INDUSTRIAL DIGITALISATION

- A DECISIVE FACTOR IN SWEDEN'S FUTURE COMPETITIVENESS AND A SWEDISH GROWTH INDUSTRY WITH GREAT INTERNATIONAL OPPORTUNITIES.

PiiA ANALYSIS
IN COLLABORATION WITH
BLUE INSTITUTE

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PREFACE

The Swedish industry is one with unique conditions. A global market outlook, world-class technical expertise, an unassuming capacity for collaboration and a willingness to effect change can all be used together to describe the typically Swedish approach. These are abilities that should be put to good use as the world's industries go through great changes, and an increasing number of countries are looking for their own recipe for success.

In Sweden, we – the social, industry and academic sectors in collaboration – have chosen to proceed by investing in **sixteen strategic growth areas** in parallel, and added to these, there are other programmes to stimulate industrialisation and commercialisation of important development areas.

Sweden's strategic innovation areas constitute a national investment with an annual turnover of SEK one billion. In our opinion, it is a good strategy geared towards the growth areas while it also allows for broad collaboration on joint success factors. Among these, the *industrial digitalisation* is perhaps the most important one, which in addition has the potential to become a great area of expertise for Sweden.

We are seeing an emerging development in which it is becoming apparent what consequences digitalisation will have unless we act, and what opportunities can be gained if we adapt skilfully to it. But concept development can sometimes be tricky. For this reason, there is a need to develop a joint idea and vision concerning the consequences of digitalisation.

This concept description is an attempt to start a conversation and share our view of *industrial digitalisation* as an important development area for Sweden. This text provides a general view of this area's taxonomy along with a description of the global market and the position of the Swedish supply industry. Finally, we relate the Swedish industry's own view of its strengths, weaknesses, threats and possibilities to use digitalisation as a competitive advantage for Sweden.

It is important to learn from and be inspired by what others are doing around the world, but it is equally important to find strategies to cover ground based on our particular strengths. Sweden has developed such a platform and a winning strategy – difficult to copy. Now, we have to make it visible to all concerned parties.

STOCKHOLM, JANUARY 2016

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1 THE INDUSTRY IS FACING **CRITICAL CHALLENGES.**

Most reports indicate that the industry is about to see a number of radical changes. Powerful expressions such as *a new industrial revolution* are not irrelevant. The background for this is an increasingly rapid technical development in combination with strong pressure for change based on growing prosperity – up to three billion people in the emerging economies will reach a standard of living similar to ours within fifteen years. At the same time, the population is rapidly growing, same as the life expectancy.

This is a challenging scenario where resource efficiency and sustainability are necessary goals for the technology development. All the phases of the value chain need to be questioned, and growth needs to be uncoupled from the negative consequences of resource consumption. Technical progress becomes the alternative to global stagnation.

Within this change, *digitalisation* is a general condition and facilitator for changing organisations, business models and product/service supplies. It directly encourages Swedish companies to make preparations in the form of digitalisation strategies, mobilisation of skills and investments into new technology.

The tempo is high as the industrialised countries gather forces in national industrial development programmes with clear ambitions for digitalisation. Billions in coordinated private and government capital is being invested. *Industrie 4.0* in Germany is perhaps the most famous of these programmes. Less known are the *Smart Manufacturing Leadership Coalition* and the *Internet Consortium* in the USA, or the large French, Chinese, English, Dutch or Danish programmes.

In Sweden, we have the *Strategic Innovation Areas*, which focus on growth areas and are intended to safeguard Swedish competitiveness. The programme PiiA (*Process Industrial IT and Automation*) is promoting the development of industrial digitalisation partly as an export business, and partly within the basic industry, which continues to grow as incomes increase worldwide.

Urbanisation, expanding infrastructures and a growing need for energy means a continued high demand for raw materials. But the growth is also at risk of being associated with hog cycle (sic) patterns, i.e. constant imbalances between supply and demand, as

[1] Hog cycle: economic term for observed fluctuations, originally used in studies of the rearing and price-development of pigs (from the encyclopaedia NE).

well as between investments and cost-cutting plans, as the price of raw materials moves faster than capital-heavy investments. This may for example mean that ore prices will spike again in a few years, now that prospecting has been put on the back burner. And as a consequence of digitalisation, millions of tonnes of newsprint paper production is being converted into packaging material – with apparent risks of temporary excess capacity in that market.

In this landscape of change, the digitalisation is both a driving and a value-creating force. However, short-term market perspectives cannot be allowed to obscure the industry's perhaps greatest challenge: resource scarcity will be a threat unless raw materials are used more efficiently. Business models that go hand in hand with digitalisation and replace *make to dump* with circular processes appear to be a necessary development.

FIGURE 1: The industry is propelled by factors such as growth and environment towards an industrial shift, which is facilitated by a technical development in which digitalisation plays the lead. The skills shown by companies and nations in taking the leap to the next S-curve will determine the industrial world map of the future.
Illustration: Blue Institute 2015.

2 DIGITAL TRANSFORMATION IS NECESSARY IN ORDER TO **FACE THESE CHALLENGES.**

The formula for Swedish industrial success has been to focus on development-intensive niches and high productivity through technically advanced facilities and world-class automation levels.

The development of labour productivity remains important but will increasingly take place in the margins, and cannot be expected to make the same kind of difference as in the last few decades. For the basic industry, the leap to the next S-curve needs to be provided with new content.

The stage for productivity improvement will be moved to the value system perspective. The potential of integrating the mobile production system into the raw materials industry and the complete logistics chains with all their shipping distances may be realised. The basic industry represents 85 per cent of Swedish transport volumes.

Resource efficiency will be a new focus area. And qualitative differentiation of formulas, process models, optimisation and customer value services that can be based on data determines the competitiveness of the offer.

Important cost benefits can be gained by streamlining the management of fixed assets. At a strategic level, many business models also need to be adapted for increased sustainability.

This becomes possible when the development of computers and software allows for digital industry environments to be integrated and not hindered by the cost of computing capacity. Data is allowed to flow freely from the time that the production processes are given a design and dimensions, to the installation and start-up phases and finally to operation and maintenance. From there, the constant work with improvements and further developments will begin.

The fact that all these processes in the digital world are created by data – and creates data – means that the physical factory can have an identical virtual copy. In that world, processes can be changed, commissioned, tested and maintained before they are released into the physical reality. Simulation and *gamification*[3] will play an important role, not least in attracting new talents to the industry.

All of this leads to increased flexibility for making adjustment to outside requirements. Integrated development and plant construction in parallel work processes reduces the time to market, as well as the life-cycle cost, while it may increase plant accessibility. *Paperless manufacturing* may become a reality. Process

OUT OF THE SWEDISH TRANSPORT VOLUMES , BASIC INDUSTRY REPRESENTS **85%**

[2] The Swedish Foundation for Strategic Research • Activity Report 2006 .

data and business information no longer occupy separate worlds, but are used together as smart data for decision-makers.

The physical production becomes digitally integrated. Not only through drive equipment, robots and 3D printers, but also through large numbers of measuring points by way of an internet of things with cost advantages.

All data produced from objects such as drives, pumps and ovens can be used for maintenance strategies to reduce unplanned stops and lengthens the life of fixed assets. Accessibility can be called-off as advanced services from specialised connected suppliers. Meanwhile, model-based optimisation using large amounts of data – *Industrial Big Data* – both atomises and provides process operators with a basis for making decisions.

Energy supply is also concerned, as the proportion of intermittent renewable energy is increasing. Factories become part of the Smart Grids, both as users and sometimes as suppliers. *Energy Management* with the help of automation, optimisation and surveillance may come to be of greater importance in the future, not only in terms of cost control but also to reduce interferences and unplanned stops.

