WHITEPAPER

Making the Business Case: Increasing Profitability with OSIsoft's PI System in the Food & Beverage Industry

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The food and beverage industries are characterized by large numbers of plants with diverse information systems, stringent manufacturing conditions, thin operating margins, and increasing regulatory requirements. Driven by globalization, consolidation, and the need to reduce time-to-market, the complexity of the industry's manufacturing environment requires agility based on real-time information.

OSIsoft's PI System is a well-accepted product in the food and beverage industry. When considering a software purchase or investment, management typically requires a justification based on expected business value that will be delivered. This paper outlines some of the expected benefits from a PI system installation, as they impact key performance indicators (KPI). Because some companies may place more weight on certain business drivers than others, this paper will assist companies in determining potential sources of value, and evaluating them based on their own internal guidelines.

The value delivered from the PI System can positively impact the following KPI categories:

Quality

Inventory Management

Productivity & Cost Reduction

Regulatory Compliance

Asset Optimization and Overall Equipment Effectiveness (OEE)

Agility

Agility is defined as the ability to move quickly and easily. Business agility is created when changes in plant or business conditions can be sensed at the proper scope, analyzed in the proper perspective, and result in action being taken quickly enough to benefit the organization. At the plant level, real-time information provides knowledge workers with the agility to adjust and correct minor process deviations before they result in quality problems like off-specification product, excessive scrap, or give-away. Advanced analysis tools allow engineers to compare dozens, or even thousands, of historical profiles to make decisions that optimize yield and cost. At the enterprise level, agility is created when real-time information on material flows, like production, inventory, and the effects of events like receipt of multiple sales orders can be viewed by knowedge workers across the enterprise. When information is provided in real-time at the proper level, decisions can be made in seconds or minutes instead of hours or days, resulting in tremendous operating efficiencies. The following examples demonstrate how OSIsoft's Real Time Performance Management System has provided the agility platform needed for many of our food and beverage customers to significantly increase their bottom line. Each example presents a scenario encountered by a customer before and after they implemented the PI system. Cost savings and solutions are clearly presented.

Quality

The ability to continuously improve the stability and capability of a manufacturing process results in greater consistency of product quality across all plants. By analyzing real-time manufacturing process trends and history, the effects of variations in process parameters on key quality variables can be understood. With availability of real-time information, process upsets can be avoided and SQC control limits for these parameters can be maintained in a tighter band. This produces greater consistency across all shifts at all plant locations. The benefits from improving product quality are widely understood throughout the industry. They include the following:

Reduced "out of spec" and "held" product

Reduced scrap and waste

Improved yield (reduced product "give-away")

Increased sales due to improved consistency in taste, texture, portion size, and consumer satisfaction

Reduced “Out of Spec” and “Held” Product

If product specifications fall outside control limits in a manufacturing process, the product stream or batch is often placed in a “hold” status while the severity of the deviation is evaluated and corrective action is taken. Early detection can result in the ability to recover or re-work the defective material, but there are costs associated with the hold time and associated re-work.

Example: A brewery was experiencing periodic filer breakthroughs in its beer filtration room, which produced a stream of beer with a high turbidity. The off-spec condition was detected during routine sampling in the holding tank before going to the filler. The filter cartridge was replaced, but 400 barrels of beer had to be stored and re-filtered. In addition, a different product was redirected into the line in order to continue production while the off-spec product was being re-worked.

Assumptions:

- Plant is operating at full capacity
- 4 lines running 24 x 7
- Frequency of occurrence was once per quarter
- Re-running filtration requires one production operator @ $25/hour for 4 hours
- Line loses one hour of production time during wash-out and changeover to new product
- Value of one hour’s production lost = $91,000
- Packaging materials removed by hand from packaging line must be scrapped, at a cost of $1,000
- Packaging materials staged for this run must be handled twice (two hours @ $25/hour)

Cost: $100 for re-work of off-spec batch (labor)
$91,000 loss of one hour’s production capacity
$1,000 scrapped packaging materials
$50 for additional handling of packaging
$92,150 per occurrence

Annual Cost: $ 368,600

With the PI System, filter room parameters including differential pressures, temperatures, and turbidities are displayed in real-time for the operators. Early signs of filter breakdown are detected by exception, and operators can predict filter changes based on filter condition rather than time in service. Filter cartridges are replaced immediately without interrupting production.

Results: Cost Reduction

Savings:	$1,150 per occurrence (materials and labor)
Annual Savings:	**$4,600**

Results: Revenue Increase
Because the plant is operating at full capacity, the hour's production can now be sold as finished product.

