Data-driven Manufacturing

RESTART IN PRODUCTION

Creating added value from shop floor to top floor
Restart with smart manufacturing

The turnaround year 2020: Companies in the manufacturing industry must reduce fixed costs in the short term, become profitable again in the medium term and regain their competitiveness in the long run. Digitization offers the best opportunities to meet this challenge. The networking of products, machines, systems, processes, and locations is the foundation for smart manufacturing.

The turning point of the Industrial Internet of Things (IIoT) era: As complex as a digital transformation may sound, its necessity is undeniable. Only those who rely on data-driven manufacturing will participate in the digital business process revolution of tomorrow. All it requires is a new IT architecture that combines all the advantages of digitization benefits - transparency, flexibility, standardization. Every single one of these factors delivers greater competitiveness and location security.

What are the technology trends in IIoT, and how can companies use them sustainably? FORCAM summarised important findings from industry-leading consultancy firms – connectivity, digital twin, edge/cloud computing and security. And finally, we created a checklist that shall guide your digital transformation.

We hope you enjoy this research collection to aid your successful restart in smart manufacturing.

With kind regards -

Franz Gruber  
Dr. Andrea Rösinger  
Oliver Hoffmann

Founder      Co-CEO  Co-CEO

About FORCAM

Founded in Ravensburg, Germany, the factory software specialist offers a fully flexible IIoT platform solution. The solution helps manufacturing companies reduce waste and increase profitability as well as to remain competitive in the long term. The product suite, FORCAM FORCE™, generates a uniform data model straight from production to finance.

It contains all the key MES (Manufacturing Execution System) applications on a turnkey basis, allowing for a flexible composition and collaboration of existing IT solutions and partner applications. It gives companies the freedom to create their own IT architecture.
How companies reduce costs and increase efficiency

„Above all, we wanted to make the costs visible. To do this, we had to bring production and controlling together. This actual feedback to SAP ERP is a real enrichment for us in controlling.”

Tanja Knechtskern, Grammer AG

Two-pronged Challenge

As a result of the factory shutdowns in the unusual year 2020, managers of manufacturing companies must meet a two-pronged challenge. They must quickly stabilize their company’s economic situation and, at the same time, initiate a fresh start that allows the company to return to sustained growth. They need to reduce fixed costs and drive sustainable liquidity management to regain long-term competitiveness.

Sustainable Liquidity Management

According to Südwestmetall’s findings, the central prerequisite for sufficient liquidity is a clear, correct and up-to-date data situation in planning and production. It is all about the transparency of inventory in warehouse and production. It is about clarity about the product portfolio and its contribution to the company’s success, as well as fast communication and decision making.

Transparency in production is the key

The key is the transparency of the entire production process. Data-supported production offers this transparency.

Take inventory management, for example: Data-supported production ensures that companies know the exact order status and the exact throughput times in production. It enables them to improve material requirements management and reduce their inventories of unfinished products. When companies improve their supply chain management in this way, they reduce inventories, lower costs and achieve greater liquidity. Accurate production data can help optimize business planning.

Take the example of idle time: Data-supported production helps to optimize shift times and reduce fixed costs. With a plant utilization of 60 percent, there is an optimization potential of 40 percent.

“Every energy-related measure on production plants or machines is permanently monitored and checked for cost savings. This ensures that we have our energy costs under long-term control. We can also access all related data in the system in real-time and at any time.”

Martin Strehl, BorgWarner

Success factor IIoT architecture

A company uses industrial IoT opportunities with a new IT architecture approach: An adaptable IIoT platform solution that enables desired innovations and protects investments in existing IT systems.

1. The first level (Edge) provides comprehensive connectivity of heterogeneous control systems for the normalization and standardization of machine data.

2. At the second level (FORCE Bridge), a rule engine works as semantic intelligence. It generates a uniform production data model (digital twin) from all production signals, such as financial control.

3. On the third level, open web interfaces (FORCE Bridge API) enable the free composition and collaboration of existing and partner solutions that create a custom IT architecture for every manufacturing business.
**Digital Transformation for More Competitiveness**

“The Internet of Things will be the greatest source of value creation of all disruptive technologies, ahead of the mobile Internet and advanced robotics.”

Alexandre Menard, McKinsey

**Empower the workforce**

The most significant challenges and the best chances for manufacturing companies: The Internet of Things - known in its industrial form as the Industrial Internet of Things (IIoT) - is the future of almost all business models. Technologies such as 5G and edge computing continue to improve the functions of IoT devices. Health data, fingerprint scans, or voice commands are now transmitted in milliseconds.