// All of this means increased flexibility for adaptations to outside demands.

The tools for all of this already exist, and they are constantly becoming sharper; the Swedish industry can start drawing up guidelines and creating strategies at any time about where we are going and how to get there. This is an important realisation. Competing production being set up in the growth economies will not choose yesterday's technology. New state of the art factories emerge, which impact on the global supply systems.

[3] Gamification is the use of game mechanics within activities that are not traditionally associated with gaming. It is a way of increasing interaction and user involvement.

Among the **consequences of digitalisation** that industrial companies must relate to, **the following are of particular interest:**

1 **PRODUCTIVITY DEVELOPMENT**

is dependent on the digital development. Growth calculations show that the ICT sector has been the main driving force behind productivity improvements in Sweden in the period 1995–2013[4]. The potential for the future lies in the willingness to invest and the ability to translate technical progress into effect in processes, organisations and value systems. New technology is not a reliable differentiation factor as it becomes globally available to everyone at a faster rate than ever before.

2 **RESOURCE EFFICIENCY**

– while labour productivity has almost doubled in the world over the last two decades, the efficiency in terms of resource consumption has improved with less than ten per cent[5] . In order to meet the increased demand that is the result of more people and a higher standard of living, completely different levels are required. Resource efficiency needs to be tripled over the next few decades[6].

// Resource efficiency needs to be tripled over the next few decades.

3 **DATA MODELS TO DIFFERENTIATE THE OFFER**

– the possibility of increasing labour productivity per hour is reduced marginally as the level of automation increases. Qualitative differentiation of products and services is instead becoming more important. Competitiveness, as well as the value of companies, is determined also in the heavy industry by *IP (Intellectual Property)* – i.e. formulas, process models and optimisation algorithms.

4 **INTEGRATED VALUE SYSTEMS AND FIXED ASSETS**

– information flows merge in two dimensions. One is the value processing systems, which span across technology areas, markets and countries, from raw materials to recycling. The second is fixed assets, from factories to mobile production systems, the use of which can be optimised using data.

5 **OPTIMISATION THROUGH THE USE OF BIG DATA**

– sinking costs and a dramatically increasing capacity in all computer components, including the algorithms that make it possible to build models that harvest and refine large amounts of data for process improvements. This is based in statistical/mathematical models/machine learning, which uses various tools to detect abnormalities, make predictions, optimise, make prognoses and increase knowledge of both manufacturing and commercial processes.

[4] Growth analysis, Digitaliseringens bidrag till tillväxt och konkurrenskraft i Sverige (Digitalisation's contribution to growth and competitiveness in Sweden), 2014
[5] Heck and Rogers, Resource Revolution, 2014.
[6] Ibid.

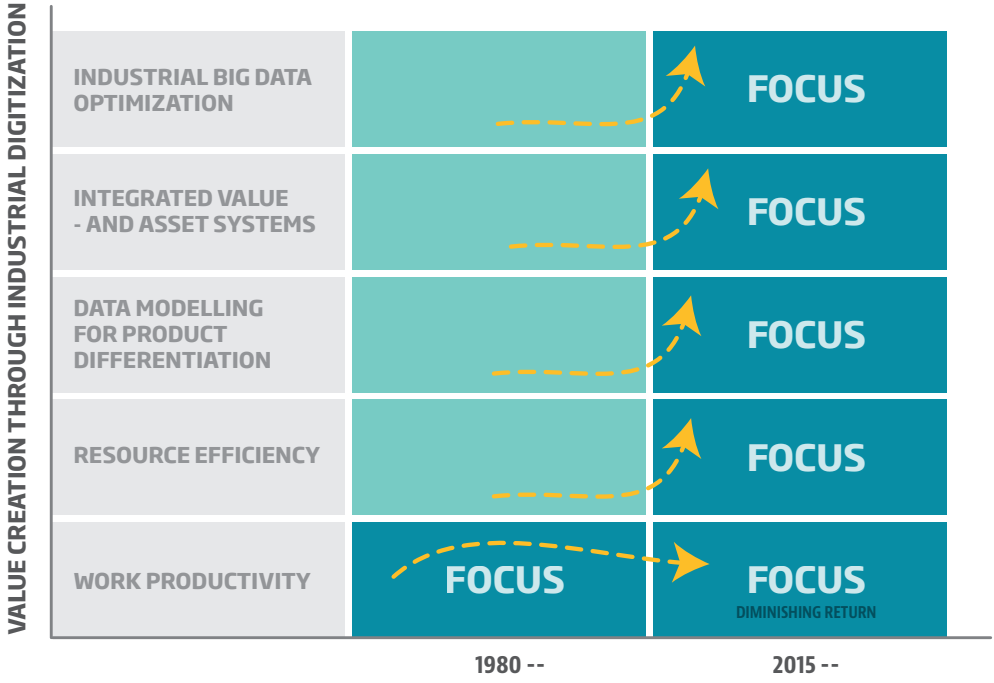


FIGURE 2: Focus is placed on new areas, which create value through industrial digitalisation. Source: Blue Institute 2015.

6 TRANSFORMATION OF BUSINESS MODELS

Digitalisation entails more data that has been refined into information and ultimately knowledge. It provides conditions for efficient and precise business models. The transformation of business models is an essential component in order to develop necessary sustainability strategies. Business models that support recycling is the strategic component in the transition to a *Circular Economy*.

7 PRODUCT/SERVICE DEVELOPMENT

The offers of the industry are hybridised as physical products are combined with customer values created based on the data streams. Digitalisation also provides possibilities for alternative revenue streams, for example through service-oriented business models that seize on usage rather than hardware.

SST - SUPER SERVICE TECHNICIAN

This project surveys technology and working methods for resource-efficient maintenance with minimal time expenditure. A need to increase value-creating time at the expense of wasted time has been identified at Mälarenergi's new combined power and heating plant, and the results of this project is expected to spread to other industries.

The aim of the project is to get closer to the vision of a *Super Service Technician* – inspired by a superhero with extra resources and heightened senses (augmented reality, vision, hearing, the right information, location readings), who acts at the right moment, implementing the right measure in the right place.

SICS Swedish ICT Västerås

Mälarenergi
DynaMate Industrial Services
Sigholm Konsult
ABB

// This is a very powerful tool to reduce development times.

STREAM INDUSTRIAL BIG DATA TOOLBOX

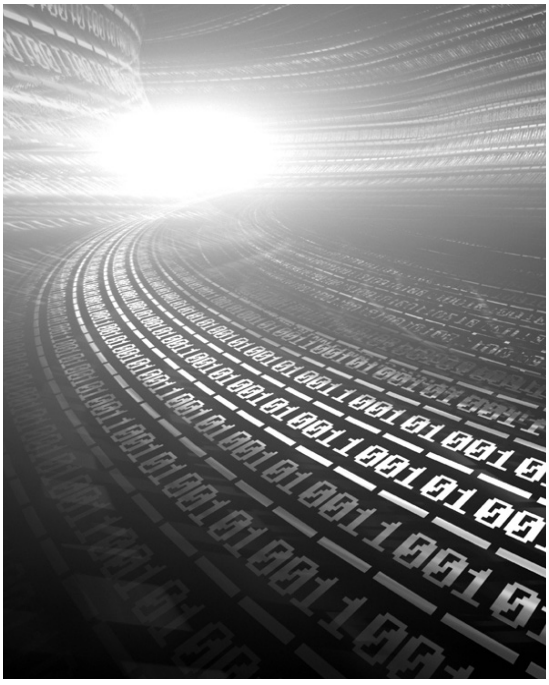
STREAM INDUSTRIAL BIG DATA TOOLBOX

STREAM offers a new type of environment for developing advanced optimisation of industrial processes based on mathematical/statistical models. This is a very powerful tool to reduce development times by recycling both models and application modules, while reducing the risk of errors and simplifying maintenance. It is also a platform for developing new industry services that can increase the value of the industry's basic offers.

