Highlights from the study

This study illustrates how industrial companies shape digital transformation and open up new growth potential. It was conducted in five core industrial sectors of Austria.

Industry 4.0 – The Industrial Internet

Opportunities and challenges for the Austrian industrial sector

100

companies in five industrial sectors were queried

more than 4 billion

euros will be invested annually by Austrian industrial companies in Industry 4.0 solutions by 2020

more than 85%

of companies intend to digitalise their value chain within the next five years

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Industry 4.0 – The Industrial Internet
Highlights from the survey "Industrie 4.0 – Österreichs Industrie im Wandel" (June 2015) published by PwC Österreich GmbH Wirtschaftsprüfungsgesellschaft by Jörg Busch (PwC), Alexander Soukup (PwC), Harald Dutzler (Strategy&), Markus Loinig (Strategy&) and Andreas Gorholt (PwC)

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A joint study by PwC and Strategy&

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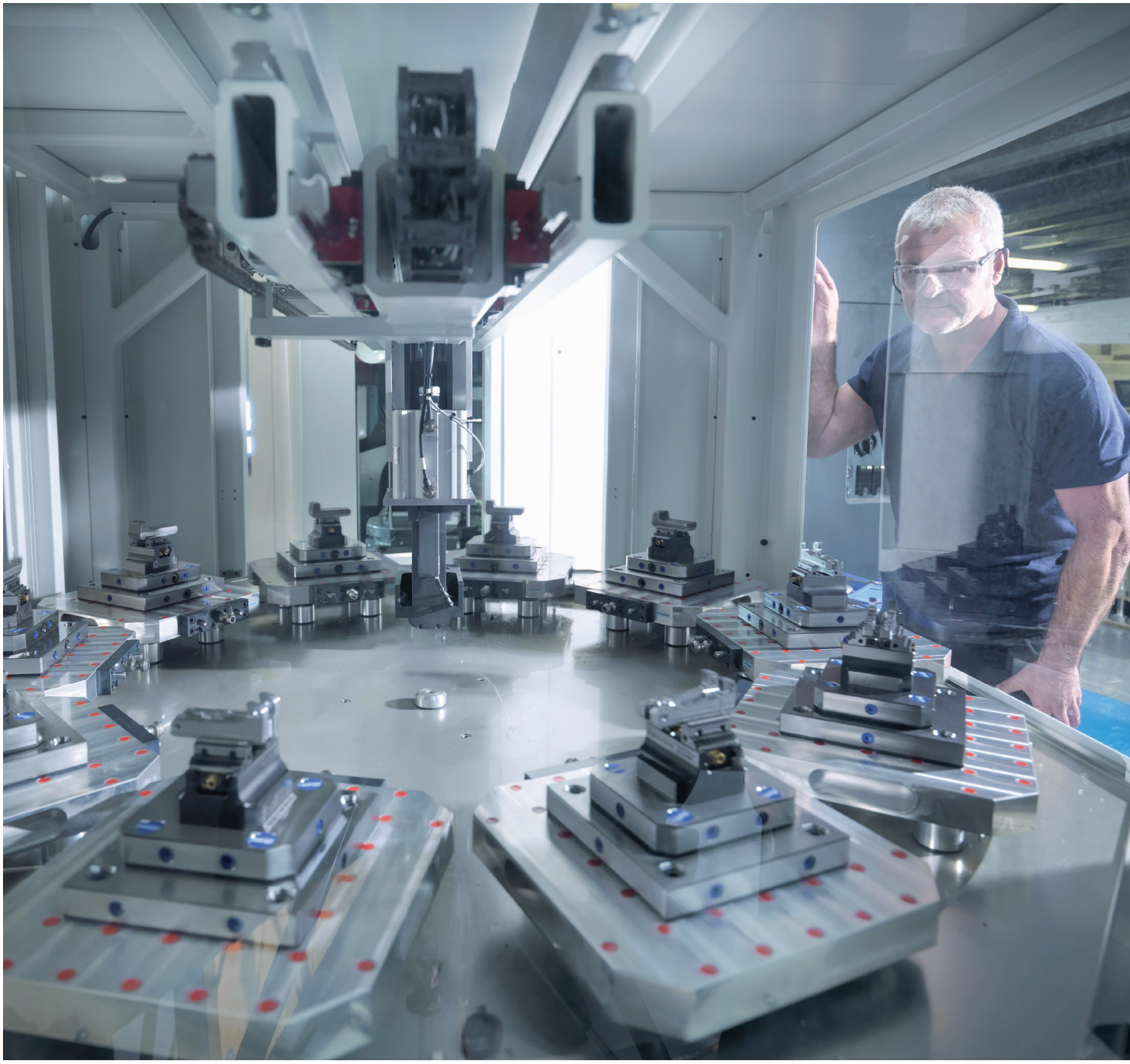
A Executive Summary



The fourth industrial revolution means increasing digitalisation of products, value chains and business models. All these developments are clearly noticeable in the Austrian industry. This study entitled *Industry 4.0 – the Industrial Internet: Opportunities and challenges for the Austrian industrial sector* presents the major features, opportunities and challenges.
100 Austrian industrial companies were queried as part of this study. From the point of view of the respondents, digital transformation means a corresponding, almost full transformation of their companies and at the same time requires significant investments. By 2020 Austrian industrial companies plan to annually invest 4% of their turnover into Industry 4.0 solutions. This corresponds to a total annual investment volume of more than EUR 4 billion.

