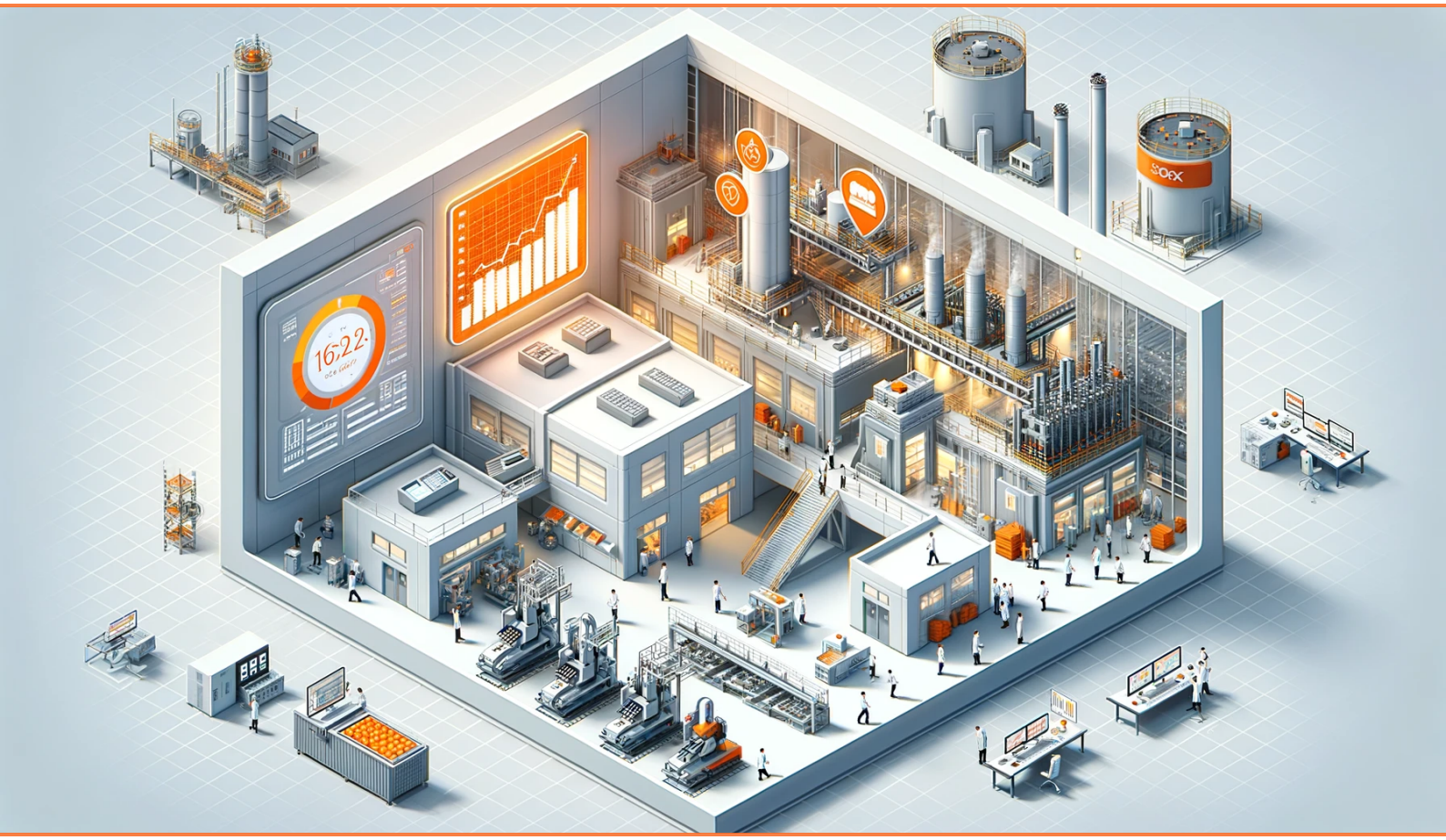
Operations & Leadership Strategy

Is Your Manufacturing Transformation Ambition Bold Enough?