Analysts at the International Data Corporation (IDC) estimate the number of networked devices at more than 41 billion, which will produce almost 80 zettabytes of data by 2025. One zettabyte corresponds to 10 to the power of 21 bytes. In industry, high-performance IoT solutions in modern factories collect Big Data from machines, sensors, or manual inputs and transform it into Smart Data, i.e., user-friendly and actionable information. The primary goal of digital transformation is to enable the workforce to identify waste potential and to initiate immediate CIP measures. As a result, the profitability and competitiveness of a business increase.

“Transformation is a continuous cycle”

Jim Little, an analyst at Ernst & Young (EY), sees 2020 as a milestone for the Internet of Things: “About a decade ago, when companies were drawing up their digital plans, 2020 was targeted by many as a decisive year,” Little writes in a blog post. According to an EY study, almost half of the companies surveyed are making good progress in implementing their plans. According to analyst Little, this is encouraging, but not enough: “Transformation is a continuous cycle that is never completed. Companies must continue to develop their programs to meet the ever-changing expectations of customers.”

“Start small and scale up in incremental steps”

McKinsey analysts consider the IoT to be a growth giant: “We at McKinsey estimate that the IoT will have a potential macroeconomic impact of up to 11.1 trillion US dollars by 2025.” The Internet of Things - just a matter of big business? Analysts are issuing clear warnings. McKinsey recommends: “Start small and scale up: There is no ready-made end-to-end solution. Start with best practice cases. Start small and scale up in incremental steps.” FORCAM’s advises:

1. First, organize a CIP process.
2. Secondly, define the desired goals and key figures.
3. Thirdly, start with a pilot project and equip the most critical machines and plants with powerful technology to support the value creation process.

**Digital strategy as a success factor**

Benefit from the digital business processes

Digitalization possibilities mean a revolution for the manufacturing industry: new supply and service chains are emerging, and new business models are displacing old ones. Companies are concerned about their future viability in the era of the Fourth Industrial Revolution. Manufacturing companies are faced with an IT dilemma: they need innovative solutions to remain competitive. At the same time, production must continue using existing machines and IT. The answer lies in an intelligent, scalable IoT business platform solution. Only those who work with flexible and cloud-enabled platform technology will participate in digital business processes.
“We estimate that productivity gains and cost savings could result in margin expansion of 200 to 600 basis points in the short term across all advanced industries valued at $200 to $500 billion.”

From the McKinsey study „The Next Horizon“

Connectivity is one of the digital megatrends. The researchers at the Zukunftsinstitut in Frankfurt/Main report: “All communication leaves data traces. In addition to computers, mobile phones, web applications, cars, dealers with bonus programs, and medical equipment. Also, collect our data.” The result is an “immense mass of data that can no longer be processed with standard databases and tools.”

The networking of the world has only just begun. The platform economy from the consumer sector with Amazon, Facebook, Google & Co. is spreading to the industry. Many companies are just starting to invest massively in industrial technology platforms. According to McKinsey, around 15 percent of the manufacturing industry systems have so far been digitally linked.

**Multidimensional connectivity as a requirement**

Free data flows are the be-all and end-all of digitization. Companies that stick to data silo structures will no longer work efficiently enough in the future. Take the example of artificial intelligence: “Advanced analyses and Artificial Intelligence can be applied to large amounts of data to generate new insights and enable better decision-making in predictive maintenance, quality management, demand forecasting, and other areas,” the study states.

Multidimensional connectivity is, therefore, a critical technological requirement for an IIoT platform. Data from a wide variety of sources (machines, sensors, systems) must be collected and validated using a rule engine based on the defined business processes and made available to the various target applications for further processing.

**Continuous Improvement - Examples**

- **Quality Assurance:** Digital labels ensure the production of parts throughout the entire supply chain. At relevant points, the pieces are automatically scanned for even the smallest differences in surface quality. It prevents counterfeiting and guarantees compliance with regulations.

- **Supply chain transparency:** Data from purchasing, production, and service are evaluated on one platform, providing real-time transparency across the entire supply chain. Take BorgWarner as an example: “With FORCAM we have reduced inventory and setup costs, but above all, we have increased delivery reliability to our customers to over 99 percent,” explains Martin Strehl from automotive tier-1 supplier BorgWarner.