Better control of value chains

One major factor for the advance of Industry 4.0 solutions is the opportunity to have better control of value chains within and across companies. The queried companies expect productivity gains of approx. 20% for the next five years. A quarter of industrial companies has already achieved a high degree of digitalisation along the value chain. In five years, more than 85% of companies will have implemented Industry 4.0 solutions in all major areas.

Increased turnover and competitiveness

The second important driving force behind Industry 4.0 is the expected average turnover increase of 2.6% per year as a result of the digitalisation of own products and services. The competitiveness of companies and of Austria as a business location is secured at the same time. For the entire Austrian industrial landscape, this corresponds to additional annual sales of almost EUR 3 billion.

Additional benefits for customers

The third major factor is the creation of new, often disruptive digital business models, which offer significant additional benefits to customers through tailor-made solutions. This development is closely associated with a considerable increase in cooperation across value chains, with the required extensive use and analysis of data contributing towards a better fulfilment of customer needs and often being a prerequisite for new business models.

Managing developments in a targeted manner

The multitude of opportunities, the extent of associated changes and the amount of investments required mean that Industry 4.0 is a topic for the top management of companies. The numerous challenges posed by these changes need to be addressed as well.

In addition to the as yet somewhat unclear calculation of economic efficiency of Industry 4.0, industry standards need to be defined and other issues such as data security issues need to be solved. The respondents also expressed concern regarding the suitability of employees' qualifications as their companies become more digitalised. Politicians and industrial associations are called upon to provide momentum in these areas. The fourth industrial revolution has begun – offering attractive opportunities to Austrian industrial companies. For companies, Industry 4.0 is by no means an end in itself, but rather describes a change which is made possible by new technologies and different user behaviour. Industry 4.0 is closely related to clear economic objectives and potential benefits, offering an opportunity for better differentiation in global competition.

This study extract is intended to contribute towards recognising the major opportunities and challenges and showing approaches to successful implementation and is based on the original study *"Industrie 4.0 – Österreichs Industrie im Wandel"* published in german in June 2015. The time to act is now!

Definition Industry 4.0

"The term Industry 4.0 stands for the fourth industrial revolution.
Best understood as a new level of organisation and control over the entire value chain of the life cycle of products, it is geared towards increasingly individualised customer requirements. This cycle begins at the product idea, covers the order placement and extends through to development and manufacturing, all the way to the product delivery for the end customer, and concludes with recycling, encompassing all resultant services. The basis for the fourth industrial revolution is the availability of all relevant information in real time by connecting all instances involved in the value chain. The ability to derive the optimal value-added flow at any time from the data is also vital. The connection of people, things and systems creates dynamic, self-organising, realtime optimised valueadded connections within and across companies. These can be optimised according to different criteria such as costs, availability and consumption of resources."

Source: Plattform Industrie 4.0 – translated from German

B The key messages of this study

1 *Industry 4.0 transforms the entire company and must be part of the CEO agenda*

2 *Up to 2020 Austrian industrial companies will invest over EUR 4 billion annually in Industry 4.0 applications*

3 *The number of highly digitalised companies is expected to more than triple over the next five years*

4 *Industry 4.0 applications lead to higher production and resource efficiency, with efficiency gains of 20% within five years*

5 *Integrated analysis and use of data are the core capabilities for Industry 4.0*

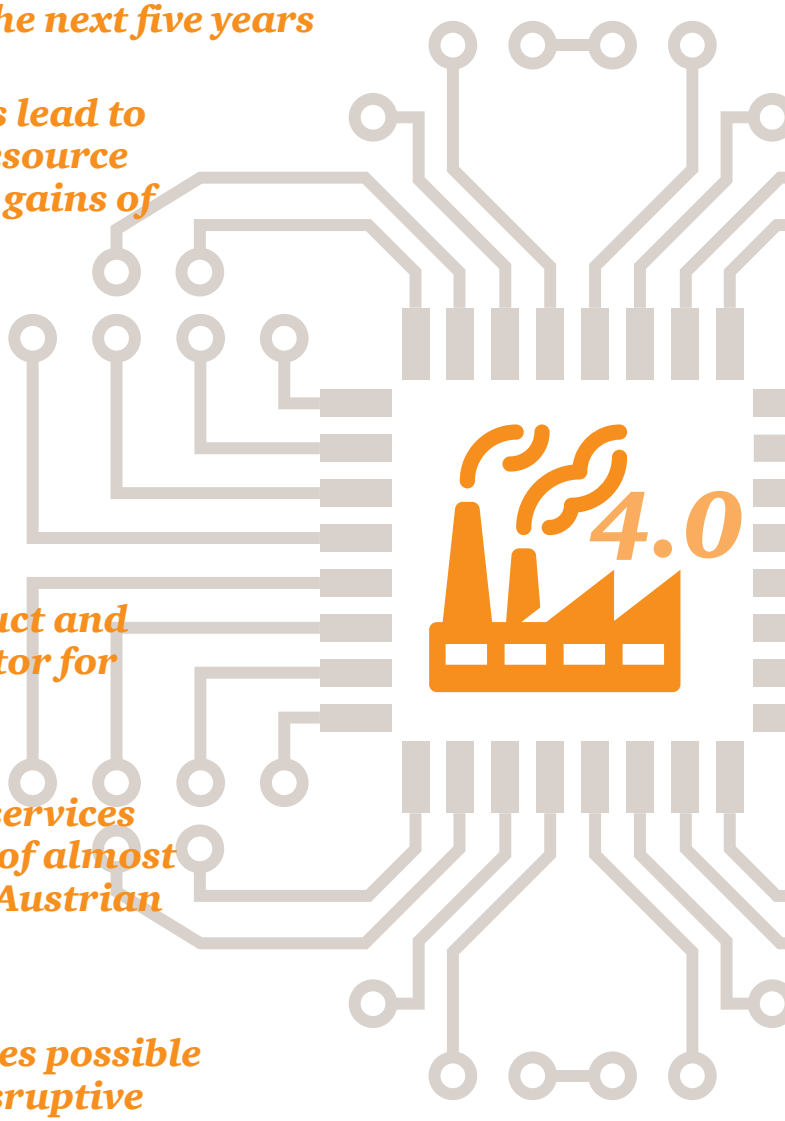
6 *The digitalisation of the product and service portfolio is the key factor for long term corporate success*

