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WHITE PAPER SMART INDUSTRY

Smart process innovation with Manufacturing Analytics

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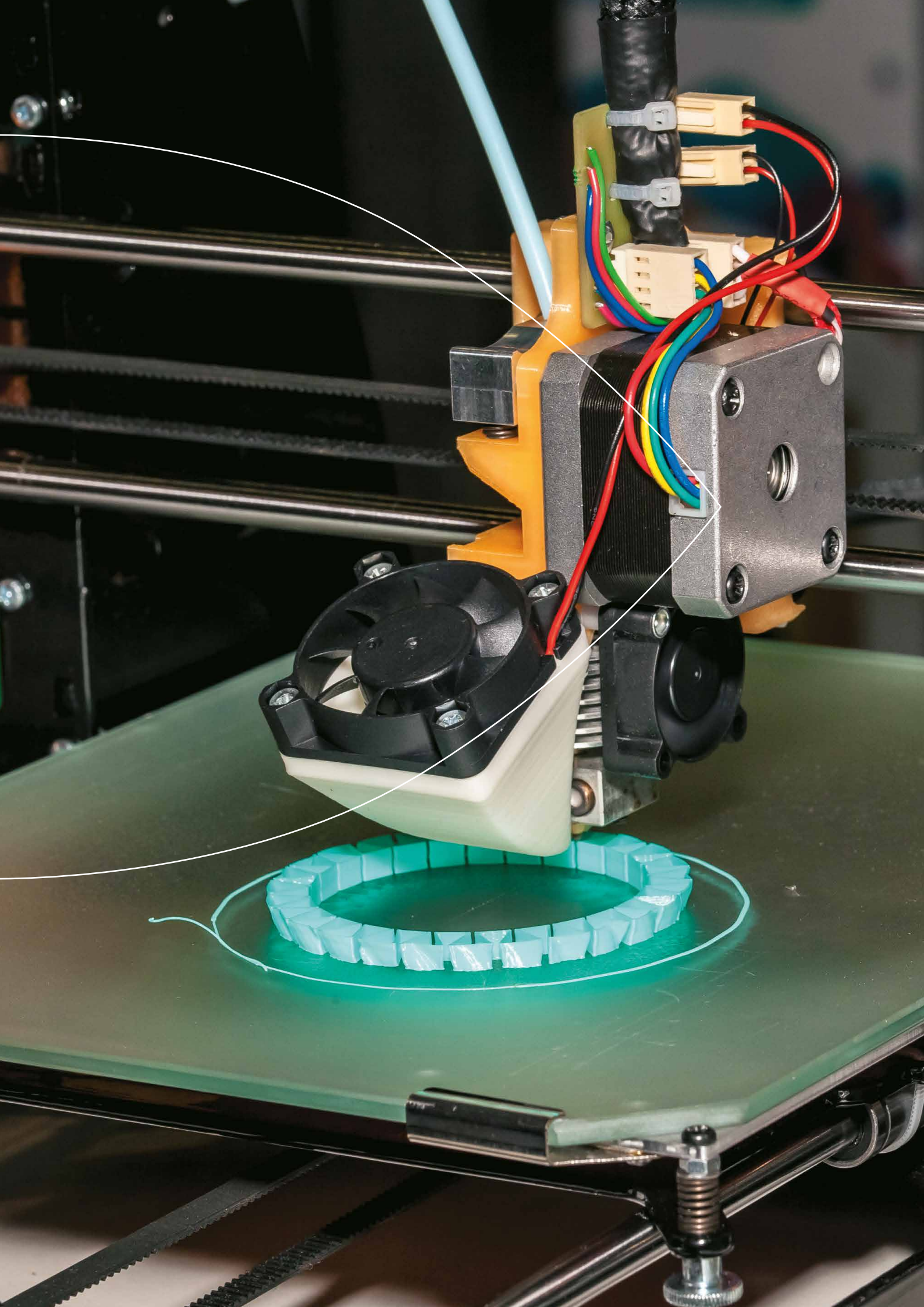
SMART INDUSTRY

VINCI ENERGIES



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Introduction

After a number of difficult years, the prospects for the manufacturing sector are substantially improved. The combination of high quality knowledge, qualityeducation and a great willingness to invest in innovation are at the heart of this. And the results are impressive. The Netherlands is high on the global list of innovative countries and is taking concrete steps towards the next industrial revolution: Smart Industry. In this way, top products are within reach at lower overhead costs in the chain and manufacturing companies are taking concrete steps towards mass customisation.

