KOMMERSKOLLEGIUM
NATIONAL BOARD OF TRADE SWEDEN

The Fourth Industrial Revolution

Changing trade as we know it

2019

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We provide the Swedish Government with analysis, reports and policy recommendations. We also participate in international meetings and negotiations.

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Our analysis and reports aim to increase the knowledge on the importance of trade for the international economy and for the global sustainable development. Publications issued by the National Board of Trade only reflects the views of the Board.

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Foreword

The so called "Fourth Industrial Revolution" (4IR) has been widely debated for quite some time. By now, we know that rapid digital technological developments will have a profound impact on production, employment, consumption – to mention just a few areas. Trade is no exception: the 4IR will indeed change trade as we know it.

Understanding the dynamics and effects of the 4IR on trade is crucial. It will disrupt industries and it will affect the entire value chain. But even though we can grasp the ongoing technical revolution, and sometimes even see it happening before our eyes, there are still questions on how, why and when trade will change.

The purpose of this report is to build a solid ground of understanding of how the Fourth Industrial Revolution – which is, by the way, rather an *already ongoing evolution* – will change trade and production over the decades to come. As trade will change, we also need to raise the question whether current trade rules facilitate or hinder new technologies and whether they address possible risks and challenges.

The Fourth Industrial Revolution – Changing trade as we know it is the first in a series of studies about the 4IR from the National Board of Trade. We will follow up this report with more in-depth reports on specific aspect of 4IR and trade.

Tomas Jonsson and Magnus Rentzhog wrote the report. Jonas Kasteng and Karolina Zurek provided internal quality assurance.

We wish to give our special thanks to the company representatives for their time and willingness to engage in discussions with us. We also want to thank Nigel Corey and Stephen Ezell at ITIF and Daria Taglioni at the World Bank for their valuable comments.

Stockholm, October 2019

Anna Stellinger
Director-General
National Board of Trade

Summary

Trade as we know it will change. The reason for this is that the world is entering an era of rapid digital technological development, labelled the Fourth Industrial Revolution (4IR). However, despite the name, it is more of an evolution than a revolution, with new technologies building upon older ones. The 4IR is the convergence of evolving, mainly digital, technologies. This convergence is driving the change that has already started and that will accelerate in the years to come. Companies are building new business models, using the opportunities derived from these digital technologies and their interactions. The 4IR is set to disrupt almost every industry in every country. It will affect the full value chain — from end to end.

The 4IR will affect how companies produce goods and services and what they will produce. Based partly on interviews with Swedish industrial companies, we have identified the following five major production trends: i) automation of physical and digital processes (eventually possibly resulting in the spreading out of production where computers make the decisions), ii) a move towards mass customisation, iii) accelerated servicification, iv) increased specialisation, and v) disintegration of global value chains (GVCs) and production in ecosystems.

The technologies will — in turn — affect trade in the following three ways:

1. Improve trade logistics and lower transaction costs.
2. Change the actual content of what firms trade — moving from goods to services and data.
3. Change production processes and the location of production. Technologies can lead to automation and, in turn, the possibility of dispersed, self-orchestrated production. The impact on trade is likely to be significant.

First, moving production closer to customers to serve local markets will lead to less measured trade. Second, the GVC setup will change when companies no longer produce their goods in one place. Beyond being close to customers, companies want to be close to "hubs", i.e., centres of coopetition, innovation and collaboration. Again, this will affect the GVC set-up. Third, trade flows will change since reorganised GVCs lead to changed movements of the inputs and regional sourcing. Fourth, trade participation will change, for both for countries and firms. For countries, trade participation will change as new GVC set-ups will make the receiving countries importers of inputs and exporters of the product now produced in that same country. For companies, often SMEs, new technologies allow them to enter the supply chain and participate in production.

The technological opportunities of the 4IR will lower the threshold to enter trade, especially for SMEs. Many SMEs have already stepped over the threshold and more will follow. However, taking the step is generally more difficult for SMEs. One central reason is that the benefits of automation have to be even more certain to small companies. Uncertainty about which direction the 4IR will take is a barrier for companies entering the 4IR.

