The data-driven factory

Insights gained from operational data can transform manufacturing

orange™ Business

Accelerating the data-driven factory journey

Factory operational managers and their CIOs are under continuous pressure to keep production lines moving and improve productivity.

It is estimated that manufacturers only use 40% of their potential because they spend too much time on manual tasks and struggle to keep the lights on. This is where data can make significant enhancements. The use of data in manufacturing is not new. However, with the arrival of digital technologies, this data can be used to better understand operations down to a granular level.

But this comes with a warning. You will not get the answers you want if you haven't got the correct operational data in the proper format.

Knowing what operational data to capture and how to structure and analyze it is the route to providing meaningful insights that will drive the business forward. The final layer of context offers insight.

Using operational data to optimize manufacturing processes

For example, data harvested from OT machines can help predict maintenance schedules and raw material inventories to keep production lines running at their optimum levels. Automated monitoring can enhance quality control and identify patterns in specific manufacturing processes that may be causing issues.

With real-time data generated from machinery and other assets, manufacturers can predict the likelihood of failure, ensuring parts and labor are on hand to minimize downtime and avoid significant operational disruption.

To use the data, you first must harvest it. According to IDC, getting this operational data out of outdated and legacy systems is one of the most cited challenges manufacturers have in their transformation. In fact, it is estimated that 74% of manufacturing companies are relying on legacy systems and spreadsheets to complete tasks[1].

The adoption of intelligent and sustainable manufacturing practices

Data from inside and outside the factory is hugely valuable. Without its collection, storage, and use, manufacturers cannot solidify their competitive edge and build resilience in a dynamic global marketplace. Manufacturers must shift to a data-driven factory model without compromising safety, product quality, or customer service.

Trailblazers are already making changes to become more data-driven and intelligent. By 2025, 40% of manufacturers will have deployed enterprise-wide AI-based tools to support the decision-making process and maximize the value of data, resulting in up to 5% improvement in revenue/profit, for example[2].

Operational excellence gives manufacturers the best foundation for adapting quickly to changing markets now and in the future. But it requires commitment and comes with many challenges.

Here, we highlight how applying data-driven techniques to manufacturing via a robust transformation strategy can significantly enhance your overall productivity, minimize risk, and reduce waste in a safe and secure environment.

Why the data-driven factory equals success

Data-driven technologies such as sensors that monitor telemetry, humidity, noise, and motion, for example, real-time asset tracking and predictive analytics, capture data that can be analyzed to glean intelligence to address operational issues and make improvements.

Data is a critical asset. It provides visibility and insight into operations, from asset performance and predictive maintenance to inventory planning. All contribute to decreasing downtime and higher productivity. Data also offers external visibility into supply chains, maintaining an agile inventory that can rapidly adapt to unforeseen demand.

If used correctly, data can help achieve operational excellence in constantly working to raise efficiencies, reduce expenses, and ensure the workforce has the required digital skills for continuous improvement.

Here are seven benefits a data-driven approach brings by utilizing operational data to meet business outcomes.

1. Predictive maintenance

Using data sourced from machines and industrial IoT (IIoT), predictive maintenance can continuously analyze the health of machines and predict, with the highest accuracy, when breakdowns will occur and the time to failure if not serviced.

Predictive maintenance improves worker safety, as unexpected breakdowns can lead to hazardous working conditions. Machines can be looked at before they break down, ensuring workers are not near them should they malfunction.

2. Preventative maintenance

Preventative maintenance analysis is used alongside the machine's lifecycle to maintain health and ensure no emerging issues that may cause production disruption.

Various indicators such as speed, vibration, temperature, and abnormalities flagged up can be monitored. This is used alongside maintenance strategies to decrease maintenance and unplanned downtime costs.

3. Improving productivity and quality control

Manual quality control processes are time-consuming and prone to human error. By analyzing data from sensors on machines, manufacturers can identify the source of defects and take corrective action. Data can also be used to map quality control to identify patterns that may indicate process issues.

Integrating quality control as an automated function in all manufacturing processes makes creating a proactive end-to-end quality check much easier and frees human resources for critical thinking and complex decision-making.

4. Achieving workforce excellence

Data is essential for enhancing workforce effectiveness. With the correct information provided to the right people, informed decision-making can happen throughout the factory floor, including improving productivity, safety, and worker engagement.