'The objective is primarily to provide insight into industrial trends and process innovations on the one hand and the ICT trends in the field of (big) data integration and data analysis (data science) on the other hand.'

The manufacturing sector is a progressive and highly versatile sector. Organisations are currently seeing a variety of processing and product innovations passing by and are trying to relate them to their own activities. The key question is then: 'How feasible are these innovations within my organisation?' More and more companies in the industry are coming to the conclusion that implementing innovations delivers a positive business case relatively quickly. Because the ICT and data analyses required can be used more and more cheaply and effectively.

In this white paper, the focus is on process innovation and we translate this into a number of new applications that fall within the domain of Manufacturing Analytics. It is explicitly not the intention to provide a blueprint. The objective is primarily to provide insight into the relationship between the process innovations and their complexity. That is the basis for exploiting new opportunities and making clear how most companies can go from A to B and why. In this way, we provide handles to support manufacturing companies in translating the potential of Manufacturing Analytics into concrete business advantages.

1. The current state of affairs in the industry

The industrial sector in the Netherlands has had a difficult time for several decades, but is now making a strong comeback. Industry is currently highly innovative and brings with it an enormous stimulus for the Dutch economy. Moreover, this development makes a direct contribution to solving wide-ranging challenges within society. These range from anticipating the energy transformation and circular economy to 3D printing and innovative applications of composites. Research by Rabobank, ING Bank and VNO-NCW underlines this. Thus industry is responsible for over 60 percent of all R&D investments and 70% of productivity growth is borne by technological innovation in industry.

'The traditional image of the industrial sector with chimneys and blue overalls is obsolete'

Knowledge infrastructure

The traditional image of the industrial sector with chimneys and blue overalls is obsolete. The transformation to Smart Industry is in full swing. The Netherlands offers the perfect breeding ground for this. Education is at a high level and, together with the government and companies, the forces are combined to create an effective knowledge infrastructure. Supplemented by an open innovation culture that offers a lot of scope for collaboration and knowledge sharing with organisations and companies at home and abroad.

Definition of Smart Industry

There is no accepted definition of Smart Industry. In this white paper, we are assuming 'smart use of ICT to connect machines (with each other) so as to support smart operational business management' [Huizinga et al, 2015].

Smart Industry encompasses concepts such as physical cyber systems (including robots, autonomous means of transport, smart grids and medical monitoring), big data (including data science) and cloud computing. The Netherlands has a good ICT infrastructure for the application of Smart Industry concepts, and companies are increasingly discovering how they can use them smartly for innovative business management.

Mass customisation

In addition to product and process innovation, Smart Industry also stands for the digitisation and robotisation of the entire production cycle. It is becoming easier and easier to combine technology and data in a smart way. The parts of the manufacturing process are increasingly automated and connected via algorithms and sensors. The result is better products, lower stock levels, shorter lead times and lower prices. In this way, customisation is possible for the price of mass production (mass customisation). A necessary development because customers (consumers and companies) are imposing increasingly specific requirements. The challenge for the industrial sector is to deliver on this in an economically responsible and sustainable way.