SICS Västerås

Bombardier / ABB / Atlas Copco Prevas / Addiva / Blue Institute Automation Region / and others

FOTO: SICS Swedish ICT Västerås



WROOMM - WIRELESS AND REMOTE OPERATION OF MOBILE MACHINES

The project is developing concept solutions for remote-controlled wheel-loaders. The project includes remote-controlled digging, wireless communications, system aspects of monitoring and maintenance of machines, as well as operator stations for remote control. Focus is on improving plant access directly after blasting and on remote-controlled ventilation of machines used to load ore onto lorries.

Luleå University of Technology

Boliden Mineral
SICS Swedish ICT Västerås
Volvo Construction Equipment
Oryx Simulations
ABB

3 INDUSTRIAL DIGITALISATION – A RAPIDLY GROWING INDUSTRY AND A CRITICAL SUCCESS FACTOR.

Sweden is dependent on its raw materials and its basic industry – the forest, mining and steel sectors, as well as the chemical, food and drug sectors are world-class industries that directly or indirectly employ 400,000 people, and another 70,000 if you include the energy sector . Around the country's production facilities, there is a network of companies with a lot of influence over regional growth.

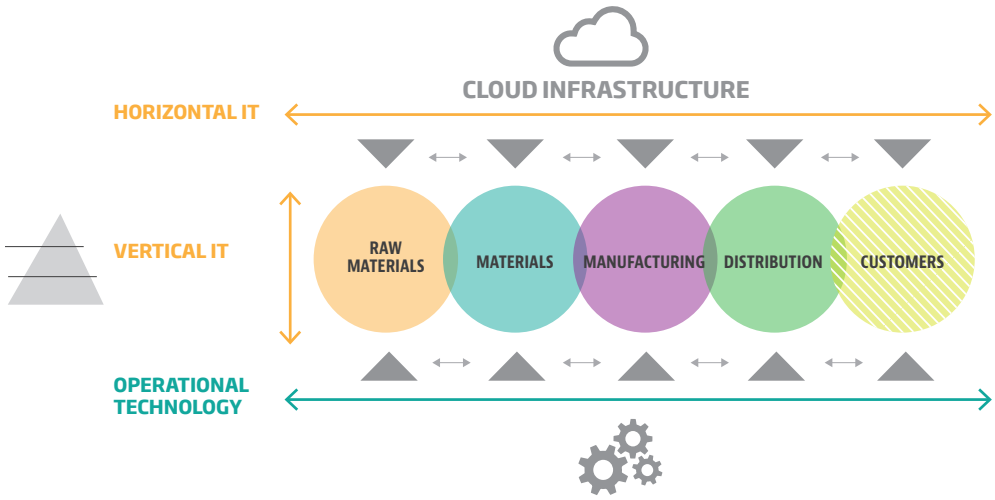
Within the basic industry, production is part of the value-creating business model, while IT and automation are among the most important tools to increase customer value, productivity and avoid negative environmental impact.

Now that we are using the term *digitalisation* more and more, it is more than semantics. It indicates a shift towards clear requirements for the automation and IT industries. Today's wave of automation started in the 1980's but is about to peter out. The marginal benefit is diminishing and the industry is demanding new attitudes and approaches to keep developing their values. It has been called the third way of automation or, using our term, *industrial digitalisation*.

What distinguishes the industrial digitalisation is a rapid development of capacity per cost, which means that computing power is rarely or never a limiting factor. This consists instead of the amount and accessibility of data, and the methods (mathematical/statistical/machine learning) become the beneficiaries of access to data and the lower cost of computing capacity. The result is that people, machines and data are effectively linked in a way that has never been seen before.

Three trends are particularly important for this development: **cloud services**, **industrial application of internet technologies** and **Big Data Analytics**.

[7] VINNOVA Analysis VA 2013:14 Företag i energibranschen i Sverige 2007–2011 (Companies in the Swedish energy industry 2007–2011).



THREE TRENDS
ARE PARTICULARLY IMPORTANT FOR THE DEVELOPMENT OF INDUSTRIAL DIGITALISATION:

1 The first one is the **cloud services** that create information flows and transparency while effectively distributing large-scale computing power in customised portions. As a platform for value-creating services, the effect is significant, both commercially and in terms of the impact on society in general.

2 The second one is the industrial application of **internet technologies**. The next generation of internet applications use the protocol IPv6, which makes it possible to communicate with every possible man-made object that can be foreseen . Sensory networks and the management of large amounts of data may make the use of resources much more effective.

3 The third is the possibility of processing large amounts of data at a low cost, which is often referred to as **Big Data Analytics**. There are billions of data points in the industry which may prove to be the key to a higher value creation.

FIGURE 3: Cloud services create information flows and transparency while streamlining the distribution of large-scale computing power.

[8] IPv6 has been developed for 2,128 addresses – a four-digit number.

1.2 INTERNET OF THINGS

The *Internet of Things* cannot be defined as a function or a functional unit. It is more accurately described as an application environment that can be used anywhere for technical solutions and new services, and when located in the cloud, it acts as an operating system for industrial applications. *IIaaS* (Industrial Infrastructure as a Service) is a term to remember.

The Internet of Things provides opportunities to measure, control, monitor and interact more, and more cost-effectively, than before. The consumer-based development of sensors and wireless data transport (with upcoming base technologies such as 5G) spills over into the industry and sets cost levels that allow for a much wider penetration of the technology in question.

Thus far, the development has been focused on the technical platforms and their standards for mobile applications etc. Today, there are many functional applications, but a common denominator is that they all require particular specifications. Systems and applications are not as well adapted as one might be led to think. For this reason, there is an intense effort to create a basic standardisation within the scope of ISO, in which Sweden is contributing through SIS. There is also growing competition between different consortiums that wish to create their own ecosystems for data exchange (which is being standardised). Only when such standards have been implemented will the development really take off. That is when the next step of a broad implementation will happen. Companies and individuals with knowledge of these activities can offer value-creating functions to end users.

There are still relatively few companies that develop applications, but some of them represent well-conceived strategies and visions.

Meanwhile, end users need to consider the benefits of the open technology and the value of integration with larger worlds, weighing this against security and integrity aspects, which both require their solutions.

The Internet of Things adds something unusual to the industrial world. Low thresholds for both technology and costs mean that many can afford testing and challenging. All of this may speed up the dynamic of industrial value systems in ways that may currently be difficult to imagine. And Sweden is at the absolute forefront when it comes to developing and industrialising mobile and wireless communication. A fundamental requisite for future digitalisation.

// The Internet of Things and data-based services are changing the commercial landscape.

