White Paper

# Sustainable Profitability

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## What's Inside:

# Sustainable Profitability

## 1. Introduction

Many industrial businesses and manufacturing operations were designed, implemented and operated around a set of basic assumptions that have served the industry well over the last century. For example, although it was expected that the values of process variables, such as flow, level, temperature and pressure, would naturally fluctuate in real time, business variables, such as production value, energy cost, and material cost were assumed to be fairly stable over long periods of time. It was also typically assumed that the production operations could effectively work independently from the business operations. Production operations would focus on making the products while business operations would focus on reporting results. This, in turn, led to a bottom-up business information flow perspective. Business information was used only for reporting results and only the required data from the operation had to be provided to the business reporting system. Often no business information flowed to the operations.

The traditional focus of industrial operations resulting from these assumptions has been on operational objectives, such as throughput and consumption of resources, as compared to business objectives. Typically, plants were designed to maximize production output, which proved to have the limited agility necessary to meet market demands during economic downturns.

Finally, the labor mindset of the industry resulting from the workforce dynamics of the early industrial revolution is, for the most part, still very much part of the standard operational philosophy utilized in today's industry. A huge separation continues to exist between the professional and management staffs from the operations and maintenance staffs that comprise today's labor force. This separation was necessary during the formative period of the industrial revolution when the available labor force was unskilled and almost completely uneducated. Although today's "labor force" is fairly well educated and highly skilled in comparison, the professional and management teams still tend to work under the traditional assumptions. For example, the operator interfaces of most industrial automation systems have been designed around a philosophy called operations by exception. Essentially this means that operators are to do nothing that impacts the plant unless an exception condition, an alarm or event occurs that requires human intervention. Once the event is addressed, operators can go back to doing nothing. This philosophy was developed to protect the plant from the uneducated and unskilled operators.

For the most part, these traditional industrial assumptions have served the industry quite well up to this point. However, there are current changes underway that are beginning to show that these traditional assumptions will not be effective going forward.

## 2. Key Industrial Driving Forces

The industry business is currently undergoing a significant transition and will require industrial companies to modify their business approach to survive and thrive over the coming decade. Although there are many aspects to this transition, it can be effectively characterized by five forces that are becoming the catalysts for change.

**The five key industrial driving forces are:**

- **The transition from labor workers to performance managers** — since the industrial revolution, industrial companies have tended to view the frontline personnel as laborers rather than as skilled craftsmen and have worked to reduce and eliminate as many of these laborers as possible. Today, many frontline personnel are very experienced and well educated as compared with their predecessors. In addition, after decades of downsizing, the frontline staff is typically below critical mass for the operation of the plant. This combination is leading industrial managers to try to obtain more value from this critical resource base, rather than eliminating them. This value can be realized when these talented people are empowered to not only operate the plant, but also help manage the business performance of the plant. This transition has already begun in progressive industrial companies, but will likely become a serious and significant trend over the entire industry during the next few years.
- **The transition from process to profit management** — traditionally, manufacturing operations have been set up to accomplish their missions of producing products by automating each manufacturing process in the plant, somewhat independently, and counting on the efficiency and effectiveness of each process control scheme to result in an efficient and effective plant business operation. Although this approach had been very successful for decades, as the profitability of many industrial operations is being squeezed, managers are striving for higher levels of profitability through higher levels of control. This will lead to a refocusing of control from controlling processes to a higher level of control focused on truly optimizing the profitability of the operations in an ongoing manner.