2. Innovation

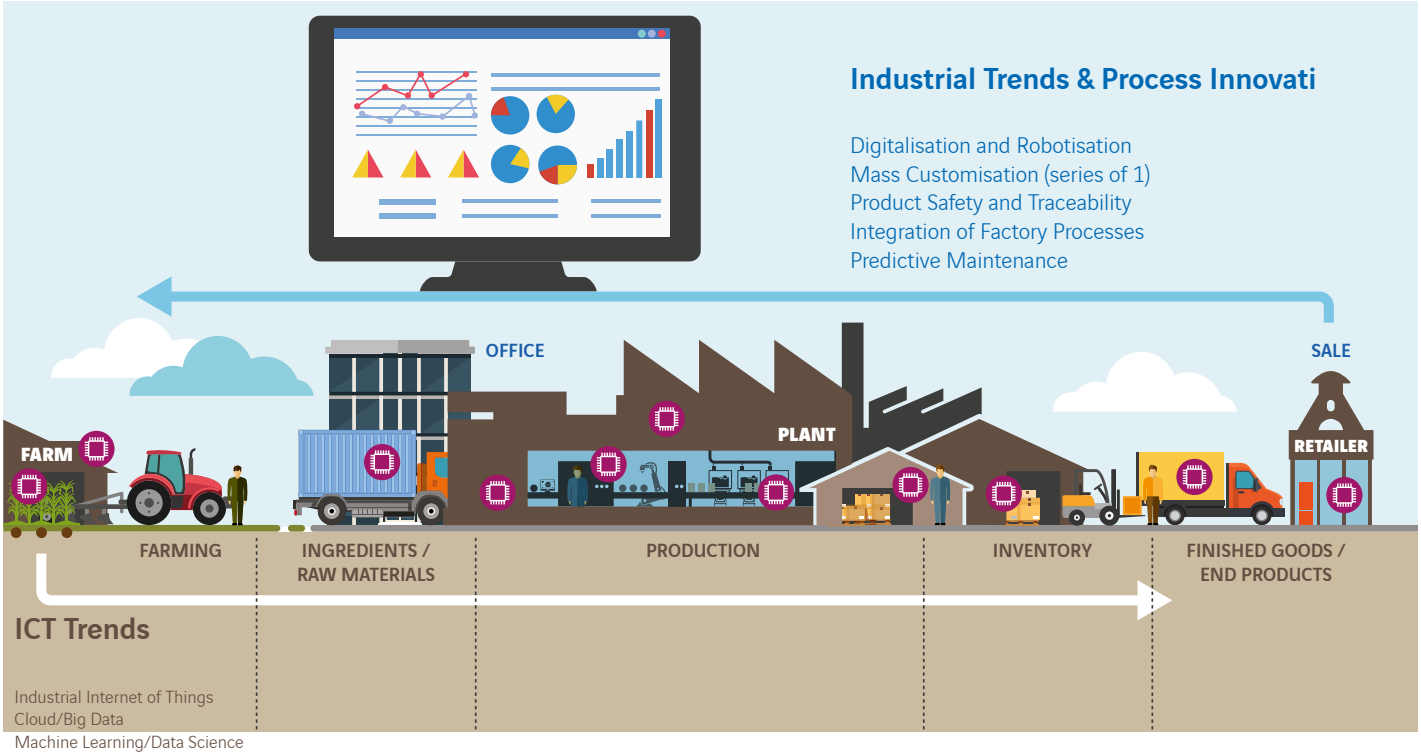
The Dutch industrial sector is highly innovative. A strong position has been built up internationally, which at the same time also entails a major challenge. New technological developments are creating enormous dynamics. Within this framework, it is essential to remain alert, to anticipate and to invest in innovation. This can be done roughly in two ways: using process innovation and product innovation.

Process innovation

The pressure to meet the high demands from the (end) customer is increasing and ensures that customer-specific, high quality products have to be delivered at the same mass production cost price. However, this places other demands on the production process; from automation, digitisation and robotisation to proactive maintenance. Complex parts of the production process require specific equipment and highly specialised knowledge and expertise. Another condition is good coordination of all the various process steps from the Top floor (the office) to the Shop floor (production floor). The common thread running through these innovations is a far-reaching cooperation and integration of business processes with support for increasingly sophisticated applications of ICT infrastructure, data integration and analysis.

