INDUSTRY VISIONARIES

The Need to Measure Industrial Business in Real Time

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Executive summary

Automation systems have been measuring operational process variables (temperatures, pressure, speed) in real time for years. But business systems have traditionally relied on a calendar-based, usually monthly, schedule. Today industrial business variables such as energy and material costs are fluctuating within less-than-monthly, even daily, time frames. This paper discusses the necessity of — and challenges involved with — measuring fluctuating business variables in real time, and presents a framework for prioritizing them as "dynamic performance measures."

Introduction

Business systems designed to report business results to management have traditionally been referred to as management information systems (MIS) and are typically designed around calendar-based schedules, with many business functions executed on a monthly basis. Automation systems, on the other hand, are designed to control the manufacturing and production processes to maximize efficiency and thus operate in a time frame relative to the operation of the physical process — real time. This functional separation and distinction between the two types of systems served industrial operations quite well as long as fluctuations to key variables occurred within a greater-than-monthly time frame.

Over the past decade a number of key business variables for industrial operations, which had previously been constants over extended time periods, started to fluctuate more frequently, often changing multiple times an hour. This began with the deregulation of the electric power grids. Electricity prices, which had previously been stable for months at a time, started to change every 15 minutes or even more frequently. This caused a domino effect to other types of energy, such as natural gas, and then to raw materials, and to the production value of many industrial operations. Monthly business measurement systems proved inadequate for decision support because the information they generated often came too late for effective decision-making.

Measuring business variables in the required time frame

Measuring variables within the time frame relative to the rate at which they may change — real time — has been a staple for manufacturing and production operations for well over a century. Flows, levels, temperatures, pressure, compositions, speeds, and other critical process variables change frequently and must be measured at a corresponding frequency if a manufacturing operation has any hope of being controlled efficiently. This has been common practice and a core competency at the plant engineering level for decades. Unfortunately, this same real-time measurement competency is not common in MIS organizations. As business variables started to experience real-time fluctuation, the organizations charged with business management lacked the capabilities required to address the situation. But what the MIS teams lacked, the engineering talent possessed.

The transition to real-time fluctuation of business variables has taken place steadily over a number of years. Because of this gradual transition, many industrial business managers did not realize that the profitability of their plants had become out of control. Therefore, they often did not immediately realize that relying on the traditional business management approaches was an impediment to increasing the profitability of their operations. Once they realized the problem. they were often perplexed as to how to solve it.

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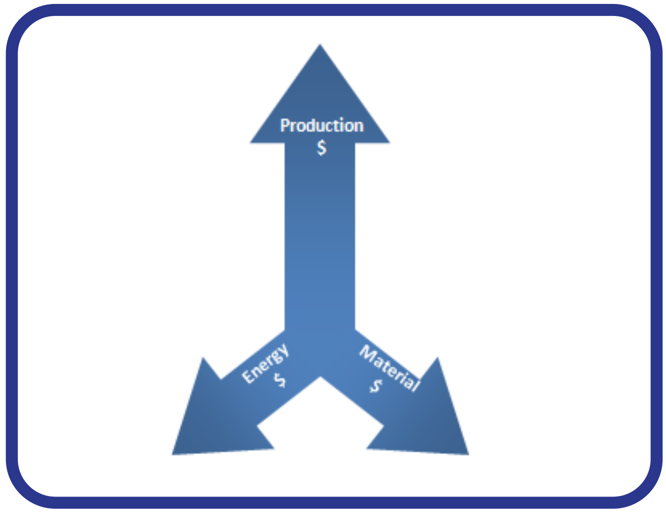
Business financials of a company are often presented in the form of balance sheets or other complex financial statements. It is daunting to consider all the variables on such reports fluctuating in very short time frames and how to manage such complex fluctuations. But it is important to understand that not all variables fluctuate frequently or within short time frames. In fact, in most industrial operations, only a few critical business variables fluctuate in less-than-monthly time frames. Those real-time business variables include