7 *Digitalised products and services generate additional sales of almost EUR 3 billion per year for Austrian industrial companies*

8 *Industry 4.0 makes possible new and often disruptive digital business models*

9 *Cooperation across companies means better fulfilment of customer requirements*

10 *Industry 4.0 brings with it a multitude of challenges and opportunities for Austria as a business location*



The results of the study are summarised in the ten key messages set out below:

1. *Industry 4.0 transforms the entire company and must be part of the CEO agenda*

Industry 4.0 not only comprises digitalisation within and across value chains. It will also revolutionise product and service portfolios as well as entire business models of companies. The ultimate goal is the better fulfilment of customer requirements. The potential benefits of Industry 4.0 go far beyond the optimisation of production techniques. However, exploiting these opportunities requires considerable investment. This issue therefore inevitably comes high on the agenda of directors and managers of industrial companies.

2. *Up to 2020 Austrian industrial companies will invest over EUR 4 billion annually in Industry 4.0 applications*

Within the next five years, the industrial companies surveyed will invest on average 3.8% of their annual turnover in Industry 4.0 solutions. This corresponds to an annual investment amount of over EUR 4 billion for the entire Austrian industrial landscape. These investments will have to be made along the entire value chain in order to achieve maximum success.

3. *The number of highly digitalised companies is expected to more than triple over the next five years*

Almost three quarters of the companies surveyed have already achieved a high degree of digitalisation of their value chains. However, it is mostly only individual units and isolated applications that have been automated and digitalised thus far. For the future, companies expect that at least 85% of the value chains within and across companies will have a high degree of digitalisation by 2020 and will therefore be closely integrated.

4. *Industry 4.0 applications lead to higher production and resource efficiency, with efficiency gains of 20% within five years*

The industrial sector is required to produce ever larger quantities using fewer raw materials and less energy. Industry 4.0 enables higher productivity and resource efficiency and thus fosters the conditions for sustainable and efficient production. Across all industries, the queried companies expect average annual efficiency gains of 3.7% and a reduction in production costs of 2.6% per year as a result of the digitalisation of value chains.

5. *Integrated analysis and use of data are the core capabilities for Industry 4.0*

Even today, efficient analysis and use of data are of great importance for more than half the companies queried. 91% expect that data analysis capabilities will already be a determining factor for the business model within the next five years. These companies primarily focus on the efficient exchange of data within their own value chain, the digital labeling of products and the use of real time data to control production.

6. *The digitalisation of the product and service portfolio is the key factor for long term corporate success*

36% of the companies surveyed have already digitalised their products to a great extent and expanded their portfolio to include connected and automated services. A mechanically perfect product will no longer be enough to ensure long term success in international competition. The share of companies with a high degree of digitalisation of their product and service portfolio is set to rise to 80% within the next five years.

7. *Digitalised products and services generate additional sales of almost EUR 3 billion per year for Austrian industrial companies*

Half of the companies queried expect double digit growth figures over the next five years as a result of a higher degree of digitalisation in their product and service portfolio. One fifth of the companies even anticipate a sales increase of over 20%. In total, this means an average sales increase of 2.6% per year. With respect to all industrial companies in the five core industrial segments, this means potential additional sales of almost EUR 3 billion per year.

8. *Industry 4.0 makes possible new and often disruptive digital business models*

Industry 4.0 means fundamental changes to existing business models and in particular the generation of new digital – and often disruptive – business models. The focal point of Industry 4.0 comprises increasing customer benefits through a growing range of value solutions (going beyond traditional product offerings) and increased networking with customer and partners. The special quality of this digital transformation lies in the drastic acceleration of change, caused by technical progress, and the fact that disruptive innovation will cause industries such as the automotive industry to sustainably transform themselves within a short period of time.

9. *Cooperation across companies means better fulfilment of customer requirements*

Even today, about 50% of the respondents are convinced that extended cooperation with value chain partners – together with stronger networking across companies – will be of great importance. As the degree of digitalisation rises, this will become ever more important in the course of Industry 4.0 – particularly with respect to the setup of new digital business models. More than 80% of the companies surveyed assume that extended cooperation and more intense networking across companies will be a key factor within the next five years.

10. *Industry 4.0 brings with it a multitude of challenges and opportunities for Austria as a business location*

On their way to becoming an Industry 4.0 champion, companies need to meet numerous challenges. The major ones include the high investments required and the frequently as yet unclear profitability accounting for new Industry 4.0 applications. Furthermore, the qualifications of employees need to match the requirements of the digital world, with mandatory standards having to be defined and IT security tasks having to be solved as well. Both politicians and industrial associations have a role to play in particular with respect to these last mentioned challenges by advocating uniform European and international industrial standards as well as promoting efficient regulations for data security and data protection.

