Digitalised production chains are central to manufacturing's productivity puzzle

Manufacturers must digitalise faster to stay competitive and be more sustainable. Accelerating the digitalisation of industrial production chains is also one of the ways to solve the industrial productivity puzzle

This is part one of our analysis of digitalisation opportunities and challenges in the manufacturing supply chain. The productivity potential of digital chain technology and the pros and cons for manufacturing companies are discussed, as is the digital state of the art. In part two of the analysis, we explore barriers and ways for manufacturers to circumvent them.

Industry 4.0: the European manufacturing industry is lagging behind

The fourth industrial revolution, also referred to as Industry 4.0, is the next phase in the digitisation

of the manufacturing sector, driven by interconnectivity, automation, and machine learning.

The European manufacturing industry is not yet halfway through this (r)evolution.

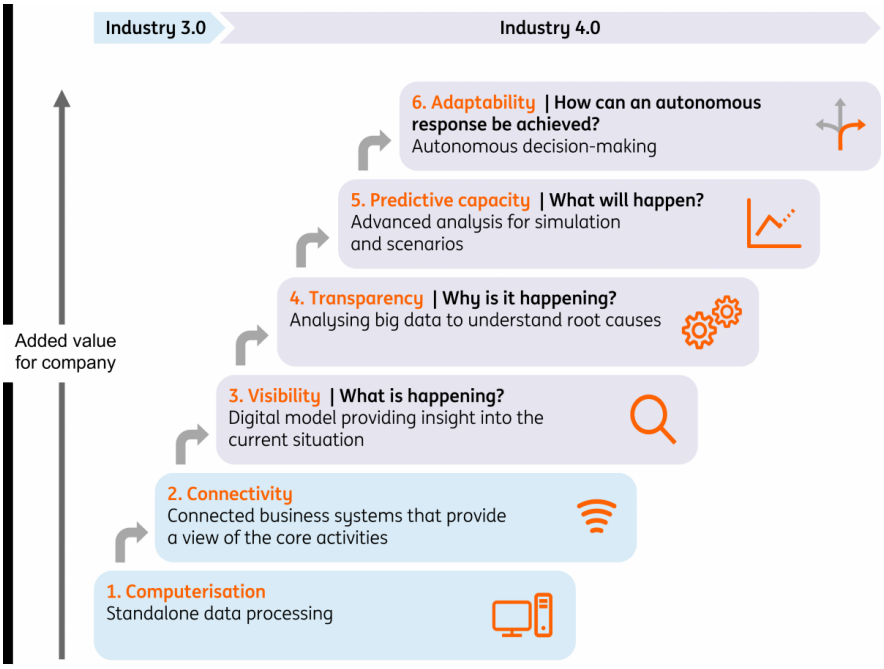
It is estimated that the majority of companies are roughly at the end of phase two of a recognised model that has six development phases (see below).

- In phase two, isolated IT systems are interconnected and provide a representation of the core business processes.
- Full integration between IT (information technologies) and OT (operative technologies) takes place in phase three of the model, in which processes are recorded from start to finish using sensors and made centrally monitorable in real time.

The next steps on the road to digital growth offer manufacturing companies more insight and speed of action. Lower failure costs, greater flexibility, a shorter time-to-market and increasingly autonomous operating processes will then be within reach.

- A better understanding of interdependencies between processes brings the company into the transparency phase (four).
- Then, in phase five, predictive skills allow the simulation of different future scenarios for timely anticipation and increased agility. Predictive maintenance is an example of using insights based on historical data, for example, about the wear of machine parts, whereby unintended downtime can be prevented through early (predictive) maintenance.
- In phase six, such anticipation takes place fully automatically. This is only possible if the company knows how to use data in such a way that optimisation decisions are made autonomously using artificial intelligence.