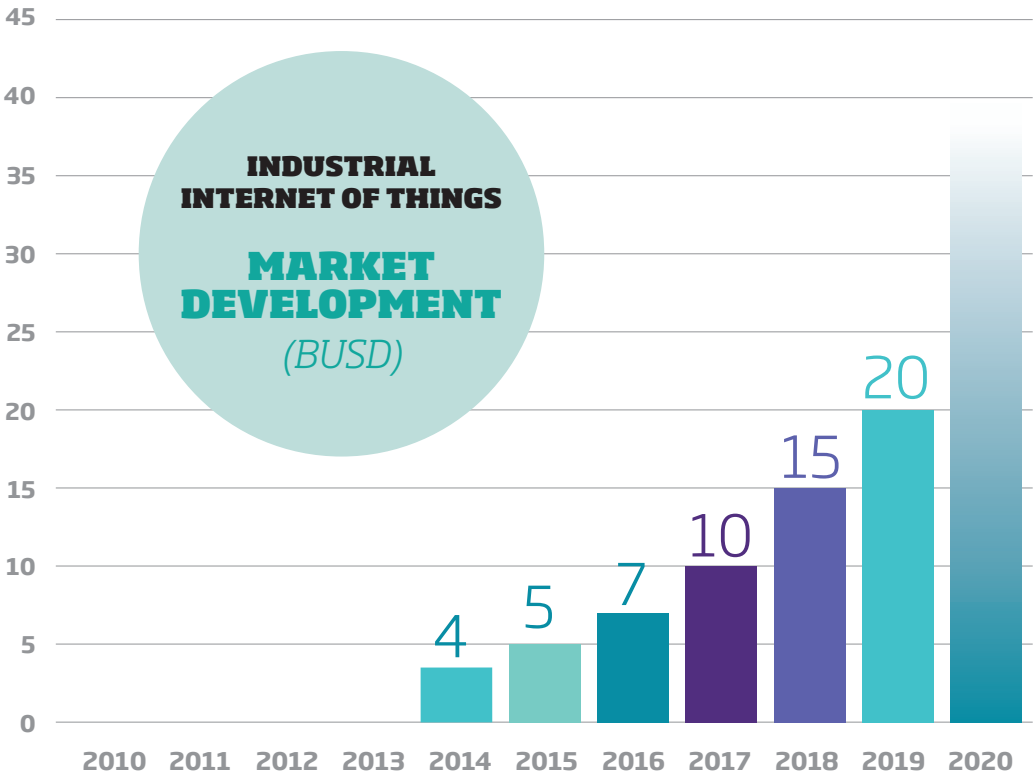


FIGURE 4: Market development for the Internet of Things. Blue Institute estimate, 2015.

1.2 SERVICES BASED ON DATA **CREATES NEW COMPETITIVENESS**

The number of objects connected to the internet is about to reach 30 billion, giving rise to an explosion of data that forms a foundation for new markets. Data is translated into customer values and presented as services in data-driven business models. One concept that is often used in this context is *digital ecosystem platform*. It is for example mentioned in connection to the German initiative *Smart Service Welt*, with a vision in which smart services are based on digital production platforms and Germany and Europe are world leaders.

For the basic industry, this is the unambiguous commercial consequence of digitalisation. Services that contribute to the companies' direct value creation in the relationship to clients, where data sources in the processes of supplies and customers alike alter the offers of the industry. Directly, in the form of new revenue sources and indirectly, by differentiating the offer.

The business models and production of the industry, and especially the heavy industry, is not going through a fundamental transformation, as is the case for example in media or communication products completely based on digital technology. However, combinations of traditionally hard products and new, value-creating services will change entire industries.

// Combinations of traditionally hard products and new, value-creating services will change entire industries.

30 BILLION OBJECTS WILL SOON BE CONNECTED TO THE INTERNET

[9] Smart Service Welt, Final Report, Berlin, March 2015.

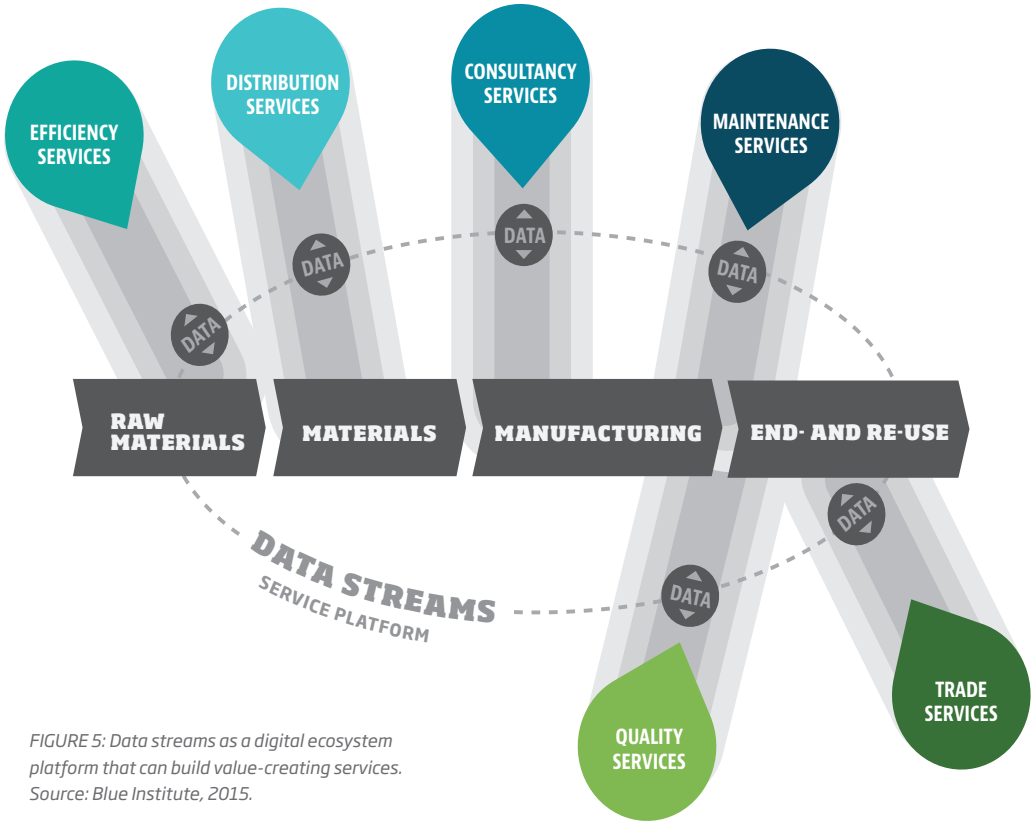


FIGURE 5: Data streams as a digital ecosystem platform that can build value-creating services. Source: Blue Institute, 2015.

INDUSTRIAL SERVICE

All definitions of the concept Industrial Service focus on the manufacturing process and services intended to keep production running while increasing efficiency. These services are based on data generated in the production. There may be a point to keeping the different motives for industrial services separate in order to focus on development possibilities. Defining a (virtual) internal data stream for control, optimisation, streamlining and a (virtual) external data stream as a platform for offering value-creating services to customers, makes the need for standardisation and business models apparent.

DEVELOPMENT IS ABOUT **CONVERGENCE** AND **INTEGRATION.**

Integration is a central concept when developing industrial IT and automation to the next level. It means that data can flow freely between computers and that values are created in the connection between the physical world and the cyberworld. Another key term for this development is **convergence**, which makes practical integration possible as well as profitable. We see convergence between separate domains, such as factory automation and the administrative IT development. It is present between process automation and the automation of discrete manufacturing processes, as well as between stationary and mobile systems. This is a technical development that tears down barriers and paves the way from data flows between previously separate worlds.

On the physical production side of industrial digitalisation, there are increasingly smart components and systems involved – switchgears, motors, drivers, gauges, actuators, valves, robots and 3D printers, which can carry out advanced tasks using distributed computing power. This also includes mobile platforms and vehicles for logistics or production – that are more or less autonomous.

These machines are connected to control systems, *DCS* (Distributed Control Systems) and *PLC* (Programmable Logic Controllers), which are now also integrated both "upwards and downwards" but remain in a coordinating role and provide important platforms for quick and advanced data processing.

The importance of software is increasing – industry software is seeing a more rapid market growth than hardware. In an analysis from 2013, Credit Suisse deems that the demand for software for industrial applications is growing at double the rate compared to the rest of the market for industrial digitalisation.