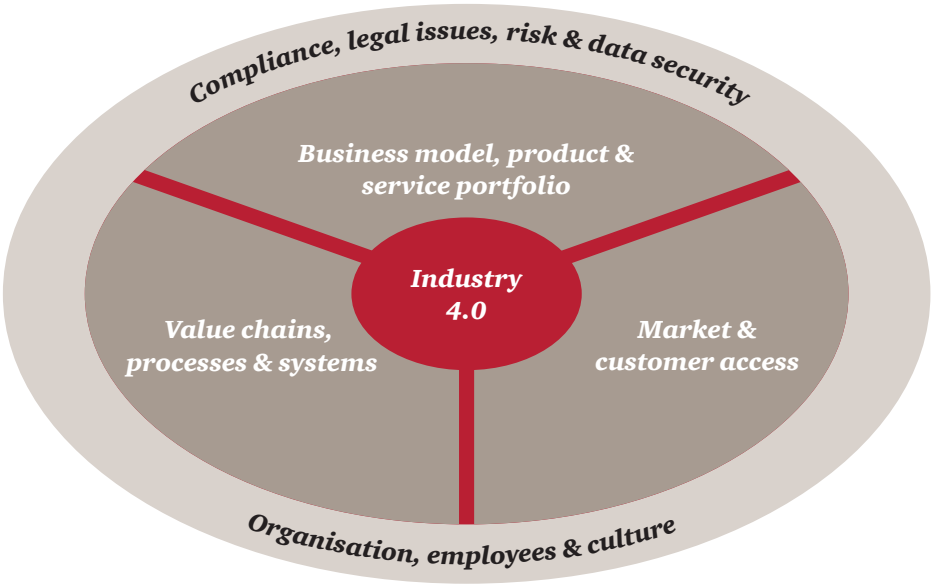
C The findings in Austria at a glance

1. Industry 4.0 is completely transforming businesses

Industry 4.0 comprises not just the digitalisation and integration of cross-company (horizontal) and company internal (vertical) value chains. It also revolutionises the product and service portfolio of companies and is leading to the implementation of new – and often disruptive – digital business models. Industry 4.0 is pushing forward not just the transformation of all major business processes but also the new alignment of their product and service portfolios. It also empowers companies to proactively deal with changing client requirements like, for example, individualised products. Direct interaction with consumers will mean big changes to the way in which companies have access to markets and clients.
So the potential benefits of Industry 4.0 go well beyond the optimisation of production techniques or 'classical' IT. In addition, a number of companies want to make comprehensive investments, as can be seen in the following section. This issue is consequently forcing itself right to the top of the agendas of CEOs, boards and managing directors of leading industrial companies, which is also reflected in the readiness of decision makers to take part in the survey. 42% of those queried were at CxO or management level or managing directors in their own various companies.

Industry 4.0 comprises the networking of value chains, the digitization of products and new business models

Fig. 1 Industry 4.0 – Framework



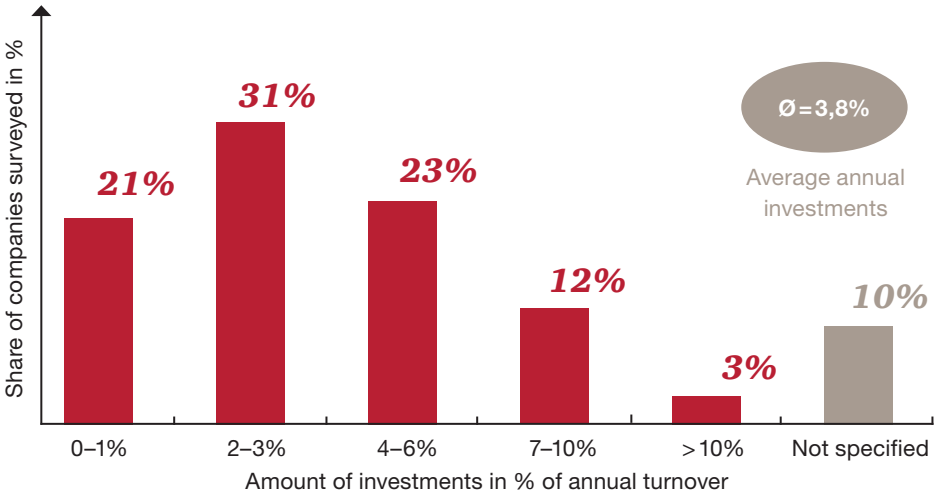
Our vision is the full mapping of actual production worlds in a virtual world – in real time!
Dr. Wolfgang Zitz, Vice President Contract Manufacturing, Magna Steyr Fahrzeugtechnik AG & Co KG

2. Industrial companies are planning significant investments

Within the next five years, the 100 industrial companies surveyed will invest on average 3.8% of their annual turnover in Industry 4.0 solutions. This corresponds to an annual investment amount of over EUR 4 billion for the entire Austrian industrial landscape, with EUR 2 billion alone going to the process industry[1].

