Digital manufacturing platforms

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1. Digital manufacturing

Digital manufacturing is a key element of the Fourth Industrial Revolution, defined as an integrated approach to manufacturing, bringing together the physical machines, data and human beings to transform the manufacturing process. Disruptions such as COVID-19 are rippling the industrial manufacturing sector, forcing manufacturers to change and uncover new efficiencies and invest in digital technologies that challenge the traditional value chains.

The COVID-19 pandemic has acted as a wakeup call for manufacturing, making it evident that this industry cannot continue to operate on the systems and methods in place prior to the crisis. Manufacturing must move even further and faster towards the aim of greater agility and higher efficiency. Adoption of a digital business model will help manufacturing achieve those aims and will ready the industry for a post-COVID-19 era where customer and stakeholder expectations will continue to become more demanding even in the face of increased socio-economic headwinds.

Adoption of digital manufacturing techniques can enable manufacturers to maximise their factory performance. A digital manufacturing platform can be adopted to achieve these objectives.

2. Digital manufacturing platforms

Digital manufacturing platforms are essential to maximise operational efficiency, by enabling clients to fast-track their entire smart factory transformation process for a quick and sustainable value-add. They do this through organising manufacturers' data from hundreds of source applications and devices, translating that data into value through advanced analytics, persona-centric visualisations, and automated workflows.

Cloud-based digital manufacturing platforms hasten the deployment of smart factory solutions while providing the necessary framework for accelerated scale-to-value as manufacturers adopt new ways of working. Essentially, cloud solutions enable more data, more solutions, better and personalised experience, and more pull for additional innovation from production stakeholders.

Manufacturers can realise the following benefits through the adoption of digital manufacturing platforms:

1	Boost in productivity, creation of capacity and protection of quality and safety on the production floor.
2	Connection and aggregation of all required sources of data in real-time (machine, material, labour and flow).
3	Analysis and detection of performance issues and provision of insights.
4	Enabling factory stakeholders to focus on what matters.
5	Integration of analytics and insights into workflows.

Sources: https://docs.google.com/presentation/d/1gTzVZc6ZNtN9UE8jx0UIpNhdpdalVd0s/edit?usp=sharing&ouid=111489196792278216855&rtpof=true&sd=true

Digital manufacturing platforms data sources

Digital manufacturing platforms play a pivotal role in breaking the data silos that exist in manufacturing and factory environments, by enabling an integration of the different data in the various levels of manufacturing operations turning the data into actionable insights. The platforms are built with capabilities to integrate with the various technologies described on the automation pyramid in figure 1 below, providing faster, more comprehensive ways to 'connect and optimise'.

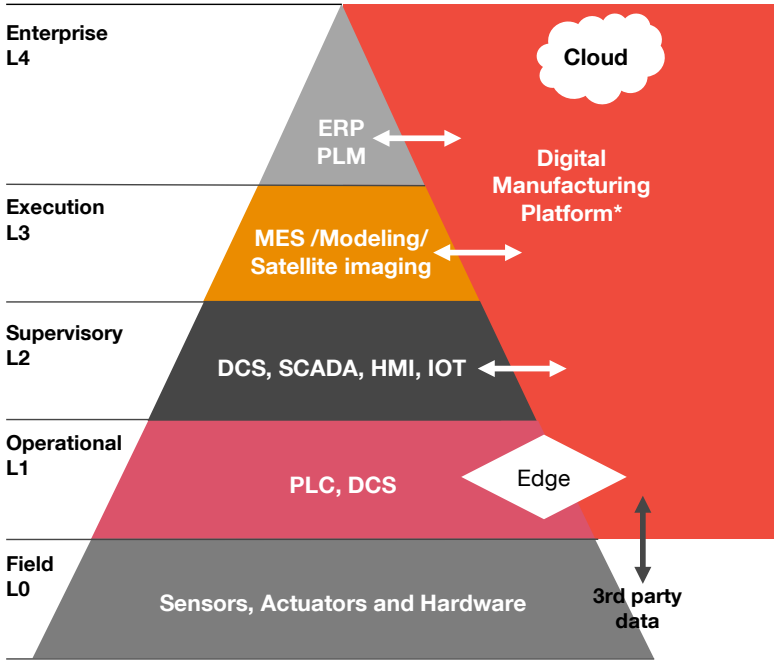


Figure 1 – DMP connecting disparate data sources

Digital manufacturing platforms are purpose-built to integrate with all data systems from plant controls and field devices including third party data sources, edge devices such as PLC and DCS providing sensor data and statuses of machines in the factories, SCADA systems and IoT devices.