Collaborative analytics and business intelligence are the first steps to establishing a trusted representation of the past and present. Once established, vast volumes of data can be leveraged to predict and forecast future scenarios using AI, such as future demand and inventory levels and predicting market conditions.

5. Enhancing sustainability

Data analytics, AI, and ML can help to reduce waste through prediction capabilities, better observability, and control. Real-time data processing can optimize production alongside sustainable development and help achieve energy savings and carbon footprint reduction.

Analytics can help manufacturers identify where they can improve sustainability efforts in their production processes and drive sustainability goals. KPIs can be established and tracked on energy usage, for example.

6. Consistent rules lead to better business outcomes

Data governance ensures data is compliant, consistent, accurate, and up-to-date to support business goals. A secure data management foundation is critical in ensuring trust and reliability in data insights to make the right decisions. It allows the organization to make decisions based on a unified version of the truth.

Data governance is central to any smart factory's overarching data management strategy and regulatory requirements in the pharmaceutical industry, for example, where the right security and tracking are essential for manufacturing drugs to take to market.

7. Demand forecasting and inventory management

Demand forecasting is essential for manufacturers to manage resources and efficiently run production lines, scaling up and down as required.

Supply chain data and real-time shop floor data can be used to manage inventory control better, identify trends, and monitor throughput and demand to manage production resources better.

The potential pitfalls in creating a data-driven factory

While many manufacturers have started their data-driven journey, some struggle to get the expected insight.

A study by the World Economic Forum found that just 39% of manufacturers surveyed had successfully scaled up data-driven use cases beyond the production process of just one single product[3].

Many still depend on manual updates to firmware. Updates are time-consuming, slowing down data capture, which means it cannot be capitalized on fast enough for optimum results. A fundamental shift in thinking is required.

As Gartner points out, a data-driven approach must embrace treating data as an asset, not a by-product[5].

With data from diverse sources and multiple system levels, there are hurdles to overcome to get the full value from factory data. These sources include product lifecycle management (PLM) systems, IIoT devices, SCADA systems, PLCs, and others. It is a complex scenario that requires integrating technologies efficiently to share seamlessly mapped data.

An unclearly defined digital transformation strategy results in high efforts but low outcomes due to a misalignment with corporate objectives. A transition roadmap is critical in determining necessary capabilities, business cases, and pilot projects to assess proof of value.

These are the main pitfalls manufacturers need to watch out for in their transformation:

1. Connecting the unconnected

Many manufacturers are unaware of their assets and what is and isn't networked. An asset inventory is essential to determine digital maturity levels and align the overall vision. Next is a plan for secure connectivity, bringing systems together in a unified environment. Without this fundamental step, your transformation will fail.

2. Data locked in silos

Operational data is often trapped and maintained manually and locked in disparate or legacy systems that are not integrated. This makes it impossible to share data or gain visibility and control. Manufacturers must look for a way to integrate and centralize their data securely.

95% **of manufacturing still use paper-based processes[4]**

3. Poor data quality

Inconsistent and poor data quality results in a lack of trust in the presented information and related decisions – and, at worst, bad decision-making. In addition, a lack of coherent standards can make it unusable.

4. Barriers to OT/IT convergence

Getting data out of older manufacturing equipment isn't an easy task. Legacy systems are not designed to exchange data. Integrating legacy OT systems with IT can be difficult as some systems may have been created in-house and lack standardized interfaces. Restructuring or modernizing may be necessary.

5. Keeping distributed systems secure

Distributed systems connected to the internet give manufacturers greater agility. But they also potentially open the threat vector to unauthorized access. Manufacturers must understand what needs to be protected and what the risks are. Strong authentication and authorization are paramount.

To mitigate risk, manufacturers should implement robust data protection policies including secure storage, regular data backups and regularly revisited disaster recovery plans.

6. The global skills shortage

A lack of in-house skills is a growing problem. According to Gartner, organizational complexity, integration, and process reengineering are the most prevalent obstacles to executing data-driven manufacturing initiatives[6]. This includes effectively building a data-driven culture.

A common problem is that manufacturers embark on a data-driven transformation without assessing their in-house resources and budgeting for upskilling and digital training.

