



Operations & Information Technology Strategy

How to Scale Equipment Productivity Management Globally

From the Front Line to the Bottom Line





Transforming the impact of data throughout the complete end-to-end value chain for an industrial company with a global footprint necessitates a methodical, IT-facilitated, and effectively executed strategy. The focal point of this whitepaper is to generate practical insights related to machine performance, human behavior, and process efficiency. The ultimate goal is to empower all managers and front line workers with the tools to consistently improve productivity. Let's delve into the critical components.

Your Operations Business Strategy

The integration of Industry 4.0 technologies enables manufacturers to align top-down performance management with bottom-up problem-solving, utilizing real-time data insights in their management strategies. Presently, a significant gap exists in manufacturing where executives utilize reporting tools to examine broadly aggregated performance metrics, while operators rely on distinct tools and often disparate data for troubleshooting. Aligning these two streams generates value throughout the organizational hierarchy. Operators gain proactive insights, enhancing their ability to resolve issues effectively and boosting their performance. This, in turn, elevates the overall consistency of data across the organization. Challenges addressed at the frontline evolve into performance improvements visible to the C-suite, positively impacting the bottom line.

This concept is particularly advanta-

geous in equipment-based manufacturing, where the industry possesses abundant data through built-in machine Programmable Logic Controllers (PLCs) but is currently lacking in actionable insights.

In the most cutting-edge manufacturing organizations, managers benefit from an integrated, real-time data overview that enables tracking productivity and equipment utilization. This comprehensive view facilitates decisions aimed at minimizing overall capital expenditure, mitigating the financial impact of disruptions in global supply chains, and optimizing the company's throughput capabilities on a global scale to maximize the bottom line. This embodies the potential of enterprise-level digital performance management, offering the entire organization—from senior leaders to thousands of frontline workers—actionable insights. These insights empower faster and more accurate decisions regarding



both financial and operational performance.

For implementation, strategy consultants recommend adopting a use-case based approach for digital transformation, emphasizing a phased implementation with pilot initiatives followed by a broader roll-out, all while maintaining a holistic perspective. A key focal point in this playbook is the use case of "Increasing equipment productivity by X%." This particular use case holds centrality as it is applicable across all locations and carries significant impact with a direct connection to the company's Profit and Loss (P&L) statement. Moreover, enhancements implemented at one site can be readily replicated throughout the network. Beyond its immediate benefits, this use case also sheds light on potential follow-on measures. When executed effectively, this use case serves as a catalyst, generating the necessary transparency and funding for further steps in the digital transformation journey.

The Future of Manufacturing Execution Support

The concept of Manufacturing Execution Systems (MES) has been around for over 40 years, rooted in paradigms of its time. From a technical perspective, the monolithic system approach is considered outdated, especially with the shift to microservice architecture. Beyond technological advancements in areas like scalability, an even more compelling argument from the operations perspective for a new approach lies in the current complexity and the need for speed and innovation in the global manufacturing marketplace.

In today's dynamic business environment, expecting a single company to provide best-of-breed solutions across all manufacturing disciplines – from planning and scheduling to quality ma-

The standardization and normalization of OEE (Overall Equipment Effectiveness) and loss data significantly enhance the effectiveness of internal benchmarking. This empowers managers to discern performance disparities between, for instance, plant X and plant Y, prompting an investigation into the underlying reasons. Furthermore, the availability of standardized data allows top-down targets to be finely tuned based on the current operational scenario and potential, offering a comparative analysis with other entities within the operations network. This approach facilitates a more nuanced understanding of performance variations and enables strategic adjustments for improved overall efficiency, drives innovation, and finally the competitive advantage.

nagement, traceability, energy management, and shop floor procedures, to just name a few, is – impractical. The pace of technological change and the diverse needs of modern manufacturing call for a more agile and modular approach. This requires manufacturing companies to integrate specialized solutions from different providers, creating a tailored and flexible ecosystem that can evolve with the rapidly changing demands of the industry and participate from the innovation potential of the specialized manufacturing app provider.

The curation and customization of apps are guided by the specific requirements of individual factories within the production network. Certain use cases, such as equipment productivity analytics, quality



Google and Apple have unequivocally demonstrated that attempting to provide all solutions internally is not the optimal strategy. Instead, they have embraced a model that encourages the development of specialized apps through the introduction of app stores. This approach, well-established in the B2C (Business to Consumer) realm, is expected to be mirrored in the B2B (Business to Business) manufacturing environment, albeit with a time-lag corresponding to the level of effort required within the industry.