Six phases of digital transformation



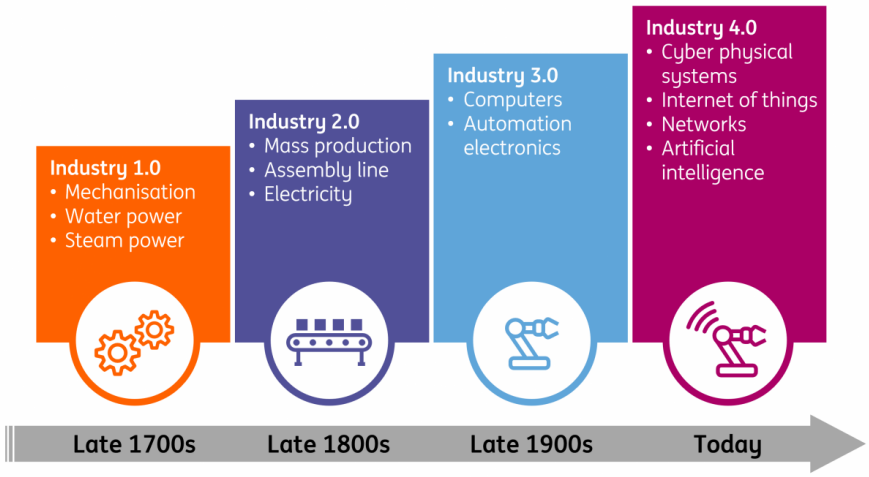
Source: ING Research based on Acatech

Digital technologies can make industrial business processes more efficient

The pursuit of a 'smart industry' has been widely embraced by policymakers and industry associations. Central to this is digital communication between companies and business units and processes. Digital technologies, such as smart software, robots and sensors, can make the design, manufacture and distribution of products more efficient. For example, via a shorter time-to-market through digital production simulations or via the optimisation of production processes by using an increasing amount of data to reduce machine downtime.

Industrial productivity is increasing structurally thanks to technological revolutions

Timeline of technological breakthroughs that increase industrial productivity



Despite acceleration, industry is well behind the digital leaders

Digital transformation is accelerating in all sectors, and manufacturing is no exception. The share of companies with high digital intensity has increased faster than before the Covid-19 pandemic and the share of companies with very high digital intensity has increased even faster. The European industry has an average digital intensity that is slightly below the average of all sectors combined. However, the gap between leaders such as ICT, business services and wholesale is considerable.

Digital transformation goes beyond the invention of new technologies. Companies must absorb and apply the innovation, for which agility and a strong innovation culture are of great importance. When innovations from frontrunners are applied across industries, broad productivity effects occur. Research by Van Ark et al. suggests that digitalisation matured enough during the Covid-19 pandemic to ensure a long-term recovery in productivity growth.

Labour productivity growth in European industry is falling

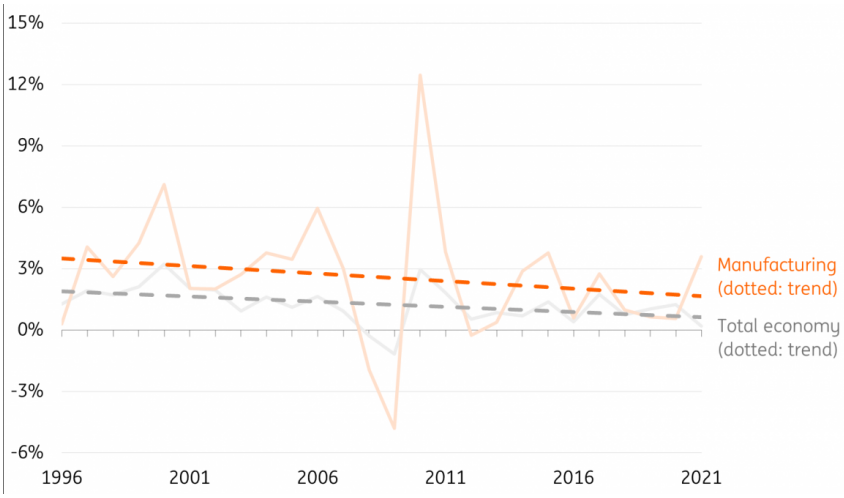
Labour productivity growth has been slowing down globally for decades, including in the manufacturing industry.

Between 2017 and 2021, manufacturing in Europe became, on average, 1.7% more productive each year. Between 2007 and 2011, this figure was 2.5% and in the period 1997-2001 it was 4%.

Higher productivity growth is necessary to grow in times of an ageing population and a shrinking workforce. Technological applications have always been an important flywheel for productivity increases. In industry, with its repetitive, predictable and serial production processes, they are relatively easy to apply.