Increase:	$91,000 per occurrence
Annual Revenue Increase:	**$364,000**

Reduced Scrap and Waste

If certain product specifications fall outside critical control limits, there is no cost-effective means to rework the product and it must be scrapped. This is often the case once a product has been packaged and is ready for shipmet.

Example: A dry baked goods plant was experiencing difficulty in controlling moisture content in its finished product. If moisture content is too high, the product becomes soggy after 24 hours in the package. If it is too low, the product becomes brittle and turns to dust during the distribution process. Off-spec material cannot be reworked and must be scrapped. Control of moisture content is challenging, and fluctuations occur periodically due to variations in hold times and other shift timing variables.

Assumptions:

- Plant is operating at full capacity
- Inability to control moisture quality causes and average of 8 bad batches per month
- Batch cost = $15,000 for labor and materials
- Batch value = $30,000 per bad batch
- Disposal cost = $300 per bad batch

Cost:	$120,000 per month (labor and materials)
	$2,400 per month (disposal)
	$122,400 per month
Annual Cost:	**$1.47 M**

With the PI System, analyses of historic production cycles reveal the critical process parameters that are early indicators of problems with moisture content. By using SQC methods and real-time information to monitor these variables, production operators are alerted to these indicators and can make adjustments before moisture content drifts out of specification. Over a period of time, the number of bad batches is reduced.

Results: Cost Reduction
By month four, 7 of the 8 bad batches are avoided.

Savings:	$105,000 per month (material and labor)
	$2,100 per month (disposal)

Annual Savings: $1.29 M

Results: Revenue Increase
Because the plant is operating at full capacity, the product from every one of those bad batches can now be sold. Seven more batches are sold per month.

Increase:	$210,000 per month
Annual Revenue Increase:	**$2.52 M**

Improve yield (1)

The variation in process parameters is not always enough to produce off-specification product, but it can result in increased material cost, larger than normal portion size, or product give-away. Improved process stability can reduce this variation and increase the yield of the manufacturing process.

For example, a food manufacturer was having difficulty controlling the amount of a high-cost ingredient in its product. Due to the high degree of variation, more than the recipe amount was added just to ensure the minimum specification is met. In addition, the particle size of this ingredient caused fluctuations in the piece weight of the finished product, resulting in product give-away each day. Multiple causes were contributing, including variations in ingredient particle diameter and shape, dynamic weighing, conveyor speed, and product spillage from the conveyor.

Assumptions: Revenue Increase

- Plant is operating at full capacity
- 3 shifts per day, 365 days per year

Cost:	$800 per day (additional high-cost raw material)
	$1,200 per day (product give-away)
Annual Cost:	**$730,000**

With the PI System, through historical analysis of the process, it was determined that variation in particle size and shape of the high cost ingredient was one of the primary contributors. Process improvements were made and the particle size and shape are now sensed dynamically, recorded, and displayed in real-time before the material enters the feed hopper. Using the real-time information, production operators are alerted when significant size or shape variations begin to occur, and can take action to correct the out of specification condition. Over a period of time, the optimum particle size and shape were deteremined through a combination of real-time monitoring and historical analysis. As a result, the manufacturer changed the specification for the ingredient from the supplier, resulting in even further improvements in yield.

Results: Cost Reduction

Savings:	$650 per day (high-cost raw material)
	$1,000 per day (give-away)
Annual Savings:	**$602,000**

Improve yield (2)

In another example, a packaged goods manufacturer was having difficulty controlling the amount of a high-cost ingredient in its product. A high degree of variation in viscosity caused them to periodically add more than the needed amount just to ensure the minimum spec was met. The nominal amount was set near the upper control limit in order to ensure low fluctuations did not fall below the minimum specification. However, fluctuations in the piece weight of the finished product regularly exceeded the upper control limit, resulting in product give-away.

Assumptions: Revenue Increase

- Plant is operating at full capacity
- 3 shifts per day, 365 days per year

Cost:	$225 per shift (additional high-cost raw material)
	$300 per shift (product give-away)
Annual Cost:	**$575,000**

With the PI System, through historical analysis of the process, it was determined that the conditions of the batch between the mixing and the extrusion phase (time, temperature, agitation) were primary contributors to viscosity. Improvements were made in the consistency of the conditions under which batches are held before extrusion. Using this real-time information, production operators monitor batch conditions and are alerted when a prepared batch requires a change in temperature or agitation in order to keep its viscosity within the desired control limits.

Results: Cost Reduction

Savings:	$190 per shift (high-cost raw material)
	$245 per shift (give-away)
Annual Savings:	**$476,000**

Inventory Management

Improving how inventory is controlled and managed can also greatly reduce cost. The ability to match actual production to the schedule can be difficult, especially if the schedule is prone to changes in the middle of a shift. The ability to match production to the schedule results in more efficient inventory control, lower working capital requirements, and cost reductions.