Over the next five years, companies will invest 3.8% of their annual turnover in Industry 4.0 solutions

Fig. 2 Average annual investments in Industry 4.0 applications



Only a fifth of companies have until now seen no necessity to make any significant investments in Industry 4.0 applications. 54% of companies are planning investments of 2% to 6% of their annual turnover. At the same time 15% of companies want to make annual investments of at least 7% in Industry 4.0 solutions. These investments will ensure efficiency improvements and cost reductions throughout the entire supply chain.

Therefore around 60% of those surveyed said that investments in their planning as well as in production and manufacturing were classed as high priority investments. Investments in the digitalisation of distribution still have the lowest priority. When extrapolating the investments of the companies surveyed to the five different industry branches represented in the survey, this results in an annual investment volume of the Austrian industry amounting to EUR 4.3 billion. Two sectors will invest beyond the average amount in Industry 4.0, these being the electrical engineering and electronics industry (4.5% per year) and mechanical and plant engineering (4.3% per year).

[1] The process industry is made up of the following industrial sectors: Chemical products, pharmaceutical products, rubber and plastic goods as well as metal production and processing.

3. Value chains' level of digitalisation is expected to more than triple

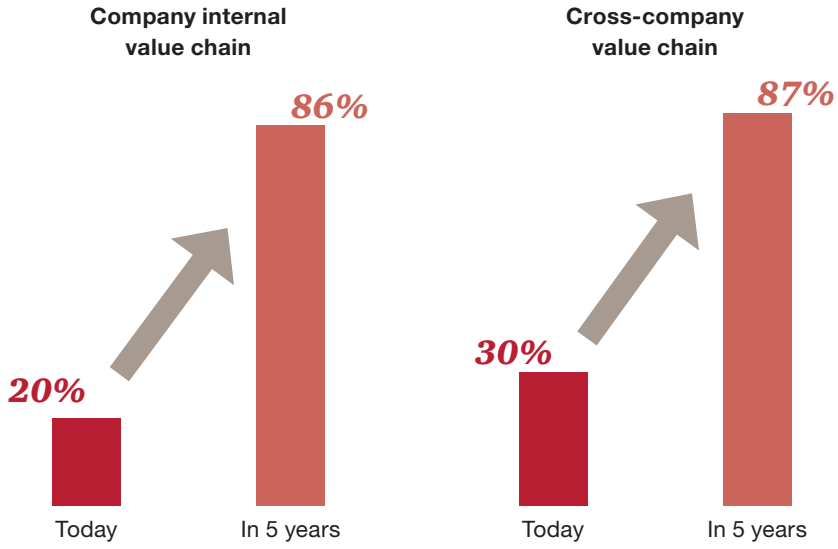
Industry 4.0 has in the meantime been placed on the agendas of most companies. Almost three quarters of companies surveyed have already (partially) digitalised their supply chains. On average 25% of those surveyed said the current extent of the digitalisation of their supply chain was already advanced. What this actually means is that most companies in fact already use or have implemented solutions for the digitalisation of supply chains in some areas. The study reveals that the extent of the digitalisation process will rapidly grow in future. Within the next five years it is expected that an average of 86% of company internal and 87% of cross-company value chains will be characterised by a high degree of digitalisation. This conscious investing in further digitalisation opportunities is identifiable throughout all industrial sectors. Industry 4.0 and the digitalisation of supply chains are important for any company wishing to remain competitive and not wanting to be left behind by the ever faster development of entire industry areas. All companies have realised this, irrespective of their size. At present, companies with turn-over from EUR 100 million to EUR 500 million (40%) are the most digitalised.

Industry 4.0 goes well beyond the digitalisation of processes and value chains – it is a transformation that is also increasing the extent of digitalisation when it comes to the products and services offered. A mechanically perfect product alone will soon no longer suffice in order to keep standing up against international competition.

The differentiation of products and services is becoming especially apparent through the increasing importance of software as well as superior sensor technology and intelligent information processing. This means digitalised products can make possible a new spectrum of product accompanying services to the benefit of customers.

The level of digitalisation along the value chain is set to increase considerably over the next few years

Fig. 3 Share of companies with a high and very high level of digitalisation along the value chain



Products which are still largely mechanical will be optimised thanks to digital solutions and interconnectivity, thereby creating greater customer benefits. Alongside the direct integration of digital 'intelligence' within products themselves, the benefits they offer can also be considerably increased through internet based services surrounding the products. Beyond this, Industry 4.0 also enables the manufacturing of products tailored to customer specific needs at a competitive cost (keyword: batch size n=1).

Examples of digitalised products and services can be found across industries: In the automotive industry, conventional braking systems have been further developed with the help of electronic control units to become what is now modern-day ABS. When it comes to mechanical and plant engineering, the use and interconnectivity of suitable sensors has enabled optimal, predictive maintenance of machinery and equipment – and with it much more efficient management.

[1] Respondents who stated that the digitalisation of their value chains was "medium" (3) to "very advanced" (5).