7. Failing to turn data into intelligence

Operational data is only useful if it has context. However, manufacturers often have no clear scope to look after their data.

Many manufacturers fail to put together a data management strategy for managing and storing data produced in a usable and contextualized format. Data management and governance is often seen as an add-on that causes issues with data protection and industry compliance down the line.

8. Scaling too fast

Some manufacturers make the mistake of rushing to scale up too fast without putting proper transitional steps in place. This inevitably creates excessive downtime, as necessary actions may have been missed. Scale at a pace the business can manage, putting the right training in place and avoiding unnecessary disruption. This means choosing business cases that will bring the most value first.

The four essential pillars in constructing the smart data-driven factory

The data-driven factory encompasses connected assets and digitization, enabling people, processes, and data to work harmoniously. Four pillars are required to achieve this – flexible infrastructure, OT/IT integration, security and smart insights.

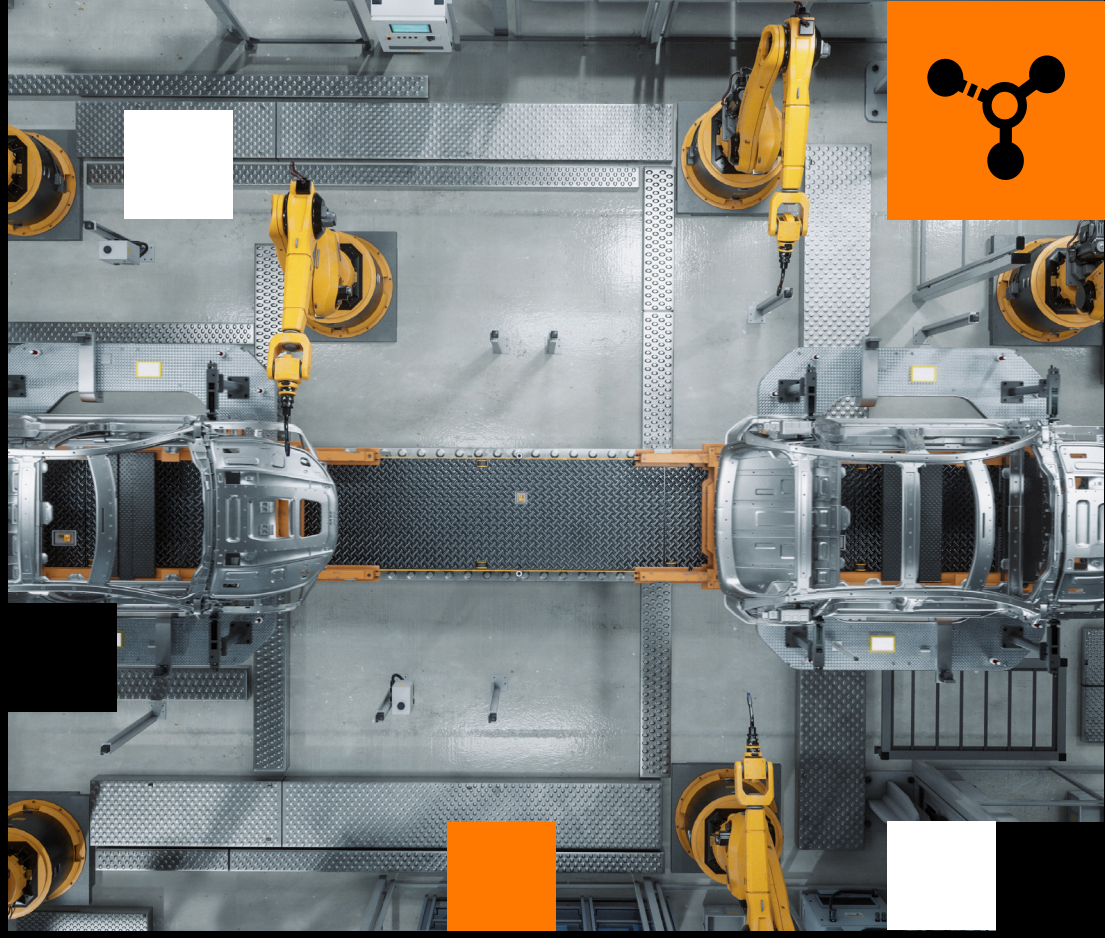
1

Flexible infrastructure

Connectivity is the backbone of the data-driven factory. Networks must be fast, secure, and reliable while being scalable and flexible enough to cope with changing bandwidth demands.