- **The transition from transactional to a real-time business environment** — since the inception of the industrial revolution, the primary business variables of industrial operations have been reported and managed on a monthly basis. Monthly business management has been adequate because the business variables did not often change. For example, only a few years ago most industrial companies were able to develop contracts with their energy suppliers that covered a period of six months to a year. These contracts essentially relegated the price they paid for the energy they consumed to a constant value over that time period. If a value is not changing, there is certainly no need to control it. Over the past few years, triggered by a deregulation of the power grid throughout the world, this situation has started to drastically change. Business variables that had been constants over extended time periods are starting to experience considerable variability, some changing multiple times within a single day. This means that the business of the industry is truly transitioning toward real-time variability and the systems currently in place are not geared to deal with these real-time business variables.
- **The transition from an island to a holistic business perspective** — as industrial operations, technologies and organizations became more and more complex during the industrial revolution, the people leading these enterprises found that the only effective way to deal with the complexity was to partition the operations into areas of specialty. Each specialty area would then try to work independently to an acceptable level and coordinate across them. This led to the development of islands of automation, islands of information and islands of organization. Each island may have adequately performed its tasks, but the coordination and collaboration between the islands became a nightmare. Specialists dedicated to one island could not understand the technology or even vernacular of the other islands. If people cannot effectively talk together, how can they solve problems together? This has become a daunting challenge to industrial companies and this challenge must be met for companies to gain the necessary business improvements.
- **The transition from rigid to agile operations** — many industrial operations were designed and built in an era in which more was better. Plants were designed to produce as much output as possible over any given time frame. The markets were such that they could typically absorb whatever was produced. The marketplace has changed for many industrial concerns with industrial supply often outstripping market demand. Profitability can only be maximized by producing the right volumes of each product made to meet demand over a rapidly fluctuating demand base. For example, in the power industry as the grids opened up it produced a highly competitive production environment. Success is defined by placing the right level of power onto the grid at the highest profit points on the grid. Running plants at full production no longer results in increased profit. However, most power plants were literally designed to be optimized at full production. This has caused power companies to build small peaking power plants that kick in as demand and profitability dictate. Unfortunately, these peaking plants tend to be much more expensive to operate per unit output than traditional plants. It is not only the power industry that is facing this dilemma, the challenge is getting a rigidly designed plant or set of plants, that had been designed for full production objectives to become more agile.

## 3. Maximizing Profitability in the Emerging Industrial World

The five aforementioned industrial driving forces are going to have a huge impact on industrial operations. Companies taking a "business as usual" approach will find it to be very difficult to compete in the emerging industrial environment. Industrial companies that continue to operate according to the traditional assumptions are going to become the laggards of industry. It is quite straightforward to understand that change is required, but it may not be as clear to identify that change.

Perhaps the most direct way to find the underlying cause required to meet the emerging challenges is to go back to the basics of why industrial operations exist and to work up from there. Industrial plants are built to produce products that have economic value in the marketplace at the lowest possible cost. Therefore, the primary objective of industrial plants is to maximize the production value of the plant. Over the past couple of decades, most industrial operations have undergone a drastic leaning out process. Today, as a result, the fixed costs of a majority of plants are extremely tight. This implies that today's primary opportunity to reduce cost is in the variable cost of the operation, predominantly energy and material costs in most heavy manufacturing operations. The primary business objectives for most plants are to maximize production value while minimizing energy and material costs. As plants are operating, the primary constraints on meeting the business objectives, aside from the equipment constraints, are safety and environmental impact. This leads to a very simple business model that applies to most industrial operations, see Figure 1.

