OPERATIONAL EXCELLENCE FOR MANUFACTURING MADE EASY

A Financial Perspective

FORCAM
we speak machine

CONTENT

The first question any manufacturing CFO must answer is:

WHAT IS THE CONNECTION BETWEEN THE SHOP FLOOR AND THE TOP FLOOR IN MY PLANT?

Why does this question matter?

Because the manufacturing organization needs a consolidated view of the production process. Therefore, the manufacturing enterprise requires a standardized business process for better control and visibility.

The promise was the Manufacturing Execution System (MES), which was to streamline data management, deliver knowledge throughout the enterprise and provide a window into the true operational state of any plant.

In reality, MES might better stand for 'Monolithic Enclosed Silos'. Instead of seamlessly meshing plant information, the monolithic MES created walls where given portions of data—sensors, maintenance information, planning, logistics and supply chain, to name a few—were kept apart from each other.

Individually, each silo of data is important, but the power of data is exponentially multiplied when that data can be analyzed to provide a single image of a plant's total operation, from the front door to the back door. For those manufacturing businesses in multiple locations on different continents, such data silos make it impossible for the manufacturing CFO to compare operational data. To be able to benchmark best practices across every facility, and to find common equipment or strategic shortfalls across multiple locations.

So, what is needed, then, is connecting the former silos together in a network that fully captures and considers the data that is already available.

Those information silos are being demolished through that operational revolution known as Industrie 4.0 in Germany and the Industrial Internet of Things (IIoT) in the U.S to provide the manufacturing CFO with powerful insight to help streamline business practices and deliver dramatically measurable savings across the enterprise.

By any name, the goal is to create a Smart Factory—to leverage the existing and latent data to provide managers with the tools they need to reduce downtime, improve human resource management, cut waste in materials and energy and improve safety. Every one of those metrics delivers cost savings right to the bottom line with no change in suppliers, capital expenditures or personnel. It is the lowest of hanging fruit.

SO WHAT ARE THE BARRIERS TO ADOPTION?

Primarily, it's an understanding—to paraphrase what Glinda told Dorothy in "The Wizard of Oz"—that you've always had the power to solve this problem.

The solution, as Dorothy finally surmised, is right in your own back yard.
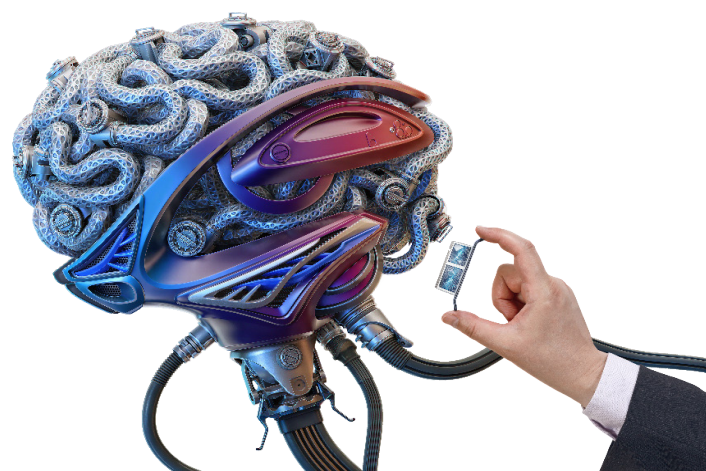
IIOT VERSUS MES: TWO PARADIGMS

Data is everywhere in manufacturing. A common myth as manufacturers cautiously consider the issue of IIoT deployment is that it will require more sensors deployed in more places, creating greater complexity. The truth is just the opposite. IIoT's primary selling point is better analytics of data. Throwing more sensors at a problem might not be as effective as analyzing what information you've already captured to get a true idea of your current state. You may have plenty of data, but without the demolition of our new definition of MES—'Monolithic Enclosed Silos' — you would have no idea whether that data is too much, not enough, or just poorly organized.

Connecting the former silos together in a network that fully captures and considers the data you have today, is by any means what we call a true transparent manufacturing enterprise. It does connect pieces previously walled off in the silos, includes supply chain, operations, personnel, sales and maintenance.

The places where inefficiencies occur most often is where one part of the organization simply doesn't have access to all the information needed to make an informed decision. For example:

- Sales creates an order with a 24-hour turnaround time—normally within the scope of established operational procedures. Sales is unaware, however, that the maintenance schedule calls for the line manufacturing the product to be down for planned maintenance for four hours that day. The order is delivered 12 hours late.

