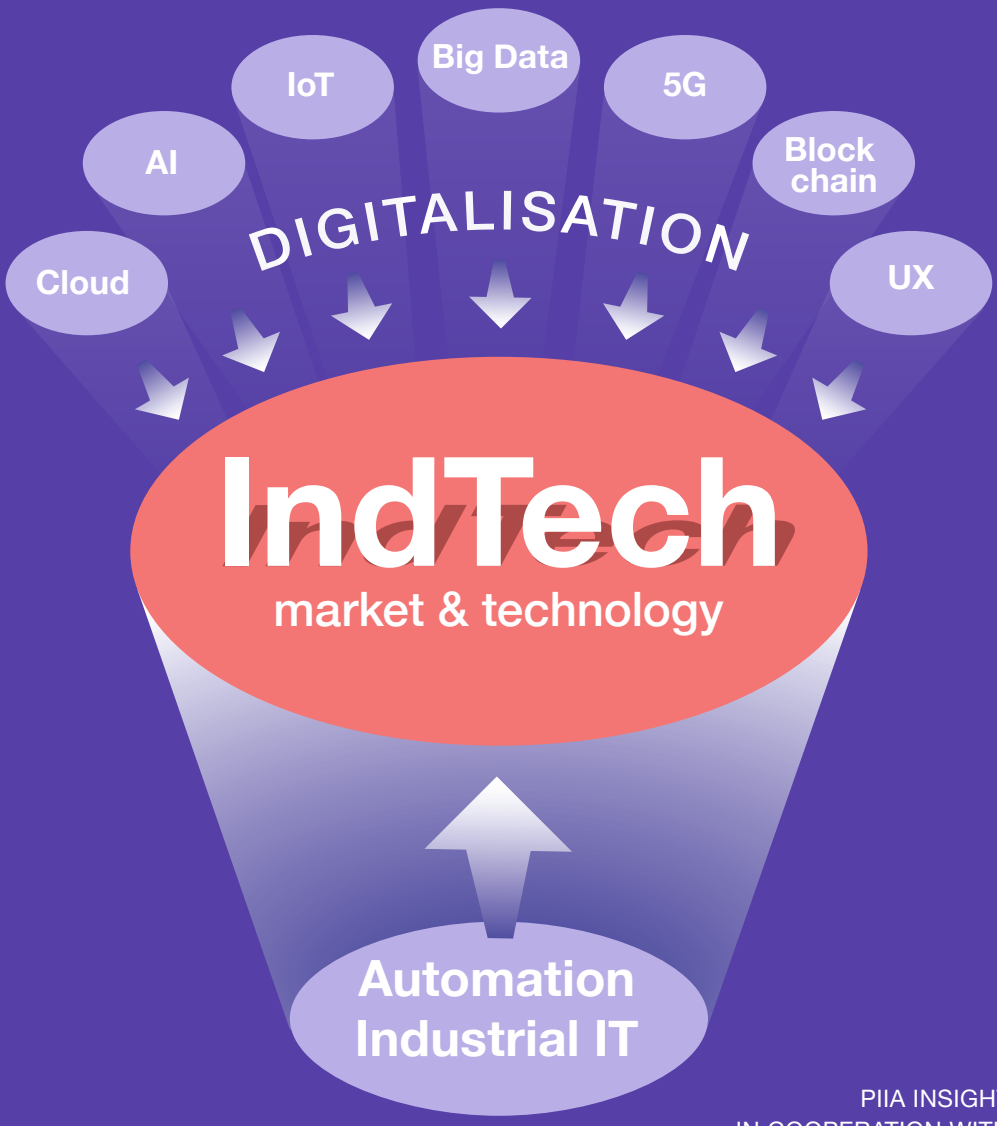

PIIA INSIGHT
IN COOPERATION WITH
BLUE INSTITUTE

Swedish IndTech

A report on the technology making industry smart

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PiiA, Process Industrial IT and Automation, is a strategic innovation programme which emphasises thought leadership within industrial digitisation. PiiA enables development through knowledge, extensive networking and the financing of research, development and innovation projects. Our projects focus on new digital technologies, services and business models. PiiA Insight is one of four strategic activities within the innovation programme.

The Blue Institute Foundation is an independent think tank and research institute conducting research and analysis activities with a focus on strategy and growth issues.

The report Swedish IndTech is a collaboration between PiiA and Blue Institute as part of the analysis of how different growth areas are affecting the strategic challenges facing Swedish industry and society.

The Swedish IndTech study has been funded by PiiA and VINNOVA, the Swedish innovation agency.

Contents

Introduction

Digitisation is changing society and the digitisation of industry is a primary actor for sustainable growth.

Smart industry means increased efficiency and the emergence of new customer values. The digital development that makes smart industry possible is what we call *IndTech* in this report. IndTech represents all the opportunities rapidly spreading within industrial value systems. But it is also about a change with its background in the *computerisation* of industry in the 1980s and 1990s. A tangible legacy we have inherited as a large technology base, often with a long remaining lifespan.

The IndTech concept therefore indicates a development in which industry's demand for digitisation solutions needs to take past investments and experiences into account. This is where industry differs from volatile consumer markets. It also places particular demands on IndTech suppliers. Just any old *"app"* is not sufficient in order to meet industry's exacting requirements. Such an app has to represent process knowledge, industrial security and accessibility requirements, whilst simultaneously being as simple and neat as we are used to apps being.

This report will primarily cover technology providers, their markets and technological developments. A global market where demand for IndTech is growing much more quickly than industry in general. A question which has been a theme during the work on this study has been whether Sweden has the conditions in place in order to develop IndTech into a high-profile export success. In many sectors, Swedish industry is among the world leaders. We have a history of industrial automation, we have a world-class ICT industry, we have an entrepreneurial culture with the will to explore new growth areas. The opportunities have never been as great as they are now. During the course of the study we found a lot of evidence that Swedish industry, together with the Swedish innovation system, has what it takes to take advantage of the opportunities. Furthermore, *Swedish IndTech* can also become a Swedish speciality in two aspects: the Swedish raw materials, process and manufacturing industries could become the best in the world at using technology to increase their competitiveness and Swedish technology suppliers could develop leading concepts and take international market share.

The study was carried out by *Blue Institute* in collaboration with the strategic innovation programme *PiiA*, as well as organisations, companies and researchers involved in the sector.

We would like to thank everyone who participated by sharing their knowledge and analysis of the sector. Transparency and uncertainty within the market means that the report cannot claim to be a perfect and complete description or to have all the answers to the questions. It is an overall analysis describing an emerging technology sector and market. Its aim is to promote development and facilitate discussion.

This version of the report is a summary of the study Swedish IndTech. The full version can be downloaded from the PiiA website, *www.sip-piia.se*

Stockholm, June 2018

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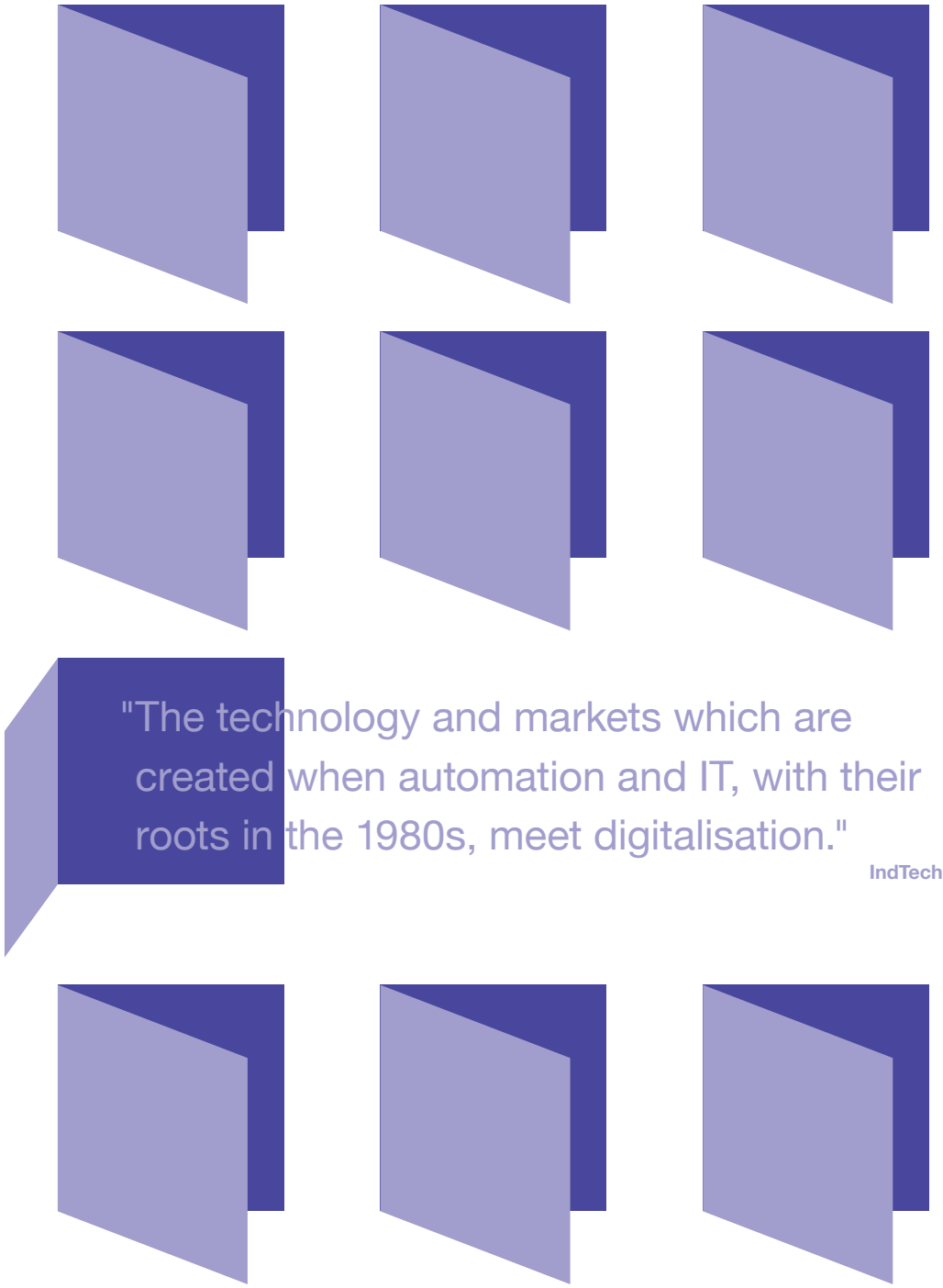


