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# The Digitalization Productivity Bonus: Sector Insights

## What value does digitalization offer the Automotive, Machine Building, Plastics, and Printing, Packaging and Paper industries?

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## Contents





# Management Summary


- Digital transformation – or Industry 4.0 – is a widely recognized imperative in manufacturing. Manufacturing CFOs, however, require measurable outcomes on which to base their investment in digital transformation.
- Research from Siemens Financial Services has shown that *measurable improvements in manufacturing productivity* are the most reliable starting point for the digital transformation business case.
- In this paper, productivity gains from digitalization and automation – known as the *Digitalization Productivity Bonus* – have been estimated for the Automotive; Machine Building; Printing, Packaging and Paper; and Plastics industries, both globally and in 11 key countries around the world.
- Creating an automated, digitalized manufacturing environment requires major investment. Specialist financing tools – Finance 4.0 – are being developed by expert financiers to enable affordable and sustainable transition to the smart, digitalized factory.
- Industry 4.0 Financing is now employing that new mindset to offer techniques that include:
  - Pay to access/use equipment and technology finance so that precious capital is not tied up in depreciating equipment
  - Technology upgrade and update to take advantage of the latest innovations
  - Software finance to embrace all aspects of an Industry 4.0 solution
  - Pay for outcomes to align rate of benefit with rate of payment
  - Transition finance to minimize disruption in the move to automation and digitalization
  - Working capital solutions to manage cash flow in a digital world

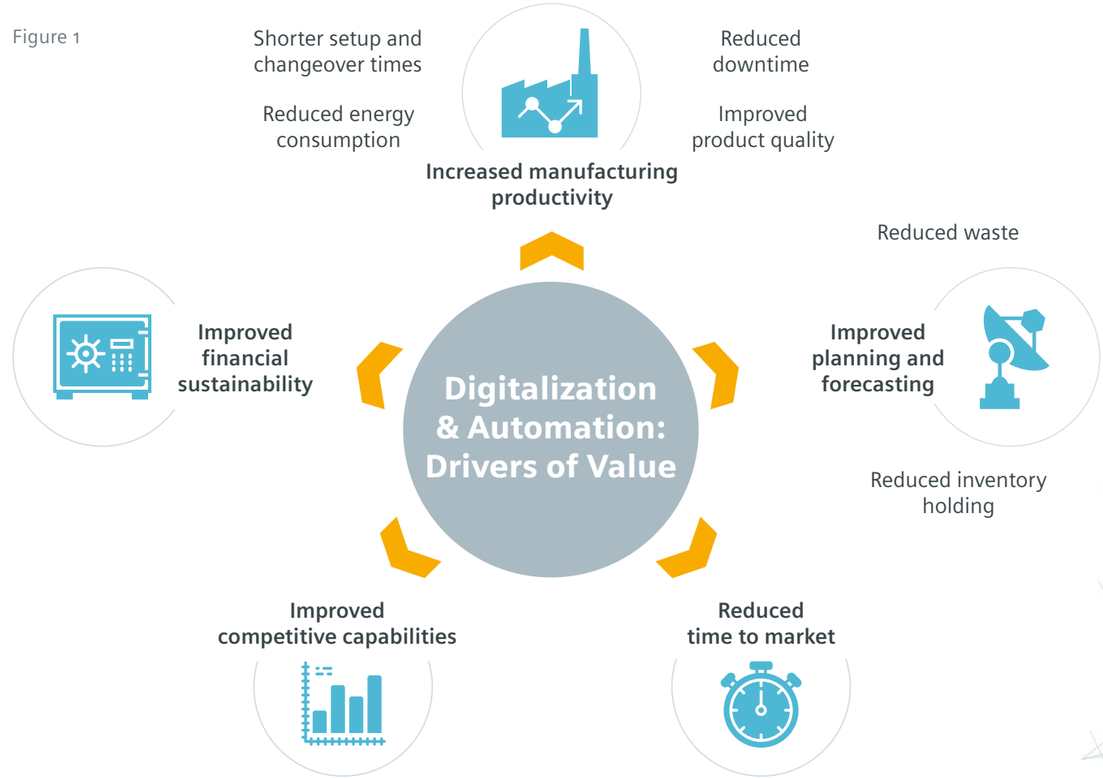
# Automation and digitalization: The new imperative

There is no longer debate about whether the Fourth Industrial Revolution – Industry 4.0 – is under way; the conversation has moved on to address where, how much and how quickly it is being implemented. Digitalization of the manufacturing environment and its processes forms the foundation of Industry 4.0, adoption of which varies from country to country and economy to economy. In some parts of the world and in certain industries, the emphasis is placed on automating previously manual processes. Automated systems are, by definition, programmed and controlled through digital systems; and where automation is already widespread, further digitalization is taking the form of the Internet of Things. This development involves the widespread installation of sensors in the physical environment and the ability to rapidly enhance production economics through real-time performance data analysis. Some digitalization pioneers are using digital controls and digital data analyses to improve a wide range of processes, including production capacity, job setup and turnaround, uptime maximization, predictive maintenance, supply-chain logistics and just-in-time distribution. There are even instances of manufacturers improving their competitive edge through mass customization, a technique where tailored products are offered with much the same economies formerly associated with mass production.[1]

For manufacturers that want to remain competitive in increasingly aggressive global markets, the move to increased automation and Industry 4.0 is not an option – it is a necessity. But seizing the competitive advantages of automation and digitalization that lie at the heart of Industry 4.0 requires a substantial investment in new-generation automated and digital platforms. Responsible business leaders will therefore need a solid business case that justifies this kind of significant investment to stakeholders and shareholders, one that paints a credible picture of the revenue, margin and growth benefits an investment in automation and digitalization technology will bring.

Early movers in the manufacturing community (see Figure 1) are already enjoying many Industry 4.0 benefits, yet the precise commercial gain from each of these benefits can sometimes be challenging to calculate. To help establish a more precise starting point for manufacturers embarking on the automation and digitalization journey, Siemens Financial Services commissioned research to understand which of these benefits could be most reliably estimated and used by most manufacturers to formulate a business case for investing in Industry 4.0 technology.

Figure 1




## MindSphere from Siemens

MindSphere is the centerpiece of a powerful IoT operating system with data analytics and connectivity capabilities, tools for developers, applications and services. It helps evaluate and utilize manufacturing data and gain breakthrough insights.

With MindSphere, Siemens offers a cost-effective, scalable cloud platform in the form of a Platform as a Service (PaaS) for the development of applications. Designed as an open operating system for the Internet of Things, this platform makes it possible to improve the efficiency of plants by recording and analyzing large volumes of production data. MindSphere provides a solid foundation for applications and data-based services from Siemens and third-party providers, for example in the areas of predictive maintenance, energy-data management and resource optimization.

# The starting point for a business case: *The Digitalization Productivity Bonus*

The vast majority of manufacturers and expert consultants interviewed for the research[2] confirmed that the ability to **increase manufacturing productivity** is a universal starting point for determining measurable value from digitalization. The ability to manufacture the same product volume at less cost, or manufacture more products for little or no increase in cost, resonates with manufacturers considering digital technology investment as a competitive enabler. This was felt to be the case for both manufacturers taking their first steps into automation and those looking to install the latest sensor-based technology to fully digitalize their production environment.

The research revealed that by automating and digitalizing their production systems, manufacturers were set to make production productivity gains equivalent to between 6.3% and 9.8% of their annual revenues. Termed the *Digitalization Productivity Bonus*, this gain was identified by respondents as the most reliable starting point to make a business case for investing in Industry 4.0 technology upgrades.