Example: A consumer packaged goods manufacturer was having difficulty matching actual production to the schedule. The operators did not have real-time production data and estimated production based on sums of machine counts. As a result, overruns or under runs were common. In addition, different support groups responsible for ordering and staging the production materials had similar difficulty estimating, resulting in a mismatch of production materials. Leftover materials were either scrapped or had to be sent back to their storage areas to make room for the next run. Under runs resulted in lost sales while overruns required additional movment and storage. Special order products were occasionally scrapped and leftover materials were handled twice, increasing costs.

Assumptions:

- •Plant is operating at full capacity
- •Typical production order is a run of 10,000 cases
- •Typical overrun or under run is 300 cases
- •Product sale value = $10 per case
- •Overruns / under runs are evenly distributed, and each occur 3 times daily
- •Leftover materials handling = 2 labor hours per occurrence
- •Scrapped materials from line after overrun: $400
- •Scrapped special order product from overrun occurs twice per month, @ $3,000 per occurrence
- •Additional product handling for overrun = 1 labor hour per occurrence
- •Hourly labor rate = $25/hour
- •Overrun inventory carried for 3 months @ 15% per year

Under runs:

Cost:	$3,000 lost sales (per occurrence)
	$50 labor for additional handling of materials
	$3,050 per occurrence or $274,500 per month
Annual Savings:	**$3.29 M**

Overruns:

Cost:	$400 scrapped packaging materials (per occurrence)
	$50 labor for additional handling of materials
	$25 labor for additional handling of finished product
	$112.50 carrying cost, per occurrence
Subtotal:	$587.50 per occurrence ($1762 per day, $52,875 per month)
Subtotal:	$6,000 per month scrapped special order product
	$58,875 per month
Annual Cost:	**$706,000**

With the PI System, operators can now view scheduling information and production order fulfillment status from the company's ERP system, and real-time production data from the plant floor systems simultaneously. This same information is also avilable to support staff in the warehouse and across the enterprise. The ability to correctly match actual produciton to schedule results in reducing the average mismatch to 50 cases for the 10,000 case run.

Under runs:

Savings:	$2,500 lost sales (per occurrence)
	$225,000 per month
Annual Savings:	**$2.7 M**

Overruns:

Savings:	$333 scrapped packaging materials (per occurrence)
	$94 carrying cost, (per occurrence)
Subtotal:	$427 per occurrence ($38,430 per month)
Savings:	$5,000 per month scrapped special order product
	$42,430 per month
Annual Cost:	**$509, 160**

Productivity Improvement and Cost Reduction

Cost Reduction: Quality improvement and cost reduction generally go hand-in-hand. As described in the Quality section above, each example includes a component of cost reduction.

Productivity Improvement: The use of the PI System to provide real-time information multiplies the effectiveness of the organization. When knowledge workers are faced with a problem to solve or a process to improve, they typically spend 80% of their time obtaining the information they need, and 20% of their time analyzing it and making decisions that will improve it. With the PI System, the current and historic data from multiple sources, systems, and locations is available instantly, in its original resolution and in real-time, with a few clicks of a mouse. Powerful client tools allow knowledge workers to compare, analyze, and manipulate the data quickly in a way that makes sense to them. The result is a drastic improvement in productivity to roughly 10% of the time gathering data, and 90% of the time analyzing it.

Example: At a Global 1000 food manufacturer, a typical process engineer is responsible for $2M in cost reduction projects annually. With the PI System, each engineer achieves more than twice that level, effectively doubling the effectiveness of the group.

Asset Optimization

In every manufacturing plant, there is a cycle of steady-state operation that must be balanced with proper equipment maintenance. If the production cycle is stretched too long before maintenance, equipment inefficiencies can increase operating costs and reduce yields. This also increases the risk of run-to-failure, which can result in unplanned down time and extensive maintenance costs. On the other hand, preventive maintenance performed more frequently than needed also results in lost production time, and increases maintenance costs accordingly.

To the extent that limiting factors of these cycles can be understood and their costs calculated, the process cycles can be optimized. With real-time information, maintenance can be performed based on the actual condition of the equipment, not a spectic time of use when it may or may not be necessary. The PI System provides the tools to collect the information, perform the advanced calculations, and help engineers optimize these production cycles.