"The technology and markets which are created when automation and IT, with their roots in the 1980s, meet digitalisation."

IndTech

Smart Industry

When industry was computerised in Sweden and other Western economies in the 80s and 90s, factory floors were depopulated. The process industry could be monitored from central control rooms and maintenance was made smarter. Both the automotive and the electronics industries were robotised. Automation and increased integration meant a healthy boost for productivity figures. However, this soon levelled off. During the subsequent period, it has not been possible to take further radical steps under the same conditions. The marginal benefits of the technology have slowed down and of course factory floors cannot be depopulated once more.

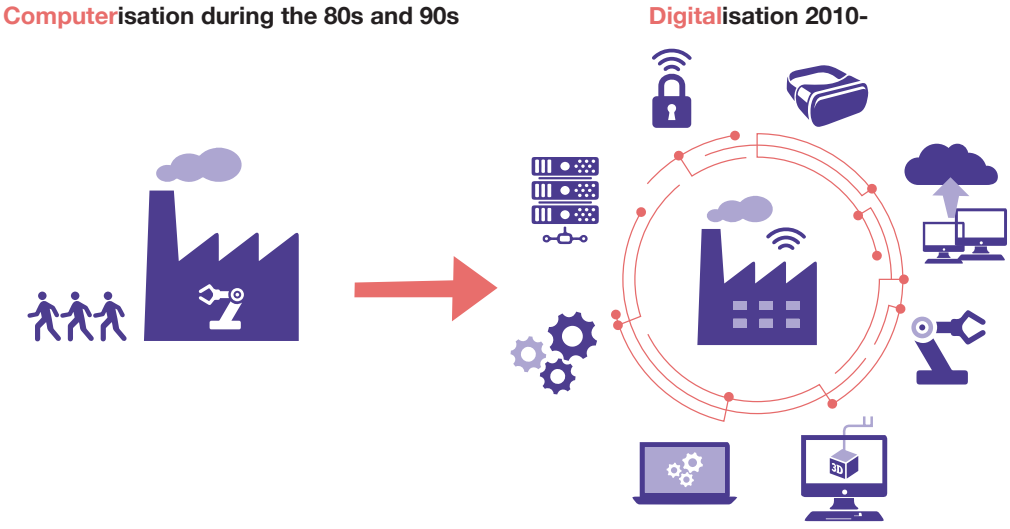


Figure 1: The difference between the computerisation of the 80s and 90s, which in industry was characterised by periodic relatively large investments and digitalisation involving a massive penetration of functions and locations. Lots of small inexpensive efforts create a web of opportunities for both the streamlining and creation of new customer values.

Forty years later, industry has reached the next significant technology-driven wave of change. This time, we do not term it computerisation but *digitalisation*, when a number of technology areas combine to influence and strengthen each other. There is a lot of talk about the cloud, mobility, analytics, the Internet of Things and social media, which together with non-dependence on location form ***the third (technical) platform*** – after the large computer mainframes of the 60s and 70s *(the first platform)* and the PCs and network servers of the 80s *(the second platform).*

The basic capacity enabling this development is the large-scale replacement of computing power with cloud-based services. Services and applications are built on this platform, not least those based on AI algorithms, with a level of costs and availability that just a few years ago would have been regarded as utopian. Through services and applications that analyse, break up and connect together in new ways, creating new values, this development represents a challenge.

The Industrial Internet of Things will be a key part of this process. The effects of each individual effort may be small, but development consists of small individual strands and adds up to a greater whole. This makes it possible for both very small and very large companies to automate data streams and make money out of them. This digitalisation makes the conditions more equal.

It is also a development that challenges traditional industrial IT and automation suppliers. There may be competition within the telecommunications industry, its operators and technology companies such as *Microsoft, Google* and *Apple*. Low costs and ease of access are factors which are realised through scale and platforms that could complement and replace parts of industry's conventional control system environments. In addition, a variety of small businesses, entrepreneurs and connected start-up companies (connected without geographical restrictions) constitute a force to be reckoned with.

The company General Electrics **believes that the market in technology and software for industrial applications within the Industrial Internet of Things will be worth USD 225 billion within a couple of years.**

The value creation **that smart industry represents is so significant that the demand for digital solutions in industry is expected to increase by double the industry average.**

The German Industrie 4.0 venture **estimates the value of its effect to be 1% of German GDP annually.**

In the long-term, our assessment is that the IT/automation industry – which consists of two distinct areas , *industrial IT* and *operational technology (OT)* – will change in nature when the powers from the third platform come into play. For the industry that will use the technology, this means countless possibilities that will in fact together create a new industrial revolution. This is often known as *the fourth industrial revolution.*

The fourth industrial revolution

One of the major characteristics of the fourth industrial revolution is integration between the real (physical) world and the virtual, digitally-created cyber world. What makes this development possible is the pace of technological development and cost rationalisation, which means that computer capacity is never a limitation, either practically or financially. Algorithms and hardware are produced on a large scale and cost (in terms of traditional industrial costs) virtually nothing. Everything is connected, delivering data flows for automation and analysis, for customer value and efficiency. The result is a *smarter industry.*

From a societal perspective, the driving force for smart industry is *better resource efficiency* – necessary so that shortcomings do not become disadvantages and slow worldwide growth. For business people and investors, the driving force is increased revenue and profitability. The concept of smart digitised industry can increase resource efficiency by a double-digit number each year, something that is necessary. Productivity can be improved by as much as the equivalent of USD 2 trillion worldwide over the next few years. Furthermore, growth from new revenues in the form of data-based services may total USD 700 billion per year. In Swedish terms, the same development would mean over SEK 130 billion in productivity improvements and over 40 billion in growth. This is equivalent to 1-2% in annual industrial growth [1)].

[1)] These calculations are based on estimates for German industry according to the report Industrie 4.0: The Future of Productivity and Growth in Manufacturing Industries, BCG, 2015 SCB, Företagens ekonomi, 2015

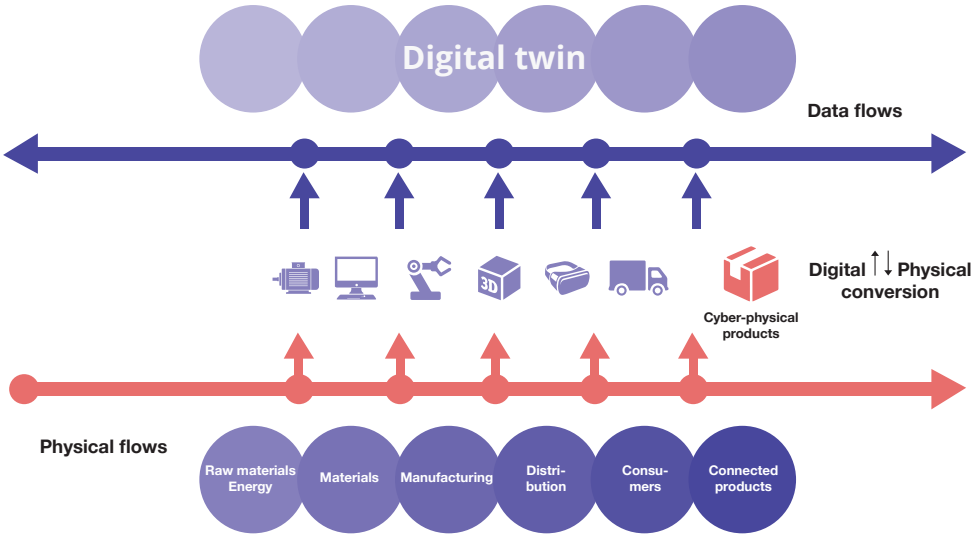


Figure 2: Smart industry is powered by data flows that become as important as the physical flows of materials, goods and products. In the cyber world, digital twins of the tangible world can be created. Between them, new technologies are being developed, along with a market for communication and translation based on data.