By fostering an ecosystem of specialized apps running on top of a harmonized technology stack, manufacturers can leverage the expertise of various solution providers. This not only promotes innovation but also allows companies to tailor their technological landscape to meet specific needs. The app model enhances flexibility, enabling manufacturers to choose and integrate the best-of-breed solutions for diverse aspects of their operations, from planning and scheduling to quality management and beyond.

control, or shop floor management, may be relevant to each factory. As the demand for additional and more specialized use cases arises, such as shop floor workflows, predictive maintenance, or energy analytics, these needs can be met through the integration of additional and in required centrally managed apps – see the trend towards infrastructure as code. This approach ensures

that factories have access to the best-fit solutions tailored to address their specific operational challenges, are taking advantage of the app provider's innovation potential, promoting efficiency and effectiveness across the manufacturing landscape.

Yout IT Infrastructure Strategy

In the past, information technology (IT), responsible for business systems, and operational technology (OT), driving manufacturing processes, were largely distinct entities. However, with the advent of modern cloud computing and data-streaming technologies, a convergence is taking place. IT and OT are now merging to create a unified framework that seamlessly integrates business systems with operational systems. This convergence reflects a paradigm shift, lever-

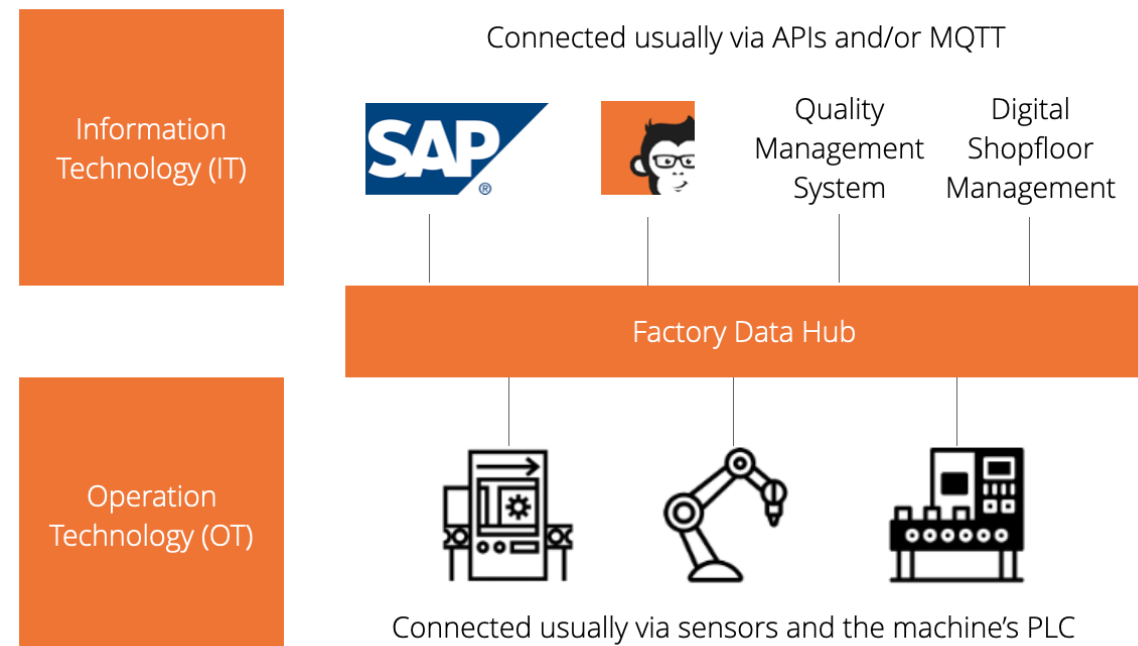
aging advanced technologies to enhance the synergy between traditionally separate domains and promoting a more integrated and efficient technology structure.

Taking a rip-and-rebuild approach for achieving convergence isn't scalable, considering the substantial investments made in factory infrastructure. Fortunately, with modern Industry 4.0 technologies, such an approach is unnecessary. The preferred strategy involves building

upon existing assets, leveraging what is already in place – the "brownfield" production network. In this approach, the diverse equipment landscape with its multitude of PLCs act as data sources. This data is then transmitted to a factory data hub, where it undergoes homogenization and normalization.

By centralizing the data in a single source, it becomes the foundation for gener-

ating digitally enhanced operational insights. These insights, in turn, drive transformative processes through the manufacturing execution support application landscape mentioned earlier. This approach ensures that valuable data is efficiently utilized without disrupting the existing infrastructure, allowing for a seamless integration of the above mentioned apps into the operational framework.



In addition to managing the substantial and continuously expanding data volume, the infrastructure must cater to the needs of a demanding user base spanning from the shop floor to the top floor. A potentially crucial aspect of the next generation of information technology infrastructure is the headless deployment of all applications, ensuring a unified user experience. This approach is essential for functionalities such as entering quality data only once, a require-

Gartner is promoting the distinct application of three data infrastructure elements: Data Hubs, Data Lakes and Data Warehouses. Data Hubs are considered the reference architecture for integrating OT and modern IT in a production environment.