9 Building Blocks to Win the Future in Manufacturing



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Prologe

The manufacturing landscape faces immense pressure. Discussions often revolve around amplified competition spurred by globalization, escalating energy costs, and a relentless battle for talent. Undoubtedly, these are macro-level challenges. However, as manufacturing executives, our focus must center on transforming elements within our control, specifically within our currently existing factories.

This document is dedicated to the metamorphosis of an existing machinery-centric factory through digital and lean manufacturing initiatives. The objective is to position technology properly for success and to mobilize both frontline workers and leadership, ensuring tech and humans jointly shoulder the transformation to sustainable next level productivity.

oee.ai functions as a co-pilot for both front-line workers and the operations leadership team. Serving as a central brain, the app provides insights into past, present, and future scenarios, guiding actions to maintain and enhance equipment productivity.

Embark on the journey as we introduce the 9 foundational building blocks for a manufacturing transformation centered around data, processes, and leadership. Enjoy the ride!

Setting the Scene:

Diverse as they are, every factory embodies its unique strengths. That's the core, a transformation process needs to be wrapped around. Within these pages lies a distillation of insights garnered through extensive operational experience and thought leadership in cutting-edge manufacturing optimization. This compendium encapsulates the quintessence of what every machinery-centric factory requires to maintain a competitive edge in the industry.

This dossier delves into the realm of possibilities offered by advanced data analytics alongside the role of progressive leadership and process management. It champions the pursuit of operational excellence.

Should your current manufacturing aspirations be more modest than what is described here, fear not. The introduced 9 foundational elements can be (pretty) independently implemented. Nonetheless, their true potential unfurls when interwoven. Allow these insights to ignite your inspiration.

> The future is already there.
> It's just not evenly distributed.
> — William Gibson

Generating Insights

(1) Automated Real-time Advanced Analytics

When driving a car, the absence of a speedometer is inconceivable. The peril of surpassing the physical limits in a curve, coupled with the risk of losing one's driver's license due to a series of tickets, makes it an indispensable instrument. If it's the basics in cars, why are factories missing it universally?

Much is discussed about big data. However, alongside big data, fast data holds equal importance. In the realm of manufacturing, data swiftly becomes outdated. Operators require real-time information to gauge compliance with speed requirements, while shift leaders need immediate insights into whether unexpected patterns are currently needing attention. If this information is received the next day, how can one provide timely support or address challenges at their source? Furthermore, what can a plant manager address during a Gemba walk with front-line workers if the current status is unknown or deviates from the planned target but this is not transparent?

A factory intelligence needs to provide the current status, trends, and predictions to all relevant team members, spanning from the shop floor to the top floor. The analytics required can range from classical statistics to advanced analytics powered by sophisticated artificial intelligence (AI).

Advanced analytics refers to the use of sophisticated techniques and tools, such as machine learning and predictive modeling, to analyze large and complex datasets. It goes beyond traditional analytics by uncovering deeper insights, patterns, and trends that may not be apparent through basic analysis methods. Advanced analytics enables organizations to make data-driven decisions, predict future outcomes, and gain a competitive advantage. It often involves the application of artificial intelligence to extract actionable information from data. The goal is to transform machine data into valuable insights that support decision-making and drive business success.

Let's confront the reality: Manufacturing is rich in data but lacks in analytics. In the past, the bottleneck was timely data availability and quality, but this is no longer the case today. With current technology the challenge lies more in the scarcity of skilled humans to analyze the abundance of data and how to handle and analyze the massive data stream in real-time. That's why the future of analytics lies in automated, real-time processes that operate in scalable data centers and are run independently of traditional human-enabled tools like Pivot-tables living inside Excel.

Distributing Insights

(2) Real-time Push Information

Now that we are uncovering the relevant information nuggets within the equipment data stream, the next step is to disseminate this information to the front-line individuals responsible for implementing the insights and realizing the benefit on the shop floor.

The primary responsibility of front-line personnel is operating the equipment, and we must engage with them without causing distraction or compromising safety and quality. The approach is characterized by tailoring the communication to the specific needs and constraints of the target audience.