Industrial growth is created through producing values that customers are prepared to pay for. Within digital development, this may mean new solutions where products become more valuable by adding a data-based service. This is also known as called *hybridisation*. However, streamlining also creates the conditions for growth. This can be achieved by optimising processes and fixed assets. It can also be achieved by increasing flexibility through the automated trading of resources, improving the overall utilisation of industrial systems. Combining spare marginal production capacity among many companies is an example of a resource that could be made profitable through cost-effective digitisation. This may be carried out via cooperation platforms – collaborative systems which break down the boundaries between OEMs and subcontractors in several ways. Efficiency gains within smart industry are characterised by the logic of many small threads, rather than the big productivity gains of the 80s and 90s, based on massive investments which depopulated factory floors.

The value of data

The systemic development of smart industry can be understood through the assumption that the *nominal value of data* is assumed to increase at the same time that the amount of data collected and freely transported and analysed in the value systems increases: *data throughput increases as a consequence.* The analysis makes machines and systems smarter. Business models do the job of converting bits and bytes into money. We also see these business models in the relationships between customers and subcontractors where *the data flows within the value systems* add new values.

"The development of the IndTech industry is expected to lead to further industrial specialisation when operational, process and maintenance functions are outsourced to connected suppliers.

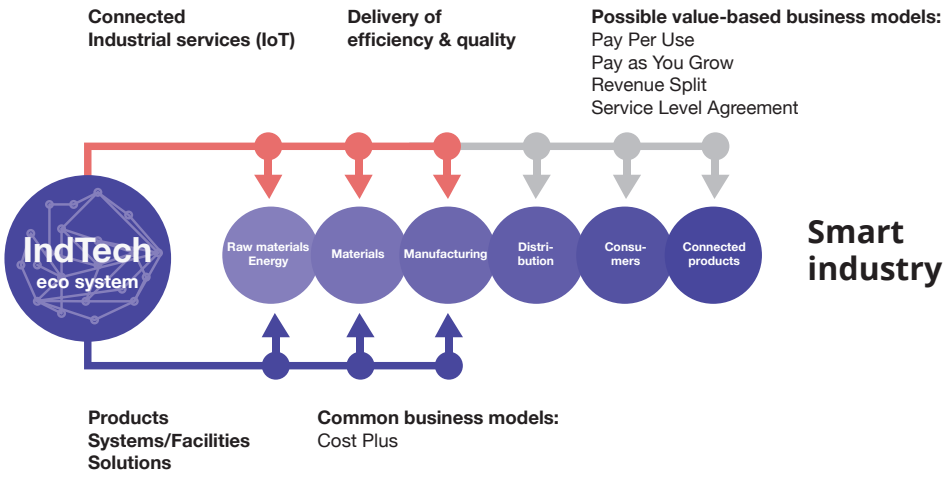


Figure 3: IndTech is what makes industry smarter. Partly through hardware and software systems, partly because connected value-creating services have the potential to change industrial thinking by adding new values based on excellence.

Business models are also present in *data streams that populate the* value systems of IndTech companies (machine, technology and service providers) and streamline the fixed assets or manufacturing processes. The latter is a development that is expected to lead to further industrial specialisation when operational, process and maintenance functions are outsourced to connected suppliers and supplier networks that have the advantage of being able to create in-depth knowledge within niche areas on a large (global) scale – *hyperspecialisation.*

Connected machines and systems ensure that the latest technological advances are always available. A development where equipment and systems are provided "as a service", where suppliers gradually improve their portfolio through updating systems and equipment.

Data is a strategic asset

Data collection and analysis creates data streams and systems which, together with services-based business models, change companies and how organisations take on assignments. This leads to the insight that it is *data* which is the new strategic asset. Rather than creating a business strategy and building applications and looking for data to supports it, good strategies need to be based on data being the driver of the strategies, supported with suitable applications. These are usually called *data-centric* business models, and differ greatly from the application-based models of today.

It is important that Swedish companies take on board the relationship between data flows and analysis: data is a new currency. *Systems of systems* of data are evolving at the same rate they are able to create new values. For companies, it is important to identify opportunities in all levels of the planning hierarchy in order to prepare the way for new thinking on a strategic level in the pyramid.

A number of international initiatives are now concentrating on understanding and organising systems of data. We have not had such a conversation in Sweden, at least one regarding industry.

PiiA IndTech hub

The PiiA IndTech Hub is a test environment and collaborative platform for connected technological industrial services. This test bed, which is aimed at both small and large companies, offers technology suppliers, together with researchers and industry, the opportunity to test platforms, connected applications and cutting-edge technologies that streamline fixed assets and optimise industrial processes. The idea is to identify knowledge gaps and development needs based on current knowledge.

The test bed resources include *IndTech Data Lab, PiiA Analysis*, and PiiA's original environments*Process IT* and *Automation Region*. The *4S* project is also an important resource for the test environment. 4S effectively connects knowledge and experience with the international standardisation work currently in progress towards smart industry within the international organs ISO and IEC.

PiiA IndTech Hub is part of *the Digital Mainline*, in collaboration with the Strategic Innovation programme *Produktion2030* and *Chalmers SII-Lab*.

Figure 4: The principal difference between data-centric and application-centric business models.

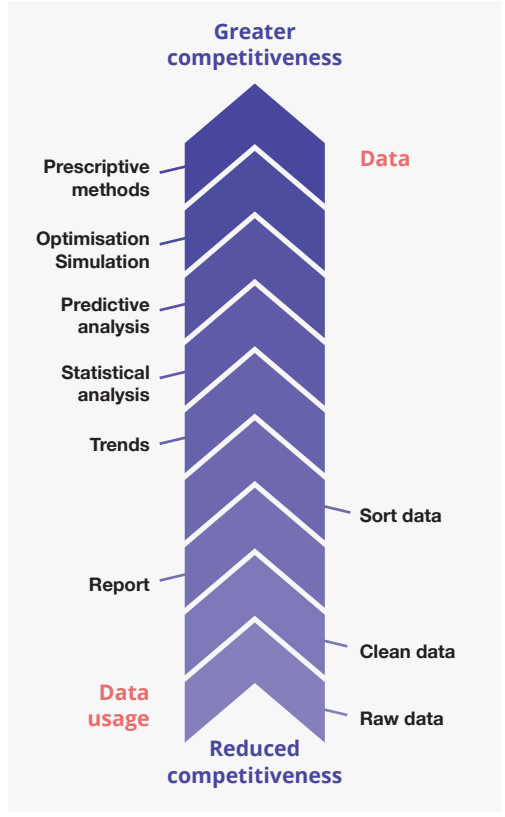


Figure 5: The ability to manage and use data will increasingly determine companies' competitiveness.

This is an important issue, not least because we need clear rules regarding who owns the data and how data such as intellectual property is to be treated in company accounts. On a concrete level: in order to make it possible to use smart systems and new types of products, business conditions and many other aspects must be reviewed.

How data creates value in industry

1. Connectivity – the ability to bridge gaps between machines and allow people to interact with each other and machines regardless of physical distance. The trend is now increasingly reliant on internet-based data and links to cloud-based and mobile services. There are many advantages with such structures, where cost-effectiveness and mobility are defining characteristics. The amount of data collected from different processes and which can be turned into something which can be analysed is increasing dramatically.

2. Insight – When more information/data is collected, knowledge increases about the status of a company and where improvement efforts are to be made. Data-driven industrial activities make it possible to observe trends within production, working time, maintenance and quality. It is then possible to minimise security and business risks on an *end-to-end* basis: from purchasing and production to customers and markets.

3. Resource efficiency – materials, machinery and people are the resources that fuel business in industrial companies. Data-driven processes make it possible to understand how best to use resources, avoid mistakes and introduce improvements.

4. Transparency – data collection made available to people and machines promotes transparency and makes the working environment more efficient. With data translated into easily accessible information, the possibility increases of a common understanding of how processes and maintenance are best implemented.

5. Consistency – One of the biggest benefits of increased data flows within industry is the ability to identify inconsistencies more easily. Identifying incompatible events as accurately as possible helps to identify the causes of problems and to introduce solutions to increase the efficiency of a given process.

6. Innovation – data also provides an advantage when developing new products. More data during the life cycle of a product brings benefits in terms of understanding usability, quality, design and attractiveness, thus having a positive influence on a company's sales.

7. Hybridisation – increased data streams make it possible to create new customer offers. These are partly services-based and partly products where traditional “hard” products are connected and combined with data and data streams, increasing their value to customers.