Change does not mean ripping out legacy systems. It is about tiny steps – integrating the old with the new and connecting them efficiently. Networking options include Industrial Ethernet, Bluetooth Low Energy (BLE), WiFI, WiFi6, LoRA WAN, and 4G together with Flexible SD-WAN for enterprise-wide communication, providing secure access to the cloud.

5G brings the ability to handle more significant volumes of data and offers lower latency than connectivity solutions we have seen before. However, rollout in Europe is still slow and has limitations indoors.



70% **of industrial organizations**

will run software-defined compute and network infrastructure for supporting IT, OT, and CT functions at the operational edge by 2024[7]

2

IT/OT convergence

Integrating IT and OT can provide a 360-degree view of operations by data analytics. Thus, manufacturers' drive to optimize operations and cost has become one of the prime drivers of the manufacturing data analytics market[8].

IT/OT integration makes drilling, managing, securing, and exploiting data sources easier to feed to analytics solutions. Integration can also cut overall costs by reducing duplication amongst people, assets, and processes[9]. It is little surprise, therefore, that nearly 75% of asset-intensive manufacturers are planning better IT/OT alignment over the next two years[10].

The transformation required should not be underestimated, however. Restructuring may be necessary to align IT and OT integration alongside investment in new tools and modernizing legacy systems. It also includes cultural change and governance initiatives.

Data from OT systems must be available in a usable format for IT systems to analyze and gain insight. To achieve this, IT and OT teams must collaborate to enable operational efficiencies and continuity and maintain a secure environment for devices and data traffic in transit and at rest.

Due to rising customer expectations, by 2026, 65% of G2000 OEMs will mine real-time service interactions and work order data to inform product development decisions and achieve quality targets[11].

By 2027, manufacturers will increase the use of the Internet of Things (IoT) and operational technology (OT) cybersecurity solutions at the edge, cutting OT cybersecurity breaches in half[12].

3

Security

IT/OT convergence has expanded the attack surface considerably. Thus, security must be baked in and not an afterthought.

Manufacturers must prepare for threats by securing internal data flows, ensuring compliance with regulatory requirements, and securing the entire digital supply chain.

Utilizing asset discovery and management tools, network security monitoring solutions, and vulnerability scanners empowers manufacturers to accurately map asset connections and proactively detect anomalies through continuous monitoring.

A multi-layered approach is vital to ensure the digital 'infrastructure's security. This includes a robust security strategy, as well as services for security detection, monitoring, and analytics, strong identity authentication, secure remote access controls, encryption, and incident response capabilities. Cybersecurity awareness training is also a crucial component.

A strong cybersecurity program should include regular risk assessments, governance security policies, incident response plans, and continuous monitoring.

4

Smart insights

With the onslaught of IIoT, AI and ML manufacturers can analyze data for greater granular insight. AI can be trained to automatically find and eliminate bottlenecks or alert operators when machines show signs of fatigue.

ML can use tailored algorithms to identify issues that may impact quality control automatically. These can be flagged up to process managers to prevent product losses.

In addition, APIs that allow for the easy integration of application software can make data available quickly to provide visibility into supply chains, for example. Dashboards built with these APIs track KPIs in real-time, such as throughput, to ensure client deadlines are being met.

Finding the best-fitting and scalable architecture and technology will depend on the 'company's individual requirements and needs the right balance between best practice and innovation.

65%

of Global 2000 OEMs will integrate customer relationship management (CRM) data into product lifecycle management (PLM) and employ collaborative product innovation to deliver higher quality and customer satisfaction by 2025[13].

The practical steps to building a data-driven factory strategy

Gathering and analyzing data has the potential to provide a 360-degree view of operations. These insights can pinpoint potential opportunities, highlight where improvements can be made, and improve efficiencies. To achieve this, you must:

Define objectives and vision

Firstly, identify development priorities and business cases. Run a data maturity analytics assessment to find all data assets and their current use. It will help to spot any weaknesses and determine development priorities.