'The price of data storage and computing power is falling at lightning speed'

Technological developments accelerate innovation in the industrial sector. For example, the price of data storage and computing power is falling at lightning speed and the availability of capacity is increasing explosively. Indeed, this is necessary in order to make effective use of trends such as cloud computing, Industrial IoT and big data or data sciences. In practice, the big question is how manufacturing companies cleverly combine the needs of customers with technological opportunities for making better products at a realistic price. At the same time, the need for innovation remains.



Product Innovation

Innovations around products are primarily focused on an increasingly shorter product life cycles and time-to-market of new product applications. Successful innovations must not only succeed each other more quickly, they must also generate concrete revenue. In this situation, there is less room to absorb a less successful innovation. One of the innovations relates to linking a product with the Internet in order, for example, to enable remote management. Another trend is aimed at improving the registration and traceability of products and components in chain for purposes of product safety. This is very relevant, for example, for food or medicines. Finally, in recent years, the environmental impact of products is a subject that organisations – must – pay more attention to. As a result, it makes good sense, already at an early stage of product development, to consider the source of components, maintainability and future reuse.

The focus is therefore no longer solely on production. Successful product development has now come to require much more than the efforts of engineers and designers. In this process, the importance of feedback from the market is also increasing. By linking products with the Internet (IoT), ever more insight is emerging into the actual usage. This information is very valuable for the design of new models and products. It is also possible to track products during their lifespan and to include the input from users in the innovation of products and services.

3. Manufacturing Analytics, driver for fast process innovations

To innovate processes in the factory effectively and manageably, both ICT infrastructure and data integration and analysis are required, in short Manufacturing Analytics. This is a collective name for a number of data analysis applications within factories. Depending on the complexity and maturity of the processes in the factory, Manufacturing Analytics supports various areas, including the following:

1. Plant Performance
2. Quality Compliance and Risk Management
3. Top floor-Shop floor Integration
4. Predictive Maintenance

Plant Performance

Plant performance offers organisations a better grip on costs, degrees of utilisation of production resources and the deployment of the right people. This additional control gives the management of a factory the opportunity to quickly calculate the consequences of changes in production volumes and production planning, in the size of the production series and orders, and in the capacity planning for people. The aim is to optimise factory performance by focusing on the coherence of manufacturing processes and on the dependencies of critical objects within the factory. These processes cover production, quality, stock and maintenance. Critical objects within the factory include the job roles performed by people, machines, products and systems that contribute a specific added value (intellectual property) to the product or service.

'An effective approach requires a detailed insight into the risks and costs of a quality product'

The desired insight is available via a Plant Performance Dashboard, an operational management dashboard with relevant KPIs. This dashboard can be fed with data from various systems (machine data, MES, ERP or HR) that are linked in a logical way. It is also possible to display the underlying information (in-depth reports). If a KPI lights up in red, the user can click on it for more detailed information.

Quality, Compliance and Risk

The customer requirements package continues to grow. The pressure to deliver in line with changing and increasing customer specifications leads to more complex production processes and higher costs. Tackling these challenges effectively requires detailed insight into the risks and costs of a quality product. The question is then whether there is enough margin left to properly interpret the demands of a customer who is getting more and more power? And if something goes wrong unexpectedly, it is essential to know how quickly a response is possible. For example, if a wrong series of products has still been delivered.

Parallel to this, legislation and regulations are becoming ever more stringent. This concerns, for example, product safety, health or targeted track-and-trace options in the event of problems.

As production becomes more and more specific, organisations want to know exactly what the Cost of Poor Quality is and exactly what the costs and revenues of higher quality products are. Another point for attention is dealing with warranty claims or claims for damages. Ever more often and ever more quickly, customers are finding their way to the courts, interest groups or (social) media to vent their dissatisfaction. In order to limit high costs and reputational damage as much as possible in such cases, it is crucial that manufacturing companies anticipate quickly and in a well-informed way. Good traceability of products and retention of production and delivery data is indispensable for this.