**Global *Digitalization Productivity Bonus*: reduced production costs resulting from conversion to digitalized technology** Figure 2




# Financing Industry 4.0

Manufacturers around the world, however, still face the challenge of having to make a major initial investment to acquire Industry 4.0 automation and/or digitalization technology in the first place. To overcome this obstacle, specialist financiers have developed a set of financing tools called Finance 4.0. These tools enable the transition to new-generation digital technology in a way that is affordable, sustainable and designed to alleviate the manufacturer's cash-flow and working-capital pressures.

These specialist Finance 4.0 tools can be summarized as follows:

## Pay to access/use equipment & technology finance

This enables the acquisition of a system or piece of equipment. Technology, service and maintenance are all included in a single agreement. Periods can be adjusted to match payments to the financial benefits gained. Master agreements can be established that help speed up future technology acquisitions.

## Technology upgrade & update

Manufacturers want to access technology innovations as they appear (and digital innovation cycles are shortening[3]). Finance can also offer options to upgrade during the financing period, whether to replace with a newer model or retrofit enhancements to the main technology platform.

## Software finance

By definition, most Industry 4.0 technology solutions involve both hardware and software. Because specialist financiers understand how the software is implemented and likely benefits in practice, they can understand the associated risks and include the software as an element in the total financing package.

## Pay for outcomes

These arrangements base payments on the expected business benefits, or "outcomes", that automation or digitalization technology makes possible. Actual financial savings, such as reduced electricity consumption, are used to subsidize or even totally fund monthly payments, making the technology cost neutral for the manufacturer.

## Transition finance

Manufacturers do not want to start paying for their Industry 4.0 technology platform until it is installed, tested and operational. Finance 4.0 recognizes the challenges of transition and offers financing arrangements that defer payment for a new system until it is reliably up and running, eliminating any period of cost duplication for the manufacturer.

## Working capital solutions

Finance can be optimized in more areas than technology acquisition. Improved competitiveness can lead to sudden growth, which exerts pressures on supplies, inventory and overall cash flow. Financing services – usually based on some form of invoice finance – are available to help manage the broader financial challenges that success through digitalization brings.

# Sector focus: Automotive

From Henry Ford's mass production to Toyota's "invention" of LEAN manufacturing productivity methodologies, the Automotive industry is well known for leading the way in manufacturing process development. Today, however, the industry is experiencing seismic upheaval as a result of regulation, market model shifts and changing consumer behavior.

One fundamental change is the transition to hybrid and electric drive technologies. Trends in the world's largest automotive market will likely greatly accelerate strong market momentum toward cleaner technologies. During the writing of this paper, China's vice minister of industry and information technology announced that the government is developing a long-term plan to phase out fossil-fuel-powered cars.[5] Automotive companies will have to fundamentally adapt their manufacturing model as a result or miss out on the largest and fastest-growing market in the world.[6]

Other factors are changing automotive manufacturing models: Digitalization is enabling data flows not only within the factory, but also up and down the supply and distribution chains. This opens up the possibility of further collaborative "co-opetition" among automotive companies where common components are made in a shared manufacturing entity.[7] Similarly, some brands are disintermediating traditional distribution networks. At the same time, digital feedback from individual customers combined with "mass-customization" capabilities is making truly tailored vehicles a reality for the many rather than the few.

Traditional automotive business models need reform: Analysts note that return on invested capital is negative in the industry[8] – and the cost of capital can only rise from its current levels. Experts expect self-driving cars to move into mainstream production by the 2020s.[9] In addition, nontraditional competitors are entering the electric car market,[10] putting a disruptive strain on margins and distribution channels already under pressure from disintermediated e-commerce car sales. As a result, the automotive production environment of the future has to become much more flexible, moving from fixed-chain production to flexible, modular production – with Industry 4.0 technologies such as Automated Guided Vehicles (AGVs) becoming a key element of new manufacturing solutions. Industry strategists are also grappling with the simplicity of electric transmissions, which is likely to introduce a radical shake-up of manufacturing costs, and reduced complexity in the supply chain. In fact, some commentators see, for instance, digital infotainment in vehicles as an increasing source of revenue as much as a car's pure transport capabilities.[11]

Coupled with changing business models, new competitive challenges, developing consumer demands and proximity, and innovative manufacturing possibilities enabled by digitalization, further production efficiencies are an imperative for an industry undergoing such major disruption.



Even the highly automated Automotive industry is looking to Industry 4.0 digitalization to improve production efficiency even further. The industry is also leveraging incremental competitive gains from digital connectivity among people, machines, systems and locations – that is, within the factory, along the supply chain and between distributors and customers. To demonstrate the fundamental financial benefit to be gained from Industry 4.0 in automotive manufacturing, this paper has applied its *Digitalization Productivity Bonus* model to the Automotive sector in 11 countries around the world.

The average "bonus" percentage range was applied to the total annual revenue of automotive manufacturers around the world (revenue data derived from official third-party sources). The amounts in Figure 3 estimate the amount automotive manufacturers could gain from improvements to manufacturing productivity as a direct result of digital transformation. These efficiencies, although not estimated here, can also be realized throughout the automotive manufacturing supply chain.

**Estimated *Digitalization Productivity Bonus*: reduced production costs resulting from conversion to digitalized technology for Automotive manufacturers**

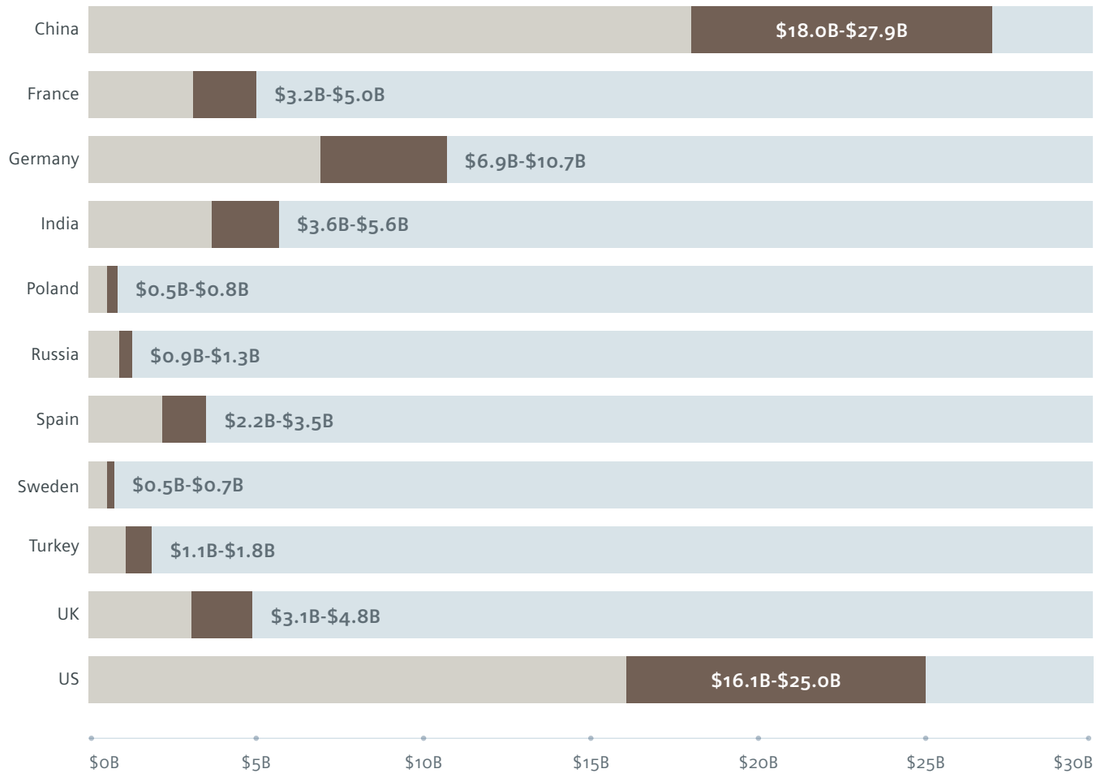



Figure 3

The *Digitalization Productivity Bonus*, however, is only one aspect of value that digitalization is delivering in the Automotive industry. Research conducted for this report reveals there are a number of key focus areas where digitalization and automation are creating value in the sector. A selection of these are described below.