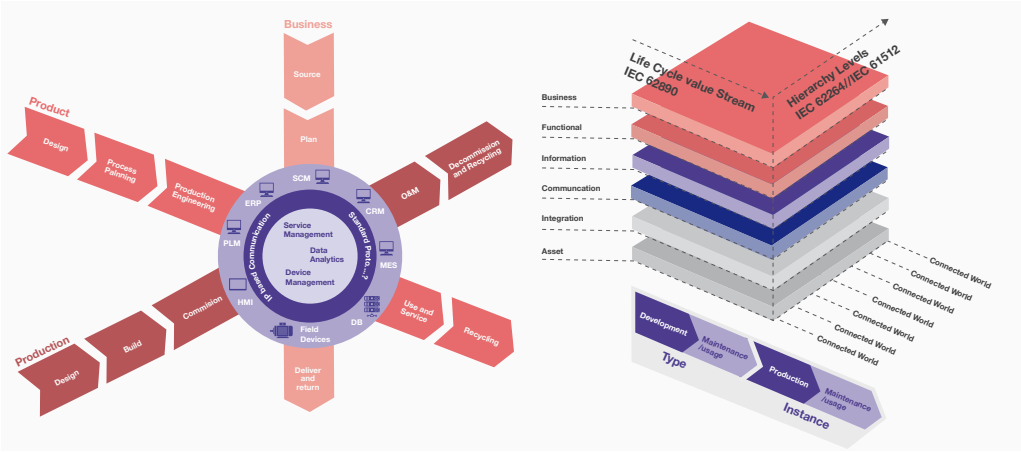


Figure 6: A model for industrial digitisation needs to cover several dimensions and aspects. Both RAMI 4.0 and NIST contain many visions/descriptions of how new architectures might look, i.e. they will be the framework for future implementations of industrial digitisation.

Reference models and standardisation

The term *smart industry* summarises the abilities of IT, industrial technology and people to develop innovation methods, production methods and business. Reference models such as maps of a smart digitised industry also cover all these aspects. Reference models and reference architectures ensure a consistent approach so that all parties can understand each other. This is the basis of interoperability (structures which allow full connectivity between different systems and thus organisations) and the reason why international standardisation is being highlighted as a critical factor in the realisation of smart industry.

Examples of models which follow these guidelines are the German *RAMI 4.0* developed as part of the *Industrie 4.0* initiative and the NIST model developed by the American research institute *NIST* (National Institute of Standards and Technology). The *Industrial Value Chain Initiative* is an equivalent Japanese initiative. There are other examples in Korea and the Chinese initiative *Made in China 2025/Chinese Manufacturing 2025.* The reference models and reference architectures now form the basis for international standardisation work on smart industry. The work on creating an industry standard has begun within the internationally-recognised standardisation bodies *ISO* and *IEC*. Active participation in standardisation activities is an important issue for Swedish technology suppliers, and also for the players within industry who will be the end users. Industry standards are a strategic tool creating leverage for the next generation of technologies.

The ability to influence the ISO and IEC work comes via the Swedish standardisation bodies SIS and SEK. In this context, Swedish skills and engineering abilities are highly respected. In the recently-launched ISO strategic group for *smart manufacturing* , Sweden is at the forefront of a number of important standardisation areas. Sweden is also contributing cutting-edge skills in similar projects for IEC. Activities to engage industry are also ongoing within the framework of the Swedish cooperation programmes PiiA and Produktion2030 via the 4S project (see fact box) in collaboration with the Swedish standardisation bodies *SIS* and *SEK*.

The 4S project

Strategies and Standards for Smart Swedish Industry
The 4S project will ensure that, based on Swedish research and the competitiveness of Swedish companies, we influence the ongoing standardisation processes with relevant knowledge of relevant market systems.

4S is a project funded through the government's Partnership programme for a smart connected industry (2018). The initiative is being run as a collaboration between the strategic innovation programmes PiiA and Produktion 2030 and the standardisation organisations SIS and SEK.

The project connects on a practical level the strategic innovation programmes' RDI (Research Development Innovation) projects with the ISO *Smart manufacturing* working groups. The project is also paving the way for effective and direct communication with Swedish suppliers and Swedish industry, in order to put their interests across. 4S is also working on increasing the knowledge within Swedish company management of the importance of standardisation for industrial digital development.

Within 4S, PiiA and Produktion 2030 programme management and project managers from ISO/SIS and IEC/SEK are represented

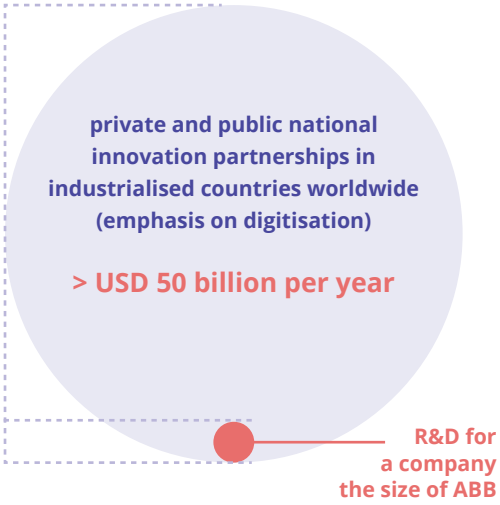


Figure 7: The participation of private and public partnerships in the development of innovation is likely to increase worldwide. Each year, between 50 and 100 billion USD is invested in such projects. In comparison, technology suppliers of the size of ABB invest billions of dollars in research and development in total.

The innovation system has fuelled the development

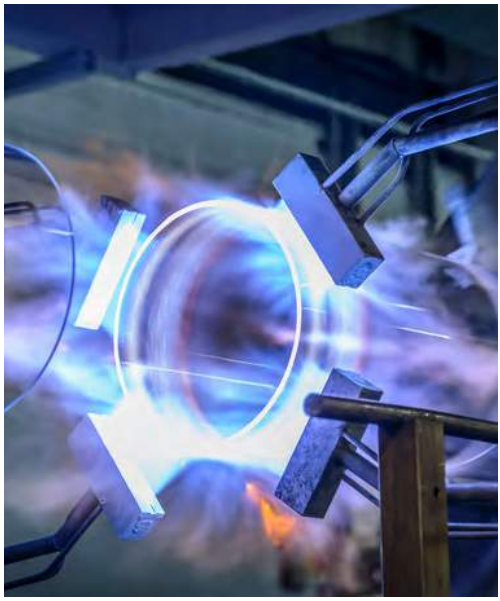
Investments in industrial digitisation worldwide are extensive, to say the least, and are in many new forms. Financial resources are not really a limiting factor any more: plenty of private and public innovation capital has been invested. Rather, the challenge is finding talents who are able to convert innovation investment into industrial benefits.

The relative share of private and public partnerships (as opposed to purely industrial or private) within innovation development worldwide is expected to increase. Each year, it is believed that over 50 billion USD is invested in such projects. Public-private partnerships often mean that the state puts up the money, while industry, together with academia, contributes resources and expertise.

Unlike large companies, which think on a global scale, nation states naturally have their own motivations for financial investment. One expectation is that the investment will benefit domestic industry and create job opportunities. However, entirely national initiatives have their limits when value chains, technology development and ownership are global and digital industry development is effectively the domain of the major technology companies. In reality, innovation systems and innovation efforts are the products of interaction between the major technology companies, national governmental research and innovation initiatives and the involvement of small and medium-sized enterprises.

In recent years, innovation systems have greatly fuelled digital technology development, but a shift is now likely, where industry will catch up with the development of knowledge and organisation. This means that it will be business values largely dictating the direction – development will be demand-driven but will continue to maintain a high tempo.

> Development is now demand driven and in the foreseeable future business values will take over, guide and determine the direction of development.



IndTech

IndTech combines the existing automation and IT base with new digital developments. IndTech means technology on the factory floor – this also includes organisational and business environments (ERP, SCM, PLM, MES etc.) [2], it means the analysis of Big Data, mobility, clouds and artificial intelligence. IndTech also involves the companies and institutions that develop and supply the technology in a global market that is worth USD 340 billion per year, with a rate of growth equivalent to double the industry average.

The word *IndTech* means different technology areas, with different areas of origin, coming together and changing industry. Where the technology currently fuelling change in most cases was developed for completely different purposes than purely industrial ones. This means great opportunities but also challenges. IndTech can be summed up as convergence between the following three areas:

[2] ERP: Enterprise Resource and Planning; PLM: Product Lifecycle Management; MES: Manufacturing Execution Systems; SCM: Supply Chain Management

- **The third platform**, which is the combination of mobility, the cloud, social interaction, the Internet of Things, Big Data and advanced AI analysis. One aspect of the third platform is that IT is no longer something only found in conventional computers. It exists everywhere and is always available.
- **Industrial IT**, for businesses and administrations. In other words, business, product development, resource management, production, customer care systems and systems for the management of technology and fixed assets.
- **Operational Technology** (OT) for the factory floor and in the field. This means control systems, sensors, actuators, drive and electrical systems, instrumentation, robots and more.