Productivity growth in manufacturing is relatively high, but slowing

Growth of real labour productivity per hour worked in the European Union



Source: ING Research based on Eurostat

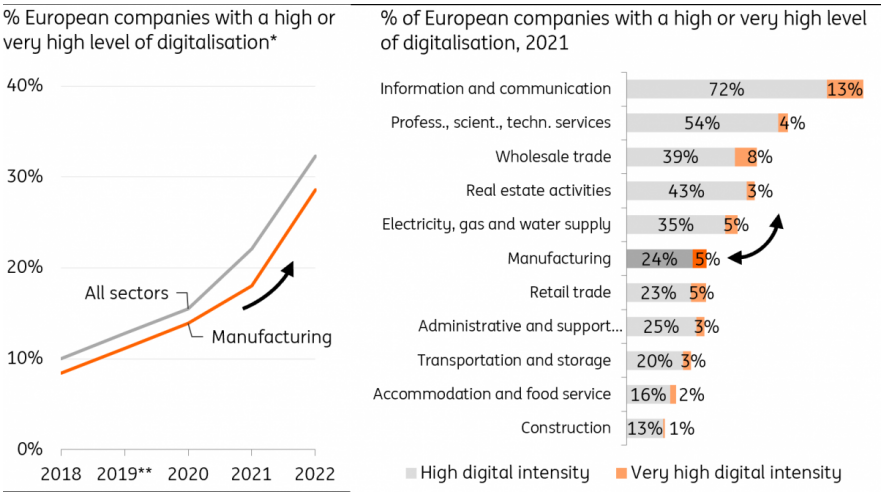
Digitalisation has a delayed effect on productivity figures

The fourth industrial revolution is accompanied by a 'productivity paradox'. Sharply increased business spending on ICT and digital services has not yet led to faster productivity growth. Indeed, although digital technologies have spread rapidly in the economy, their adoption and translation into better business performance have been rather slow and uneven. Yet there is evidence that digitalisation improves productivity in the longer term.

Evidence of positive coherence at sector and firm level

Productivity appears to be positively related to the adoption of digital technologies at the sector and company level. In the US, sectors producing digital products and services are the largest contributors to productivity growth. In the eurozone and the UK, the most digitalised sectors do show higher productivity contributions. According to other research, digital adoption in an industry is related to productivity gains at the firm level. Effects appear to be relatively stronger for serial production processes and for the most productive companies, and weaker when digital skills are insufficiently developed.

Industry is rapidly becoming more digital, but is lagging behind the frontrunners



Source: ING Research based on Eurostat *based on the Digital Intensity Index **estimate due to missing figure

Governments are trying to accelerate digitalisation

Under the umbrella of The Digital Europe Programme, the EU promotes the implementation of digital technologies, such as artificial intelligence, 3D printing, autonomous systems and Internet of Things technologies. The European Digital Innovation Hubs (EDIHs) is an important part of this policy. This is a European network of organisations that unlocks knowledge and helps small and medium-sized enterprises (SMEs) to test digital technologies, gain digital skills and obtain funding for implementation.

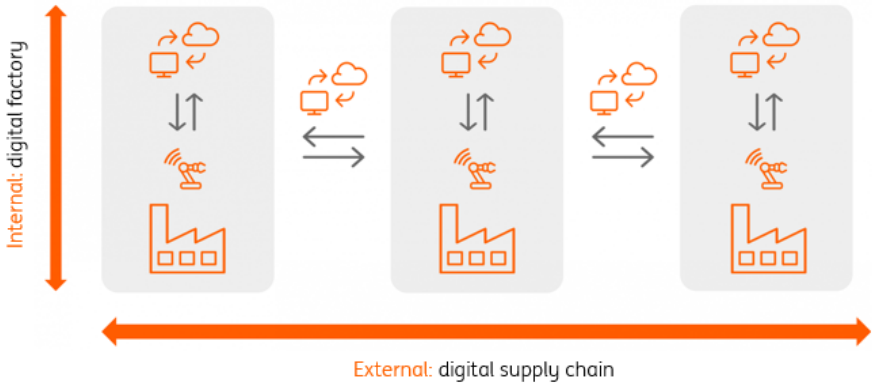
The first EDIHs started in 2022. They act as a support desk in the region that distributes the digital knowledge gained from the dozens of existing 'field labs' to companies. The latter offers a practical environment where entrepreneurs and knowledge institutions experiment together with the development of new technologies and their implementation in new business and revenue models.