The supply chain is becoming more agile as digital data and communications are shared between manufacturers and the complex web of suppliers and OEMs. This has a major impact on inventory and supply management, matching near real-time demand data (and predictive models) to just-in-time ordering and supply. Agility in the supply chain is a particularly relevant topic in light of emerging industry standards and regulations – in particular, emissions and fuel economy (which in turn is driving a move to vehicle lightweighting).[12]

In fact, the Automotive industry relies very heavily on not simply component supply, but also on subcontracted manufacturing. Industry 4.0 allows subcontractors' operations to be digitally linked to overall measurement and management systems at the car-brand headquarters, which offers an increased transparency in supply-chain performance that helps to improve overall production efficiency.[13]

Even within the automotive manufacturer's wholly owned operations, most car brands have locations all over the world. Industry 4.0-ready manufacturers are able to strategically connect all of these locations. If production or demand fluctuates, operations can shift among facilities as needed.[14]

As manufacturing plants move increasingly to 24-hour production, the ability for plant and machinery to self-monitor (using digital sensor technology) is critical for avoiding costly outages or faults. Potential maintenance issues can be spotted before they become acute, allowing preemptive action to fix errors at the least-costly time.[15]

Process efficiency also benefits from digital virtualization. Digital virtualization software optimizes throughput in a factory by creating a digital twin and then simulating alternative production processes and techniques in alternative scenarios to better plan production and remove bottlenecks.[16]

The competency to customize is expanding beyond just luxury brands to encompass many products. The ability to customize products to meet the specifics of each individual order while maintaining current mass-manufacturing efficiencies will become an increasingly important marketing factor for car brands. Evolving Industry 4.0 capabilities give auto manufacturers the ability to not only customize individual vehicles, but also shorten the delivery time for those vehicles.[17]

*In the global Automotive industry, it is estimated that conversion to digitalized technology could deliver a Digitalization Productivity Bonus of between $173.3 billion and $269.5 billion.*

*"It's very important to have access to a widening range of financing techniques, especially to invest in the latest digital technology. The beauty of these financing techniques is that we can make regularly scheduled payments that fit with our cash-flow needs."*

**Russia: Automotive manufacturer**

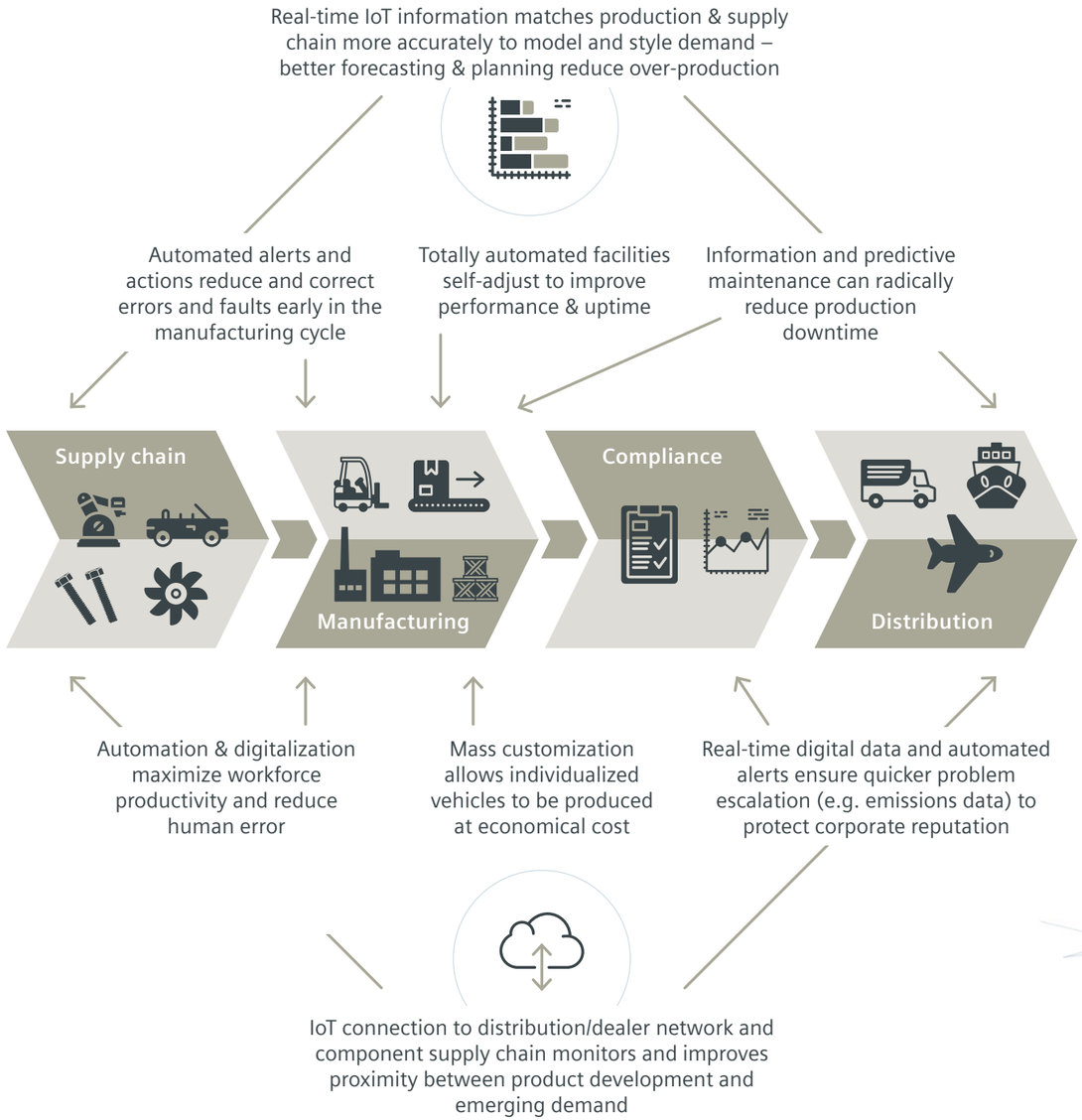
*"This year, we are investing in a major energy-efficiency upgrade for all our factory sites which relies heavily on sensor-based IoT technology. And the financing is structured so that the monthly upgrade costs are exceeded by the energy savings."*

**Germany: Automotive manufacturer**

*"We're automating our processes quickly with a substantial investment in robots – a wide variety of financing packages relevant to us and our ambitions is obviously supportive… and has the advantage that we don't have to own the equipment; we just pay to use it."*

**Sweden: Automotive precision-components manufacturer**

## From factory to forecourt




One manufacturer estimates that its use of digital simulation to develop rapid prototypes can save it weeks of work. With 3D-printed prototypes taking hours to fabricate rather than the weeks of machining associated with predigital methods, new models can be brought to market months earlier.[18] Using advanced manufacturing technologies can also enable engineers to optimize manufacturability by making it possible for them to evaluate their designs while bearing in mind the eventual assembly process and how to make manufacturing as efficient as possible.[19]

Spare parts are also an important commercial factor in the aftermarket. Some early instances[20] of additive manufacturing (3D printing), a hallmark technology in the digital factory, can be seen in the creation of spare parts on demand. This results in improved part availability without the need to store and manage inventory. And in the product design process, the same technology is being used to turn ideas into 3D models, which makes it possible to produce prototypes within a matter of days. Applying innovations to the new product development process in this way is enabling some manufacturers to create and test prototypes more rapidly and cheaply and thus bring new designs to market even faster.