Svensk sammanfattning

Handeln, som vi känner den, håller på att ändras. Det är en följd av att världen är på väg in i en era av mycket snabb teknologisk utveckling kallad den Fjärde industri-revolutionen (Fourth Industrial Revolution, 4IR). Trots namnet handlar det mer om en evolution än en revolution, med nya teknologier sprungna ur gamla. 4IR är sammanfogningen av framväxande, främst digitala, teknologier. Denna sammanfogning driver förändringen av produktion och handel som redan påbörjats och som kommer att tillta under de kommande åren. Företagen kommer göra affärer på nya sätt baserade på de möjligheter som dessa digitala teknologier medför. 4IR kommer att påverka i princip all industri i alla länder. Den kommer att påverka hela värdekedjan i varuproduktionen — från start till slut.

4IR kommer att påverka hur och vad företag producerar. Vi identifierar här fem produktionstrender: i) automatisering av fysiska och digitala produktions- och beslutsprocesser, ii) en rörelse mot mass-anpassning av varor, iii) accelererad tjänstefiering, iv) ökad specialisering och v) produktion i så kallade ekosystem istället för i globala värdekedjor (global value chains, GVC).

Dessa teknologier kommer att påverka handeln genom att:

1. Förbättra transport- och logistikhantering och sänka transaktionskostnader.
2. Ändra handels innehåll — från varor till tjänster och data.
3. Ändra produktionsprocesser och var produktionen sker. Produktionen blir mer geografiskt utspridd, självkörande och ytterligare automatiserad.

Automatiserade processer och utspridd produktion kommer att få stor påverkan på handeln. För det första skulle en produktion flyttad närmare kunderna leda till lägre uppmätt internationell handel. För det andra skulle utformningen av värdekedjor ändras som en följd av att produktion sker på flera ställen — istället för på ett. Förutom närheten till kunderna så vill företag även vara nära centrum för samarbete och innovation, så kallade hubbar. Detta kommer att förändra värdekedjorna. För det tredje kommer handelsflöden ändras eftersom omorganiserade värdekedjor leder till nya destinationer för insatsvaror och -tjänster samt till regionala inköp. För det fjärde kommer handelsdeltagande ändras för både länder och företag. Omorganiserade värdekedjor gör att nya länder blir importörer av insatser och exportörer av de produkter som nu produceras i landet. För företagen, ofta små och medelstora företag (small and medium-sized enterprises, SME), ger nya teknologier dem möjligheten att ingå i andra företags värde-kedjor och bli del av produktionen.

De teknologiska möjligheterna kommer att sänka tröskeln för att kunna handla internationellt, speciellt för SMEs. Men klivet över tröskeln är vanligen svårt och kan bero på en osäkerhet på om automation lönar sig för företaget. Denna ovisshet är mer påtaglig för små än stora företag. Det är svårt att bedöma hur 4IR kommer att utvecklas, inte minst vilka teknologier som kommer att bli dominerande, och detta utgör ett hinder för många företag. Men många av dem har redan klivit över tröskeln och fler kommer att följa efter.

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1 Introduction

> "We stand on the brink of a technological revolution that will fundamentally alter the way we live, work and relate to one another. In its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced before."
>
> *Schwab, 2016*

Trade as we know it will change. This is the basic premise in this report. Changes in trade will be the result of how companies change their production and where the production takes place. With 80 percent of world trade taking place within production networks[1], reorganising how and where production takes place will affect trade.

New ways of producing goods and services are the result of the fact that the world has now entered a period of rapid technological development, labelled the Fourth Industrial Revolution (4IR)[2]. As this report will explain, changing technologies – alone but more importantly together – will change production and, in turn, trade. Much of what will happen (digitalisation, servicification, changed global value chains (GVCs)) has already happened, but the 4IR will accelerate these processes and the world will see new trade patterns and participation and transformed GVCs.

The report gives the reader an overview of the changes in production and trade that are likely to happen over the next decades due to the ongoing technological and organisational changes. However, even though we write about a "revolution", the change is not immediate; rather, it is gradual. New technologies and systems do not automatically replace old. In a way, the revolution is more like an evolution.

We base the report on interviews with seven companies established in Sweden, backed with an ever-growing literature. The interviewed company representatives all had a clear understanding of the concept of the 4IR. The report has a focus on the effects on manufacturing, as the seven interviewed companies are in the following sectors: automotive, pharmaceutical and biotechnology, paper and packaging, engineering, electrical equipment, and telecom equipment. The analysis focuses on production, meaning the end-to-end activities that go into innovating, producing, selling, and using industrial goods.