Operators receive pertinent information on a machine-dedicated screen directly at the equipment, where they also input loss reasons. This function provides them with real-time insights into whether the default speed is being met, when the next change-over process is scheduled, and the expected duration of the next process. The information is delivered precisely when needed, and it is tailored and limited to the content that is directly influenceable, preventing information overload.

Front-line leaders receive a comprehensive overview of their area of responsibility through an Andon on the shop floor and at their desks. Additionally, they receive push notifications on their mobile devices at the machine level. The key to success is customizing the notifications to highlight the most relevant messages, preventing information overload and ensuring effective communication.

Both front-line leaders and operations managers receive advance notifications before e.g. shopfloor meetings, outlining the top 5 to 7 topics to be addressed during the short meeting duration. This transformative approach shifts the character of the meeting, moving away from simply receiving information and as a manager being surprised by upcoming topics. Now, the focus is on directing the team toward solutions for thoughtfully selected priorities to address the top issues efficiently.

An Andon is a visual management tool used in manufacturing to alert operators, supervisors, and other relevant personnel about the current status of production. It typically involves a signal system, such as lights or displays, to communicate information on quality, performance, or other key metrics. The purpose of an Andon is to enable quick response and decision-making to address issues and improve overall efficiency.

Applying Insights for Impact

(3) Data-driven Management for Daily Improvements

The lean methodology of shopfloor management is gaining traction in factories worldwide as a leadership methodology. While shopfloor boards and meetings are common, the application of the method frequently lacks the necessary elements to have a substantial impact on operational performance. If the following requirements cannot be confirmed, it's time to reengineer the process:

1. Extreme Focus: The shopfloor meeting should have an intense focus (over 90% of the meeting time) on a limited set of KPIs that can be influenced by the operational team.
2. Visualization: Each KPI must be visually represented, using at least green and red indicators to immediately realize underperformance where a green status is skipped in discussion.
3. Measures for Red KPIs: Every (!) red KPI must have a corresponding measure, outlining the action to be taken for improvement.
4. Responsibility Assignment: Responsibility for each measure is individually assigned, and the progress of these measures is tracked transparently for all team members.

To underscore the essence of the shopfloor management procedure, it's conceivable to rename the method as M4DI: Management for Daily Improvements – emphasizing its primary focus on continuous and daily operational improvements.

Go digital? Whether digital or analogue, the methodology of M4DI remains consistent. A well-designed analogue M4DI can mirror the principles and effectiveness of its digital counterpart without compromising the underlying methodology. The choice between digital and analogue may depend on specific organizational preferences and needs. Getting started with an analogue M4DI approach is advisable. Unlike OEE calculation and loss reason tracking, which require digital support for precision, M4DI can initiate in an analogue form and progress from there. This allows for a gradual and adaptable implementation that aligns with the organization's readiness and needs.

Changing Human Behaviour

(4) Leadership Transformation

The role of leadership undergoes significant challenges and changes throughout this manufacturing transformation process, a journey that spans several years. As the transformation unfolds, leadership plays a crucial and evolving role in steering the organization toward its long-term goal of rising productivity as a cultural element.

The oee.ai co-pilot plays a supportive role in the process, assisting with decisions such as determining the next work order, expected completion times, addressing deviations in real-time, or preparing managers for the next M4DI meeting. From a continuous improvement perspective, it provides valuable insights on what to tackle and also what has already been accomplished. However, technology can only serve as a supporting tool. Ultimately, the captain, sitting on the left side of the flight deck, is human and holds the responsibility for navigating the course.