*"If we want to be at the cutting edge and have a competitive edge, we need to replace parts of our plant on a regular basis. It's really important to have access to ways of financing these updates that properly fit our business."*

France: Automotive parts manufacturer

# Sector focus: Machine Building

The Machine Building industry, along with Automotive and Aerospace, consumes the majority of precision-engineering services, which are mostly delivered using some form of machine-tool technology. Machine builders then design and build finished machines that range from industrial robots and tunneling equipment to medical devices, pumping systems and production lines. These machines are enabling manufacturers to increase automation in their processes in order to deliver greater production efficiency and production intelligence. Growing digitalization of the machine-building environment is enabling current trends in the development of machine-building and industrial automation. These fall into three key areas: first, machine-learning algorithms embedded in the operating software that help systems automatically adjust and refine their parameters to improve accuracy and efficiency;[21] second, modularization is enabling machine builders to separate, connect or combine different production modules to create customized and varied products in one facility; and third, Supervisory Control and Data Acquisition (SCADA) functionality,[22] made possible through digital sensors, is making it easier for manufacturers to collect and archive production data, draw on this intelligence to predict the future, and implement the resulting process refinement remotely.

This paper has applied its research-based model to the Machine Building industry in each of 11 countries to provide an estimate of the Digitalization Productivity Bonus to be gained by the sector as a result of investment in digitalized Industry 4.0 technology. The average 'bonus' percentage range has been applied to the total annual revenue of the Machine Building industry in selected countries across the globe (revenue data derived from official third-party sources). The amounts in the Figure 4 estimate the potential financial gain the Machine Building industry could realize from improvements to manufacturing productivity as a direct result of digital transformation.

*We need to keep our business sustainable and competitive... so we're using finance to acquire the new breed of automation and manufacturing technology. We're also using finance to more broadly improve our cash-flow and working capital management.*

**China: Industrial machine builder**

**Estimated *Digitalization Productivity Bonus*: reduced production costs resulting from conversion to digitalized technology in the Machine Building industry**

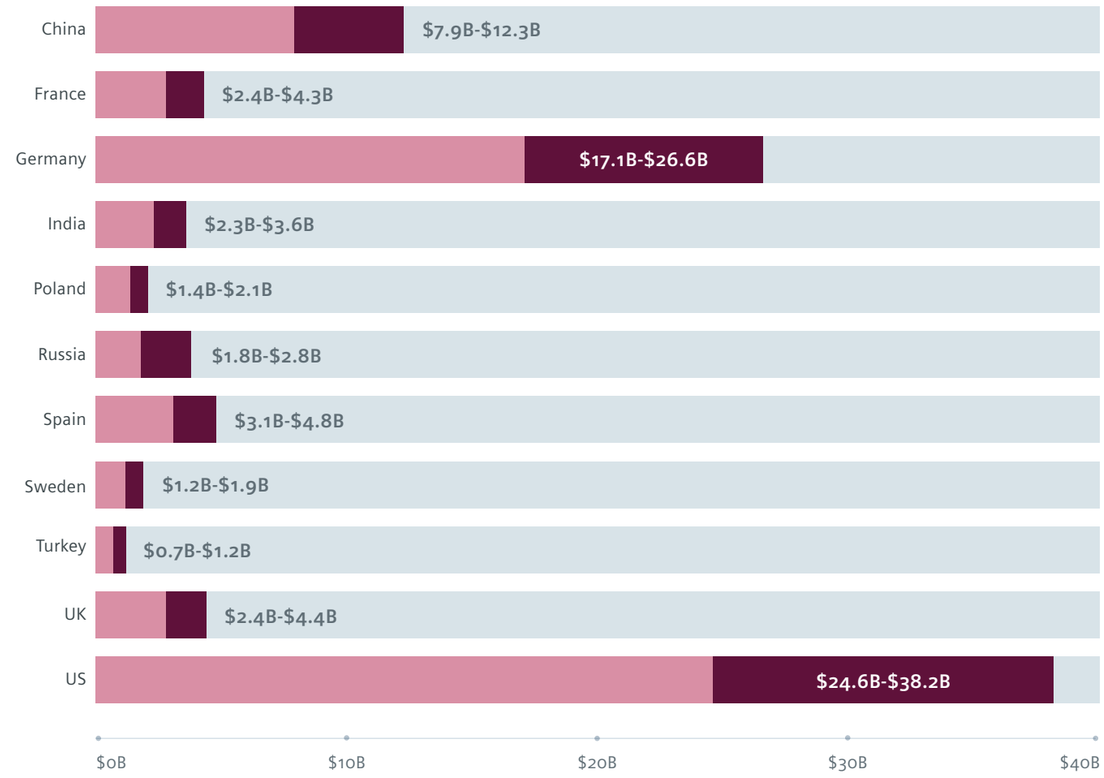



Figure 4

As noted in the previous section, these *Digitalization Productivity Bonus* estimates provide CFOs in the machine-building industry a reliable starting point. Nevertheless, there are other commercial benefits that also accrue from the move to digitalization. Qualitative research conducted for this report helps to illustrate in specific industry examples how digitalization and automation are creating value in the sector. A number of these examples are outlined below and to the right.

Rising levels of automation associated with Industry 4.0 implementation means machine builders will have more equipment and technology to monitor and control.

To meet these changing requirements, machine builders are making decisions about the technological building blocks of their products. Industry 4.0, including customer-specific compliance standards, is placing increasing demands on machine communication networks, for example, requiring them to handle more data types and larger data volumes while at the same time maintaining the operating performance required by regulators for safety and reliability. Digitalization and sensor technology enable remote control, monitoring and in-line adjustment, all of which allow processes to be refined and maintenance to be predictively scheduled to maximize uptime.[23]

Customers' preferred network standards also have to be seamlessly accommodated. Digital virtualization is certainly making it easier, faster and less expensive to develop and test client machine configurations. Machines are developed in a virtual environment and various options and configurations are tested; the results are then reported back to the client before physical specification and construction are finalized. Similarly, software modules are tested in the same environment. One source claims this can eliminate up to 80% of the work required to develop machine control applications.[24]

One machine builder reports on the use of virtualization for its multicarrier transport system. In a first step, a digital, virtual version of implementation for the actual machine is created and developed at the same time the initial mechatronic studies are carried out. The machine builder uses high-performance software that reliably creates a digital twin of the configuration in order to more rapidly develop, test and deliver each client sale.[25]

Advanced metrology is a further Industry 4.0 benefit for machine builders. The ability to leverage huge amounts of information about a product and the processes used in its manufacture is already having an impact on quality controls and management. With equipment now sensor enabled, machine builders can eliminate the delays of offline sampling inspection and progress toward the nirvana of a near-zero defect environment.[26]

*In the global Machinery & Equipment industry sector, it is estimated that conversion to digitalized technology could deliver a Digitalization Productivity Bonus between $103.2 billion and $160.5 billion.*