In summary, effective Quality, Compliance and Risk Management requires clear management information on the costs of poor quality. On the other hand, management needs information about the impact of quality requirements on (manufacturing) costs and a good picture of the limits (range) and risks of production activities. At a detailed level, good quality and risk management requires insight into the costs of quality losses per series or batch, but also of waste, products failing to meet customer specifications and reworking costs. In addition to the use of diverse available information within a production environment, the data accessible via machine learning is also very valuable. For example, when analysing risks (FMEA), error codes, faults, reports and suppliers.

With the increasing pace of implementing change, the boundaries between strategy and implementation are becoming blurred.

Top floor-Shop floor Integration

Many companies struggle with a disconnect between strategy and implementation. There is ineffective communication between the boardroom and the shop floor. If, for example, those responsible for implementation are asked what is necessary to arrive at a good decision, they come up with a totally different list of conditions and steering parameters. These are not necessarily in line with the business objectives or KPIs as defined during the long-term planning process. In other words, decisions taken by the company 'on the spot' – when the most critical decisions are taken – do not steer the organisation in the intended direction. And where this is the case, it is very probably more a coincidence than a deliberate decision.

With the increasing pace of implementing change, the boundaries between strategy and implementation are becoming blurred. In order to still guarantee the quality of the production and improve the operating profit, a detailed understanding of the manufacturing costs is necessary in the first instance, preferably already before the start of production. This provides a good picture in advance of what the costs of a specific series will be at a certain point in time. This information is very valuable when planning campaigns. But certainly also to process changes in the ordering and purchasing behaviour of customers more quickly. In this way, organisations can anticipate changes in demand from the market quickly and in a targeted way and translate these opportunities into a better operating profit.

'Shop floor-Top floor integration' is the collective name for a number of technologies that can be used to quickly calculate scenarios and enable KPI-driven control for the entire shop floor. This can be done, for example, by first storing data from office systems – such as ERP and CRM – in a data warehouse. Together with data from factory systems – such as MES and LIMS – real-time planning and analysis techniques can then be let loose using these data. These support the decision makers during the implementation.