- A new product design requires new parts to be incorporated into the manufacturing process. Unfortunately, the supplier isn't notified and the launch of the product is delayed while the supplier ramps up parts production. This delays sales, marketing and production planning.

- At the peak of the manufacturing season, the sensors indicate a number of bearings are running hot on one of four production lines. There is an opportunity to bring the line down smoothly to address the issue, but what is the issue? Without historical data, it's impossible to tell if when the bearings were last lubricated. It's also not clear without more accurate trending data from all four lines whether this is specific to the one line, or whether all four lines might be susceptible to the same issue.

Such level of insight through connectivity to the shop floor not only makes the business more transparent and helps minimize costly impact, it also allows for modeling of data, so that manufacturing leaders can predict the cost and the operational impact of a decision before putting it on the plant floor. A fully connected operational supply chain can extend beyond the receiving department through to sales, procurement, operations, maintenance and delivery.

Boston Consulting Group (BSG) suggests manufacturers are too slow to adapt IIoT or Industry 4.0 standards. Manufacturing needs to apply processes and controls to improve production capabilities throughout the entire enterprise to remain competitive in a fierce market environment. There needs to be a strict focus on powerful metrics such as Overall Equipment Effectiveness (OEE) for all CNCs and PLCs in a factory.

What manufacturers also need is deeper knowledge on how to apply digital technology on the shop floor.

CFOs are constantly concerned with cash flow, unit costs, utilization rates and the overall issue of return on investment (ROI). If the manufacturing plant had the same kind of financial-based data transparency, the CFO would better identify such critical alerts such as machine downtime and waste reduction. Alerting can be immediately transmitted to the CFO using wireless internet platforms. A focused approach by paying close attention to OEE provides greater accuracy in getting the real-time data to the CFO. The clarity of these numbers allows the CFO to take decisive action -- in real time.

Of course, there are distinct differences between small, medium, and large manufacturing operations. Small companies usually have a CFO who also acts as a controller and focuses on the plant floor unit costs and utilization. In a mid-size company, the CFO may delegate this activity to the controller and focus only on the overall ROI of the business. In a large company, the CFO may be far removed from the plant floor production process.

However, a modern and truly integrated manufacturing business can answer these questions, and provide a glimpse into the future, in order to prevent costly incidences during production no matter of its size.

In addition, looking past the preventive maintenance strategies of the past, we now see the way toward a Predictive IIoT Platform—one where any member of any team can see at a glance how a decision will affect the entire enterprise.

We think Manufacturing is powerful and exeptional.

These are still operational dreams today, but in a day where end-users will expect a single-batch production process, customized to their whim—and that day is almost upon us—such operational flexibility will be the rule of manufacturing. Manufacturers want to be exceptional. They do not want to be the exception.

In the next few pages, we will guide you through the process of destroying silos by creating a truly transparent and connected manufacturing business with cutting-edge technology. The paper intends to highlight the importance of data usage and the benefits it will bring to the Manufacturing CFO and the future growth of the company.

Manufacturing is undergoing a seismic disruption in data collection. Gone are the days of the spreadsheet and the factory floor burdened with paper; today's digital manufacturing operation is transforming factories into Smart Factories, where Big Data analytics are available instantaneously and in real time.

But as an Industry Week special report recently noted, more than half of manufacturers say they are using the Industrial Internet of Things (IIoT) to collect data only and are not connected to an ERP system.

Just 44% of North American manufacturers collect data from sensors embedded in their machines. This data is used to generate reports and perform root cause analysis when problems arrive.

Often the analysis does not get acted upon until later in the shift. This gap must be closed to ensure a seamless "Just In Time" production process and to desired quality standards. Industry Week's survey found less than one out of four respondents use IIoT data for more proactive purposes, such as development of optimization models or data mining to make better plant floor decisions.

Effective data mining and management allows CFOs to perform more accurate financial planning. Using a cloud-based interface to ERP systems, a progressive CFO can then generate more accurate reporting, visualization, alerts and metrics, including key shop floor metrics such as Overall Equipment Effectiveness (OEE).

So what is needed is a systematic way to bridge these data gaps while breaking through the silos. And in destroying those silos, manufacturers do not want to replace sensors or add complexity. They want a new way to see their data without untying their existing network.

The promise of IIoT is in the development of powerful and intuitive software solutions that can provide a bridge between the existing data and the new analytics. For example, IIoT platforms like FORCAM's FORCE™ are modular IT systems that are configured to the manufacturer's existing data.