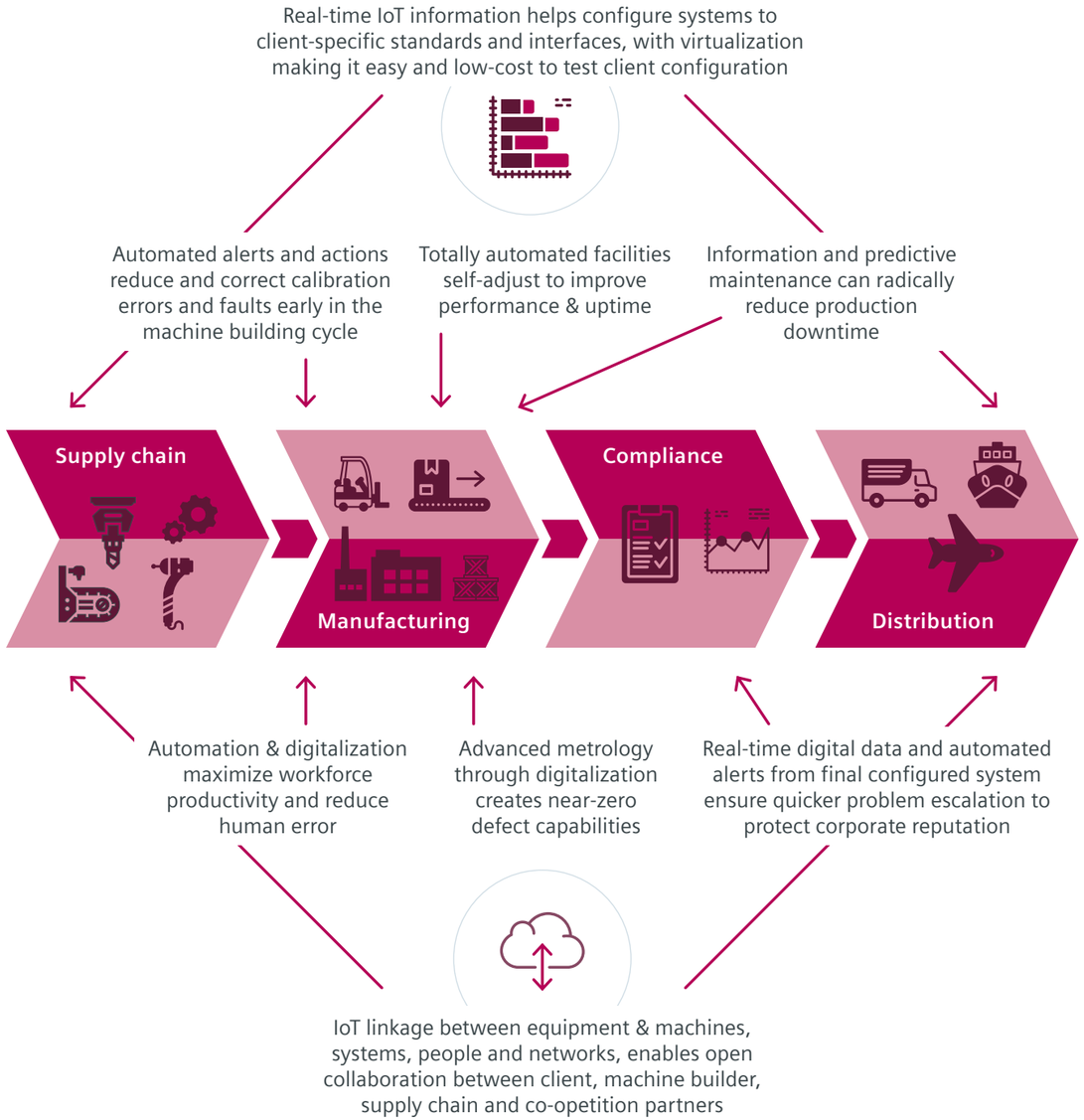
*"In order to be competitive in the market, we need to produce using the latest technologies – that's the pressure from our customers. But we cannot afford to always buy them, and in any case we have better ways of deploying our own capital. With high-tech, regularly updated equipment, the only sensible option is financing – as long as the provider can match your cash-flow needs."*

**Turkey: Industrial machine builder**

*"We upgrade our technology platform every three years – all on financing plans – to keep our business competitive … [We] never buy outright. At the moment we are creating an intelligent machine shop environment where fourth generation innovations allow the equipment to "talk back" to us, allowing predictive, preemptive improvements and maintenance."*

**Poland: Power tools manufacturer**

## From materials to machinery




Enabled by IoT connectivity that links equipment and machines, systems, people and networks, the Fourth Industrial Revolution also appears to be spurring open collaboration. Various machine manufacturers[27] report they are collaborating with research organizations, OEMs, IT developers, component suppliers, etc. via digital networks that incorporate data from people, systems and machines within a single sharing environment.

Moreover, digital innovations are making it possible to extend LEAN methodology to encompass the design of automated systems. LEAN automation means fewer components and less engineering. Digital capability is, for instance, being embedded in switchgear; this includes such functionality as variable speed drives, soft starters, motor protective switches and the like, ultimately eliminating the need for entire device layers.[28]

In summary, one major industrial analyst[29] notes that companies in the Machine Building sector are "concentrating their Industry 4.0 investment in manufacturing automation, recording real-time data along the supply chain, as well as on the expansion of manufacturing execution systems." The full capability of digital integration and extensive automation offers value not only on the factory floor, but also throughout the innovation, supply and distribution chains.

*"We have many areas of the business that need to be constantly updated for us to stay ahead in our markets. That requires a lot of investment in the digital era of technology and equipment, and we really rely on our financing partner to offer funding that exactly fits our projects, especially in our production area. Equipment now gets updated very quickly, so we need arrangements that do not leave us stuck with outdated technology."*

**Spain: Machine tools manufacturer**

# Sector focus: Printing, Packaging and Paper

There are a wide range of automation and digitalization benefits that Industry 4.0 is bringing, or has already brought, to the Printing, Packaging and Paper industry. It could be argued that mass customization – where short runs or personalized products are produced at mass-manufacturing prices – was first implemented in the Printing industry as early as the last decade. Of course there are many other Industry 4.0 developments happening in the sector, including active and intelligent packaging that embeds RFID chips; tracking print technology to meet regulatory requirements for traceability, in such areas as medicine and medical devices; just-in-time movement of goods through intelligent packaging print that can, for instance, monitor and manage cold chains in the food industry; and cloud linkage between customers and producers that helps improve the customer experience by bridging digital and physical interactions.

Not all these interesting Industry 4.0 benefits can, however, be fully evaluated in terms of concrete financial benefit. Senior company managers will therefore always want to base their business case for investing in Industry 4.0 technology on benefits that will bring a reliable return on investment. Productivity gains in the production arena provide a solid starting point. To demonstrate the reliable gains from production productivity offered by Industry 4.0 technology, this paper has applied its research-based model to the Printing, Packaging and Paper industry in each of 11 countries, in order to provide an estimate of the *Digitalization Productivity Bonus* to be gained from digitalized Industry 4.0 technology. The average "bonus" percentage range has been applied to the total annual revenue of the industry in selected countries across the globe (revenue data derived from official third-party sources). The resulting amounts in Figure 5 estimate the potential financial gain the Printing, Packaging and Paper sector could realize from improvements to manufacturing productivity as a direct result of digital transformation.



These *Digitalization Productivity Bonus* estimates provide CFOs in the industry a reliable starting point to make a business case for investment in automation and digitalization technology. As mentioned above, this technology offers many other benefits, perhaps not so easily quantifiable in financial terms, that can clearly add further value on top of the *Digitalization Productivity Bonus*. Qualitative research conducted for this report helps to illustrate in specific industry examples how digitalization and automation are creating additional value in the sector. A number of these examples are outlined on the following pages.