// This is a technical development that tears down barriers and paves the way from data flows between previously separate worlds.

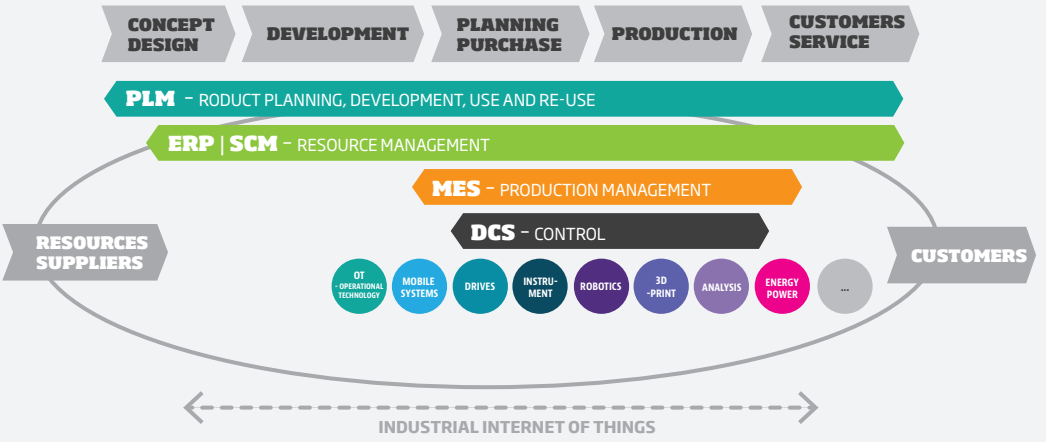


FIGURE 6: The industrial digitalisation includes everything from operational control of machine objects down to the millisecond, to planning horizons for manufacturing, resources and entire product lifecycles. Source: Blue Institute, 2015.

For the suppliers, it is also an interesting question because the applications may overlap different system environments and open up possibilities for integrated solutions. Software also entails interesting business opportunities with stable revenues and a high IP value that is difficult to reproduce.

Among the traditional, software-based systems for resource planning and commerce are *ERP* (Enterprise Resources and Planning), *PLM* (Product Lifecycle Management), which follows the entire lifecycle of a product from concept to recycling, and *MES* (Manufacturing Execution Systems) for production control and planning. The PLM environments cover many different functions for design, calculation, simulation, product management and customer relations. *CAD* (Computer Aided Design), *CAM* (Computer Aided Manufacturing), *CAE* (Computer Aided Engineering) and *CRM* (Customer Relations Management) are some commonly occurring abbreviations.

// Applications that may significantly improve efficiency, quality, working environment and safety.

INCODE INFORMATION AND COMPETENCE ON DEMAND

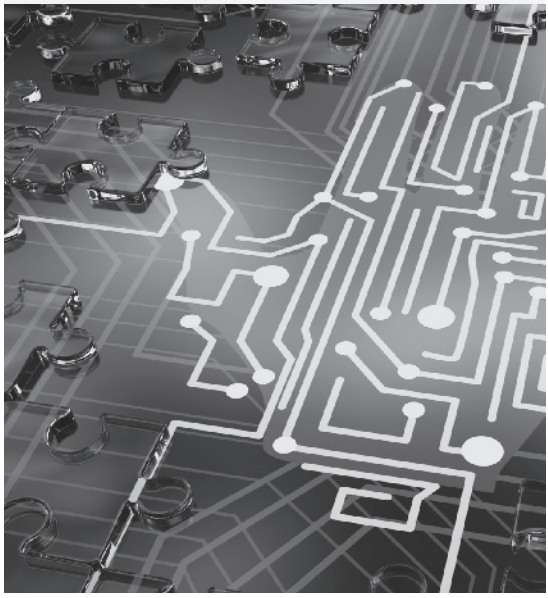
Photo: SICS Swedish ICT Västerås

INCODE INFORMATION AND COMPETENCE ON DEMAND

The project INCODE is intended to adapt, develop and combine the technologies of *augmented reality* (AR), *virtual reality* (VR) and smart sounds in applications for processing industries. Applications that may significantly improve efficiency, quality, working environment and safety. *AR* is a mix of real and virtual visual impressions, augmenting reality with the use of virtual text and 3D models.

SICS Swedish ICT

Interactive Institute Swedish ICT Mälarenergi / XMReality / Gyproc ABB / Smurfit Kappa Kraftliner IFS / Ifa / Automation Region VINNOVA

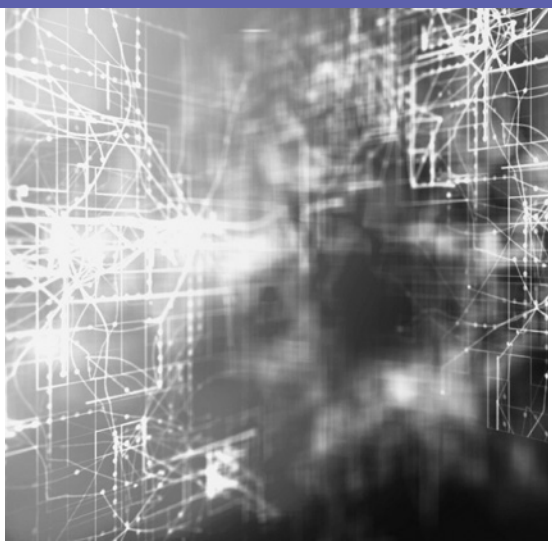


ADVANCING SYSTEM INTEGRATION IN PROCESS INDUSTRY

Based on the collection of sensory data, wireless networks and surveillance, the project is intended to develop solutions for wireless control and monitoring for the processing industry. The functionality includes brand new possibilities to integrate monitoring, maintenance, configuration and surveillance.

Uppsala University

Holmen / ABB / KTH



IOTSP, INDUSTRIAL INTERNET OF THINGS, SERVICES AND PEOPLE INITIATIVE

IoTSP is an initiative that involves research and innovation, but also development of hardware and software based on advances within "cyber-physical systems" and cloud technologies, including 5G infrastructures. The aim is to create a foundation for the next generation's smart industrial systems, which will also be the platform for new business models and services. The project will result in several testbeds to show the different opportunities that digitalisation and an industrial internet can entail for the Swedish industry.

ABB

SICS Swedish ICT Västerås
Mälarenergi / Boliden
LKAB / Sandvik / Ericsson

PiiA-BIOREGULATION AND AUTOMATION OF INDUSTRIAL BIOLOGICAL PROCESSES

Biotechnology, and the biopharmaceutical industry above all, generally has a low degree of automation as well as high or very high quality requirements that result in overly robust processes with a low productivity. This project aims to increase productivity, while maintaining quality, through product optimisation and automation. The project focuses on the two most important stages of a biotechnical process, i.e. the fed-batch culture and the industrial chromatographic separation.

Lunds University

Novo Nordisk A/S
Novozymes A/S
Pfizer Health AB

FOTO: Novozyme

// This project aims to increase productivity, while maintaining quality, through product optimisation and automation.

PiiA - BIOREGULATION AND AUTOMATION OF INDUSTRIAL BIOLOGICAL PROCESSES

4 SWEDEN ALREADY HAS **400 COMPANIES** AND **72 BILLION.**

A study done in collaboration between PiiA, Automation Region, Stockholm Business Region and Mälardalen University estimates that Swedish companies within Industrial IT and Automation had a total turnover of SEK 72 billion in 2013, with a high share of exports. A significant increase from 2009, when the turnover was calculated at SEK 50 billion. The study identifies close to four hundred companies active as suppliers, system integrators and consultants.