A branch of industry with Swedish strength

During the Eighties, Swedish industry was early to adopt the most advanced automation technology. In particular, the process industry was one of the international trailblazers. Collaborations between industry, the automation sector and industrial IT suppliers laid the foundations for success within technology exports. ABB's leading position within industrial process automation is without a doubt the result of this cooperation. However, at the same time as productivity gains are being realised, the willingness to invest is waning. *Marginal benefits* are decreasing Since the 90s, development in the automation industry has been notable for being *incremental* rather than *disruptive*, and it is still relatively closed or *proprietary*.

At the same time, there is a staggering increase in the price-performance ratio for computer components and software solutions. In this development, telecoms, transport, finance, gaming, media, etc. create the demand and drive the development. In total, around USD 3,500 billion [3] is spent in these markets on digitisation and digital equipment. This can be compared with USD 300-400 billion annually in industry.The conclusion is that industry must take advantage of the open opportunities created for other applications. At the same time, a large amount of technology needs to meet particular industry requirements and be robust and fast.

> IndTech is when automation and industrial IT, with its roots in the 1980s, meets strong and fast influences from technology which was actually developed for other purposes – *stability meets hyperdynamics.*

This is not a straightforward meeting and leads, among other things, to an exposure to security problems. For industry, it is a challenge to adapt its existing base of automation and industrial IT, worth the equivalent of maybe USD 3,000 billion worldwide – and often thirty or forty years old – to new technologies that are evolving at an exponential rate. Industrial automation investments have been shown to have a longer economic life than most people anticipated. Technology adaptation and knowledge therefore needs to be well-thought-through in order to bridge the gaps between the existing and the new. The difference between good and poor implementation undoubtedly has an effect on industry's financial results.

Like other technology terms, ***IndTech*** is a portmanteau word, which in this context means *Industrial Technology*, referring to the basic meaning of the word *industrial*: the production of goods and services.

[3] Gartner Worldwide IT Spending Forecast, 2017

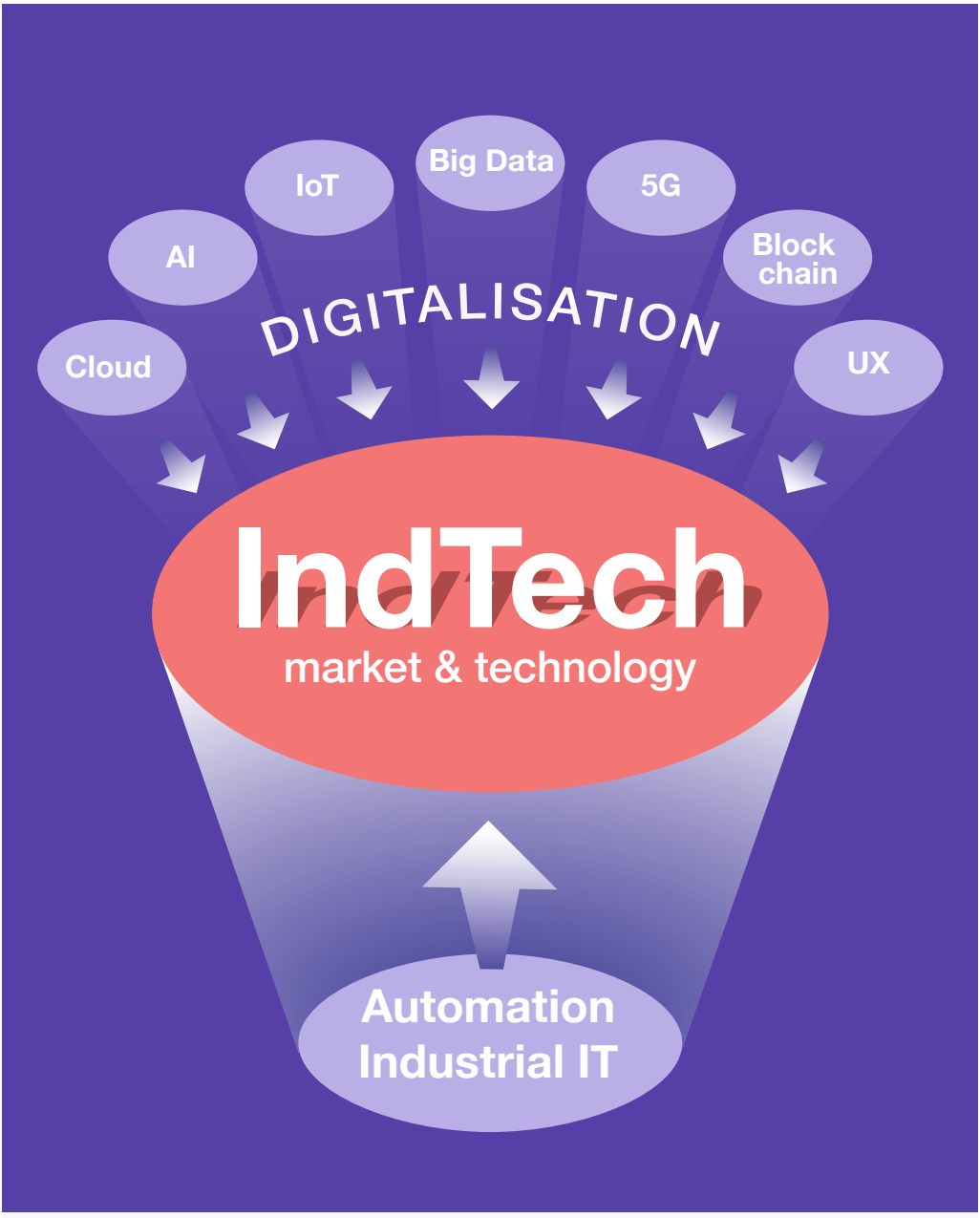


Figure 8: The IndTech model: Traditional and new technologies meet and make smart industry possible. Traditional automation and industrial IT meet the "third platform" of the 2010s, creating new concepts and new markets.

An analysis of the IndTech sector

An analysis of the IndTech sector follows two streams: the first concerns the convergence within development that can be practically translated into integration both vertically within companies and horizontally within value systems – a development that has actually been going on for decades and is now moving further towards genuine standardised **interoperability**. *The second applies to new technological verticals that affect all levels of IT and operational technology drastically. The three most important of these are cloud technology, analysis with artificial intelligence (AI) and large data sets, and the Internet of Things (IoT) as an emerging generic application platform.*

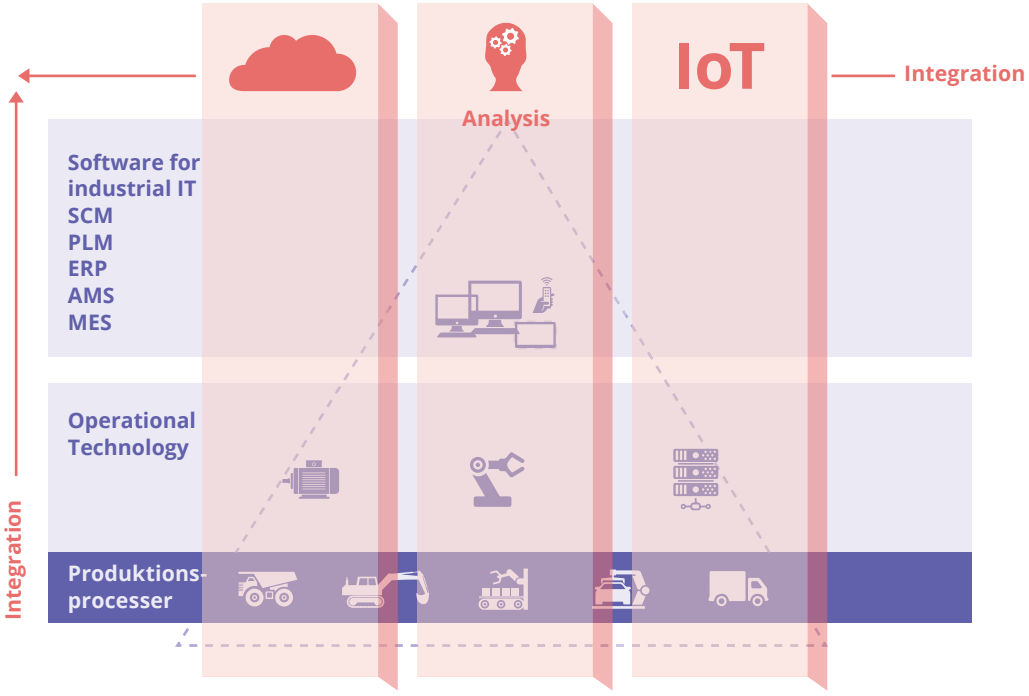


Figure 9: This development can be summarised by vertical and horizontal integration, and with new technologies that complement, improve and challenge the traditional environments and hierarchies.