Printers and packaging designer-producers who take advantage of all-digital workflows and single-pass digital hybrid printing with product decoration and converting will better coordinate their offset work centers and digital print centers, creating flexibility in-job and asset management that will yield more sellable units, lower costs and ultimately higher profits for the entire operation.

**Estimated *Digitalization Productivity Bonus*: reduced production costs resulting from conversion to digitalized technology in the Printing, Packaging and Paper industry**

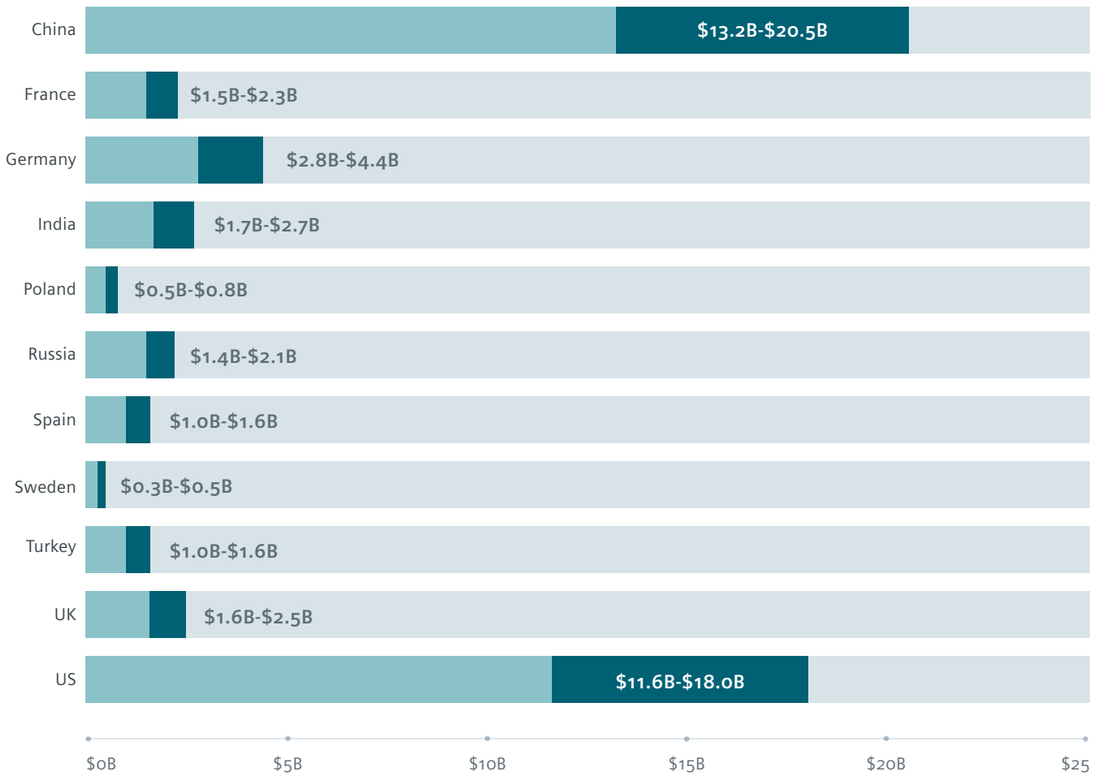



Figure 5

Specifically, Industry 4.0 technology is allowing printers to minimize downtime; utilize machines more effectively; proactively service systems (sensor-based remote monitoring activates maintenance before a component fails); and, through closed-loop color-management systems, highlight the start of color drift before it is visible to the naked eye.[30]

Industry commentators have also emphasized the higher rates of return and competitive advantage that Industry 4.0 investments offer, with one noting: "Traditional IT was usually characterized by high costs yielding mediocre results which were easy to replicate. Industry 4.0 is about agility: lower costs and higher impact. This is much more difficult to copy."[31]

In one Packaging industry example, digitalized dip printing techniques have been reported to have saved over €3 million per year thanks to a variety of factors, including reduced energy consumption in flotation pumps; reduced usage of fixing agents; and proactive, predictive equipment maintenance to reduce production disruption.[32]

Another company, this one in the printing and packaging supply chain, claims to have increased annual revenues by 11% by employing new-generation technologies, as well as using 40% less water and 50% less electricity than standard industry guidelines. In addition, automation and digitalization investments have enabled remote-sensing of product quality control, online customer access to ordering, the ability to change orders prior to delivery, transparency in the progress of jobs, and other benefits.[33]

Another Industry 4.0 example describes in-plant coordination that integrates the company's workflow into a hybrid printing process that includes a plate recorder, a sheet-fed offset press and a sheet-fed UV inkjet digital printing system. These systems are also digitally linked to post-press devices, creating a workflow that supports comprehensive integrated control of all processes. The printing task control software is positioned between the management information system and production site, collecting and sharing the latest production details and enabling real-time control of all production devices.[34]

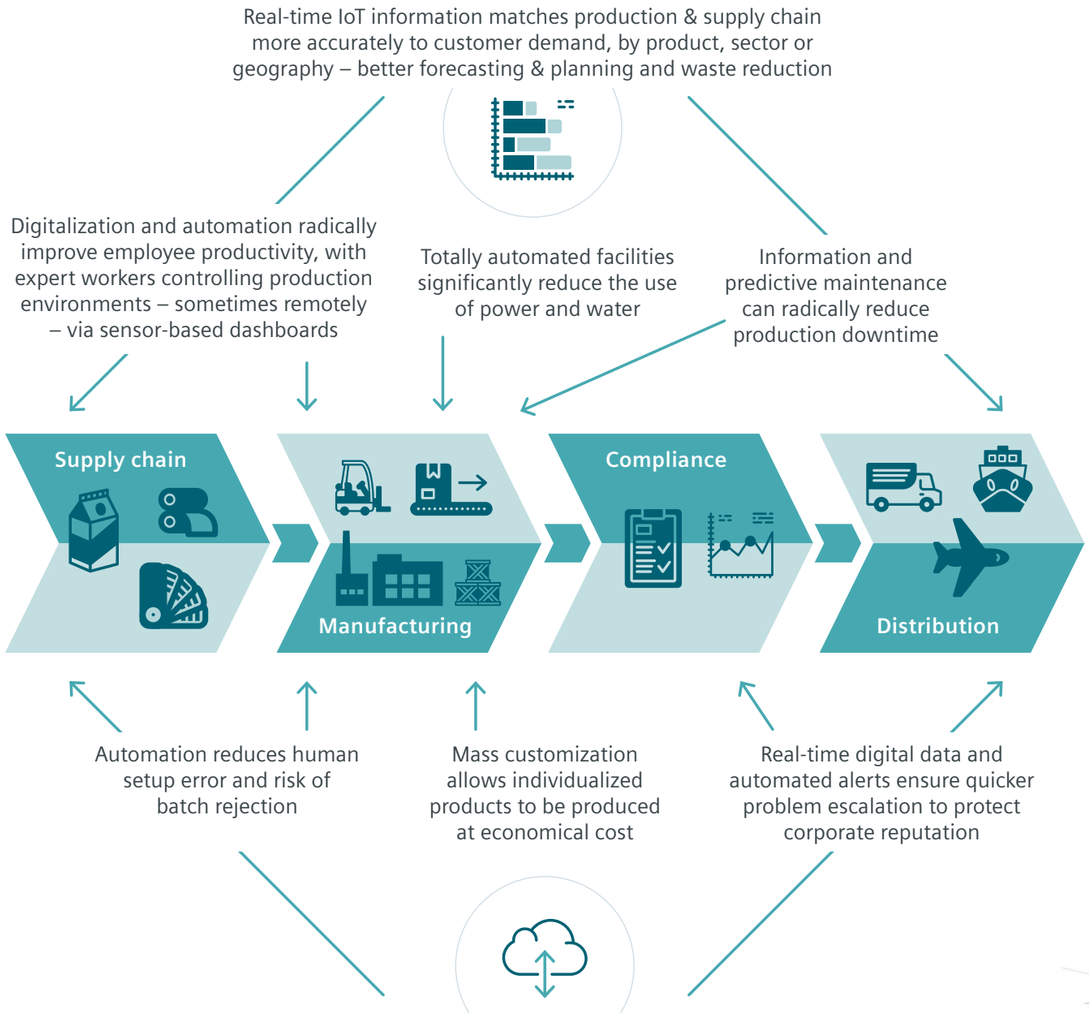
Finishing processes are also benefiting from fourth-generation technology. One system on the market has a revolutionary drive, transport and trimming concept, where separate drives of all knives and grippers, along with sensor-based remote control and virtual 3D simulation of the finished product, means no setup process is required. This enables production with a touchless workflow that is suited to short and ultra-short runs right down to individual copies.[35]