The new IIOT-based software platforms cover all of the existing challenges faced on the plant floor with one solution, including but not limited to:

- Performance Analytics
- Dynamic Scheduling
- Track and Trace
- Document Control
- Product Data Management
- Energy Control and Management
- Predictive Analytics

All of this is accomplished through an integrated system built on the FORCAM FORCE™ Bridge. The Bridge does just what the name says; it provides seamless data collection in real time from a variety of sources. This creates a single, standardized collection of data, regardless of whose sensor is gathering the data or whose PLC is processing the information.

It also connects through infrastructures and connectivity standards such as OPC, MTConnect®, and to machines as diverse as Siemens, DMG Mori, Omron, Makino, and MAZAKs. It further creates a connection to established IT systems like product lifecycle management (PLM), tool data management (TDM), computer-aided quality assurance (CAQ), computerized maintenance systems (CMMS), and enterprise resource planning (ERP) systems from SAP, INFOR, Oracle, and other vendors.

In this way, the promise of IIoT is realized.

Software innovators such as FORCAM offer a connection to the data as it exists today—on any machine, any existing platform, controls and IT systems, which then can be accessed on any web-based device - at any time to intervene in case of any deviation.

$$OEE = Availability \times Performance \times Quality$$

THE DATA DECISION

Improved operational connectivity changes the dynamics in a manufacturing operation, here is how:

1. **Downstream connectivity**: the operations and maintenance teams are all working from the same playbook. Plant sensors and controls can provide the data, and the software contributes a predictive model from the data that shows where trouble is today—and where it might be tomorrow. The ability to take down a piece of machinery on your time rather than when the machines breaks down is not only just an equipment replacement cost. Other factors include idle employees, damaged or ruined product, production scheduling and safety. All these "soft costs" are overlooked when machines go down, yet they contribute to the largest part of the cost of an unplanned downtime. This is especially true if there is a safety incident.

2. **Upstream connectivity**: It's important to look past the simple ability to connect production data to your business system. It seems like a luxury, but in a truly transparent and integrated manufacturing business, it's an essential benefit. No one wants to carry more inventory at either end of their supply chain than is necessary. With a business system that can sense raw material needs and also create the right level of inventory, the needs of the business unit and the production team become homogenized. Waste is replaced with efficiency.

3. **Modularity**: In the IIoT system, devices can be connected simply and seamlessly. Outfitting maintenance teams with hand-held devices can speed the delivery of data from IIoT to the site of a breakdown. Scaling and connecting such a system is easy and most devices can be bought off-the-shelf. The system is only as large as it needs to be.