Internal and external digitalisation on the rise

As stated, the share of manufacturing companies that have been extensively digitalised is lagging behind. The majority of manufacturers use software for production planning and scheduling, but only a minority of companies have digitalised their processes to a larger extent. Think of the digital exchange of technical drawings and instructions between the engineering department and the manufacturing floor, the use of systems for real-time production control, for managing internal logistics or for machine-to-machine communication. Just like internal digitalisation and automation, automated data exchange with various partners outside the company can also yield efficiency benefits. The exchange of information about ordering, invoicing and production planning with suppliers and customers is on the rise, but just like internal digitalisation, it still has a long way to go to maturity.

Digital information flows inside and outside the factory

Schematic representation of digitalisation of internal and external information flows



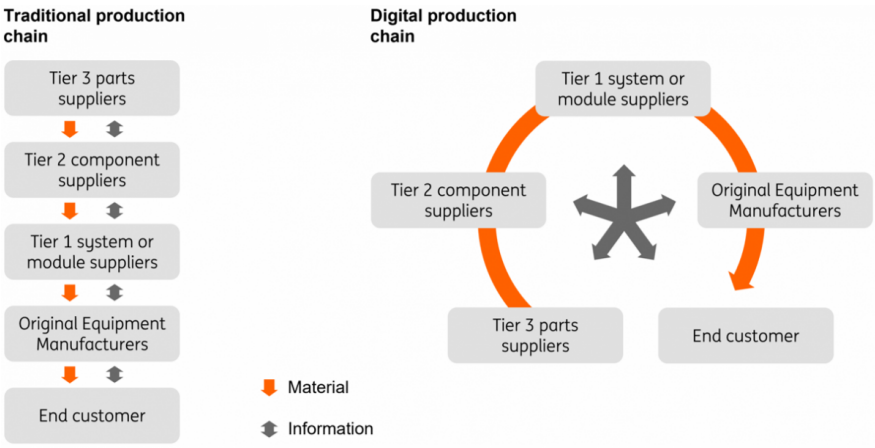
Source: ING research

Smooth information exchange is essential for well-functioning production chains…

Continuing specialisation and outsourcing have led to long production chains in the manufacturing industry. The many links in the chain make continuous coordination with suppliers and customers necessary. Delays or unexpected changes at one company can have major consequences throughout the entire production chain. The pandemic has made it clear that this can lead to long-term disruptions. Also, stock positions in long chains are spread over many companies, which creates a strong 'bullwhip effect'. The extent of stock adjustments becomes stronger as more parties in the chain have to anticipate each other's order changes. Much depends on smooth information exchange throughout the chain.

From 1-to-1 information flows to data exchange throughout the entire production chain

Schematic representation of digital data exchange in a traditional and a digital production chain



Source: ING Research based on Deloitte a.o.

…and improvement of processes and products

Digitally automated data processing in the production chain makes it possible for information flows, for example regarding orders, delivery times, invoices, stock positions and product quality, to be processed in the business system without additional actions. At the moment, incoming orders are still often processed manually, which takes more time and causes more errors than having them read in automatically. In a sector where 'high-mix, low-volume, high complexity is increasingly the norm, costs can quickly spiral out of control. The risk of more errors and failure costs increases with manual work because the variety of products increases, production series become smaller, and the complexity of products and processes increases.

Volkswagen is working on a digital supply chain

According to its 2022 annual report, the car manufacturer wants to fully digitalise its supply chain in the long term: “In the future, the procurement division wants to standardise transactions with suppliers and automate them where possible. This not only reduces transaction costs but also speeds up business processes. The integration of Catena-X, the data network for the automotive industry, is an important part of this. As a result, potential supply risks can be identified earlier and appropriate measures and alternatives can be developed together more quickly.”

Less manual work is key

Producers can have various reasons for working on a digitally automated production chain. The central point is that a human action, for example to approve an order or invoice, is no longer necessary. The client can then 'submit' an order under predetermined conditions without further price negotiation or approval, provided that it meets the agreed purchasing and sales conditions, after which the invoice is automatically processed. This increases efficiency by linking internal digitalisation to that of external partners. In this way, a fully automatic or 'autonomous' flow of interconnected production processes can be created throughout the chain.