The structures within industry are affected by the development of the third platform. This means that the rules of the game for the market's stakeholders are changing. New capabilities are becoming available through being packaged as cloud services: *AI development can boost optimisation and automation to new levels; the Industrial Internet of Things (IIoT) concept encourages new approaches to old problems.*

The development is now moving surprisingly fast, something confirmed by a study *(Third Wave Automation, Critical success factors)* from *PiiA Insight* as recently as the spring of 2014. In the survey, the factor *effect on development of new business actors* was ranked as the least critical for sector development among suppliers and industry.

Today, insight is greater among suppliers, but it is still evident that visions and clear strategies are often conspicuous by their absence.

The worldwide market for *IndTech*, i.e. products and systems for industrial digitisation and automation, was worth approximately USD 340 billion in 2016/2017 and is approaching an average growth rate of 6-8% according to Blue Institute estimates. The area can be divided into two parts: IT (industrial IT) and OT (operational technology). The share that can be attributed to industrial IT is approximately USD 100-120 billion. The remainder of approximately USD 220-240 billion is operational technology in the field and on factory floors. This in turn is traditionally divided into discrete automation (approximately 45%) and process automation (about 55% of the global market). OT includes different types of industrial control systems (ICS) and field equipment such as instrumentation, analysis, drive systems, engines, robots and the like.

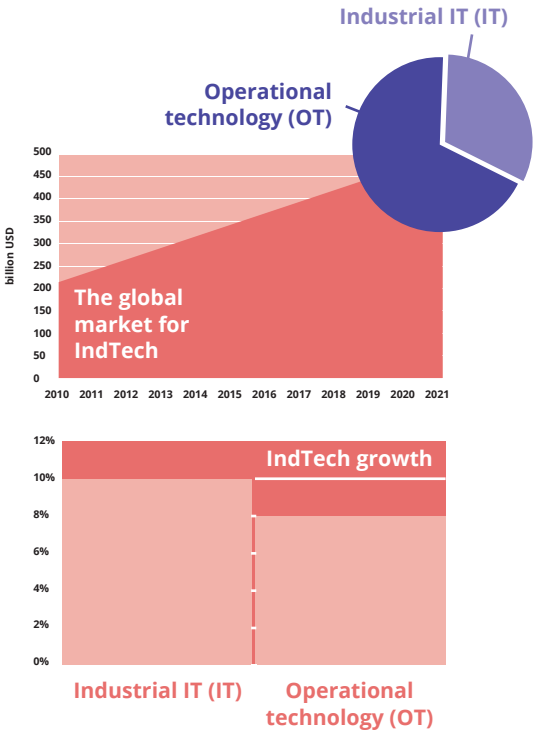


Figure 10: The global IndTech market according to the definitions set out in this report. Industrial IT has a greater rate of growth than operational technology. The IT part is also more profitable.
Source: Blue Institute 2017

A particular area of growth is the Industrial Internet of Things (IIoT). The industrial internet can overlap with traditional system environments but also add completely new functionality. A further development in the market relevant to industry is cloud-based services.

The market outlook is good for IndTech suppliers. The growth is partly because the extent of the portfolio increases with the industrial internet, cloud services, AI and analysis of big data. At the same time, there is convergence when different process environments with both discrete and continuous elements are integrated. In addition, there is closer general integration between the IT and OT areas, which also fuels demand for IndTech.

The underlying demand from industry and for different infrastructures is also increasing. Development on an enterprise level includes elements of both acquired growth and growth created through innovation. For individual companies, these convergence strategies are a way of differentiating themselves by offering more advanced software-based process solutions. This in turn is a way to reduce dependence on standard products that can be mass-produced, with eroded margins as a result.

In the full version of the report, the markets are divided into a number sub-levels and technology disciplines. Also see the PiiA and Blue Institute websites.

> "The overall picture provides evidence that the growth rate should remain at a high level for the foreseeable future, approximately twice as great as general industrial output [4]."

Since the market is consolidated, with a diversified customer base and established market channels where pricing discipline can be considered high, the conditions also exist for the sector to maintain good earnings if suppliers can protect their markets with effective strategies.

The margins for OT suppliers are around 4% higher than the industrial average. At the same time, the OT/automation industry is heterogeneous and profitability between different product segments can vary greatly. For industrial IT suppliers, the overall picture is similar but earning capacity is even higher for niche SMEs and the major suppliers such as *SAP, Oracle or Microsoft.*

China: an important market

Unsurprisingly, China is one of the most important markets. Even if the end-user markets are generally reducing the tempo, the automation market is expected to be an exception. The peak of cheap labour has long since been passed, and salaries and the urban middle class are growing. At the same time, the level of automation within Chinese industry is still low in comparison with industrialised countries in general. Growth of between 15-40% annually has not been ruled out, and the demand from the automotive industry for discrete automation solutions, along with the chemical and petrochemical industries' investments in process automation, will be a driving factor.

Third platform suppliers

To summarise developments within IndTech (the value of a new word – IndTech – for the industry becomes clear here), it is not just traditional suppliers such as *ABB, Siemens, Emerson, Honeywell and Rockwell* who are starting to become players on the industrial market. *Microsoft, Google, IBM, Apple and Amazon* can offer third platform technology easily and cheaply, with the scale benefits that a broad application base brings. This may occur directly, or by using automation providers as channels for various offers.

This is a development which is not limited to cloud services alone. For the next significant area of application, artificial intelligence, more complete structures can be imagined. Both *Google* and *Apple* are launching dedicated hardware for machine learning in neural networks at a local level. Naturally, there is similar hardware from other chip manufacturers such as *Intel*, but the Google approach is of interest as it connects local edge capacity [5] on the factory floor with the cloud in applications which also have the potential to be used in industrial optimisation.

The second potential challenge for automation and IT suppliers comes from communications companies such as *Ericsson, Cisco, Huawei, Nokia and Samsung* and operators within the sector such as *Telia, Tele2 and Telenor*, and global giants such as *AT&T, China Mobile* or*Vodafone*. Everyone is looking for new applications for 5G technology and sees the Industrial Internet of Things as a suitable platform. The purpose of 5G is to make wireless technology available to

[4] Credit Suisse, Global Industrial Automation. Blue Institute estimate 2017.

[5] Edge computing optimises data traffic to and from data sources, such as sensors, by moving calculations to servers where connections are managed, i.e. close to the production machines within.


LS_505
A20PW
24220L
T-506
LS_525
MIX_505
TT_505
Temperature
14.6DegC
LT_507
I10AB
9637L
T-507
LS_527
MIX_507
TT_507
Temperature
16.9DegC

technology applications that have significantly higher bandwidth, speed and reliability requirements than applications for personal use. According to Ericsson, calculations have been made showing that operators could increase their revenues by 34% if, for example, the process industry and the electricity sector increased their use of wireless communication [6]. Using this logic, Ericsson is supporting the development of their operators and other customers through a SaaS initiative [7] called IoT Accelerator. It is a one-stop-shop covering the key areas: *4G or 5G connectivity, simple connection of IoT modules, data security, and support in translating technology into business.*

> According to Ericsson, operators could increase their revenues by 34% if the industry increased its use of wireless communication.

It may be assumed that the aforementioned global technology companies, at least within the current development paradigm, cannot be surpassed by suppliers of industrial IT and automation suppliers. However, industrial suppliers need strategies to engage them either as partners or providers of infrastructure, computational capacity and applications. In the real world, it will not be possible to be without their resources and the automation companies will thus become a marketing channel for the services of the tech companies. The challenge for automation companies is to use them in ways that simultaneously develop the sector's strengths (industrial and process knowledge, customer relationships), that create customer values and that differentiate them from the competition.

IT and automation supplier strategies

What is currently happening in the automation and IT industry is that companies are quite naturally acting in a uniform way, as the conditions are largely determined by a market system larger than their own. Quite simply, all that is required is to concentrate on the platforms and infrastructures which the tech companies, through their multi-billion-dollar investments, are now starting to reap the fruits of. Typical industry development can be summarised with the following points:

- Coordination and consolidation of existing digital resources and products in the form of M2M applications [8] and other relevant potential products. Within ABB, this initiative is called *ABB Ability*; General Electric's has been named *GE Digital*. Siemens calls its initiative *MindSphere*. At the same time, the development of new connected products, optimisation and maintenance which adhere to future Industrial Internet of Things standards is beginning to gain pace. *General Electric* in particular has made a name for itself with its *Predix* platform. As early as 2012 [9] the company announced its intention to invest USD 1.5 billion over three years in the industrial internet.

- The establishment of cloud-based platforms *PaaS/APaaS* as systems on which to build IIoT services. This will preferably occur with one or two of the major suppliers, such as *Microsoft, Amazon AWS, IBM* or *SAP*.