4. **Intelligence:** If there has been one quantum leap in the past five years, it is in the quality of data analytics available to plant operations. FORCAM's work in this area, and the work of other software and network companies, has created a cloud-based analytics platform that can connect data. But software development has progressed to the stage of machine learning, where the artificial intelligence built into the software can lead to predictive analytics. It is connected through the entire IIoT network—from the device to the software and then through the cloud to a global network.
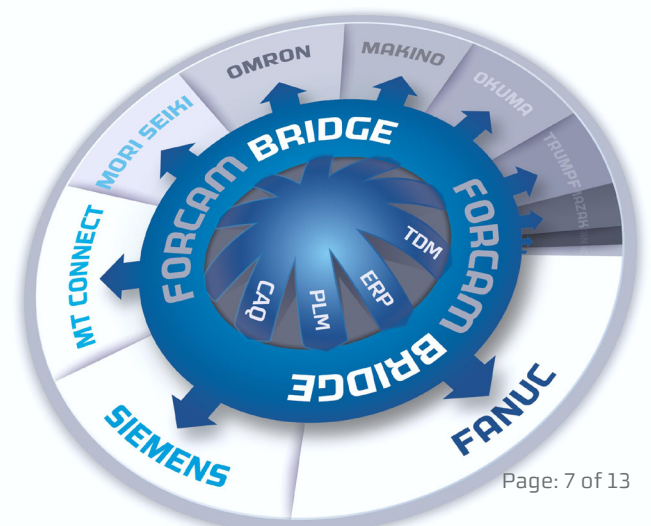
5. **Plant metrics:** Once in the cloud, the data from far-flung plants can be compared, analyzed and reviewed. A strategy around machine maintenance and effectiveness can emerge, and results will be available much more quickly than ever before. OEE was once the definite data point to show a plant's operational efficiency. Today, this can even be enhanced with data about machine health and meantime to repair (MTTR) and Mean Time Between Failure (MTBF) can provide a heads-up to all plants in a system about machine trends in common equipment. Tracking these metrics leads to overall optimization of the Return on Capital Employed (ROCE).
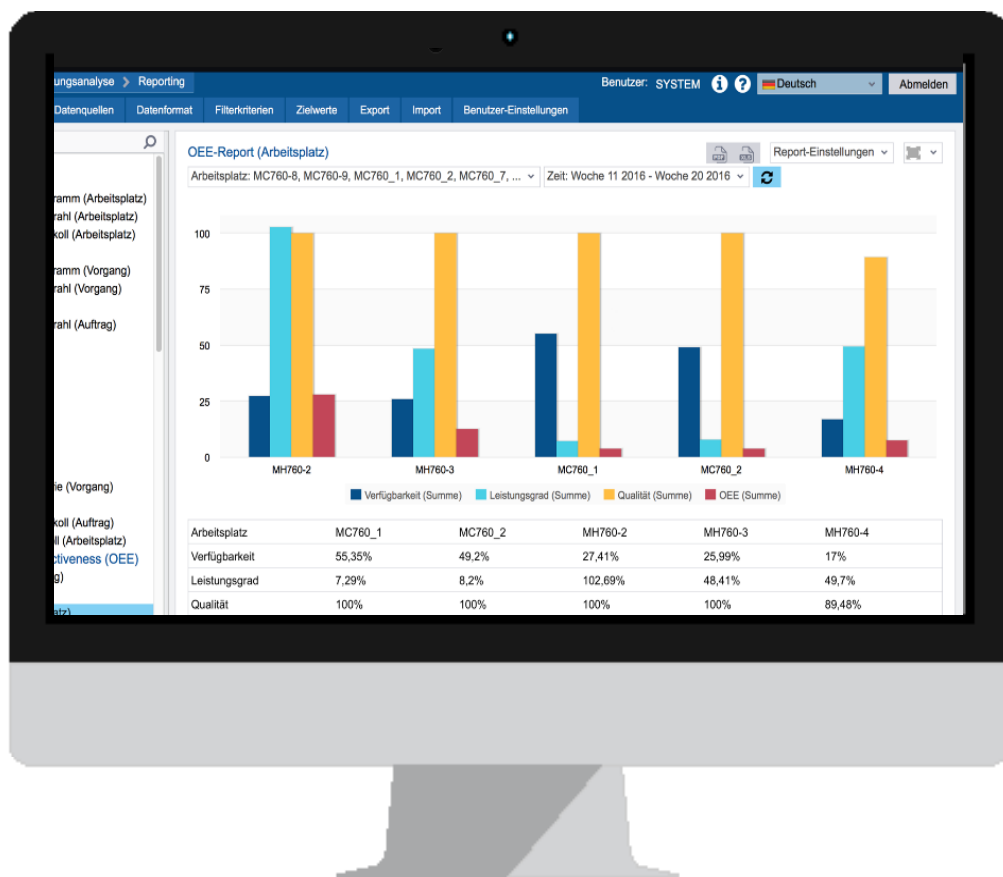
The Smart Factory approach provides true tangible results, such as:

- Increased shareholder value.
- Increased profitability.
- Decreased capital expenditures.

That in turn delivers:

- An increase in revenue.
- A decrease in costs, working capital, and fixed cost.

"A fully loaded or an-at-capacity factory that increases its OEE will have more leverage and higher revenue," a CFO interviewed added. "The increase in capacity will increase revenue. A partially-loaded or not-at-capacity factory that increases OEE will realize cost savings."

Arbeitsplatz	MC760_1	MC760_2	MH760-2	MH760-3	MH760-4
Verfügbarkeit	55,35%	49,2%	27,41%	25,99%	17%
Leistungsgrad	7,29%	8,2%	102,69%	48,41%	49,7%
Qualität	100%	100%	100%	100%	89,48%

PRODUCTIVITY IMPROVEMENTS

Machine Tool Builder

KRONES

+11%

PRODUCTIVITY INCREASE IN 4 MONTHS

Medical Devices

mps

+20%

EFFICIENCY IMPROVEMENT (OEE) IN 12 MONTHS

Automotive OEM

Audi

+20%

MORE THROUGHPUT IN 12 MONTHS OF DEPLOYMENT

Automotive Tier 1

GRAMMER

+24%

PRODUCTIVITY INCREASE IN 12 MONTHS

Aerospace Supplier

GKN

+20%

DECREASE IN CYCLE TIME IN 12 MONTHS

SUMMARY OF BENEFITS

When we talk about the connected manufacturing business we tend to think of it in traditional terms—cables and connectors, I/Os, PLCs, and Manufacturing Execution Systems (MES). But in the IIOT revolution, the emphasis is on bringing ideas together as well as machines. It also means linking all business processes—not in a chain, as we have thought of connection in the past, but in a truly functial connected manufacturing organization.