The linchpin of the leadership transformation lies in the role model. For front-line leaders it’s threefold:

1. With operators receiving digital instructions and default values, the focus of front-line leaders shifts from identifying deviations towards addressing the digitally identified deviations. That’s a significant shortcut to more performance. The decision frame revolves now around immediate intervention versus incorporating the topic into the continuous improvement process agenda – but it’s not any more about finding the problem at all.
2. The second significant change entails a shift in leadership behavior. Informed by available information, shopfloor leaders are required to adopt a more coaching-oriented approach. This involves demonstrating how identified best practices are executed, actively listening to the challenges faced by operators who may not be reaching the established benchmarks. It's a commitment to spending time with the team, providing support, and fostering a collaborative environment for joint success.
3. As the process evolves, the co-pilot must also undergo adjustments. While self-learning algorithms on the analytics level are inherently self-adjusting, the future of continuous improvement lies in enhancing the co-

pilot's capabilities. Identifying what is currently not analyzed but requires attention poses a substantial challenge for front-line leaders, as much of this occurs virtually in a server without tangible elements. However, in the most effective organizations, human input directs the analytics on the next level.

In the executive suite, tasks also shift towards managing identified deviations. With the co-pilot proposing improvement areas, the focus lies in reviewing priorities with company necessities and allocating resources to facilitate execution. This involves a strategic approach to aligning resources with the identified improvement opportunities. Moreover, fostering a supportive environment by highlighting and promoting improvement successes is undoubtedly appreciated by the operational team. Recognizing and celebrating achievements contributes to a positive and motivating workplace atmosphere which is the change the manufacturing environment is striving to achieve.

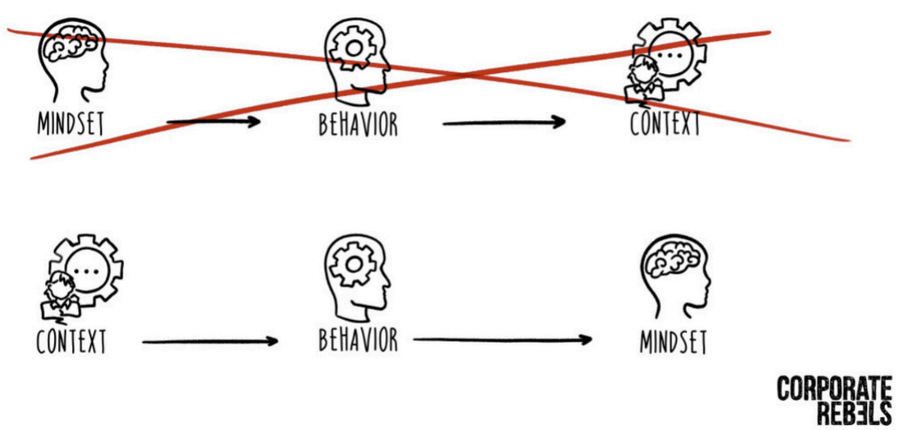
Upgrading the Mindset

(5) Organizational Change

Manufacturing transformation is not a technology pure play. Actually the opposite is true: It’s all about the people with technology serving as a supportive force for change.

Manufacturing, by its nature, has not traditionally embraced an agile mindset, and this is for good reason. The primary objective of manufacturing is to consistently deliver high-quality physical products—whether they are grinded, welded, molded, or anything else. Unlike software, these products cannot be fixed over the air, making stability a paramount consideration. Like it or not: This is the environment that every change process must contend with. Having acknowledged the challenge, let's now delve into understanding how to cope with it.

Change can be approached from two directions: By addressing the desired mindset or by addressing the context.



The concept presented here follows the latter path, focusing on the specific context to drive effective transformation.

In addition to the fundamental need for a specific "Why?" tailored to each factory or even manufacturing area, the M4DI provides the context: Meticulously defined KPIs, targets, and management routines enforce a disciplined approach. The process is based on a trustworthy data source, leaving little to none room for interpretation, encourages contributions from frontline workers, and minimizes the effort required for data collection and analysis.

The context encompasses the physical side of the change process. Additionally, there's the human element. Effecting the necessary leadership behavior change usually requires individual or group coaching of the front-line leaders to encourage reflection on one's decisions and reactions in the myriad leadership situations that arise throughout the day.

The recipe for sustained success involves all of the aforementioned elements, accompanied by sufficient time dedicated to training on new tools, skills, and routines within a trustful environment.