This level makes Sweden one of the leading countries in the business and provides an excellent platform from which to move to other market positions in the world. It also makes industrial digitalisation a Swedish economic activity to count on in one of the most interesting market segments of today.

Industrial digitalisation around the world has a value of around USD 290 billion, with a growth rate close to 7 per cent[10] according to a study conducted by the Blue Institute in 2015. It is distributed more or less equally over **discrete or industrial automation** and **process automation**. The proportion of computer and **control systems** along with **industry software** amounts to approximately USD 166 billion. The rest – USD 123 billion – is field equipment such as instruments, analysis, drivers, motors, robots, etc .

The growth consists partly of a larger range, through an internet of things and the processing of large amounts of data, and partly of an increasing demand from the infrastructure industry and markets.

As the market is well consolidated with a diversified customer base and established market channels, there are also excellent conditions for profitability.

SEK 72 BILLION

IS THE ESTIMATED TURNOVER OF SWEDISH COMPANIES WITHIN INDUSTRIAL IT AND AUTOMATION FOR 2013.

400 COMPANIES

ARE ACTIVE IN THE SECTOR AS SUPPLIERS, SYSTEM INTEGRATORS AND CONSULTANTS.

USD 290 290 BILLION

IS THE ESTIMATED VALUE OF THE GLOBAL MARKET FOR INDUSTRIAL DIGITALISATION.

[10] Blue Institute, August 2015.
[11] Ibid.

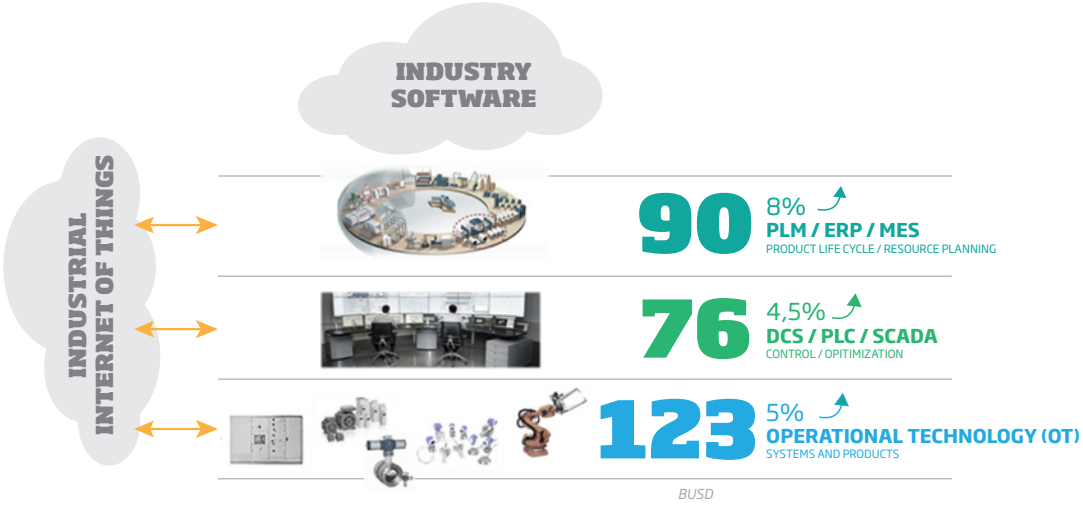


FIGURE 7: Size and growth rate of the market segments. Industry Software, including the Internet of Things, has the fastest growth rate and a good profitability. Source: Blue Institute 2015.

The margins are approximately 4 per cent higher than the industrial average , while at the same time, it is a heterogeneous industry where the profitability of different product segments may vary greatly.

One of the important driving forces of this market is, not unexpectedly, Chinese demand. Cheap labour has reached its limit. At the same time, the automation in Chinese industry is comparatively low.

A growth rate between 15 and 40 per cent per year is not impossible, and the vehicle industry's demand for discrete automation offers along with the investments made by the chemical and petrochemical industries into process automation will push the market forward.

A particular growth sector is segment industry software, which includes products and systems for operations management, product planning and optimisation. According to General Electric, the company's industrial internet investment already has a turnover of USD 1.4 billion (2014), with the aim of reaching 5 billion by 2017. According to the Blue Institute's estimations, the markets for industrial applications could reach a value of more than USD 30 billion by the year 2020.

A report from Markets & Markets of November 2014 estimates the value of the Internet of Things' market, including commerce, households, transports and healthcare, at USD 319 billion (2020) with an annual growth rate of 8.5 per cent.

Sources Credit Suisse, Markets & Markets, BCG, Research & Markets, Allied Markets Research, CIM Data, IAE Market Tracker et al., Blue Institute (development estimation, fact check).

[12] Ibid.

[13] Markets & Markets, Industrial IoT Market by Technology (Wired, Wireless), Components (Sensors, Memory & Processors, Networking Components, RFID & others), Industry Verticals (Manufacturing, Transportation, Retail, Healthcare & others), and Geography - Global Forecast to 2020, november 2014.

// The project takes its departure point in the strict requirements for safety, robustness and productivity that are set for underground mining activities.

PIMM - PILOT FOR INDUSTRIAL MOBILE COMMUNICATION IN MINING

PIMM - PILOT FOR INDUSTRIAL MOBILE COMMUNICATION IN MINING

This project is to evaluate new mobile communication infrastructure for the industry, validating technology, applications and business models alike. The project takes its departure point in the strict requirements for safety, robustness and productivity that are set for underground mining activities. As part of the project, a state of the art mobile network is being constructed in Boliden's mine Kankberg Several applications will be implemented, tested and evaluated. From voice communication to machine steering.

SICS Swedish ICT

Ericsson / Boliden / Telia Sonera
Volvo Construction Equipment
ABB / Wolfit
Luleå University of Technology

Photo: Boliden

5 STRENGTHS AND CHALLENGES FOR BASIC INDUSTRY IN SWEDEN

During the autumn of 2015, PiiA has been working with its industrial and academic networks to take stock of strengths and challenges in a SWOT analysis of the Swedish automation and processing industries.

It is apparent that many of these strengths are linked to the fact that Sweden is a small but competitive industrial country that uses high technology expertise skilfully and has the ability to collaborate across traditional boundaries. Regardless of whether we are selling paper pulp or automation equipment around the world, Swedish industry inspires confidence, which is confirmed by a strong global presence and large market shares. This, in turn, may be our greatest commercial assets.

The value of unassuming collaboration based on mutual trust is something we must also utilise as an important resource for renewal. The possibilities lie in collaborations between various clusters and areas of expertise, all along the value chain. This is done with the help of test beds and pilot projects, and not least by sharing experiences and inspiring one another across industry lines.

WORLD-LEADING PROCESSING INDUSTRY

For the suppliers of industrial digitalisation, there lies a great value in having a world-leading, demanding and investment-prone industry in Sweden. This is an industry that skilfully uses our natural resources, such as forest and ore with an already high degree of automation and great faith in the value of continued automation. In continuous processes, we are world-leading in terms of flexibility during transitions where an increasing variety of products lead to shorter campaigns.

From this perspective, it may seem unfair that the basic industries fall low on the list of attractive

// It is important to show where the profitability of the investments lie and to free it up through building a strong business case and smart business models.

employers. It is especially problematic when staff with deep-seated expertise go into retirement and take their invaluable experience with them.

A typical characteristic of the basic industry is also to prioritise what is safe, tested and secure over concepts that are overly futuristic. With a lot of tied down capital and expensive investments, this can mean that the necessary integration in the value chains does not take place, whereas it likely does in new facilities elsewhere in the world – something that can alter the conditions for competition. The Swedish market is also small, which is why it can be difficult or expensive to meet specific technical needs. Customised solutions tend to be expensive, as they require large engineering efforts.