Overall, this report will present the 4IR mainly as an era of opportunities. However, with changes come challenges and risks, such as the effects on employment, cyber security, and the digital divide[3]. While acknowledging these risks, the report will not dwell on these issues. We will discuss some of these issues more in future reports.

The report starts by explaining the 4IR, followed by some central consequences of the 4IR for production. From there, the report will discuss the potential effects on trade, trade patterns, and global value chains.

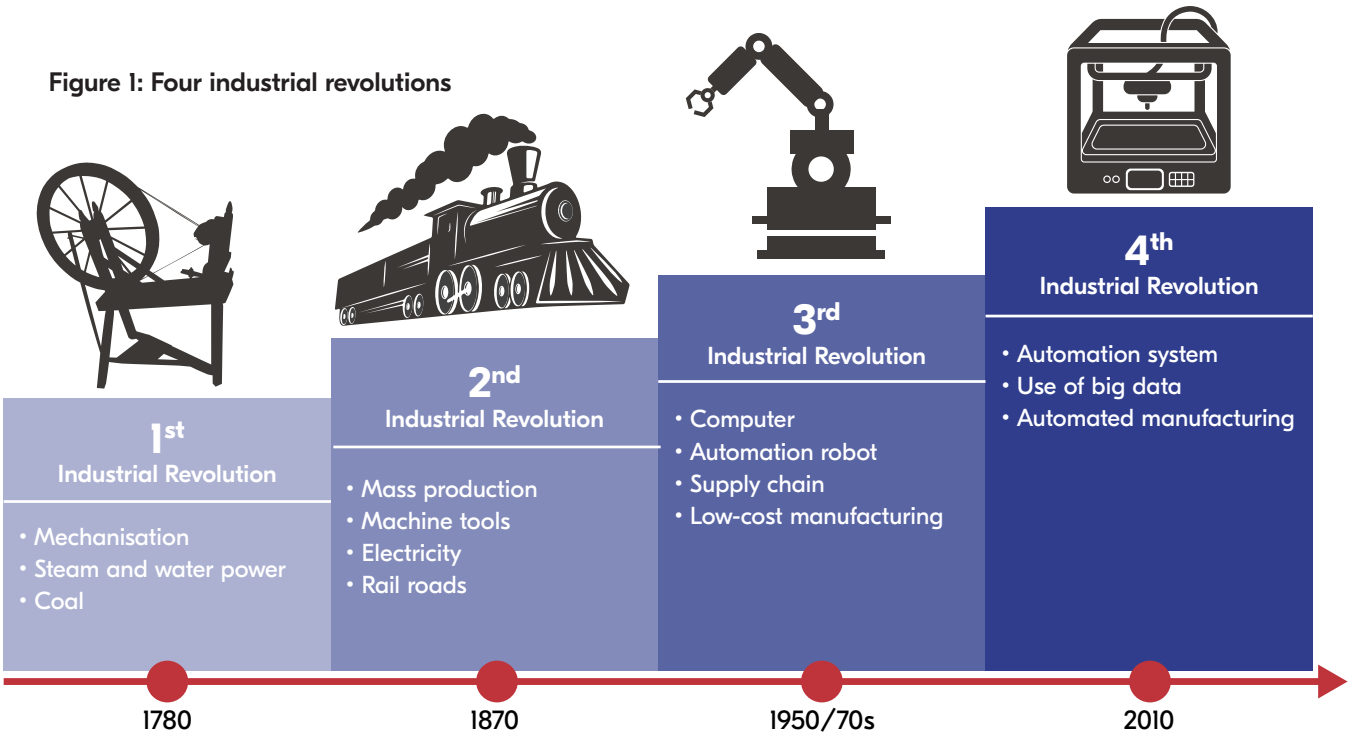
2 The fourth industrial revolution

This chapter sets out to explain and exemplify the 4IR. However, despite the name, it is more of an evolution than a revolution. The 4IR is the convergence of evolving, mainly digital, technologies. Companies are building new business models, using the opportunities derived from these digital technologies and their interactions.

Economic development has already gone through three phases of very rapid change, i.e., three so-called industrial revolutions (Figure 1). In all these prior revolutions, the development and diffusion of new technologies have led to significant changes in both production and trade [4]. As Lund and Bughin (2019) state, "[t]he history of trade reflects the ongoing march of new technological innovations."