The platforms are also built with a capability to interface to plant systems such a MES, see figure 2 below, providing a 360 degrees view of the manufacturing process, including factory floor matrices, labour, equipment performance and production efficiency. Lastly, digital manufacturing platforms integrate to management/enterprise platforms such as ERP/PLM providing a view of the overall corporate landscape of the manufacturing operation.

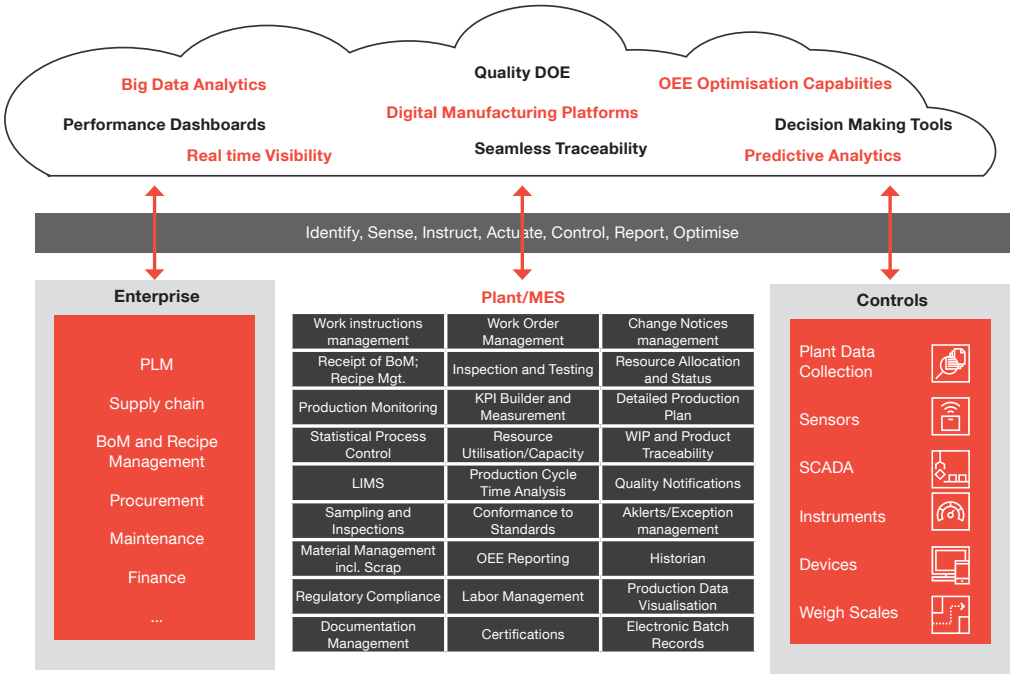


Figure 2 – DMP interfaces with other existing systems

Combining data from all these silos provides insights to identify deeper manufacturing problems that would not be visible with a siloed approach.

3. Digital manufacturing platforms value creation areas

Insightful dashboards

Manufacturers face challenges with dashboards that are either overloaded, not displaying relevant information or are scattered over multiple applications, therefore insights are not translated into actions to optimise business performance. Recent events in the production network and historic reports are not linked to each other, thus holistic decision-making based on a 360° perspective is not possible.

Digital manufacturing platforms provide standardised user-centric dashboards and activity feeds that are used as the single point of information to gain insights, trigger actions and ensure closed loop activities. Development of the integrated dashboards requires input from the manufacturer's business experts, providing real-time activity feeds employing a user-centric approach to drive better decision-making. Through the dashboards, the user can trigger alerts and actions to ensure closed loop analysis. The dashboards also enable self-service analytics by supporting mobile devices and natural language queries.

Through these dashboards, manufacturers are provided with a one, ready-to-use, reporting and reliability portal to monitor and steer production across plants and assets by integrating existing systems and ensuring closed action loops. Increased transparency and comparability across all plants, production lines and assets with reduced efforts to generate personal insights and workflows.