- energy costs
- material costs
- production value of the operation

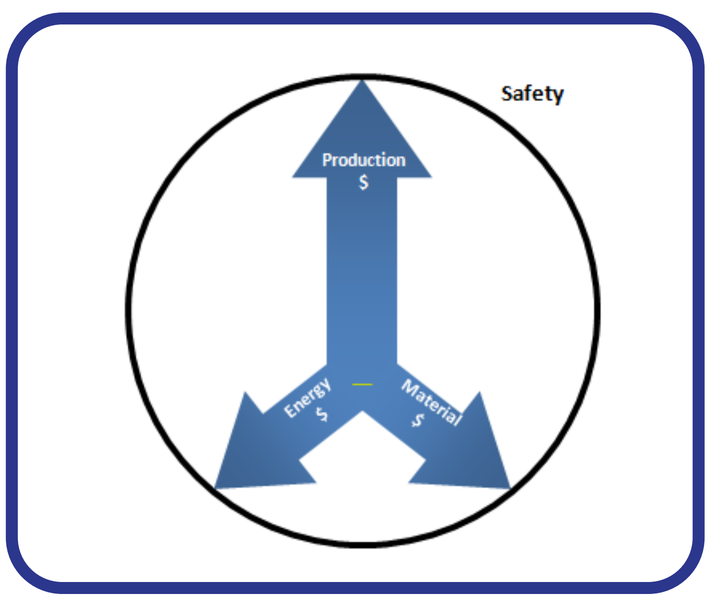
The primary business objective of any industrial operation is to maximize the production value while minimizing the costs of operation. The two variable costs of operation that experience real-time variability are energy and material costs. So the real-time profit model is actually much simpler than what may have been presumed. It involves maximizing production value while reducing energy and material costs in real time (**Figure 1**). Notice that these components that change in real time. The other key variables typically fluctuate over greater-than-monthly time frames and can therefore be effectively managed using traditional MIS systems. The real-time measurement of the variables that comprise these three vectors is referred to as real-time accounting.

Figure 1
Real-time profit model maximizes production value while minimizing energy and material costs in real time



The model in **Figure 1** presents a fairly classic optimization problem: maximizing production value while minimizing energy and material costs. As with any optimization problem, there are constraints on the vector lengths. Certainly the physical equipment presents some constraints since there are limits to the capacity and capability of the equipment. In many industrial operations the equipment constraints are not the first encountered. Since the safety of the people, equipment, and environment is typically of prime importance in these operations, the safety constraints tend to be encountered prior to other constraints in the production processes. The resulting optimization model is displayed in **Figure 2.** Referring to this model, the primary business measurements that must be made on a real-time basis in order to effectively manage and control the profitability of industrial operations are production value, energy cost, material cost, and safety of people, equipment, and the environment. Providing the real-time accounting and safety measures associated with these variables is a critical first step in enabling improved operational profitability.

Figure 2
Constrained real-time profitability model reflects constraints on the three vectors — here, safety of people, equipment, and the environment



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Most industrial operations supplement the business measures with sets of operational measures, often referred to as key performance indicators (KPI). These KPIs may measure important variables across the operation. Many of these KPIs also fluctuate in real time and, therefore, must be measured on a real-time basis to support effective operational decisions.

Teams charged with managing the performance of industrial operations require both real-time business measures and real-time operational measures of performance to effectively control today's dynamic industrial operations. Complete dependence on business measures may cause the teams to deemphasize critical safety and operational conditions, while complete dependence on KPIs may cause them to operate at less-than-desirable profitability levels. A balanced view is required. The problem is that the sheer number of real-time accounting measures and KPIs can overwhelm operations personnel with too much dynamic information. The solution is to present the measures that are of prime importance to the operation at any time, based on the current operational strategy, and to present them in priority order. Experience has shown that operations personnel making real-time decisions can typically handle about four measures at a time. Applying a strategic filter to the combined real-time accounting measures and KPIs that prioritizes the measures according to the current operating state and strategy can meet this requirement (**Figure 3**). One example of such a filter can be produced through a Vollmann Decomposition process. The resulting prioritized measures are referred to as the dynamic performance measures (DPM) of the operation. This description has both operational and business connotations and provides a nice bridge phrase between the traditionally separate functions.