Specifically, a Factory Data Hub is a centralized software platform that collects, standardizes, contextualizes and distributes data within an industrial production environment.

The data hub bridges the gap between data producers (= equipment) and data consumers (= apps). It serves as the backbone for Industry 4.0 and digitalization strategies by providing a consistent and interconnected data flow across production assets, shop floor OT and business IT systems.

ment that is imperative for efficiency. The infrastructure automatically distributes the data to all systems requiring





input, streamlining processes, enhancing data quality, and eliminating redundancy, thereby enhancing the overall user experience.

The third strategic building block involves ensuring that the infrastructure, whether it's the factory data hub or the corresponding applications, supports a multi-cloud strategy. This means that components of the infrastructure may reside in a private cloud or a public cloud, depending on specific needs such

as data security requirements. Adopting a multi-cloud strategy strategically balances risks and dependencies, allowing the manufacturer to diversify its cloud infrastructure across different providers rather than relying solely on one hyperscaler. This approach enhances flexibility, resilience, and strategic control over cloud technology resources.

The inflection point happens when the culture embraces the changes. Senior executives can compare operations and make strategic decisions. Middle managers can make better choices to achieve higher productivity. Frontline operators can solve problems in real time and course-correct during the same shift.

Absolutely, the essence of this approach is empowering every individual within the organization at their respective level of influence. While the idea of decentralizing decision-making from a select few to a broader base of thousands of individuals may initially seem daunting, it becomes a transformative multiplier when

implemented with the right guardrails and shared transparency. By providing the necessary framework, this approach not only distributes decision-making but also taps into the collective intelligence and expertise of the larger and more diverse workforce, fostering innovation, agility, and productivity throughout the organization.

Your Implementation

The adoption of a data-driven performance management strategy represents a substantial organizational change process, enabled by technology. While top-management support is crucial, the success of this initiative is significantly influenced by the existing or to be established improvement organizations, such as industrial engineering, lean manufacturing, world-class manufacturing (WCM), and similar entities. These organizations play a pivotal role as change agents, bridging the gap between the shop floor and the executive suite. Their expertise and involvement contribute substantially to the effective implementation of the strategy, ensuring a seamless integration of technology and organizational processes for enhanced performance management.

The primary function of these organizational units over the implementation phase is to offer training and support, ensuring that employees possess the skills and knowledge necessary for the effective utilization of data in their respective roles. Execution is pivotal,

translating data insights into tangible internal successes, serving as lighthouses to illuminate the path forward and build momentum for the ongoing journey. In addition to top management, these units play a crucial role in fostering a data-driven culture within the organization. Their responsibility extends beyond imparting technical skills; they must actively promote an environment where employees are encouraged to base their decisions on data. This cultural shift is essential for maximizing the benefits of data-driven approaches across all levels of the organization.

If enterprise performance management becomes a performance-reporting tool, there will naturally be resistance. But if it's treated and communicated as a continuous problem-solving tool that empowers operators with the data they need to do a better job, while giving the C-Suite with visibility to where they should focus resources to help front-line operators address key challenges, resistance can be replaced with acceptance and even enthusiasm.





Our Offering for Your Transformation

Consulting:

The Aachen-based Institute for Productivity (IfP) offers consulting services to assist in crafting an Industry 4.0 vision for factories. Their expertise extends to designing strategies that can effectively operationalize the broader vision into a value-centered implementation approach. With a team boasting extensive managerial and consulting experience across various industries, and with a background in Porsche Consulting's "Strategic Vision. Smart Implementation," they provide an "Experience-as-a-Service" model to complement and enhance your Industry 4.0 strategy and implementation team or also support companies in special situations requiring process optimization or cost reduction.

Manufacturing Intelligence App:

Additionally, the IfP team has translated its operational manufacturing intelligence expertise into the oee.ai app, which plays a central role in the performance management of various global manufacturing companies across diverse industries. This app is specifically crafted to deliver actionable insights into equipment productivity, leveraging state-of-the-art technology. By focusing on real-time data and utilizing cutting-edge technologies like e.g. AI algorithms, oee.ai aims to provide manufacturing companies with a powerful tool for optimizing their equipment productivity. This integration of knowledge and technology showcases the team's commitment to delivering innovative solutions in the realm of operational manufacturing intelligence.