Example: Condition-based maintenance
In a food processing operation requiring heating and cooling, crystalization occurs within the tubes of the heat exchangers. With continued operation, the thickness of the deposits increases and heat exchanger efficiency is reduced, resulting in higher energy costs and lower process yields. In addition, heating and cooling cycles take longer, reducing Overall Equipment Effectiveness. However, the need for efficient operation must be balanced against the need to meet production schedules, and the down time and labor costs required for heat exchanger cleaning.

Currently, the plant is having difficulty meeting its production schedule. Weekly heat exchanger cleanings have been postponed in order to avoid lost production time. Production yields are suffering.

Assumptions:

- Plant is operating at full capacity
- Yield reduction of 7% over last 2 weeks and worsening
- This situation happens roughly 4 times each year
- Total Cost = $110,000 per occurrence, or $440,000 per year

With the PI System, engineers can measure and examine the interaction of complex variables in real-time. PI Advanced Calculation Engine (ACE) is used to calculate the optimum point to take the heat exchanger out of service for cleaning. The heat exchanger efficiency calculation is an array based on differential pressures, temperatures, flows, and energy losses. Energy usage costs are drawn from the cost of coal, boiler efficiencies, and steam usage. Combined with the increase in cycle time, the energy costs are compared against the known costs and estimated down time for each heat exchanger cleaning. The result is the optimum time to take the heat exchanger out of service for cleaning. The PI System allows operators to monitor the conditions in real time, and alert maintenance in advance so that the exchangers cleaning can be planned and completed efficiently.

Results: Cost Reduction

Savings:	Yield losses cut to 3% (from 7%)
Savings:	$63,000 per occurrence (material)
Annual Savings:	**$252,000**

The improved yield from the clean exchanger more than offsets the production losses from the cleaning down time.

Information Accessibility

Process Troubleshooting: The PI System makes information available to knowledge workers anywhere in the world. This provides teams of engineers with better capabilities to analyze and resolve problems and/or determine the root cause of an outage, even from a remote location. Corporate Central Engineering or staff can access plant data from their remote offices.

Example: In a Global 1000 food manufacturer, the Shanghai plant experienced an equipment failure, which idled two of its lines. The automation engineer was located at corporate HQ in London, and the plant process engineers were away from the plant, speaking at a conference in Syndney. Some plant information was relayed to London via e-mail and fax, but the automation engineer was unable to direct the troubleshooting without more detailed real-time information. Additional process engineering resources were available in Frankfurt, but also could not troubleshoot effectively without more detailed information. It took a full 8 hours to contact the engineers in Syndey, and they could not solve the problem by troubleshooting remotely. It took another 12 hours for the engineers to travel back from Syndey to Shanghai. Once back at the plant, the engineers successfully solved the problem, and the plant was up and running again in 4 hours.

Assumptions:

- Plant is operating at full capacity on 4 lines
- 3 shifts per day, 365 days per year
- Line 1 production rate = 20,000 cases per day
- Line 2 production rate = 40,000 cases per day
- Line 1 product value = $12/case
- Line 2 product value = $5/case

Cost = $440,000 in lost sales for this event

With the PI System, all knowledge workers can instantly view the same detailed historic data leading up to the failure, and the real-time data during troubleshooting, from their respective locations. Therefore, expert assistance to the plant can be provided in a timely fashion and without expensive travel costs. In this case, the automation engineer can immediatley access the process trends, and begin directing the troubleshooting effort from London. While the plant is trying to contact the process engineers in Sydney, the engineers in Frankfurt begin accessing the data in the PI System, bringing their expertise to bear. The problem is narrowed to one of three possible issues. As soon as the engineers are reached in Sydney, they review the data in PI, discuss the troubleshooting effort with the other engineers, and quickly solve the problem. The plant is up and running again in 9 hours, rather than the 24 it would have required previously. Also, a special trip is not required for the engineers to return from Sydney.

Results: Revenue Increase

Savings of 15 hours of downtime. Because the plant is operating at full capacity, the product from every hour of production can now be sold.

Total: $264,000 for this event

About OSIsoft, LLC

With the belief that people with access to data can transform their world, OSIsoft created the PI System to capture and store real-time sensor-based data. For over 30 years, OSIsoft has delivered the PI System with the singular goal of connecting people across operations to data and operations. Today, the PI System is embedded in critical infrastructure and involved in some of the largest data initiatives around the globe. Sixty-five percent of the Global 500 process companies use the PI System to help transform operations. Our customer base includes Fortune 100 and Fortune 500 companies in power generation, oil and gas, utilities, metals and mining, transportation, critical facilities and other industries. OSIsoft remains faithful to its original mission – to push the edges of innovation and create software that brings high fidelity data from disparate operational sources to people in all corners of our customers' enterprises – wherever, whenever and however it is needed.

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