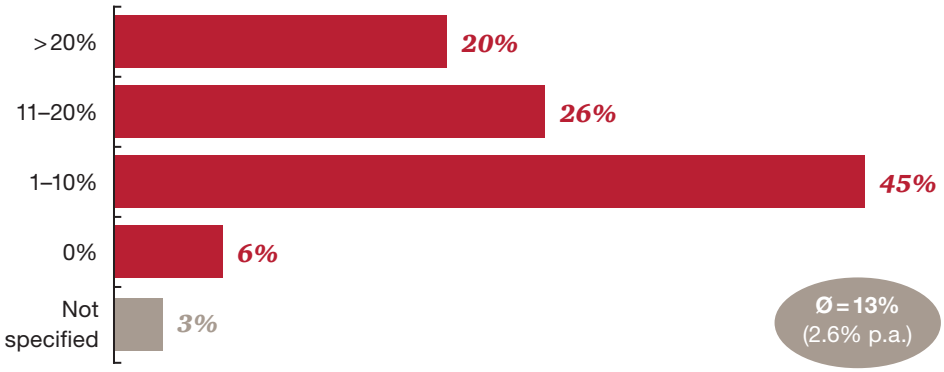
4. Industry 4.0 solutions create additional sales potential

On the whole, the impact of software and digital elements in the total added value of a product – and thus also in the company turnover – will pick up considerably. Companies associate clear growth targets with Industry 4.0 applications, such as the digitalisation of the product and service portfolio. The study shows that at least 46% of respondents expect an accumulated double digit sales growth for the next five years solely as a result of Industry 4.0 and the enhanced digitalisation of the product portfolio. One fifth of the companies queried even assume sales growth of over 20%.

Across all industries, this means an accumulated expected sales increase of 13% over five years, which equals 2.6% per year on average. This corresponds to annual potential additional sales of EUR 2.8 billion on average through Industry 4.0 solutions. Over five years, this results in additional sales of approx. EUR 15 billion. The focus on Industry 4.0 will therefore make a substantial contribution to growth in Austria over the next few years. For most companies such growth targets are rather ambitious. In this respect, the expectations of companies with a turnover of less than EUR 1 billion are quite a bit higher than those of larger companies.

Companies expect marked sales gains through Industry 4.0 solutions and products

Fig. 4 Expected increase in turnover attributable to Industry 4.0 - Cumulative growth in 5 years



In high wage countries such as Austria, the competitiveness and success of companies depends on fast innovation which meets market requirements.

Univ.-Prof. Dr. Ing. Dipl.-Ing. Prof. eh. Dr. h.c. Wilfried Sihn, Fraunhofer Austria Research GmbH and Vienna University of Technology, Institute for Management Sciences

5. Companies increase efficiency and save costs

For Austria as a business location, the fourth industrial revolution is decisive when it comes to ensuring sustainable economical production in a global context. The industry will have to produce ever larger amounts with ever fewer raw materials and less energy. Industry 4.0 will help companies achieve efficient production processes with higher efficiency in terms of production, energy and resources. For the next five years, the companies queried expect to reap a noticeable quantitative benefit from the planned investments in Industry 4.0 applications. Across all industries, companies anticipate average efficiency gains of 20% as a result of Industry 4.0. This corresponds to annual efficiency gains of 3.7%. In actual fact, more than 40% of companies predict even higher potential gains, with the automotive, electrical engineering and electronics industries expressing the highest expectations on average.

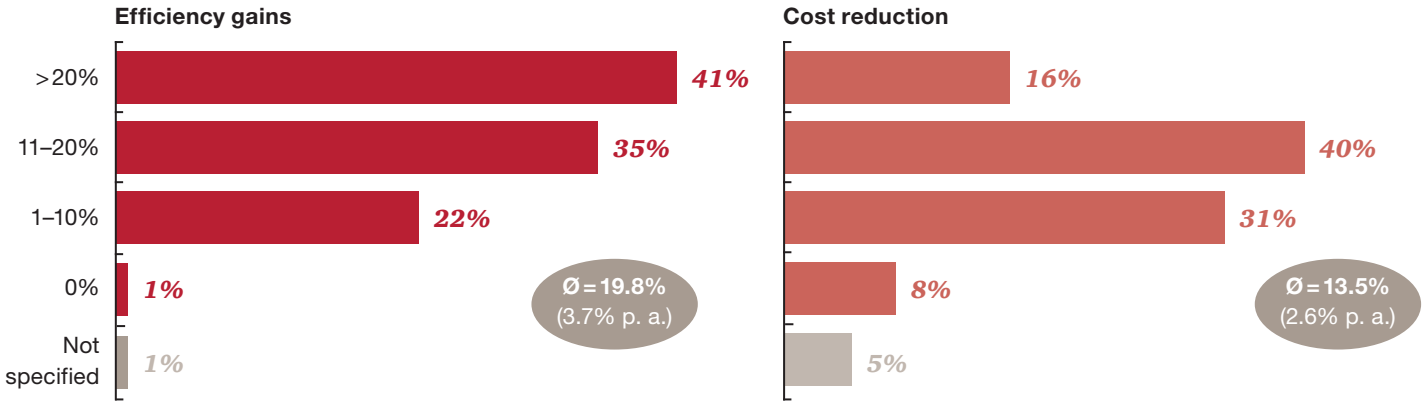
The digitalisation of processes and value chains can mean a multitude of improvements, such as:

- Focus on the core areas of a company's added value
- Reduction of redundancies in the process model
- Minimisation of quality losses
- Process standardisation and automation

When it comes to cost reduction, the companies queried expect annual additional savings of 2.6% resulting from Industry 4.0 beyond the customary cost savings. Particularly machinery and plant engineering companies have high expectations in this regard and express the highest expectations with annual cost reductions of 2.9%. A comparison across industrial sectors shows the process industry to have the most conservative expectations for the future – both in terms of cost reductions (2.3%) and efficiency gains (3.1%). The cost savings expected on average are not merely associated with efficiency gains within one company, but also with stronger integration across companies. Production costs can only be reduced by 2.6% per year if all partners along the entire supply chain are also able to reduce their costs and pass on such savings. Given the customary cost reductions of 3% to 5% per year in industrial companies, the planned savings through Industry 4.0 will play a major role when it comes to the long term improvement of the competitiveness of Austrian companies.