Look at how data can be harvested from legacy systems. IoT devices with the right connections, protocols, and firmware can aid this process, for example.

Next, develop business cases by looking at control, efficiencies, and savings gained alongside the availability of consistent quality data. Consider prioritizing cases that will address urgent business issues and stimulate overall growth. Creating metrics to track the progress of chosen data-driven projects is imperative.

Address the IT/OT stack for successful integration

Several challenges come with integrating the OT stack with IT. These include connecting existing legacy assets, which can be many years old. There are also inconsistencies in technical standards and cybersecurity policies also create difficulties.

Transitioning from siloed IT and OT architectures to a highly integrated data platform requires a multidimensional approach – aligning technology with processes and business goals.

IT/OT integration is complex and needs a strategic and holistic integration plan to link both environments successfully. This includes assessing the legacy estate, securely extending OT data to the cloud, and choosing the scalable use cases that will benefit the fastest from integration. Every factory is at a different stage in its transformation, so be prepared to execute gradually.

To break down data silos, you must know precisely where all your data sits, how it is harvested, and how relevant it is to your needs. Once the data is audited, you can map it to ensure it is easily discovered, used, and shared across the organization.

You also need to decide which platform you want to use as a single source of the truth. For example, this may be via a Unified Name Space (UNS) that exchanges real-time data in a central place. Developing technological and human capabilities to gather, merge, manage, and analyze data is also essential.

It is essential to draw up a strong data governance and management plan. Data governance provides policies and procedures to utilize and protect your data. In addition, data management ensures that stored data is reliable, easily accessible, and current. This ensures that the correct data is used in dashboards for analytics, reporting, and decision-making.

Develop a data-driven mindset across the enterprise

Getting maximum value from a data-driven culture means everyone must have the skills to share and understand the collected data. All too often, manufacturers underestimate the digital literacy of their workforce. Ensure your workforce is trained to get the maximum benefit from the technology they use and can see why data insight benefits their roles.

Enable faster time-to-value by being more agile

Agile methodologies and agile team structures are effective tools to ensure tangible and value-adding results. The more important aspect of this structure is setting the focus on clear business outcomes, starting small and iteratively past a working Proof-of-Concept (PoC), and delivering the initially anticipated benefits. As Gartner points out, every factory is unique, and even when carefully scoped out – transformation may be more challenging than initially thought[14].

What is a Unified Name Space and why do I need one?

A UNS is a concept of distributed data that uses a hierarchical data structure to provide standardization and a single source of truth for an enterprise's production data. It connects all systems, including edge devices and other platforms, to a central hub or repository for data interoperability. This means every machine and software application across the organization accesses the same information as all data passes through the hub.

Future-proofing your factory

Manufacturing companies often aspire to achieve the long-term vision of becoming a lights-out or lights-sparse factory. However, this journey entails complexity and necessitates significant strategic exercises to determine the best way to use operational data.

To navigate this journey effectively, collaboration and partnerships play a pivotal role. Collaborating with trusted technology providers and industry partners allows manufacturers to tap into diverse expertise and best-in-solutions – reducing complexity, mitigating risks, and speeding up transformation.

But this is not a tick-box exercise. It is a continuous journey. Regular reviews and, strategic updates of the data-driven manufacturing roadmap are essential in approaching data excellence.

Why Orange Business?

Orange Business is your get-go global transformation partner for the data-driven factory. We provide enterprises with state-of-the-art Industry 4.0 solutions to increase their agility, scalability, and resilience while increasing productivity and opening opportunities to explore new connected products and digital business models.

Our individual approach is designed to make your business outcomes a reality. Our consultants have extensive industry experience and vertical expertise supported by best-in-class partner ecosystems.

Our consultants can answer your transformation challenges at every stage of the data journey using a secure, scalable, flexible approach.

With our business approach, methodology, and skills, we will work closely with you to outline business goals, organize efficient and secure data sharing, and accelerate innovation.

- **Expert advice and consultancy on building resilient future-proof “data-driven factory transformation” strategies**
- **250 plus Orange consultants across the globe**
- **Agility to improve productivity and overall competitive advantage**
- **Partner agnostic**
- **3,900 digital and data experts**
- **2,400 plus cloud experts**
- **2,500 plus cybersecurity experts**

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