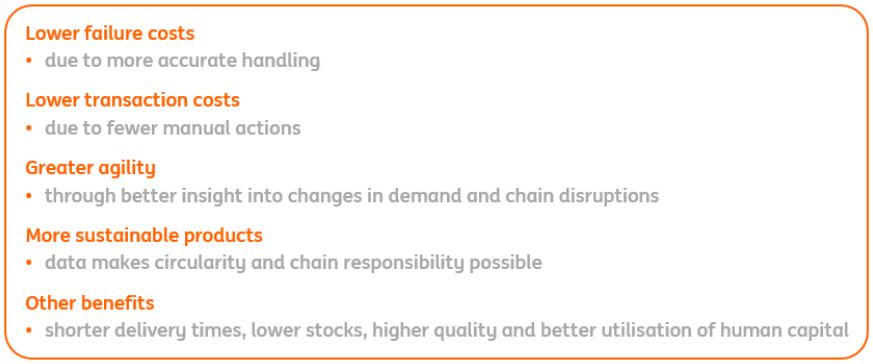
The potential benefits for individual companies

1. Lower failure costs due to more accurate handling. Because chain partners make agreements in advance with automated processing, the risk of failure is small. A set of agreements about what they can expect from each other forms the basis in order to enter and process new orders without prior consultation. For example, what is the maximum delivery time, order size or error tolerance in terms of quality, when processing the order flow digitally?
2. Lower transaction costs due to fewer manual actions. At a Dutch manufacturer, we spoke to, this saved roughly three minutes of actions per order line, including packing slip and invoice. With the 8,000 order lines that it now automatically sends out per year, this amounts to a saving of approximately €12,000 at wage costs of €30 per hour, while the additional costs are approximately €2,400. Such savings can increase significantly when multiple data streams are exchanged automatically, such as invoices, design, quality and origin data in addition to orders.
3. Greater agility through better insight into changes in demand and chain disruptions. Optimal digital connections with the rest of the production chain can make changes

elsewhere in the chain, for example in demand or delivery times, immediately visible. This allows the receiver to anticipate changing circumstances more quickly.

4. More sustainable products: data makes circularity and chain responsibility possible. Automatically supplied data certificates can enable better traceability of products. Digital information can demonstrate not only the origin but also the composition and recyclability of products and parts. This makes the path travelled through the chain more traceable so that sustainability can be better estimated. Without digital data streams, it will be difficult to keep track of scope 3 climate effects that take place elsewhere in the chain.
5. Other benefits: shorter delivery times, lower stocks, higher quality and better utilisation of human capital. Delivery times become shorter if there is less delay during purchasing and sales processes. Better information about the situation in the production chain can reduce the need for buffer stocks. In addition, the exchange of increasingly complex information enables early quality control and digital co-creation, for example, via so-called digital twins. These are virtual simulations of products, machines and installations, with which the operation of a design can be tested without the need for physical drawings or prototypes. Finally, in times of major staff shortages, it is important to be able to get by with as little manpower as possible and to deploy staff as productively as possible.

Digitalisation of the production chain has many potential benefits



Source: ING research

Cost, required digital base and transparency can be barriers

In addition to advantages, there are also potential disadvantages. A digital production chain requires highly fluctuating IT investments without there being any certainty in advance that these will be earned back. That depends on the individual business case. With a limited number of suppliers and a limited order flow consisting of more complex products, turnover is lower due to the limited numbers and the many manual changes that are then required. With large series of orders for basic products without many changes, you can, for example, have the order flows run more autonomously.

There are also some basic conditions. For example, data management must be in order and a company must have well-secured IT systems and well-functioning ERP software (Enterprise Resource Planning) that connects the various business processes. ERP suppliers must also support links to any existing data networks. This is not always the case, while making connections yourself is expensive. Finally, there must be trust in the chain partners in order to work transparently. Caution may be called for with new suppliers or competition-sensitive information. Large-end

producers also generally find it very difficult to open up their own environment to smaller suppliers.

Acceleration towards digital chain collaboration has started

For industrial companies, the time seems ripe for further digital chain collaboration. The pandemic and the war in Ukraine have already accelerated development. In a study by the US Materials Handling Institute, a large majority (78%) of companies operating in supply chains indicate that ongoing global disruptions have accelerated the pace of digital transformation in the supply chain. Almost two-thirds (64%) also indicate that their own organisation will invest more in chain innovation.

More and more German car manufacturers and Dutch and Belgian manufacturing companies are connected to a central data network. For example, three hundred companies from the Benelux are now part of the Smart Connected Supplier Network (SCSN). All the benefits of the digital chain increase as more parties participate. Agility then increases due to faster and better information flows and the available production capacity is better utilised due to fewer outages.

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