The question of IT security is a central one. New open solutions increases risk exposure. The possibility that security concerns may take the upper hand and stop the introduction of innovative solutions should not be neglected. Integrity is another important part of IT security, and a relevant one – the feeling of being under surveillance may impede the development of effective technical solutions. New regulations regarding the collection and sharing of data, even if they are highly reasonable, may also slow the development rate. Within this and many other areas, the level of consensus and collaboration between process IT and corporate IT needs to increase.

THE SUPPLIER'S PROCESS KNOWLEDGE IS IMPORTANT

The qualified industry makes demands on the suppliers' knowledge of industries and processes. This knowledge is primarily found in the specialised consulting companies and the system integrators. Knowledge is important not only to the development of products and systems, but also because many investments will not take place unless there is a knowledgeable dialogue between the industry and the suppliers. It is important to show where the profitability of the investments lie and to free it up by building a strong business case and smart business models.

For the traditional suppliers, there is also the threat of brand new competitors emerging when the IT world converges and the Internet of Things becomes an industrial reality. From this point of view, the products of traditional suppliers may be perceived as outdated and their innovation rate too low. Competition from emerging economies, such as China, which may be expected to develop their own automation industry as their home markets become automated, can also be perceived as a threat.

THERE ARE GREAT OPPORTUNITIES IF WE RISE TO THESE CHALLENGES

Despite both threats and challenges, we have an incredibly strong foundation to stand on in order to develop the processing, automation and IT industries further. Collaboration, flexibility, global presence and a high level of technical expertise guarantee it.

Digitalisation opens the door for new product and service offers that raises customer value. This is true for the manufacturing industry as well as for the suppliers, who can meet their customer's needs quickly by adding functionality without having to install and maintain any systems.

Leadership and collaboration to develop and implement standards for information exchange within the industrial infrastructure of the future (such as 5G) increases integration and contributes to closed value systems. Customer knowledge can be increased, for example, by gathering more information about how the products are used. We will also know more about what type of raw material, and from where, should be used so that adaptation to the manufacturing process and order situation is optimised. Commercial and operational data can be made into a business in its own right by deciding what information is collected, owned and then combined with different business models-

The processing industry can develop even better knowledge and predict quality and operation through more data and analysis. This is also the foundation for new manufacturing processes based, for example, on renewable raw materials, which will often be more complex to produce than those with a petroleum base.

Processes can be made more resource-efficient and sustainable.
Digitalised management of fixed assets may yield great cost advantages, and the digital virtual factory can be used for testing and customisation of new products before they exist in reality. Visualisation and use of process models in simulation environments also provide much better conditions for on the job training. New exciting and engaging tools and systems that make it easier to recruit the talents needed.

// Collaboration, flexibility, global presence and a high level of technical expertise.

OUR COMPETITIVENESS IS DECIDED BY OUR SKILLS

For the basic industry, it is a good idea to work out a strategic route to digitalisation. What areas to prioritise, how and which development projects that are to be carried out, how to build and use expertise – these are important questions to answer. It is also important to have prioritisations across several areas of expertise. The development of Swedish industry is as much about skills as about technology.

For the suppliers, it is important to be part of this process. The combination of knowledge about the customers' needs and processes with forward-looking technical innovation is the surest way of contributing to the development of Swedish industry as well as the supplier's own success on the global market.

// How new services and apps can be made accessible to the processing industry.

CLOUD BASED PLATFORM STRATEGY FOR THE PROCESS INDUSTRY

CLOUD BASED PLATFORM STRATEGY FOR THE PROCESS INDUSTRY

A study that looks at how new services and apps can be made available to the processing industry based on business models and ecosystems.

Umeå University

ABB
SSG Standard Solutions Group
SCA / Optimation / BNearIT
PROTAK / Mobilaris / Sogeti
Itrium

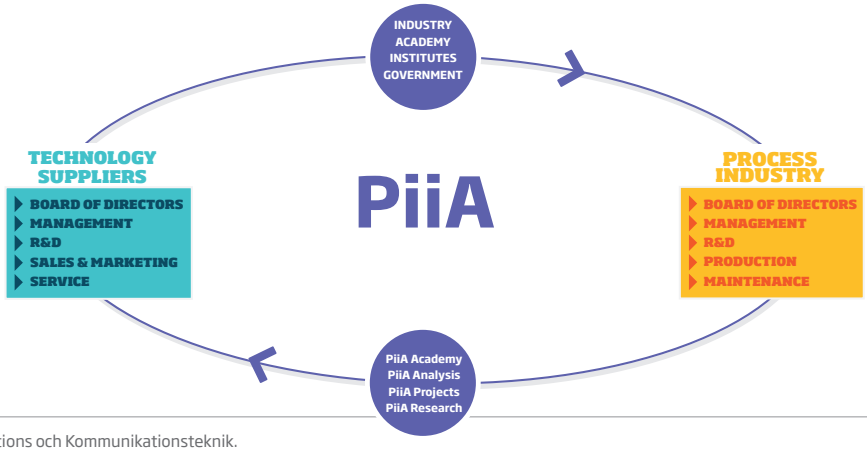
6 PiiA LINKS UP
THE POSSIBILITIES OF INDUSTRY, ACADEMIA AND GOVERNMENT.

History shows that when ICT[14] and automation suppliers have ventured to create visions and development plans that include the Swedish industry in larger pilots/test beds, it has pushed development forward, creating competitiveness, growth and export success.

PiiA's task is to actively work on the market to encourage, identify and support such initiatives. This is done in the networks by linking the possibilities of industry, academia and government. It is done through financing interesting ideas and projects. It is also done through PiiA focusing particularly on understanding *industrial digitalisation* as a development area, putting it into a commercial context. But also, on a wider perspective, to look at how it affects industrial systems and society.

PiiA develops and operates activities in close collaboration with regional innovation initiatives. At first with the fundamental environments of Automation Region, ProcessIT Innovations and processing industry centres in Lund and Linköping, and then continuing and developing collaborations with several initiatives.

PiiA focuses its investments on promoting development through **four development areas and three fronts.** The goal is for the industry to create new successful exports while also increasing its competitiveness with the help of digitalisation.



[14] Informations och Kommunikationsteknik.

4 STRATEGICALLY IMPORTANT BUSINESS AREAS

PiiA ACADEMY

is to contribute to increased productivity within the companies' production and business processes by reinforcing the national skills provision systems of the area. Something that is to result in effective skills development processes in the companies, which in turn strengthens their long-term capacity to adopt new innovations and use them for their own development.

PiiA ANALYSIS

highlights and advances industrial trends and activities within PiiA's business area. Articles and analyses are published on the website and in reports. PiiA Analysis also provides a meeting place with space for reflection and knowledge exchange between industry, academia and government.