Production analytics

In manufacturing, shop floor workers and production supervisors often do not have real-time visibility and lack the analytical insights to identify the cause for plan deviation. Root cause analysis is often performed retrospectively based on historic data days after the production took place and is often limited to machine availability.

To overcome this challenge, digital manufacturing platforms provide real-time dashboards that visualise whether production goals are being met. The application identifies causes of deviation and enables further analysis in a comprehensive report with drill-down functionality. The dashboards allow production supervisors and operators to drill down into the different elements of overall equipment effectiveness (OEE) and into all contributing factors (material, labor, machine, flow).

The dashboards also have functionalities to alert the appropriate person or trigger other predefined actions when a production resource is interrupted. The dashboards also provide visualisation of movement patterns and workflows with real-time location information.

With these functionalities, production supervisors can realise benefits from a predefined cockpit with configurable production KPIs which also allows drilling down into details. Each dashboard can be scaled from mobile to desktop view, providing a consistent view in a variety of situations, from a manager's mobile device to large shop floor screens.

For an effective and end-to-end analysis of production performance, a fully integrated digital approach is required. Figure 3 below is the comparison of both traditional and digital approaches indicating the pain points and relief from traditional and digital approaches respectively.

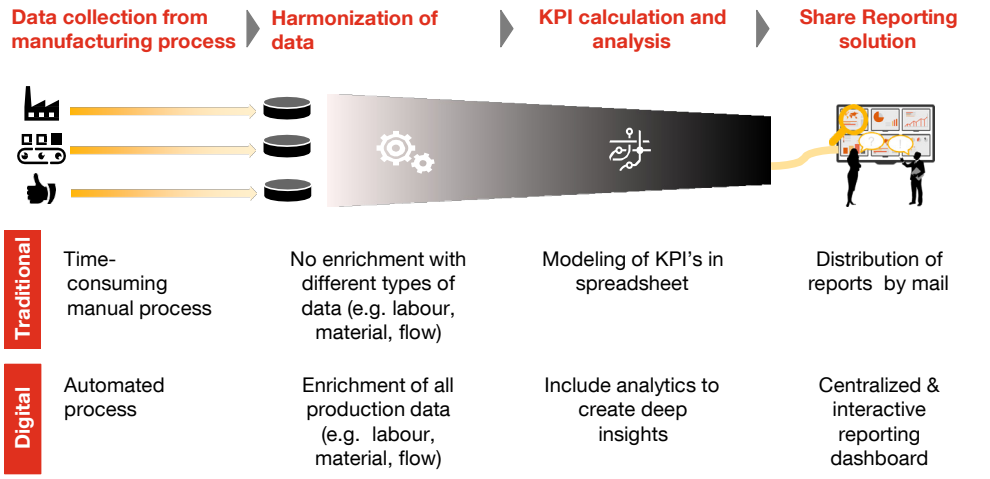
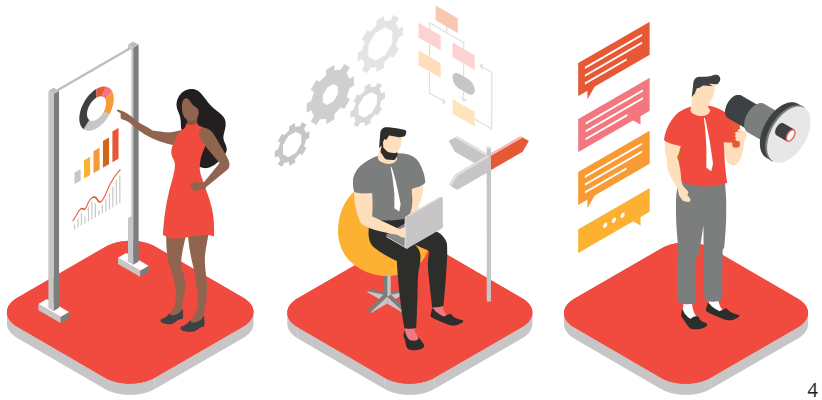


Figure 3 Digital vs. traditional approaches in reporting



Intelligent maintenance

Traditionally, maintenance teams were engaged in reactive maintenance which means they focused on responding to daily emergencies such as equipment breakdowns or failures. Maintenance schedules were prescribed and often highly ineffective, which led to workers often firefighting daily challenges and causing safety incidents or delayed production. Due to unused or missing data, no root causes of failure could be identified and consequently no future breakdowns could be prevented.