The IfP & oee.ai Management Team



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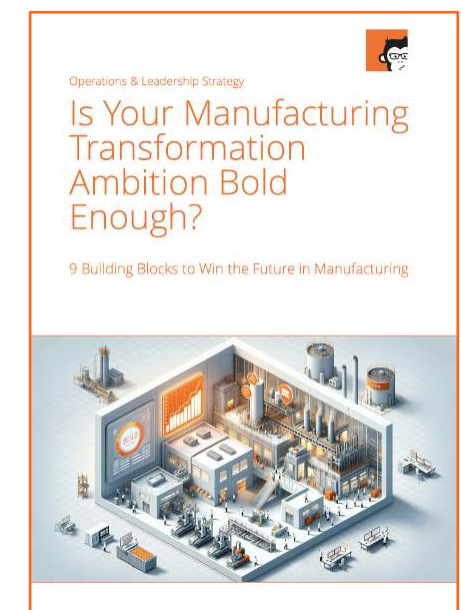


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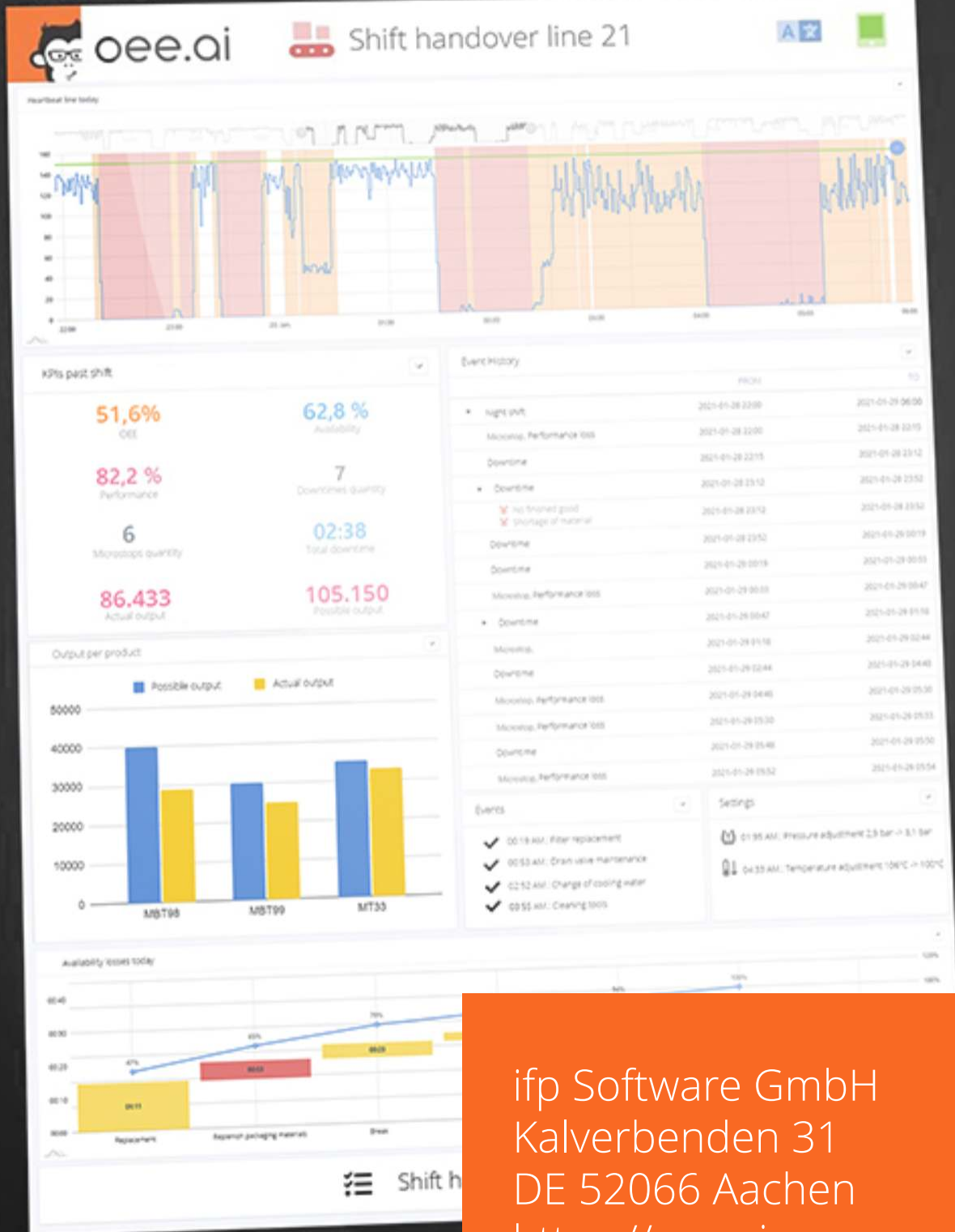
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Additional Reading

A whitepaper from the team focussing on a company-wide digitalization approach for manufacturing.



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



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