Benefits from Industry 4.0 solutions are particularly expected in terms of efficiency increases

Fig. 5 Cumulative quantitative benefits expected from Industry 4.0 applications in 5 years

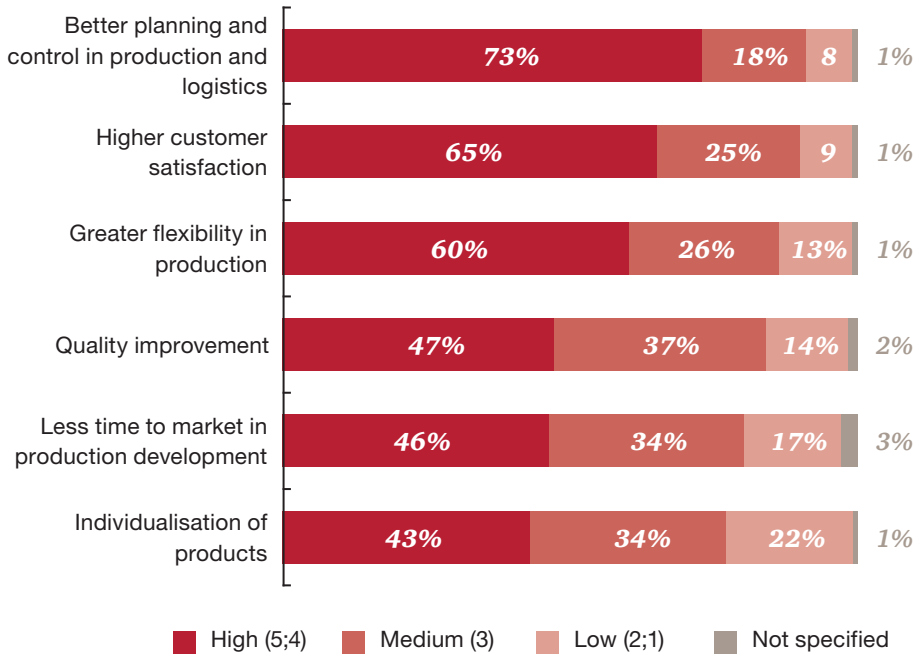


6. Industry 4.0 brings with it a number of qualitative benefits

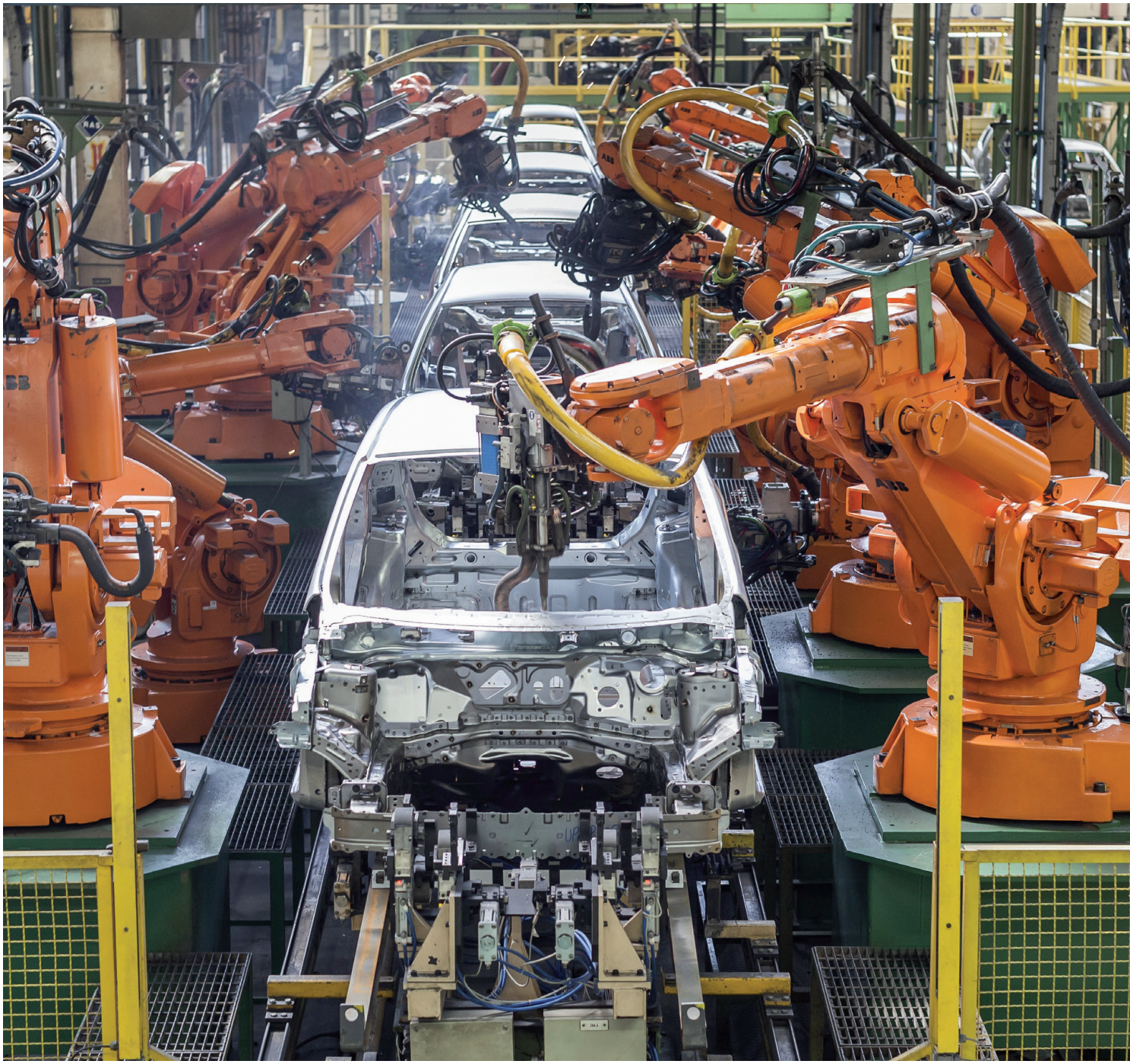
Industry 4.0 also offers an opportunity to meet customer requirements with respect to the traceability of material, product and process data. Many corporate groups, for instance in the automotive and electronics industry, move quality controls further upstream in the value chain and expect to receive full information from their suppliers so as to be able to trace the entire lifecycle of a product. Without losing sight of economic efficiency, the ever increasing requirements can only be met if all traceability data are considered, sensors and actuators are used more extensively in production and all – instead of only a select amount of – data ("Big Data") are recorded.