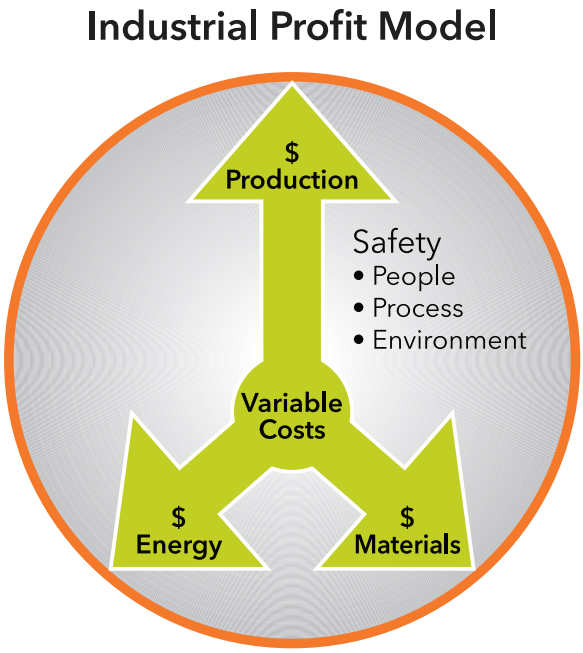


**Figure 1: Industrial Profit Model**

What makes this simple model so interesting is that it can be used to demonstrate the impact of the impending driving forces on the industry. For example, the transition of the business of the industry from transactional to real time essentially means that the five variables displayed in this model did not frequently change in the past, which enables industrial companies to reasonably manage business concerns by controlling the process. Today, all five of these variables (production value, energy cost, material cost, environment and safety) tend to fluctuate multiple times a day. This real-time variation of business variables presents an emerging business control problem to industrial companies that essentially did not even exist 5 years ago. Some industrial companies have tried to deal with this chaotic business environment by assigning specialists or specialized teams to deal with each of the five variables independently. For example, a company may have a team focused on energy cost, another on environmental issues, with a third focused on production value. Although this focusing of talent may be a noble attempt at addressing the problem, the model clearly shows that all five variables are highly dependent and addressing them independently will lead to sub-optimizing the operation. For example, an energy cost team might most effectively meet their objectives by turning the plant off. However, this action would clearly have a drastic consequence for both the production value team and the overall profitability of the plant. Optimizing the profitability of an operation requires effectively balancing all five real-time business variables in a manner that maximizes profit on an ongoing basis. This is the only approach that will allow industrial companies to continually maximize profitability.

Philosophically this may makes sense, but practically how can an industrial operation accomplish real-time profit optimization? This is actually simpler than initially appears. However, it requires letting go of some traditional assumptions that are beginning to block success. For example, as previously mentioned, most business systems and operations have traditionally had a strong reporting mentality. They view their jobs as reporting results rather than improving the business. Much of the data created and collected within a business system is for reporting purposes. Although reporting is important, it is more important to provide the actionable information that will allow plant personnel to drive improved results. Industrial companies require both reporting and action enabling information management and business intelligence systems.

To make the transition to actionable information, what type of new information is required? Process plants have measured critical process variables, such as flows, levels, temperatures, and pressures in real-time for decades in order to bring the process under control. To bring real-time business variables under control, the first step is to measures those variables in real time. The model in Figure 1 provides a good starting point for identifying which business variables need to be measured to optimize profitability, production values, energy costs, material costs, environmental and safety measures. Since all five of these categories of measures are starting to fluctuate in real time, all must be measured in real time to provide the necessary actionable information. This is not to imply that traditional operational measures or key performance indicators (KPIs) may also be required, they certainly may, but the real-time business measures need to be included as well.

# Sustainable Profitability

Measuring the business in real time creates no additional business value improvement until the measures are used to drive better business decisions throughout the operation. When discussing empowering personnel, many management books focus on empowering the professional and management levels in the operation, which is necessary but not sufficient. The workers who have the greatest impact on the profitability of a plant on a real-time basis is not the professionals or the managers, it is the frontline "laborers" – the operators and maintenance staff. All levels of the operational organization must be effectively empowered to perform their activities in a manner that drives improved profitability. This is the essence of the driving force in an industry of the laborers transitioning to performance managers. This involves both the actionable information and a mindset change across the industry to use this valuable human resource base more effectively. The information presented to each worker should be contextualized to the exact responsibilities and capabilities of the individual. Display technologies enable the presentation of information in creative ways and in real time. Therefore, the most effective presentation of this information is on a dashboard display designed specifically for that person. Information presented in this manner enables a level of manual feedback control of the business variables of the operation. This is very analogous to the early instrument and control systems used in the industry to bring highly volatile manufacturing processes under control. Sensors inserted into the process provided the process measurements and gauges showing the value of those measurements provided the empowerment. Process operators would control those variables in real time by watching the gauge and adjusting a valve to bring the measurement to the desired value. With business measurements and dashboards, operators can view the information in real time and then judge the value of each of their actions on the profitability of the section of the operation within their domain of responsibility. For example, an operator might adjust a set point and watch the dashboard to determine if that action added or destroyed business value. By obtaining this feedback, the operator can learn to adjust the set point to the point driving maximum value, just as operators learned how to adjust valves to control the process variables in years past.

Some business variables may change too rapidly, too slowly or be too complex for operators to deal with them through the feedback control process enabled via the business performance dashboards. In these situations, automatic feedback control strategies may need to be applied (see Figure 2). For business variables that change too quickly, the automatic feedback control of a business variable may involve the development of a variable specific control algorithm or expert system rule set that responds immediately when the value of the variable changes. For business variables that change too slowly a different approach may be required. For example, if an operator adjusts a particular set point in the operation, the resulting business value gain or loss may not be realized for a few hours due to the natural lags in the process. The operator may be at home having dinner and when the impact of the change is realized, they will never really know if it was an effective change. In these cases, technologies, such as process simulators may be employed. When the operator makes the change, the simulator takes the change as an input and goes into fast forward mode to calculate the business impact of the change that will occur in the future. In this manner, the operator can receive immediate feedback and make better-informed decisions. For business variable combinations that are too complex for operators to deal with, new forms of multivariable business control approaches may need to be applied.