Manufacturing strategies are not as stable today as they had been previously. In interviews with one food company it was discovered that in years past they would establish a manufacturing strategy that was expected to be effective for decades. Today's industrial market is much more dynamic. Operational and manufacturing strategies often require adjustment multiple times *daily* in the most dynamic industry segments, such as power generation, transmission, and distribution. Other industries may not be quite as dynamic, but the outside market drivers are certainly causing them to change or tune their operational strategies much more frequently. Each time there is a strategic change, the strategic filter for the DPMs must be adjusted to reflect that change. The result will be a new prioritization of the measures that reflects the new strategy. In this way the operational and business control system can be reprioritized to the current environment. The result is a set of prioritized measures that can be contextualized to empower every person in the operation who has an impact on profitability with the exact actionable information needed to make better decisions that drive improved profitability.

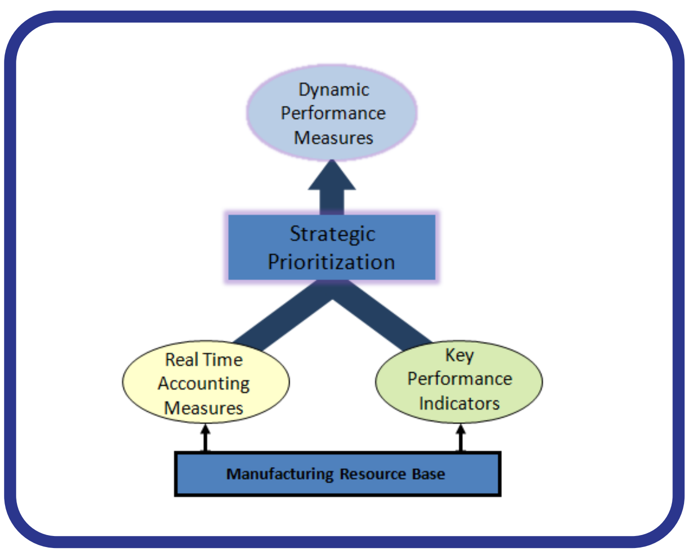

Figure 3
Apply a strategic filter to the combined real-time accounting measures and KPIs to identify prioritized measures, or dynamic performance measures

Conclusion

A fundamental rule in control theory is that what is not measured cannot be controlled. This is certainly true, but there is more to it than merely measuring the critical variables to be controlled. Variables must be measured in a time frame appropriate to how frequently they may change. These rules have been employed for decades for plant-level manufacturing process control. In fact, they have also been employed by default for business-level control, since traditionally most business variables did not change appreciably in less-than-monthly time frames.

Continuing to try to manage the profitability of industrial operations on monthly data has proven to be futile. The skills exist in most industrial operations to meet the challenge, but they tend to be in different organizations. Pulling these skills together across the engineering, MIS, and business teams is critical to increasing operational profitability. New real-time performance measurement systems based on dynamic performance measures (DPM) are required to enable both real-time operational and real-time business controls. The challenge may be daunting, but the solution is at hand.

About the author

Dr. Peter G. Martin has been a member of the MC&A Hall of Fame since 2018. He is VP of Innovation and Marketing and an Edison Master at Schneider Electric. He has worked in industrial automation for over 40 years in training, engineering, product planning, marketing, and strategic planning. Peter holds multiple patents for dynamic performance measures; real-time activity-based costing; closed-loop business control; and asset and resource modeling. He is a published author, was named one of Fortune magazine's "Hero of U.S. Manufacturing" and one of InTech magazine's 50 most influential innovators of all time in instrumentation and controls. He is an ISA Life Achievement Award recipient, an ISA Fellow, member of the Process Automation Hall of Fame, recognized for his work in integrating financial and production measures that improve the profitability and performance of industrial process plants. Peter has a bachelor's and a master's degree in mathematics, a master's degree in administration and management, a Master of Biblical Studies degree, a doctorate in industrial engineering, and doctorates in biblical studies.