rail car being tied up for recycling. Since this is a 365/24/7 operation, this cost was near $500,000 annually. As stated, since there is no “paper trail” associated with rework, this has been estimated to decrease as a result of the project to much less than 10%.

The DCS enabled the operators to finely control the pH addition, which is a critical process variable. Prior to the installation of the DCS, this was controlled much differently than today; consequently, the pH specifications were exceeded at least 24 times annually. This cost the dryer unit around $3.6 million annually.

The DCS enabled real time data for:

- Accounting purposes
- Yield
- Energy audits
- Customer audits
- Process change decisions
- Product improvements
- New product development
- Statistical Process Control charts for the operators
- Statistical Quality Control

They finally had a window into the unit, and engineers and operators made contributions toward improving product quality and operations. They were astonished with the irrefutable results of a DCS, more and better instrumentation, and automation.

The final project cost was $750,000. The final return, which is mostly due to the intangible benefits, was $4.9 million annually. Intangible benefits constituted 96% of the total payback.

Expanded growth

The irrefutable returns of the intangible benefits of this project prompted executive management to convert the remainder of the silica plant to the new DCS platform. These projects increased product quality and production with equally significant returns.

The dryer project also enabled the addition of a new production train without an increase in manpower, which would not have been possible without a DCS. Indeed, the existence of the DCS was a pivotal point in the decision to proceed with the new production train.

Intangibles are not so intangible

The analysis arose on the back end of this project due to the stark contrast between how they operated prior to and after the DCS installation. Putting dollar amounts to intangibles is something we all struggle with. By definition, they are elusive, indefinite, or vague.

Will this knowledge increase your ability to find and analyze potential intangible returns? That is the goal. The ideas presented are translatable to other industries, with thought, and they will prompt even more creative thinking. Even upgrading from obsolete platforms to modern platforms has substantial returns. The ease or success of your job will be a function of depreciation.

Therefore, intangible benefits are worthy of greater consideration rather than dubious glances. Intangible benefits exist, and management needs to accept those as valid, just as they do the tangible benefits. Now is the time for manufacturers to invest in newer equipment to improve the way they run their business. This will poise them for even greater returns when the economy begins to grow again.

ABOUT THE AUTHOR

Pamela Quillin is a Professional Engineer in Electrical Engineering, with 21 years of industry experience. Pamela is the President of Quillin Engineering, LLC in Erie, CO and has a master's in engineering from the University of Pittsburgh.

Depreciation

By Pamela K. Quillin, P.E.

Depreciation has meaning management often overlooks. In essence, depreciation is devaluation of an asset with time and usage.

The IRS establishes guidelines for depreciable property, and all must be met to define an asset as depreciable. The guidelines are straightforward and are as follows:

- The asset must be used in a business or retained for production of income.
- Its useful life must be definable and longer than one year.
- It must wear out, rot, get depleted, become obsolete, or lose value from natural causes.

There are numerous methods to depreciate an asset. The reader is encouraged to learn more about each method and run through calculations to understand the nuances of depreciation on income taxes and cash flows.

The element of depreciation considered here is what to do with a fully depreciated asset. By IRS guidelines, it has reached the end of its useful life.

Engineers are required to economically justify equipment replacement. Usually the equipment has been fully depreciated (i.e., the useful life of the equipment has been utilized). The equipment is worn out, and it is more than likely not supported by the manufacturer any longer from spare parts to software, where applicable.

When equipment is worn out and unsupported by the manufacturer, it is time to replace it. Management resists capital investments to avoid taxes on assets. However, that philosophy causes untold costs in quality stagnation, poor operating conditions, excessive maintenance, and downtime.

When worn out equipment is replaced, quality improves, throughput increases, maintenance costs decrease, operators have an easier time running the process to meet business needs, and uptime increases.

When a property is fully depreciated, replace it, which can make everyone's job easier and may increase business profits.

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