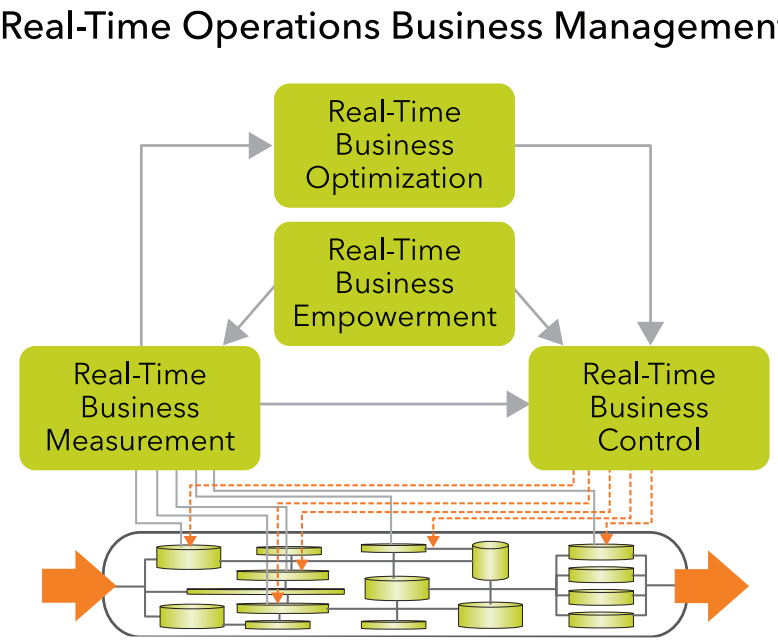


**Figure 2: Feedback Control of Industrial Businesses**

The combination of manual and automatic feedback control approaches can be deployed to provide a level of control to production value, energy cost, material cost, environmental impact and safety. It may begin to move the business in a more profitable direction, but as previously mentioned, to truly optimize profitability requires the balancing of the five business variables on a real-time basis and in a manner that results in maximum profit on an ongoing basis. Unfortunately, referring back to the model in Figure 1, accomplishing this requires a multiple objective optimization approach since there are three primary objectives; maximizing production value, minimizing energy cost and minimizing material cost. The mathematics necessary to effectively solve multiple objective optimization problems in real time has not yet been developed. Single objective optimization problems with multiple constraints can be resolved effectively by mathematics, but not multiple objective problems. Interestingly, although mathematics cannot solve these problems, people can. Operators even with a fairly low academic education can develop an experiential understanding of how to optimize multiple objectives if the actionable information associated with the objectives and the constraints of environmental impact and safety are presented to them in real time. It may take the operator time to learn how to balance these variables for maximum profitability, but over time they will learn and the result will be real-time optimization of the profitability of industrial plants.

Once each plant section is optimized, it is not difficult to replicate the entire plant. In addition, once all the plants in an enterprise are optimized it is not a huge leap to optimize the entire enterprise. What is required to accomplish this optimization is to understand the forces driving the industry that require new approaches and to change the traditional assumptions about industrial operations that have become critical barriers to necessary change.

## 4. Sustainability Through Visibility and Transparency

It is one thing to optimize the profitability of on operation at any point in time. It is a much more daunting challenge to continually optimize the operation over time and to sustain the profitability. Traditionally, when process optimizers were employed to try to optimize sections of a process, they initially worked well but degraded over time and often were eventually turned off. The real-time profit optimization approach discussed in this paper is naturally sustainable. By making all of the key business variables visible to the responsible individual and to the organization as a whole, the inclination will be to sustain the profitability over time. Visibility breeds sustainability. A visibility-based optimizer, such as this one ensures sustainable profitability.

## 5. Summary

The business of the industry is currently undergoing a subtle but very large transformation. Industrial companies that understand the ramifications of these changes have the potential to transform in turn by using technology and talent to drive improved, ongoing and sustainable profitability. Indeed, the consequences of not keeping up with this transformation may be dire. Sustainable profitability is not only available – it is absolutely necessary.

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