Current asset management solutions often don't focus on the business implications of the status of an asset. This makes it difficult for shop floor staff to determine whether a change in an asset's status jeopardizes daily production targets. Often, when technical teams such as maintenance, engineering, or quality need to be involved, they are informed manually with a time gap that hinders quick resolution.

The introduction of digital manufacturing platforms enables the provision of real-time asset information and sends alerts to appropriate persons in case of deviation conditions from the desired plan, in order to trigger intelligent countermeasures like re-scheduling and paperless maintenance procedures.

This is done through pre-configured solutions that help manage critical assets more effectively by using pre-trained algorithms and insights for asset performance. This includes artificial intelligence (AI) based pattern recognition of error states which trigger associated countermeasures for maintenance scheduling or paperless maintenance, as well as assurance of maintenance procedures to increase quality and safety.

The introduction of this platform functionality enables benefits including pre-configured asset management data models and 'dashboards that matter' visualisations that can be customised to meet specific requirements. Pre-onfigured connections to machine level data as well as integration into maintenance schedules (e.g. SAP PM) and paperless maintenance systems.

Predictive quality

Most industries are unable to resolve their quality problems due to too many interfaces, heterogeneous data sources and lack of analytical capabilities, which prevents them from enabling their workforce to perform end-to-end root cause and subsequent defect analysis. Furthermore, not all relevant quality features are available to create a clear defect image as input for the decision-making process, e.g. all features for the end-of-line testing process.

Through digital manufacturing platforms, manufacturers can be provided with dashboards that visualise all the necessary information on quality issues in the factory floor. Through the platform, a variety of data types can be combined providing insights, enabling manufacturers to react fast or even predict quality issues before they occur. Digital manufacturing platforms enable root-causes and subsequent defect analysis for quality issues by providing 'best-in-class' methods that combine all relevant data sources. The platforms are also pre-built with analytical models like clustering and classification algorithms to detect quality issue patterns and rework recommendations, e.g. in the end-of-line testing.

Digital manufacturing platforms can provide capabilities to reduce rework efforts and optimise machine configurations to increase product quality and reduce required resources for quality assurance, e.g. test benches. They can also increase both the speed of quality analysis as well as the quality level through the use of artificial intelligence.

The adoption of data driven predictive quality measures enables capabilities to improve quality operations and help to realise the following benefits:

1. Reduce product quality issues (scrap, loss and waste, warranty and returns).
2. Performance improvement (optimum asset utilisation and performance, minimum process instability and variability).
3. Enables the shift from a focus on correction to a focus on prevention.

Typical predictive quality benefits are depicted in figure 4 below:

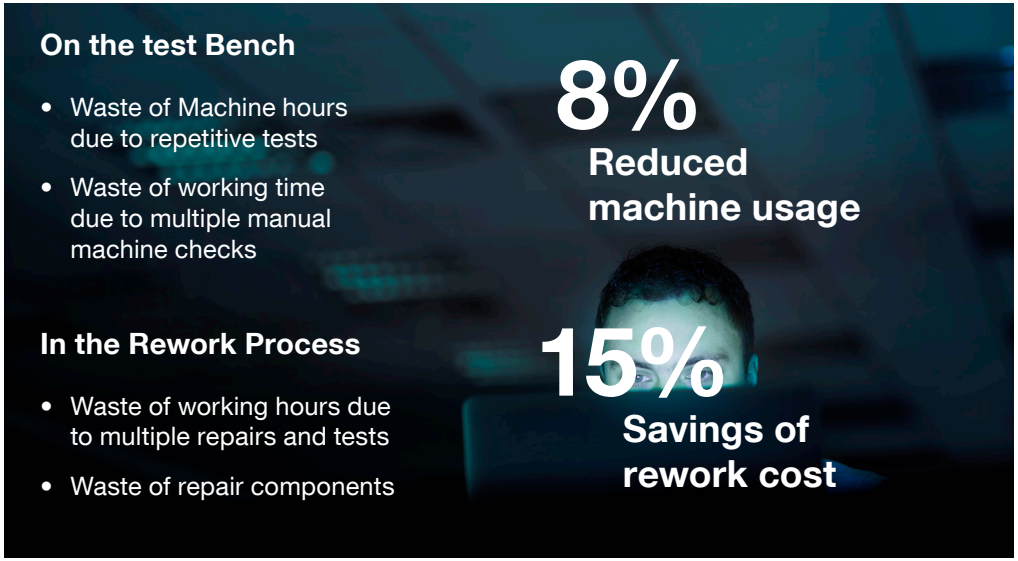


Figure 4 – DMP quality benefits

Digital lean

Although adoption of conventional lean provides benefits to manufacturers, over the last few years, it has shown decreasing incremental benefits. Adoption of digital lean can reveal untapped benefits by leveraging data-based waste identification, to reveal hidden improvement potentials. One of the functions of digital manufacturing platforms is to enable the digital lean capability for manufacturers, by providing the digital toolsets to enhance traditional lean methods and tools to generate additional transparency on the shop floor for further efficiency gains.

Digital manufacturing platforms can do this by digitising traditional lean tools, e.g. analogue shop floor management and capturing the data in a structured way (including 'non-smart' machines and workplaces). Digital manufacturing platforms can also enable the digital visualisation of shop floor incidents, analyse them and use them during shop floor meetings to systematically eliminate waste. Through the platform function, assignment and tracking of countermeasures for shop floor incidents is enabled.

Digital lean implementation on the platform can reveal untapped benefits by leveraging data-based waste identification to uncover hidden improvement potentials. Figure 5 below indicates how digital lean capabilities help organisations to overcome challenges and boost the conventional lean methodology in a smart way.

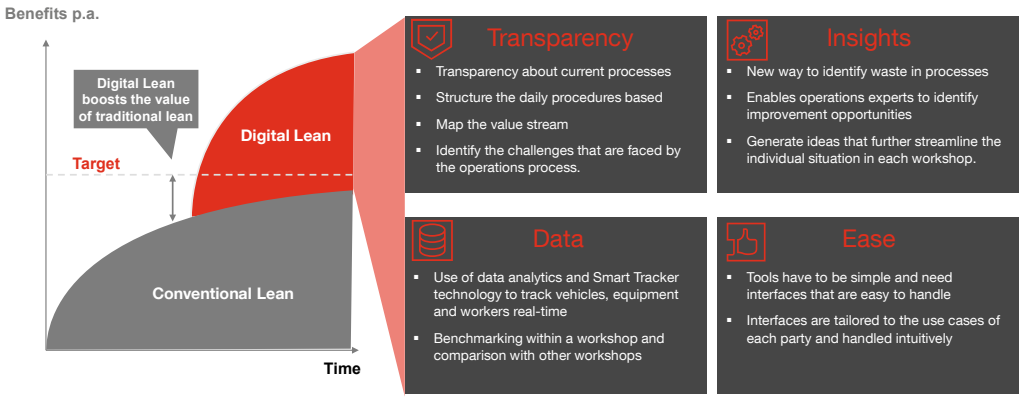


Figure 5 – Benefits of Digital Lean

Digital twin

Most companies are not able to track and trace the journey of one specific product throughout the production process. This prevents them from identifying root causes of customer complaints, due to bad quality and to narrow down the defects to specific parts, instead of batches.

With a digital manufacturing platform, companies can track and trace a specific part throughout the production process and trace the exact production conditions and resources used for each part. With the digital twin component of the platform, manufacturing processes of a production line — e.g. type of machines, type of processing, type of workers etc — can be described in detail so that any changes to the process can be evaluated / simulated digitally.

With this functionality manufacturers can benefit from a standard reporting and reliability portal to monitor and steer production across plants and assets, by integrating existing systems and ensuring closed-loop action. Furthermore, manufacturers benefit from increased transparency and comparability across all plants, production lines and assets with reduced effort to generate personal insights and workflows.

Summary

Digital manufacturing platforms are a critical element of modern manufacturing, in order to remain globally competitive. They provide dashboards for management by exception, deep insights via production analytics as well as benefits for maintenance and quality to name a few. A smart manufacturing journey starts with a digital manufacturing platform.

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