*In the global Printing, Packaging and Paper industry, it is estimated that conversion to digitalized technology could deliver a Digitalization Productivity Bonus of between $68.6 billion and $106.7 billion.*

*"We have used specialist finance to invest in 4.0 technology that allows us to quickly implement simplified and agile processes and bring the entire plant under a single interface – or rather dashboard – control. In the two full years of implementation that we have been able to measure so far, this investment has helped us grow sales by 25% per year, with an annual worker productivity improvement averaging 40% and customer satisfaction (NPS) up 20%."*

**Spain: Commercial printing company**

## From forest to factory




Effective virtualization is particularly important in the Printing industry, where a series of approvals are the norm. Approvals have to remain a human process, but they can be made more efficient. One commentator notes: "Consumer-packaging approvals involve complex surfaces and multiple viewing angles. They also involve many more decision points – from brand-marketing managers and designers to legal teams and manufacturing and materials specialists."[36] As a result, digital remote systems can significantly streamline creation and production schedules.

Some strategic minds in the industry are also thinking in holistic terms. One technologist predicts: "[By] 2025 ... all devices, peripherals and processes will be connected using IoT concepts, enabling dramatically improved transparency of real-time operations. A single operator will control multiple systems, part-time employees, AI and robotics. Our vision is to create a smart factory that uses next-generation printing logistics to achieve a truly new dimension of productivity."[37]

*"Our firm is in the process of linking into a digital cloud platform that makes us part of an international collective of high-quality print suppliers – each having its own specialization that doesn't really overlap with another. The cloud platform links us together both to provide a rich set of capabilities for clients and to also report job progress via sensor-derived data from our production lines. It's had a really positive impact on our business."*

**China: Commercial printing company**

# Sector focus: Plastics

The advent of Industry 4.0 automation and digitalization is having a fundamental effect on the Plastics industry – not simply in terms of process and production efficiency and agility, but also disrupting the landscape of international competition by allowing smaller manufacturers to achieve the market access and technological capabilities that previously could only be attained by medium-to-larger players.

Robotics, virtual testing, economic prototyping and real-time machine data[38] are just a few of the advantages that plastics manufacturers are seizing to improve their competitive position. CFOs, however, require a solid basis for return on investment to justify the transition to Industry 4.0 technology. To demonstrate the reliable gains from production productivity, this paper has applied its research-based model to the Plastics industry in each of 11 countries, in order to provide an estimate of the *Digitalization Productivity Bonus* the sector can gain as a result of investment in digitalized Industry 4.0 technology. The average "bonus" percentage range has been applied to the total annual revenue of the Plastics industry in selected countries across the globe (revenue data derived from official third-party sources). The resulting amounts in Figure 6 estimate the potential financial gain the Plastics industry could realize from improvements to manufacturing productivity as a direct result of digital transformation.

These *Digitalization Productivity Bonus* estimates provide CFOs in the Plastics industry a reliable starting point to make a business case for investment in automation and digitalization technology. Such technological transformation offers many other benefits that are more challenging to quantify in financial terms. Qualitative research conducted for this report helps to illustrate in specific industry examples how digitalization and automation are creating additional value in the sector. A number of these examples are outlined on the following pages.

Digitalization is bringing major advantages to the Plastics industry by cutting out manual intervention. As one commentator notes, "Current methods of collecting information are very inaccurate: Excel spreadsheets, scanning barcodes, product information are very slow and archaic. A Manufacturing Execution System (MES) allows automated real-time and accurate data collection about machines and materials from different suppliers and different time periods."[39]

There are also instances of plastics manufacturers with geographically diverse sites linking various locations using digitalized MESs. In one example,[40] UK and Thai manufacturing sites were linked with development and sales centers in China, Japan and the United States using ERP systems to coordinate the diverse systems so they now provide a unified, real-time view of productivity, capacity, inefficiencies and areas for improvement.

**Estimated *Digitalization Productivity Bonus*: reduced production costs resulting from conversion to digitalized technology in the Plastic Products industry**

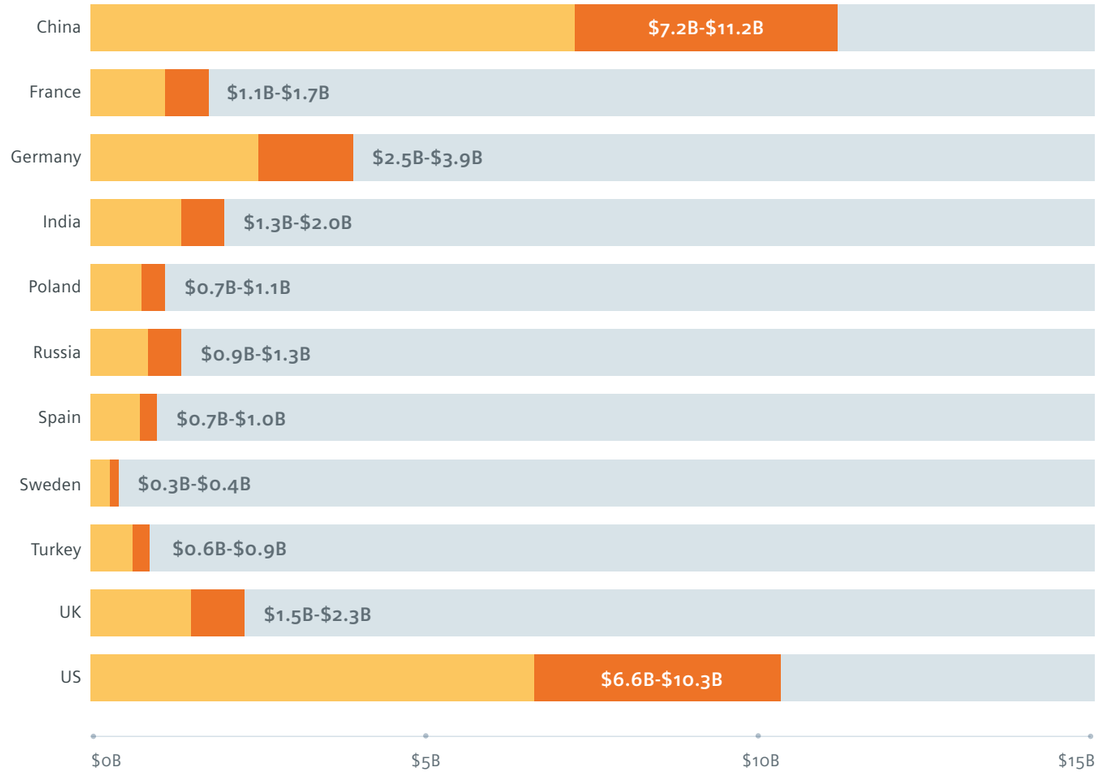



Figure 6

In another area of application, the Plastics industry is leveraging Industry 4.0 technology to create individualized, customized component parts as virtually a mass production process, along with shortened development, setup and start-up times.[41] One good example of this is the smart addition of three-dimensional individualized designs on a piece-by-piece basis to deliver personalized products at mass-production speeds and costs.