**The three cornerstones of a modern IIoT architecture**

1. **Open technology platform:** It enables the integration of third-party solutions and opens up participation as a community.

2. **Multidimensional data model:** It forms the central intelligence of an IIoT solution: It reflects the importance of both signals and industrial solutions (production semantics).

3. **Vital partner ecosystem:** Participation in a strong community of manufacturers and suppliers provides access to new IIoT applications.
DIGITAL TWINS MAKE OUR EVERYDAY LIFE EASIER

"You can monitor CO2, streetlight and personal data at a glance: Digital twins will be widely available by 2020."

Bill Pugh, Smart Connections Consulting

Twins everywhere: The 'Digital Twin' is the virtual image of a real process. Digital Twin has no limits to what can be replicated: a new product, a new production machine, a complete factory or a car, its driving characteristics, etc. With the help of digital twins, developers save a lot of time and money. All functions can be tested on the computer, and complex situations can be simulated. Examples:

1. Mackevision developed an engine block for Daimler: "The replica, which was created solely based on existing design data, enables Daimler developers to simulate engine parts at different speeds," reports the magazine Produktion.de.

2. The wind turbine manufacturer GE from California uses digital twins for the wind turbines in its wind farms. The report states: “The data collected during operation is evaluated in real-time via the digital twin, compared with the other turbines' performance data in the wind farm and then optimized.” GE would thus achieve around 20 percent more output with its turbines.

3. In the city-state of Singapore, politicians and administrators use the digital twin in planning construction measures and their effects on traffic and possible noise pollution.

4. In real-time, the city of Palo Alto in California, USA, has digital twin mapping of around 120 traffic intersections. The digital twin visualizes traffic lights, pedestrian movements, and car traffic in real-time, enabling it to identify problems and help traffic management intervene quickly.

Virtual analysis, real optimization.

The digital twin in the factory requires a high-performance platform technology with a semantic data layer. It gives each signal the correct meaning in a fraction of a second - machine on/off, malfunction, setup, etc.

Result: Managers and workers alike can immediately detect and eliminate errors or wastage on their devices using the digital twin - in other words, analyze them virtually and optimize them in real terms. The digital twin means a big step towards a near-zero-defect factory.

Controlling as a success factor

One source of information for the shop and top floor

Data - Big Data - is the oil of digitalization. Just as oil must be refined into a fuel, data must be converted into information, the Smart Data. When this utility information from a unified production data model is available to all areas in real-time, from manufacturing to finance, from signal evaluation to unit cost analysis, the entire company benefits:

- less waste
- increased profitability
- increased competitiveness
Cloud solutions are on the advance

“At the start of the new decade, one thing is certain: cloud acceptance will continue to grow as companies look to flexible deployment in both hybrid and multicloud environments.”

Paul Sallomi, Global Tech, Media, & Telecom Industry Leader Deloitte

Cloud Computing - is the demand-oriented use of a shared pool of computing resources that are available online and can be quickly provided and released with minimal management effort.

The advantage of demand-based use: If a company’s needs change, the services can be dynamically scaled up or down. No additional resources need to be built up to cover peaks.

Hybrid and multi-cloud solutions

The suppliers on the market have different strengths. That’s why companies rely on multi-cloud solutions to leverage the strengths of various providers. According to Deloitte, 58 percent rely on Microsoft Azure, Amazon Web Services (AWS), and Google Cloud. Here, too, connectivity plays an increasingly important role; a seamless collaboration between providers is necessary.

Hybrid clouds are another common hybrid form. These consist of a private and public cloud. This form is particularly famous for keeping business-critical assets away from public clouds and increasing data security.

Edge-Complements Cloud Computing

Cloud computing is revolutionizing the way manufacturers do business. However, cloud computing also has limitations such as latency, bandwidth, and lack of offline access. Exceptionally low latency is required for applications where data must be processed in real-time analysis. Bandwidth determines how fast the data can be downloaded.

Enterprises can overcome these limitations by using edge computing, a local solution that typically complements cloud computing. Edge computing allows data to run and store with local on-premise solutions. The most important reasons for companies to rely on an on-premise infrastructure:

1. Reduce the amount of data that must be sent over the network
2. Accelerated decision-making
3. Faster response times

A hybrid solution comprised of Edge and Cloud computing

Two critical requirements for a 4.0 platform technology are adaptability and scalability. These requirements can only be met digitally via hybrid solutions of edge and cloud infrastructures in technological terms. It is especially true for manufacturing networks that must work internationally and multi-client capable of real-time. Hybrid edge and cloud capabilities are, therefore, the future of the industry.
FOUR-STEP PLAN FOR CYBERSECURITY

"Cyber attackers are well camouflaged - to expose them - you need IT security that can detect a threat even when it appears to fit seamlessly into your environment."