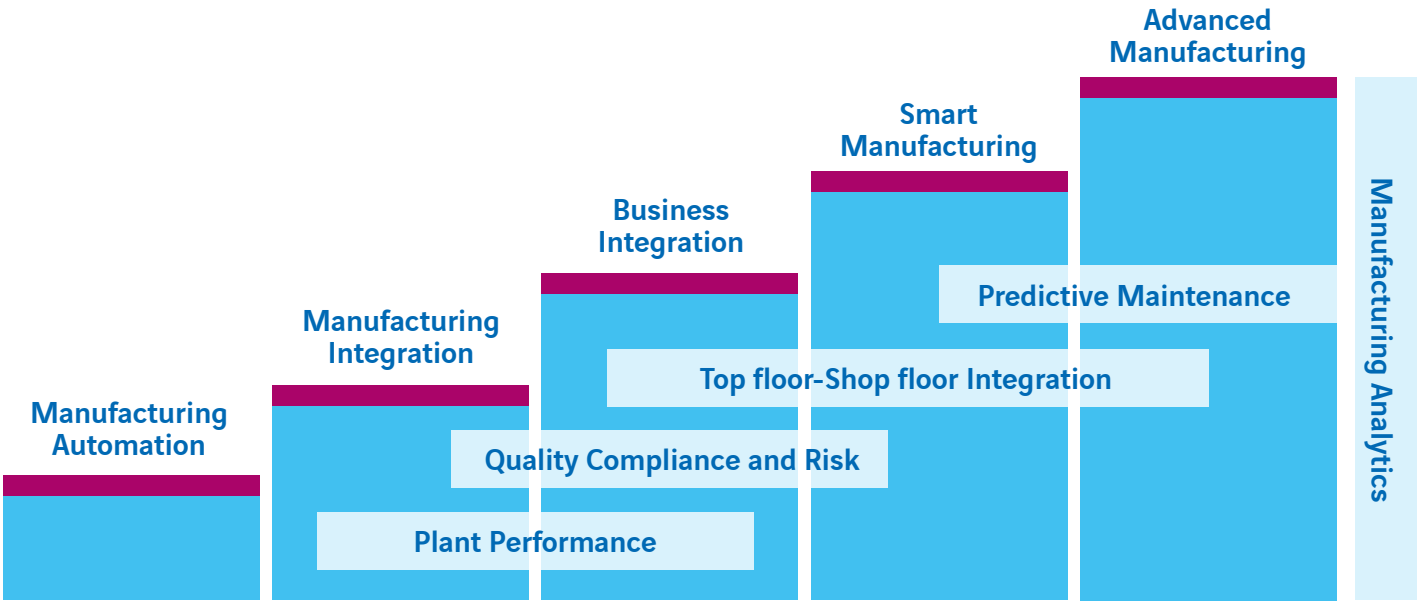
Predictive Maintenance

The industrial sector is very capital-intensive. The available capacity must be used as efficiently as possible. Unplanned downtime of machines can give rise to many unexpected costs in a short period of time. For that reason, optimal planning of maintenance is an important cost-saving factor. Predictive Maintenance integrates data from machines, maintenance planning and production

prospects, and creates an automated system for monitoring and alarming asset/machine sensor data. The probability of asset/machine failure can be calculated using predictive models. Operators automatically receive a signal in the event of an increased risk of failure.

The use of Predictive Maintenance in practice requires pro-activity. The integration, analysis and monitoring of sensor data from machines or assets ensures that breakdowns and failure are predictable. This transcends the machine level, for example by automated parameter exchange between components and machines throughout the entire chain. It is also possible to trace bottlenecks and downtime at machine level using process mining. This information increases the insight into the required response time in case of emergencies. Predictive Maintenance is especially effective if an organisation chooses an holistic approach, in which the relevant departments, such as Logistics, Sales and Services, Procurement of machines and components collaborate intensively and exchange data.

4. Manufacturing Analytics: from A to B



Many companies are taking these steps in their development and in the application of manufacturing analytics. At the same time, we see that many companies are investigating the successful application of predictive maintenance with all its challenges or have already started to do so. Within this development path, it is very well possible to skip steps or accelerate their implementation. However, these steps can help in making conscious choices and holding the right discussions when starting to use manufacturing analytics.

The industrial sector is very multifaceted and that certainly also applies to the variety of organisations that are active in this area. They each have their own activities, specialisations and characteristics. Innovation is a common denominator, but within this, every organisation has its own growth path. At the same time, there are similarities in the development steps that can contribute to this. The aim of these steps is always to ensure that Manufacturing Analytics are used effectively for successful and sustainable business management. For many manufacturing companies, the importance of process innovation is beyond dispute. The complexity and maturity of a factory determines the extent of development and innovation opportunities. Precisely because organisations are at different stages of development, this white paper focuses on a number of growth steps that a factory can still make in its development.

In many cases, the first step concerns the automation of the production process itself. The reason for this step is often an increase in demand for products. If this automation is successful and