- A number of suppliers state that ecosystems which invite collaboration on the industrial internet are a key part of the strategy. A way of taking the initiative. For example, *General Electric* says that companies such as *AT&T, Intel, Cisco Systems, Verizon Communications, Tata Consultancy*

[6] SvD, Ericsson ikapp och förbi Huawei I 5G-racet, 8 sep 2017

[7] SaaS innnebär Software as a Service

Services and *China Telecom* are part of their *Open-Source Digital Industrial Network.*

- Suppliers' commercial programs are being adapted for the IIoT environment to varying degrees. This includes challenges that may arise in the gap between the *edge* (the factory) and the *cloud*, including areas such as security, robustness, and communications technology.

Given the similar conditions and the same suppliers of cloud services, products offered have been similar from the outset. The opportunity for differentiation lies in genuinely solving customers' problems, translating greater process knowledge into secure applications. This reveals a weakness of most automation suppliers: during the process of many years of development, they have tended to favour the lower risk of selling standard products, rather than creating value through adaptation and genuine process knowledge. This development can be regarded as an imperfection in the system, where better business models are likely to benefit both suppliers and industry.

> The opportunity for differentiation lies in genuinely solving customers' problems, translating greater process knowledge into applications.

For *machinery and process equipment suppliers* who already possess the process knowledge, the logic of the Internet of Things is opening up new opportunities to consolidate and connect their knowledge in order to increase the efficiency of fixed assets and processes. This is instead of the current situation of often being limited by the process knowledge of automation suppliers in individual projects. This may lead to a shift in the market, to the advantage of process and machinery suppliers.

It is also likely that competition for value-adding industrial applications will increase thanks to the low-cost Internet of Things providing extensive (global) market access. This also lowers the threshold for small process-savvy entrepreneurs. The technology giants are accelerating this development with large-scale initiatives to start the development of industrial applications and thus new business. For example, *Microsoft* is launching *IoT Central* to make it easier for both small and large companies to create connected products in order to speed up digital business. This uses a cloud-based SaaS solution that helps users build, use and maintain their products. It is being marketed with a completely industrial focus. As mentioned above, Ericsson also has similar ambitions.

The development of the IIoT means that there is also a threat to the automation providers in terms of hardware. The key aspects are cost benefits through scale and that the quality of hardware produced on a large scale for the automotive industry and healthcare must at least maintain industrial standards, thereby allowing its use in a number of sectors. The key to producing both qualified I/O devices and ICS functionality (control systems) on such platforms is more a question of the time it takes to advance along the learning curve of industrial requirements than anything else. Within this market segment, better-known brands such as Bosch, Intel and Raspberry mix with names such as *Arduino Yun, Beaglebone Black, Arduino + Shields* and *Tessel 2.*

[8] M2M refers to machine-to-machine connections with supplier-specific protocols, as opposed to internet connections (comprehensive standards for which still do not exist).

[9] MIT Technology Review, General Electric Pitches an Industrial Internet, 28 November 2012

Even in the case of the ultimate domain of automation suppliers, *industrial control systems (ICS)*, cloud technology can change the playing field. There are many ideas and experiments devoted to adding intelligence to real-time critical control systems in the cloud. The benefits would be lower costs and greater flexibility. So far, the barriers have proved to be real-time requirements and operational availability. Hybrid areas, such as network and real estate surveillance, will probably lead the way. In this scenario, ICS will become a lesser, integrable (with MES, EAM, PLM, etc.) software module among many, rather than a system in itself. A development where, before too long, major software companies acquire automation companies to access control system capabilities is not unlikely.

Another factor in the analysis is the rapprochement between IT and operational technology, OT. This is not a new phenomenon. Over the decades, IT and OT suppliers have made mutual attempts to cross the border, generally without long-term success. This is due to major differences in application: real-time versus long-term planning timeframes; extremely high versus moderate availability requirements; production skills versus administrative skills; different sales/relationship interfaces with customers, etc. Another reason was that the initiatives were neither concerted nor long-term.

The natural overlap between IT and OT consists of *MES* and *EAM (production and maintenance planning tools).* There are examples here of both IT and OT suppliers being represented. One company which has consciously invested in the industrial software sector is *Siemens*, which has successfully established itself in the *Product Lifecycle Management (PLM) market,* i.e. systems for the management of products during their service life. The purchase of the American *UGS Corporation* in 2007 has been followed by a number of acquisitions, which today make up the *Siemens PLM Software* business unit. The company is currently one of a trio of market leaders along with *Dassault and Autodesk.* These acquisitions have also involved strategic links for "upwards" integration with *ERP* and "downwards" with ICS through *MES solutions*.

Conditions for small businesses

The landscape that is emerging, where the major tech companies and the telecoms industry have as a business model to offer both infrastructure and qualified application services easily and on a large scale, on-line and cost-effectively, is a good environment for start-up companies. If you have ideas, know-how, a computer and a credit card, in principle you have the opportunity to realise your entrepreneurial dreams.

"If you have ideas, know-how, a computer and a credit card, in principle you have the opportunity to realise your entrepreneurial dreams.

Furthermore, venture capital is readily available, from both the capital market and industry. In the case of the latter, all large companies have structures in order to capture and finance ideas at an early stage. Open innovation hubs, where large companies welcome innovation from outside, is one concept that is becoming more common. All in all, this allows for the conversion of process knowledge, maintenance and optimisation, with low entry thresholds, into business models and payment services.

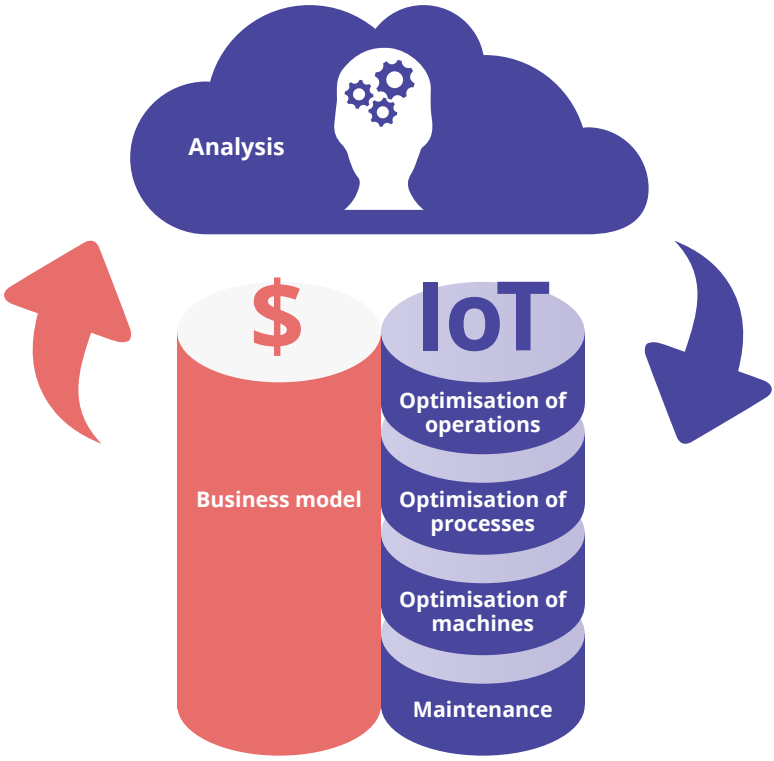


Figure 11: Today, all cloud services are available in order to turn business ideas into reality, both on a technical calculational level and providing support for financing and business models at a low cost.

In the spring of 2017, the US company CB Insights (which offers an analysis platform to assess market opportunities for investors) produced a report[10] on the subject of startup companies in the industrial IoT area. The report covers 125 start-up companies categorised according to: sensors & connectivity; edge devices; universal platforms; applied sensor networks and advanced analytics.

During 2016, over three hundred *IIoT* startup initiatives were financed, at a cost equivalent to USD 2.2 billion. There is also increased activity whereby large companies acquire smaller ones within the sector, and it is also clear that large companies like *ABB, GE, Samsung, Cisco, Bosch* etc. are financing a large proportion of start-up projects through their own venture companies.

The Swedish start-up environment is often praised. It is innovative, advanced and keeps up-to-date with the latest trends. This is especially true within gaming, betting and fintech. There are many much-discussed examples of successful Swedish initiatives and companies. What is less well-known is that there are many start-up companies concentrating on the industrial side of the digital market. We also have a number of established small and medium-sized companies within the IndTech sector.

One of the more acclaimed projects is *ABB's* investment in IndTech start-ups. The growth hub *SynerLeap* is an ecosystem that will give companies opportunities to grow and expand in three areas: industrial automation, robotics and energy.