Paul van Kessel, EY Advisory Cybersecurity Leader

The more networked a workflow is, the more complex the security requirements become. However, in reality, most companies do not consider themselves sufficiently armed against data leaks and attacks from outside.

In Ernst & Young's Global Information Security Survey (GISS), 70 percent of surveyed said their managers had a comprehensive understanding of cybersecurity. However, 77 percent of the companies surveyed stated that they work with limited cybersecurity measures. Eighty-seven percent indicated that they lacked the resources to perfect their security measures.

Paul van Kessel, Advisory Cybersecurity Leader at EY, recommends the following measures for cybersecurity:

**Point solutions form the security basis**

The "core element of cybersecurity resilience," according to van Kessel in his report. The tools belong to the traditional means of security measures: Antivirus software, intrusion detection, and protection systems (IDS and IPS), encryption technologies, employee password management.

**Defense against advanced attacks**

Establishment of a Security Operations Centre (SOC): This center coordinates all passive measures and practices active defense. The SOC continuously conducts campaigns to "identify and eliminate hidden threats and fend off potential attackers targeting key assets."

**Security by Design**

The most innovative form of hazard prevention: is creating systems and processes that can react immediately and appropriately to unexpected risks and new hazards.

**An effective action plan**

If a cyberattack hits a company despite its measures, the Cyber Breach Response Plan comes into effect. This plan defines all operational and strategic measures in the event of an attack.

**Data security in the cloud is all about:**

- If a company organizes its Smart Factory in such a way that the hardware is provided from its capacities and resources - i.e., on-premise: on-site - the company's IT security measures take effect.
- Benefits If, on the other hand, companies use the cloud infrastructure of established providers such as Microsoft Azure or AWS (Public Cloud), security standards are offered that individual companies usually cannot achieve with an on-premise solution.
- If a company decides on the private cloud path, it either operates its data center or uses its own, separate cloud service providers' server areas.

The FORCAM FORCE™ solution can be flexibly adapted to different needs.

**Security as a success factor**

Sources:
- https://www.ey.com/de_de/advisory/how-to-better-prepare-for-cyberattacks
DEFINE GOALS & STRATEGY
- Greater competitiveness
- Reduce fixed costs - transparency of all cost sources in the production
- Fast project implementation through preconfigured solutions (best practice)
- Achieve a fast ROI
- Integrative IT architecture - protect investments, enable innovation
- Interdepartmental rule communication
- Digitization Roadmap

MANAGING LIQUIDITY
- Controlling with real-time data on production
  - Transparency in warehouse and production
  - Transparency about the product portfolio and the contribution to the result
- Online feedback to ERP
- Forecast scenarios

PLANNING PROCESS
- Definition of the production processes to be evaluated
- Rough recording of the production processes, including system interfaces
- Mapping/Prototyping of production processes with FORCAM FORCE™
- Forecast scenarios

CREATE ACCEPTANCE
- Leaders: Key messages on goals and benefits for the teams
- Designate interdepartmental transformation team
- Plan the change process of the digital transformation (schedule and measures)

EVALUATE IIOT TECHNOLOGY
- Define goals and requirements for data-supported manufacturing
- Analyze supplier market
  - Architecture - Rapidly deployable platform solution with its own App Marketplace
  - Ecosystem - Semantic production data model, MES turnkey
  - Flexibility - open web interfaces (Open API) for existing and new systems
  - Scalability - hybrid IT infrastructures possible (on-premise, edge, cloud)
  - Usability - User-friendliness

START THE PILOT
- Shopfloor-Walk with potential analysis
  - As-is recording Optimization potential
  - As-is analysis of infrastructure
  - Prioritization and value-added assessment
- Select start machines (the primary production must continue)
- Optimize supply chain management
- Train rule communication (e.g., daily meetings in the factory)
- Communicating successes widely

ROLL-OUT
- Clarify design & capacities: own teams and/or with service providers
- Ensure cross-factory / global project governance
  - Responsibilities (headquarters vs. self-sufficient locations)
- Schedule with delivery packages
- Cyclical performance review
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