The 4IR is set to disrupt almost every industry in every country. It will affect the full value chain – from end to end [5]. New technologies, materials, and processes are starting to blur the lines between the physical, digital, and biological spheres. From our interviews and the literature, it is evident that manufacturing companies are

Figure 1: Four industrial revolutions



Source: Kommerskollegium

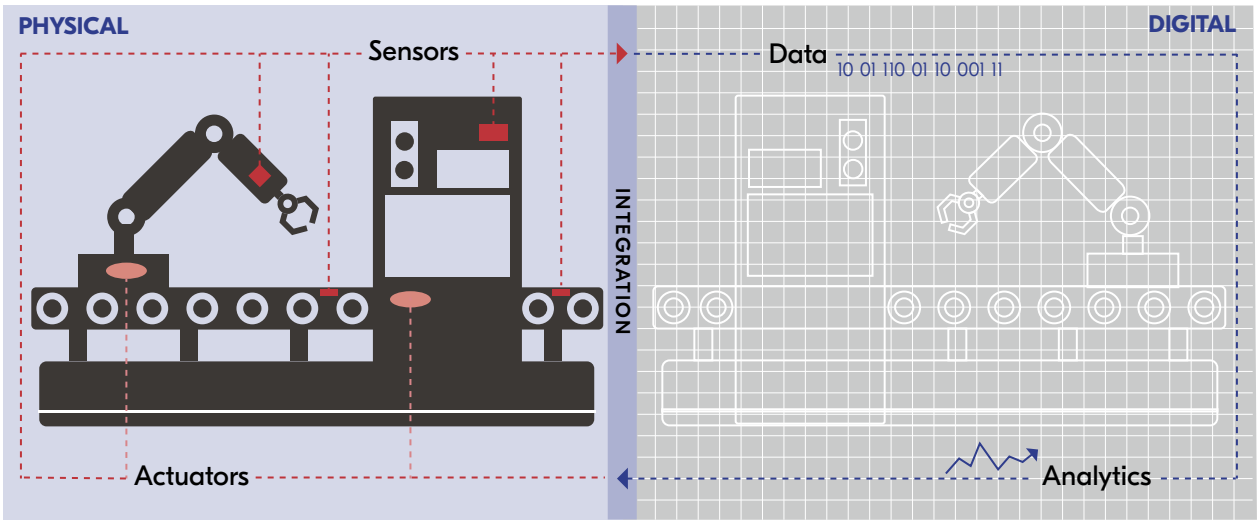
developing the tools to merge, and closely intertwine, the digital and physical worlds, i.e., so called cyber-physical systems.

An example of a cyber-physical system is the "digital twin". Figure 2 shows the digital twin as a virtual replica of a physical object or process. It provides a real-time copy of the physical counterpart. Companies use them to optimise their operations and maintenance [6].

The 4IR takes digital technology from mainly being a complement, a support, to be the technology at the core of business, trade, and production. In this way, technology transforms the entire relationship between companies and technology – technology moves into the centre of business processes, operations, and even decision making. [7]