Single Source of Truth

(6) Equipment Connectivity

Now, you may wonder, "That's an intriguing narrative, but where do I obtain the necessary data streams from my diverse and, in parts, old equipment?" The answer is straightforward. You need to connect to the machine’s PLC. This challenge has been resolved conveniently — and it doesn't even require a significant financial investment.

Two primary architectural archetypes exist. Option one involves a dedicated factory data hub, while option two entails direct connectivity from the PLC to the manufacturing analytics application. Each option comes with distinct characteristics.

The factory data hub infrastructure is typically employed in larger factories and offers additional features such as PLC connectors and access management. Essentially, this infrastructure serves as an API for the entire factory.

The direct connection between the PLC and the app necessitates an IoT gateway, which is occasionally integrated into the machine (search e.g. for OPC-servers, especially in newer machines) or needs to be retrofitted. One notable retro-fit gateway, provided by a German automation powerhouse, is the SICK Telematic Data Controller, definitely worth exploring.

Equipment connectivity is the enabler of precise and real-time data availability for operational excellence programs.

Unlocking Humans Contribution

(7) Frontline Staff Data Engagement

Human beings are extraordinary creatures. For an extensive period, if not indefinitely, we will have to rely on their sensors, dexterity, and, perhaps most importantly, their creativity for problem-solving and process improvement. However, this productivity factor is becoming increasingly scarce in virtually all industrialized countries. That's a very good reason to treat our fellow human frontline workers properly – and not handle them like robots.

While the office world engages in discussions about the privileged concept of "New Work", frontline workers often experience less freedom. Nevertheless, numerous opportunities exist to enhance their work environment beyond the basics of a well-appointed break room, well-maintained toilets, and neatly painted walls. Consider, for instance, the implementation of gamification as an engaging concept.

Offering information beyond unit counts such as projected completion times for production orders, and visualizing progress indicators, provides frontline workers with short-term milestones. Additionally, a dynamic bar graph, using red and green to signify machine stoppage and operation, respectively, creates a straightforward yet compelling game. Humans instinctively set the goal of maximizing the green portion, fostering a sense of accomplishment and motivation (see lower right part of top image).

On the contrary, currently factory management expects employees to run a marathon in a gray concrete tunnel and don't even give transparency at which mile marker they are.

Another illustrative example involves gamifying the entry of loss reasons using emojis (see sequence of „thumbs up" in upper right part of left image). This feature proves particularly beneficial for the advanced analytics function mentioned earlier. A thoroughly annotated time series is invaluable for AI analytics, enhancing the depth and accuracy of insights from these algorithms.

Foundational Data

(8) Master Data Excellence

To execute a data-driven transformation approach, a robust master data foundation is essential. In the context of equipment productivity, there are two specific master data elements that warrant focused attention. These are the default cycle times and the change-over duration. Both are crucial elements for execution and also the planning process and therefore foundational – but unfortunately often overlooked in operations. Micro-management is not enjoyable for humans. But the nitty-gritty details of data are a success criteria. And the beauty is: It can be automated easily with today's technology. For more details see box "Data Deep Dive".

Furthermore, the synchronization of master data elements between different systems necessitates attention. The era of up- and down-loading data via files between systems is over. Modern systems come equipped with API interfaces that are easy to handle, ensuring seamless data synchronization without the need for manual effort. This technology allows a worry-free distribution of data and functions in any application environment even across organizational boundaries. APIs are also the go-to technology to interface local systems and Software-as-a-Service (SaaS) cloud applications.

Data Deep Dive:

Default cycle times: The cycle time is defined as the time required for a specific volume of a product. Examples include 12 seconds per part or 12 minutes per 1,000 kilograms. The cycle time is often product-specific and, in some cases, additionally machine-specific. This default cycle time is input for the calculation of the OEE performance factor – that's why it needs tight control. The manufacturing team is tasked with running the machine at the specified speed. In daily operations, there are various ways in which this crucial data point can be altered. That's why oee.ai provides algorithms designed to automatically identify the best demonstrated cycle time for any given combination of product and machine.

By automatically feeding back this data point to the ERP/PPS system, the planning, and, in terms of customer satisfaction, the order confirmation date also sees an improvement in its quality.