To accomplish this, we must put aside the old ways we gather and distribute data. The new model requires that we not only gather and analyze the information from our machines, our supply chain and our enterprise, but also share that knowledge within our organization. A fully connected manufacturing business effectively communicates the value of the data and the jobs that result from the use of that data to all members of the team.

We must also realize this is not accomplished by just adding more sensors or nodes. We already collect a tremendous amount of data on our plant floor. What we have not done well is evaluate that data for knowledge. It is the emergence of software solutions such as the FORCAM FORCE™ and related services like the FORCAM ACADEMY that allows this data to be understood and to be used to improve operational excellence, reduce downtime and make our plants safer.

Changes and benefits of IIOT-based technology for the Manufacturing CFO:

1. **The Shop Floor**: Legacy machines may still have value, but there also is a great deal of aging equipment in a plant. Understanding the state of each piece of equipment, maintaining it on a prescriptive maintenance model, and replacing equipment on time and as needed preserves both **uptime and capital**.

2. **The Top Floor:** The evolution of data management helps the C-Suite bring ERP systems, PLM networks and the business and operations systems into an interconnected and yet cooperative data stack. Now, a work order can be performed at one part of the plant, the purchase order for the replacement parts can be ordered and delivered through procurement, and the CFO can **see at a glance how money is being spent and how decisions are being made**.

The IT Infrastructure In Plain Sight: Information technology no longer is "the man behind the curtain." IT professionals obtain visibility to all parts of the enterprise through revolutionary technology of the FORCAM FORCE™ Bridge that connects any existing IT component of the manufacturing business from one source only. The IT team will get knowledge of not only what must be instrumented, but why, and how the data is being used. Think Predictive Analytics and Advanced Shop Floor Management technology working in harmony to help the manufacturing business to drive throughput and uptime. In turn, they will also be a visible part of the manufacturing team, which creates a culture of **true collaboration and win-win mentality**.

They will create robust wired networks where needed, secure wireless networks where appropriate and integrate and maintain powerful Shop Floor Management software to transform Big Data into actionable information that the plant floor can turn into productivity and profitability, a necessity to **stay ahead of the competition**.

4. **The Culture Shift:** What these first three steps really do is to raise awareness of the interconnected roles of each part of the overall enterprise, and **demolish the silos that have separated these teams**. This not only serves to let each department in a manufacturing organization understand how they are all parts of the whole, but also provides a fresh set of eyes. From this comes new perspectives, and new ideas that can be more easily shared, evaluated and implemented.

5. **The New ROI (Return On Information):** In an interconnected manufacturing business, the speed of change is profound, but so is the improvement of processes. Managers can **evaluate energy costs in real time**. Maintenance projects can be done with a purpose instead of a calendar. The supply chain at both ends of the building can be streamlined and optimized. And the customer can count on the free flow of products that can be produced in batches of one and delivered almost as soon as they are ordered. That leads to faster delivery, greater turn time and more product out the door—without adding employees or equipment. In the end, the customer is surely is to benefit from modern IOT-based technology to provide rapid ROI (Return On Investment) and more business.

Data collection and modeling capabilities now make it possible to test scenarios and then optimize operations and financial performance as circumstances change. Advanced manufacturing technology was not available 10 years ago. Manufacturing is doing what it always strives to do, reduce costs and increase revenue by satifying customer needs. The digitalization of manufacturing is creating more opportunities for innovation.

With Advanced Shop Floor Management technology, the CFO is able set the goals for what is expected from mining plant floor data. This will help create a better understanding of how to align production goals and corporate strategy by utilizing technology, such as FORCAM FORCE™ to maximum benefit and rapid Return On Investment.

" *Strategically, the biggest risk of NOT having FORCAM's Shop Floor Management Technology is that we would be out performed by our competitors.* "

Martin Thorden, President
GKN Aerospace Newington, CT

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"If you cannot measure it, you cannot improve it."
Lord Kelvin