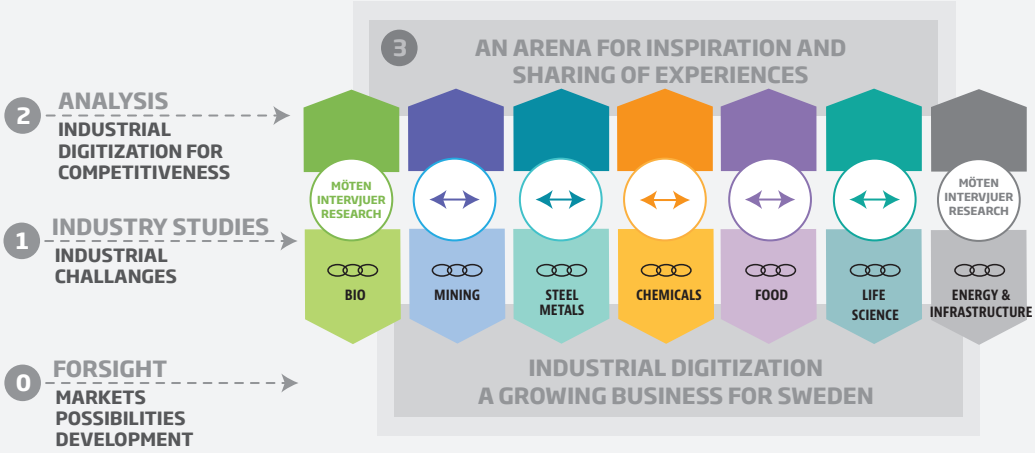
FIGURE 6: PiiA Analysis identifies the challenges and opportunities of the basic industry when it comes to industrial digitalisation through state of the art industry studies and industry-wide dialogue. We also believe that an important success factor is to be inspired by and learn from one another.

PiiA RESEARCH

is a strategic initiative intended to strengthen, coordinate and network research groups in Sweden working with PiiA's research areas. One component is a national postdoctoral programme to ensure the long-term ability of the academic sector to plan, lead and carry out research, development and innovation projects within PiiA. Another component is the creation of an active researcher network.

PiiA PROJECTS

gathers PiiA's project portfolio, which is developed within select market and functionality areas through targeted research, development and innovation calls, strategic projects and a continuous portfolio analysis. The PiiA projects must never be perceived as solitary, but are part of a greater context – the project portfolio – where synergies are created and innovations of innovations and systems of systems are developed.



3 FRONTS

1

The first front creates knowledge and understanding of **what digitalisation entails for the industrial, academic and social sectors**. This is an ongoing effort, which is coordinated with the activities of PiiA Analysis.

2

The second front shows **what digitalisation means through demonstration and pilot projects as well as other activities** to increase knowledge and understanding. One guiding principle is for the target groups to identify with the development and realise that they can and must heed it.

3

The third front is a **broad introduction of thoughts, ideas and knowledge.** An effort to ensure that Swedish industry realises all its potential. In this context, it is a matter of suppliers adapting their offers so that they can quickly benefit the industry.

PiiA Academy
PiiA Analysis
PiiA Projects
PiiA Research

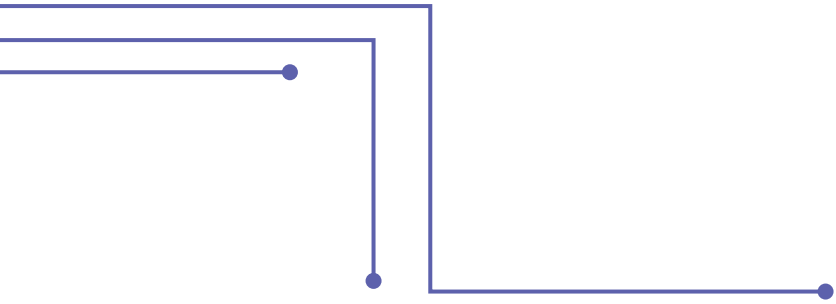
PiiA'S PROJECT PORTFOLIO AS OF THE END OF 2015:

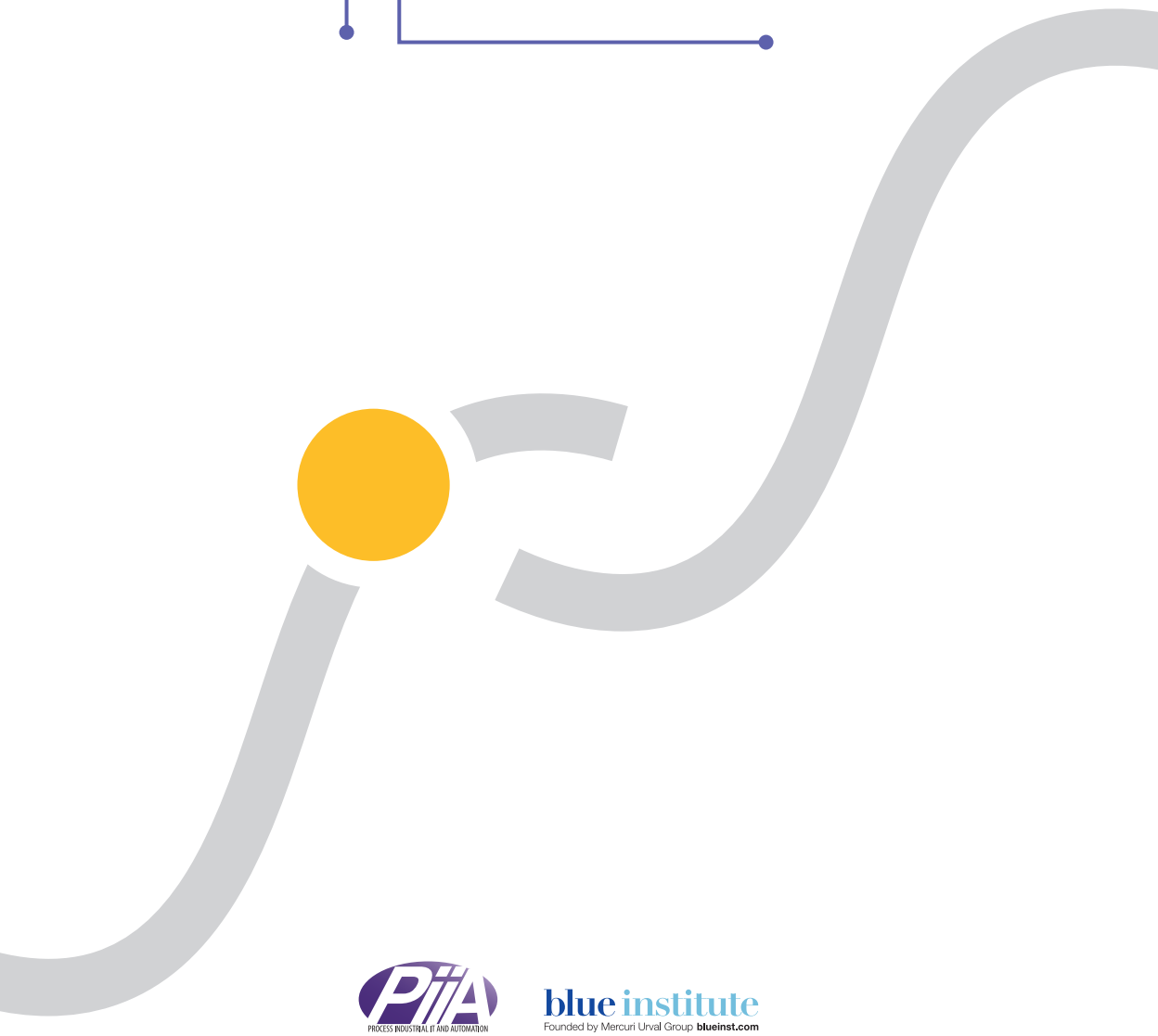
- More than 65 projects.
- More than SEK 250 million in total for set projects.
- Half from PiiA and half industry-funded.
- More than 300 project partners in these projects.
- The project partners are evenly distributed between processing industries, supply companies and the academic sector.

PiiA'S PROGRAMME SPONSORS:

ABB BOLIDEN SIEMENS Modelon ORYX SIMULATIONS
Optimation mobilaris AGELLIS group minetec

GRAPHIC DESIGN: SNAP!





PiiA
PROCESS INDUSTRIAL IT AND AUTOMATION

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