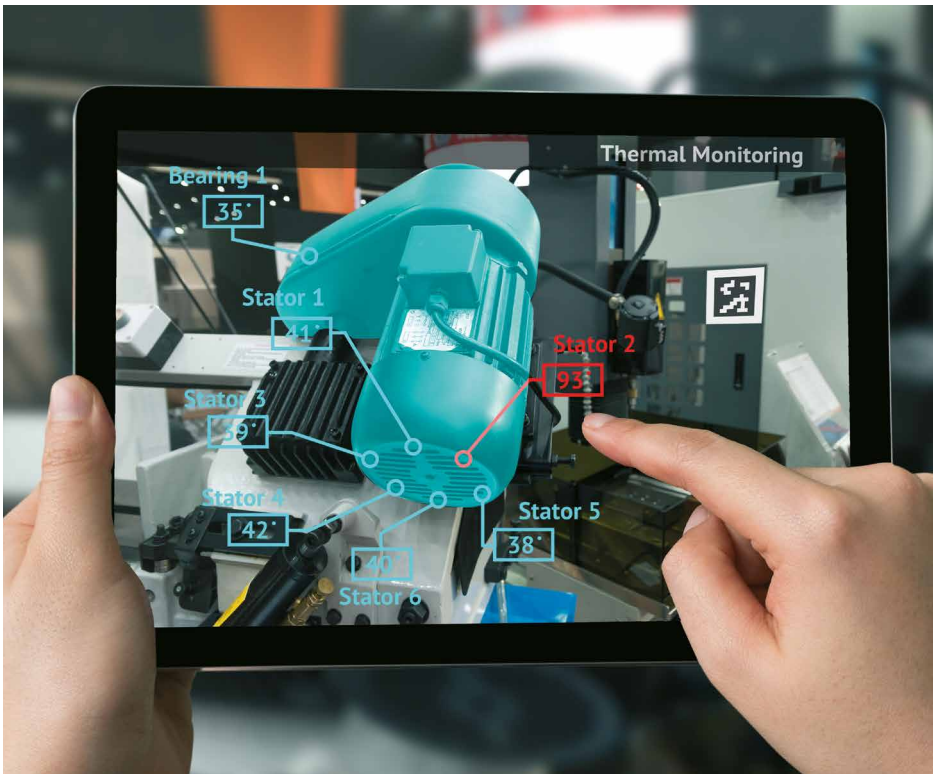
production volumes exceed the break-even point, further optimisation is possible by integrating manufacturing processes and data. What we are talking about here includes data on production, stock, quality, maintenance, team direction and cost control.

'The development of a factory grows from inside out in terms of complexity.'

Breadth versus depth

When this basis is in order, the next moment of choice arrives: does an organisation go further into the depths to gain even more insight into the factory's performance and risks? Or is the emphasis on the breadth to improve coordination with suppliers and customers. Choosing the first means a risk analysis of critical processes and objects or a cause-effect analysis to detect the cause of certain faults. Choosing the second revolves around far-reaching integration with business systems, such as ERP and CRM. This is followed by the integration and coordination of processes within the chain, including linking with customer and supplier information systems. The objective of these steps is to quickly and efficiently process the events in the chain that affect the demand for products. The sooner it is clear what happens further down the chain, the better an organisation can anticipate. Once this has been set up, there is a good basis for further digititalisation and robotisation within the chain.

In summary, the development of a factory grows from the inside out in terms of complexity. In order to move from pure production control to the development and management of intellectual property, many more steps are needed. This requires a transformation from a reactive or corrective mode to a more proactive approach including demand forecasting and Predictive Maintenance. The focus in doing this is also shifted from producing and offering an item to a combination of product and service as part of an ecosystem. This therefore involves blends with products and services from other suppliers.



If factories are able to expand a stand-alone production system with real-time monitoring to a platform where (product) data is the lubricating oil of new developments, feedback and needs, then successful innovation is within easy reach.

5. Conclusion

'Data is approached as the raw material'

Manufacturing Analytics is a collective term for methods and techniques based on data analysis that are applied in and around the factory domain. More and more often, companies are finding the balance between customer demand and product range, strategy and implementation, risk and return, production and maintenance, and reactive and proactive behaviour. This is possible because they smartly combine process domain knowledge and data analysis knowledge. In doing this, data is approached as the raw material. Process experience and expertise are then the catalysts that ensure the correct application. In this way, it is possible to implement process innovations and ICT trends in the right way. Smart Industry is becoming embodied more and more concretely in this way.

Axians is following the latest developments in the industrial sector and in the field of ICT infrastructure, data integration and data analysis and has developed best practices over the years to achieve a good and feasible application of this among its customers.

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