Injection molding firms, in particular, are also using virtual simulation technology to examine flow simulation in extrusion dies,[42] mainly to optimize process quality and reduce defects, which both have a considerable effect on commercial efficiency and customer satisfaction.

Digitalizing the production process makes it possible to capture and retain a detailed audit trail of production. This is enormously important for ensuring traceable safety standards, such as those that apply to toy manufacturing, right through to minute and provable compliance with stringent regulatory standards, such as those that apply to medical device manufacturing.[43]

*In the global Plastic Products industry, it is estimated that conversion to digitalized technology could deliver a Digitalization Productivity Bonus of between $39.3 billion and $61.2 billion.*

*"The general speed of innovation is rapid [in the age of Industry 4.0]... We are having to take a big step forward with these innovations and developments. The main benefit of external financing is that it allows you to acquire technology that you perhaps would not otherwise be able to obtain."*

**UK: Injection moulding company**

*"There is an increase in the available new-generation technologies, and we need to access them to stay competitive – particularly in the areas of order processing and being able to deliver highly tailored products to customers."*

**Finland: Plastic products manufacturer**

## From concept to customer


When considering plastic product fabrication using the most iconic Industry 4.0 technology – additive manufacturing (3D printing) – most people think of prosthetics and implants. In fact, great effort is being made to place prototypes into the hands of surgeons and other healthcare specialists so they can rapidly test the usability of a series of designs before manufacturing the product and bringing it rapidly to market. There are even instances of the soft plastic manufacture of an individual patient's affected body part so that surgeons can practice prior to the actual operation.[44]

The Plastics industry is itself also inventing smart products that help optimize uptime across the manufacturing industry. One such innovation inserts sensors (RFID chips) into plastic wiring and connection units that can then be networked with a communications module to provide direct integration with the manufacturer's IT infrastructure, making automated continuous condition monitoring and predictive maintenance possible. This same innovation can also connect with a data cloud, which opens up the possibility of automatically ordering an external maintenance crew or replacement parts. This constitutes a significant step toward realizing the benefits of the Industrial Internet of Things.[45]

*"In our sector and given the products we manufacture, there are constant changes in the technology that manufactures and monitors the manufacturing process (to improve product, efficiency, setup, etc.). So we have to get hold of upgrades, whether SPC [statistical process control] equipment, or measuring equipment, or whatever. Access to a range of sustainable and tailored financing options is essential to this."*

**USA: Plastic products manufacturer**

# Supporting case studies

## ASR Industries

ASR Industries is a leading supplier of fixtures and customized engine parts to India's largest automotive companies. Two years ago the company witnessed increased demand, which required expansion of their production with the purchase of a VMC machine within one week. Their traditional route of bank financing was unable to meet this turnaround time, which was crucial since ASR risked losing 5% of new orders due to a lack of production capacity. Siemens Financial Services was able to provide a hypothecated loan within three days, enabling ASR to effectively address the increased demand and needs of their customers.

## Chin Fong Machinery Industries

Chin Fong (China) Machinery Industries Ltd., a key partner of Siemens' Digital Factory Division (DF), is a specialist in metal-forming equipment. The company wanted to meet increasing financing demands from its customers. Siemens Finance and Leasing (SFLL) was able to provide a strategic agreement offering customized leasing solutions to the end users of Chin Fong (China). With the leasing solution from SFLL, Chin Fong (China) has been able to win business that could otherwise have been lost due to end-user budget constraints.

## Pilkington

One of the UK's foremost glass manufacturers, Pilkington United Kingdom Ltd ("Pilkington"), a part of the NSG Group, has worked with Siemens to drive a major energy management project across its production sites. The program with Siemens is designed to enhance Pilkington's overall energy performance, cut costs and create a more sustainable future. The agreement enabling these projects to be realized comprised of an industry-leading energy performance contract between Siemens and Pilkington. The principle of the arrangement is that Siemens Financial Services funds the initial capital expenditure required for the projects, which have typical three-year payback periods in terms of generated energy savings. Pilkington then simply makes a monthly payment that matches its monthly savings in energy costs. This effectively results in a zero net cost investment, which not only modernizes the Pilkington manufacturing infrastructure but also sustainably reduces the company's carbon footprint.

## Südzucker AG

Südzucker AG is Europe's biggest sugar producer. Because of the high energy intensity of sugar production, Südzucker is investing in energy-saving technologies that contribute to process efficiency and, ultimately, climate protection and sustainability. In order to achieve these goals, the Südzucker Zeitz plant in Saxony-Anhalt decided to optimize a fan system with a new Siemens drive. It was financed by Siemens Financial Services (SFS) using an energy performance contracting model. The monthly installments are adjusted according to the actual savings that result from the reduced energy usage. As a result, the company did not need to raise capital to acquire the technology. Südzucker is saving 930,000 kilowatts each year, or 680 tons of $CO_2$ emissions.





## dpm Daum + Partner

dpm is a mechanical engineering company operating in the automotive industry, specifically in the field of automated guided vehicles (AGV). Siemens provides dpm with engines, Simatic control systems and switch cabinets. Due to the growing importance of AGV's, especially in the light of initiatives implemented by Google, Apple and Tesla, the demand for dpm products has increased. Major orders boosted dpm's purchasing volume, but the high demand was also challenging for the company. As most of the projects were ongoing, dpm would only receive payments in the medium or long term. To support the company's growth, Siemens Financial Services (SFS) and dpm agreed on a fine-trading financing model that allows dpm to extend payment terms for Siemens products. The solution is highly flexible as dpm can decide for each individual order whether an extension of payment terms is necessary. In this way, even major orders can be managed with a low financial burden.

## AK Steel

It is AK Steel's mission to become North America's premier steel manufacturer. The company is focused on expanding its production capabilities and modernizing its products and, therefore, wanted to acquire Russian steelmaker Severstal's operations in Dearborn, Michigan, US. This would improve the company's access to automotive customers. AK Steel required $1.5 billion to facilitate the acquisition. Siemens Financial Services committed $100 million in a multilender working capital facility to ease AK Steel's acquisition of the Severstal facility. As a result, the company was able to increase its shipment capabilities by more than 40%, improve operational flexibility and increase scale to better serve customers.

## Modern Dental

Established over 30 years ago in Beijing, China, Modern Dental is a leading global manufacturer and provider of dental prosthetics. Modern Dental wanted to refinance its core debt, provide business flexibility through a working-capital facility, and build a new plant in China following its initial public offering (IPO). To facilitate these requirements, Siemens Financial Services supplied $25 million of an $85 million credit facility provided with three other financial institutions.

## Intas

Intas is a top-12 Indian pharmaceutical company and has operations covering research, manufacturing and formulation development. The company's products are marketed in over 70 countries including in the US, Europe, Central and Latin America, Africa, Australia, New Zealand, Asia-Pacific and MENA countries. As part of a syndicate, Siemens Financial Services provided a credit facility of approximately €710 million that allowed Intas to acquire Actavis UK from Teva Pharma in 2016. Actavis manufactures and distributes generic pharmaceutical products to the UK.

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Siemens Financial Services
80200 Munich, Germany

For more information:
Phone: +49 89 636 40019
E-mail: communications.sfs@siemens.com

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