[10] CB Insights, The Industrial IoT: 125+ Startups Transforming Factory Floors, Oil Fields, And Supply Chains, May 2017

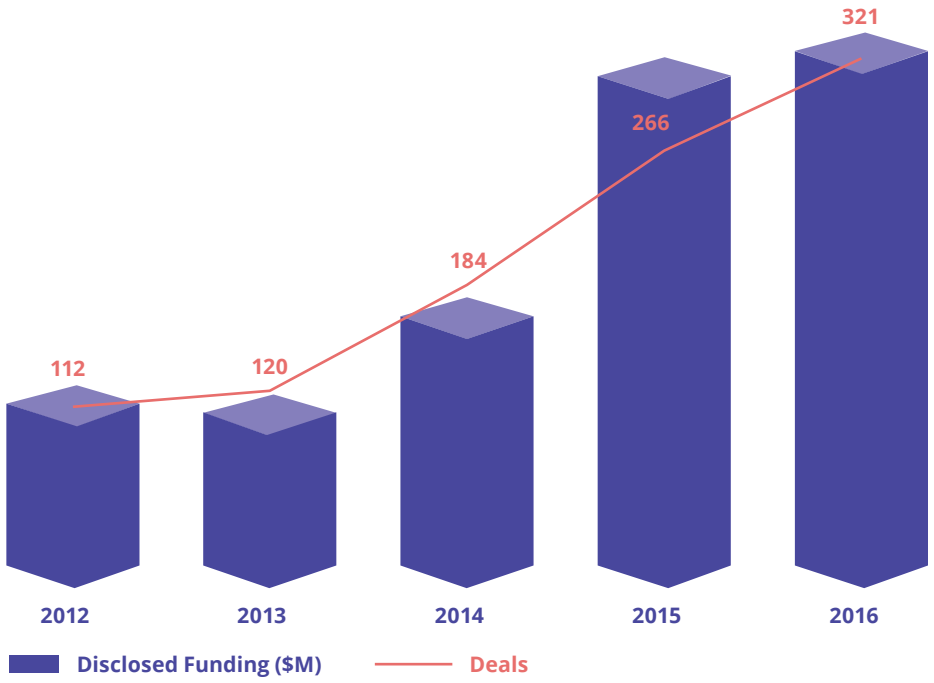


Figure 12: Financing of startup initiatives within the Industrial Internet of Things sector.
Source: CB Insights

SynerLeap is run from ABB's research centre *Corporate Research,* together with partners such as *Automation Region, Almi, Vinnova, Mälardalen University and the City of Västerås.*

One area that will be more important than others in the years to come is AI. In the first quarter alone, thirty-four international acquisitions have been made in the sphere, as the large IT companies position themselves. There is also a great demand for specialists in the sector, which makes the purchase of suitable small AI companies particularly interesting.

Small businesses are likely to play a significant role in the changing market caused by the digitisation of industry. What is new is that small companies are not necessarily restricted to roles as subcontractors to the big companies in the value chains. The opportunities offered by *the third platform* allow small businesses to play a part in industrial production under the same conditions as the large companies. The key is the ability to deliver *values*, rather than infrastructure and generic services. Digitalisation creates on a large scale while using aspects of small scale.

"The key is the ability to deliver *values*, rather than infrastructure and generic services." Digitalisation creates on a large scale while using aspects of small scale.

Summary

In conclusion, the analysis shows that the Ind-Tech sector is at the start of an accelerating structural change where pure automation companies face more challenges than suppliers of industrial software. The industrial internet, in combination with cloud analytics services, is putting new players like Microsoft, IBM and Google into positions of strength. It is not unlikely that tech and ICT companies can both contribute to simplifying and making standard automation solutions in a cost-effective way, and also add new value.

Industrial IT suppliers have the advantage of both faster growth and higher margins and better profitability than pure automation companies. In addition, in contrast to standard or semi-standard products, they add value, which differentiates and often provides returns, especially with developed business models. When more and more applications move to the cloud, software may also supersede conventional control system technologies.

> As part of this change, automation suppliers, who often have a mixed product portfolio, need to make clear choices, show visionary strength and dare to be unique. The market usually rewards this.

As part of this change, automation suppliers, who often have a mixed product portfolio, need to make clear choices, show visionary strength and dare to be unique. The market usually rewards this. General strengths which differentiate are in the installed base (which undoubtedly also involves responsibility for future-proofing), knowledge of industrial requirements, sector-related expertise and market relations.

The strengths of the sector could develop in different ways. Knowledge of hardware and systems for advanced applications may be translated into broad IoT platforms. Other qualified applications are in areas such as transport, logistics, infrastructure and life sciences.

There are opportunities to focus on industrial IT and software and/or roles as system integrators (for an example, see Schneider's acquisition of the English company AVEVA for GBP 3 billion in the autumn of 2017) where all market segments will grow significantly, not least as an effect of IIoT.

Joint venture and acquisition strategies are other openings. For example, there are potential synergies in collaborations between telecommunications providers (who are busy understanding and developing IoT platforms that meet industry requirements) and automation providers who are already familiar with the conditions In rolling mills, car plants and nuclear power plants. There are opportunities to accelerate the learning curve with strategic collaborations.

Finally, there is the opportunity to retreat from certain sectors, to concentrate on other, better-defined software or products for electricity, instruments, analysis, robotics, etc.

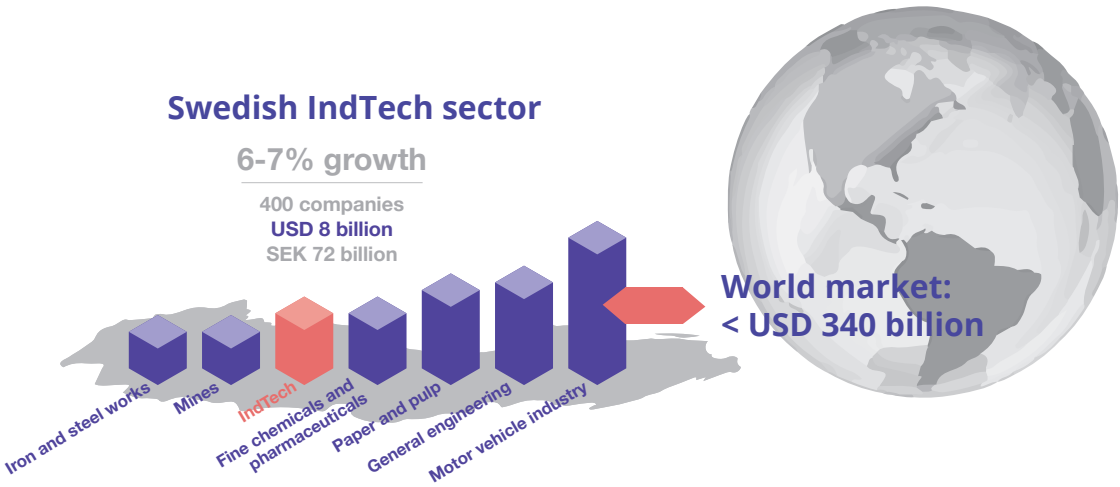


Figure 13: The IndTech sector compared to other industrial sectors.

Could this be a new Swedish speciality?

IndTech represents a business area with a large and rapidly-growing global market, where Swedish suppliers already have a significant share of the world market. Large companies such as ABB and increasingly also (we expect) Ericsson with their 5G investments, are the foundation of a system of otherwise small-to-medium-sized suppliers which, according to a previous survey, has invested well over SEK 70 billion. This means that the Swedish IndTech sector is already comparable in terms of size with several of the more traditional branches of Swedish industry.

The sector is undergoing a technology-driven structural transformation while the underlying demand for digital solutions in industry is increasing. Such a highly dynamic situation in the market means opportunities, *occasione,* if they can be exploited with the necessary skills and experience. As an open trading economy founded on a world-class industrial base and manufacturing, as well as the environment, tradition and know-how, Sweden has the ability to exploit these opportunities.

There is also a lively startup environment, that with the right incentives could move even more towards the IndTech sector. There are many examples of skills which bridge a number of sectors, including AI applications, gamification and UX (user experience).

> The conclusion must be that, as a sector in the making, *Swedish IndTech* has great potential for development.

The conclusion must be that, as a sector in the making, *Swedish IndTech* has great potential for development. It represents a large global market but is nonetheless regarded as a niche in the overall context of IT. As a development environment in Swedish test beds and pilot applications, Swedish IndTech can provide smart benefits and time advantages for the Swedish industrial base and manufacturing. At the same time, it can create success for itself in the export markets. The sector is also in tune with both the government's investment in *Smart Industry,* the collaboration area *Connected Industry* and the strategic innovation programmes *PiiA* and *Produktion 2030*. The *Internet of Things* area also has an effect on IndTech, as does the *Digital Mainline hubs* project in collaboration with the strategic innovation programmes Produktion 2030 and PiiA.

This report is about IndTech.

IndTech is the digital development that can realise the idea of the fourth industrial revolution and smart industry. IndTech is when industrial IT and automation, with its roots in the 1980s, meets digitalisation and is a future growth sector, where Swedish suppliers are in a good position to make a difference. The world market is worth USD 340 billion and is growing rapidly. In Sweden, it is an unknown sector, which already accounts for SEK 72 billion, and has every chance of growing internationally.

The report explains concepts such as smart industry and the fourth industrial revolution, discusses data as a strategic asset and the importance of the innovation system and standardisation. The term IndTech is explained, and the report concludes with an analysis of the industry's development and the opportunities for Swedish suppliers to make IndTech a Swedish high-tech export success story of the future.

PiiA
Process Industrial IT and Automation

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