Change-over duration: Change-overs represent planned standstills, often constituting a substantial source of OEE losses, and can be influenced by the front-line team. Therefore, having a default change-over duration for every combination of two products readily available is crucial. This change-over matrix, generated automatically and incorporating outlier elimination, serves two purposes: firstly, it informs the planning process to determine production plan details, and secondly, it provides realistic expected times for the front-line team to work against.

Curating the Best Fit

(9) Best-of-Breed App and Service Centricity

The world is becoming progressively complex, and relying on a single piece of software to fulfill all requirements is no longer a viable option. In the past, tradeoffs had to be accepted in the name of data integration. However, those times have come to an end. Thanks to modern interface and data streaming technology, it is now possible to choose the most fitting application for each use case without compromising data integration.

Apple and Google have been pioneers in the consumer IT market through their respective app stores. This model, where consumers curate apps for their smartphones, reflects the approach that forward-thinking manufacturing companies are already adopting today to satisfy their app requirements – with one important difference: companies are not limited to one app store but can integrate every app which is built on a modern technology stack.

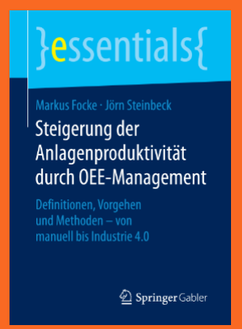
With that being said, the era of monolithic Manufacturing Execution Systems (MES) is over. These systems can be likened to the dinosaurs. The industry is moving towards more agile, lightweight, and specialized solutions. The future is a best-of-breed app selection providing, maintaining, and expanding the best set of functions in e.g.

- manufacturing intelligence,
- digital shopfloor management,
- predictive maintenance,
- production planning,
- frontline worker workflows,
- quality management,

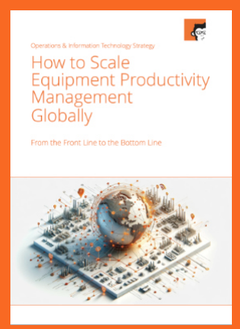
and the list goes on.

Leveraging the manufacturing intelligence app oee.ai, and supported by a team of experienced and passionate manufacturing experts, we specialize in crafting and implementing bold manufacturing transformations, tailored to small and mid-sized companies with one or several factories. However, it's intentional that the oee.ai technology provides only a fraction (but the core according to our conviction) of what's needed for a broad transformation to a benchmark manufacturing site. We believe in the power of focus — our emphasis lies in delivering cutting-edge technology and service within the specific realm of equipment productivity as a nucleus for all of operations.

Further Reading



A book on equipment productivty management published with Springer, available on Amazon currently only in German language.



A whitepaper for globally operating manufacturing companies about a technology strategy perspective on performance management.

No Joke: A Co-Pilot is Supporting Factory Management

Epiloge

The catalyst for future manufacturing efficiency lies in data-centricity, leveraging the abundant data already available in today's factories, waiting to be unlocked from the PLCs and being combined with correct master data from ERP/APS level systems.

The oee.ai co-pilot directs the attention of factory management to pertinent information, providing it in real-time or just-in-time for the next meeting or decision, depending on the context. Insights are derived through the utilization of advanced analytics algorithms, including artificial intelligence and other tools, to discern meaningful signals and patterns within the noise of data.

A seamless integration of front-line workers and their requirements into the overall process is fostering a holistic and collaborative approach to operational improvement. The broader context encompasses changes in leadership behavior and also the approach to change itself, creating a more holistic and adaptive environment for the people delivering the value.

Developing and/or Fixing Factories

Your Journey

If the described vision resonates with your ambition for your factory, we should engage in a discussion. Our experienced leadership team, with a background in operations and strategy consulting (Porsche Consulting), is equally available for workshops and also longer-term small to large transformation projects. We bring expertise not only in oee.ai's manufacturing analytics technology but also in the decade-long experience of comprehensive performance improvement initiatives for industrial companies. Choose to leverage both or only one – for your bold manufacturing transformation ambition.

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