Companies expect major advantages regarding production and customer satisfaction

Fig. 6 Qualitative advantages of Industry 4.0 applications



D Outlook and recommendations



For most companies, the implementation of Industry 4.0 means a transformation process of several years, at the end of which value creation will have undergone a significant change. The company-wide changes and innovations expected for the next three to five years need to be treated as top management issues of the highest priority. More than 40% of this survey's participants are CxOs. This shows that the topic of Industry 4.0 has well and truly established itself in the boardrooms of Austrian companies.

A strategic perspective and active management involvement are now called for. Each company should determine its own status quo regarding Industry 4.0 in a specific strategy procedure – focussing on existing capabilities, changes in customer demands and target definition. Our Industry 4.0 maturity model supports companies in systematically addressing the various measures towards digitalisation. In doing so, all ongoing and planned activities need to be combined to form an integrated Industry 4.0 strategy.

The entire strategy process takes into consideration five dimensions which are shown in the illustration below. The maturity level of each of these dimensions can be evaluated and targeted for improvement in a structured process: In a first step, the current maturity level will be determined, ranging from "digital novice" to "digital champion". The status quo of capabilities and digital initiatives within the company forms the basis for the definition of Industry 4.0 targets and the identification of any gaps. The defined targets and the path towards achieving them will by no means be the same for every company, however. The objective lies in defining the target level of maturity for the next three to five years – depending on the starting position, the customer and competitive situation and the willingness to make investments. This can in turn be done by choosing one of three different strategic approaches:

- **"Shaping"** companies are those which act quickly and are willing to take risks in order to utilise the opportunities offered by digitalisation early on, which help develop Industry 4.0 concepts and potentially even create de facto standards. This approach is, however, also associated with the higher risk of having to first develop and implement new and untried solutions.

- **"Quickly adapting"** companies learn from the initial experiences of the pioneers and quickly adapt and implement apparently successful concepts. This approach carries the risk that the full potential can no longer be realised.

- **"Waiting"** companies wait for the widespread implementation of Industry 4.0 solutions and then apply only tried and tested concepts with defined standards and established economic viability calculations. However, these companies face the (not to be underestimated) danger of falling behind the global competition in a rapidly digitalising world and of having missed adjusting to the changes in customer behaviour.

Once the advantages and disadvantages of a strategy have been evaluated and adjusted to the defined target situation, specific steps towards pragmatic implementation as well as major milestones can be defined. Ultimately, there will be a set of clearly defined measures with underlying economic viability calculations tailored to a specific company as well as time schedules. In parallel, a change management system should be set up, which helps safeguard the change in the long term and aids rapid success through select pilot projects.

The establishment of Industry 4.0 solutions requires high investments, the potential economic and competitive benefit of which will have to be critically assessed time and again. The major prerequisite for such a development is a clear management commitment to the digital agenda. In addition, stringent data management and an efficient analysis and use of (real time) data need to be established in order to ensure optimisation along the supply chain. There are many ways towards becoming a digital champion. Depending on the individual capabilities and the existing configuration of the product and service portfolio as well as its operational and administrative processes, each company needs to decide for itself which path leads towards success.

Companies' Inudstry 4.0 maturity develops across five dimensions and four stages

		1 Digital novice	2 Vertical integrator	3 Horizontal collaborator	4 Digital champion
Core dimensions	*Business model, product & service portfolio*	Which degree of digitalisation and individualisation do product and service portfolios have? Does the current business model respond to the requirements of the digital age?			
	Market & customer access	What channels exist for interaction with customers? What data are being analysed to understand customer needs?			
	Value chains, processes & systems	How well integrated are processes, IT systems and technological infrastructure within and beyond the company?			
Supporting dimensions	*Compliance, legal issues, risk & data security*	Which measures are taken to protect data? To what extent are privacy policies and other regulations being addressed?			
	Organisation, employees & culture	How agile is the organisation to respond to change? How are employees being trained in order to cope with future requirements?			

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