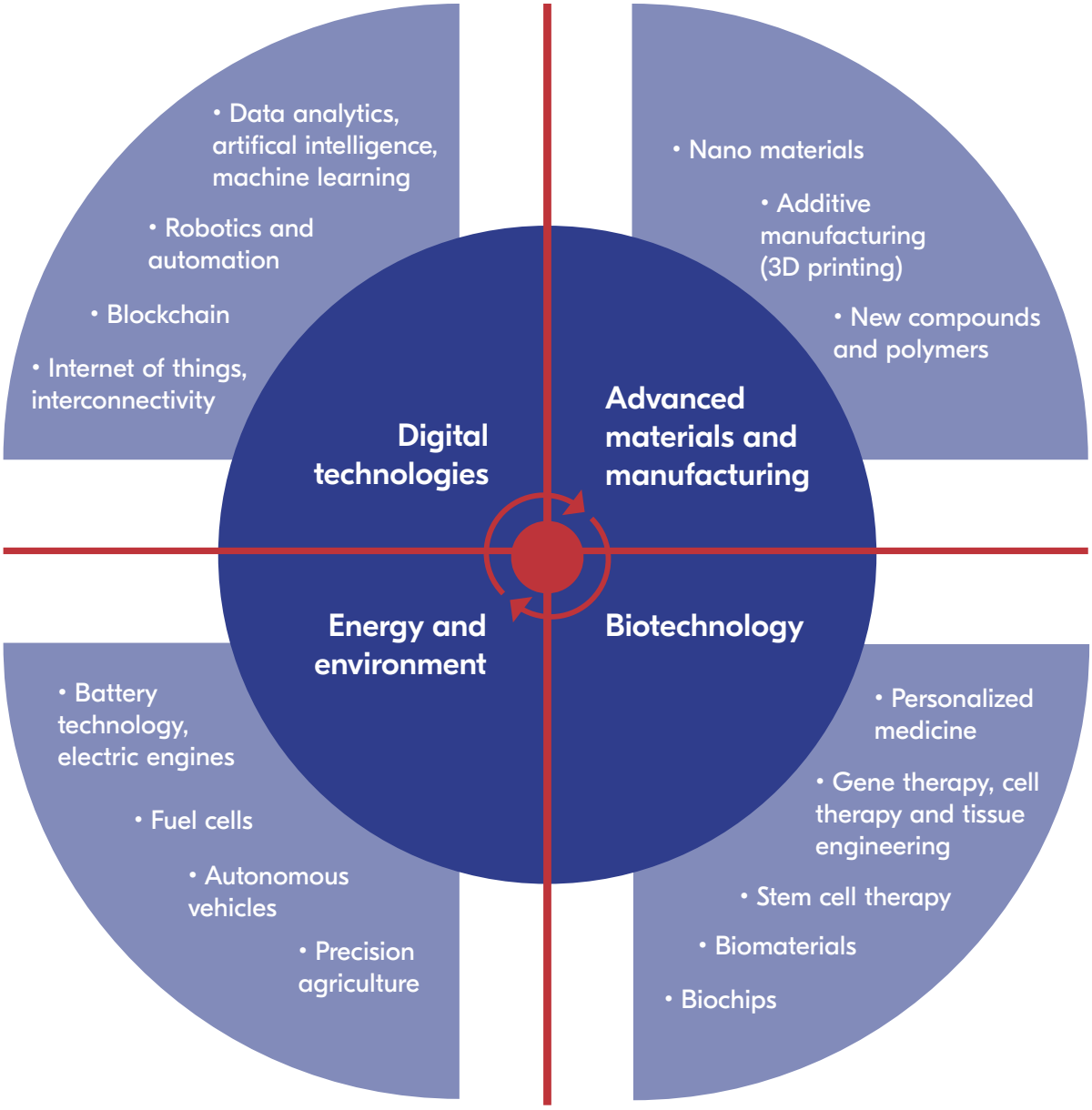
Figure 2: The digital twin — merging the physical and digital worlds

Note: Sensors build in a physical machine transmits data that creates a living digital copy of the machine. This digital copy analyses the physical machine's operation and performance in real-time. It transmits orders, many times without human intervention, back to the machine to ensure optimal performance and to avoid breakdowns.



Source: Kommerskollegium based on Parrott and Warshaw (2017)

Figure 3: Examples of new technologies, processes and materials



Source: Kommerskollegium based on OECD (2016)

The 4IR will introduce automation systems, as opposed to automated single machines, automated assembly lines and data-centred management systems. This will pave the way for the possibility of establishing factories without workers. It will make use of enormous amounts of data from consumers, devices, and companies, processed by computers with artificial intelligence software.

The merging of the digital and physical worlds will give many companies significant competitive advantages. Companies in all sectors, not the least in manufacturing, will need to adapt new technologies to stay competitive. In the end, this might be a question of survival for many companies. One interviewee stated, "to survive, Swedish products must be the most intelligent in the world".

The increased usage of digital technologies, and the business models built upon them, will make information/data a central input in production but also a currency. Business-models are information-based. Accumulation of information will be more important than ownership of assets.

As information flows across networks, as companies and individuals exchange it, and more metadata is collected, it grows in value. Companies can use information as a commodity (see Business example 1), or they can use it to improve processes, goods, and services. Making sense of data and using it correctly will distinguish winners from losers in the next decades.

> "To move into the Fourth Industrial Revolution is as big as moving from the agricultural society to the industrial age."
>
> *Partner Manager, Ericsson*

2.1 Moving towards the tipping point when 4IR takes off

The term "revolution" refers to the fact that the 4IR will be "a very important change in the way that people do things" [8]. So far, however, this has not happened. Instead, industry, as a whole, is currently in a stage of moving from yesterday's technologies towards a more general adoption of tomorrow's technologies.

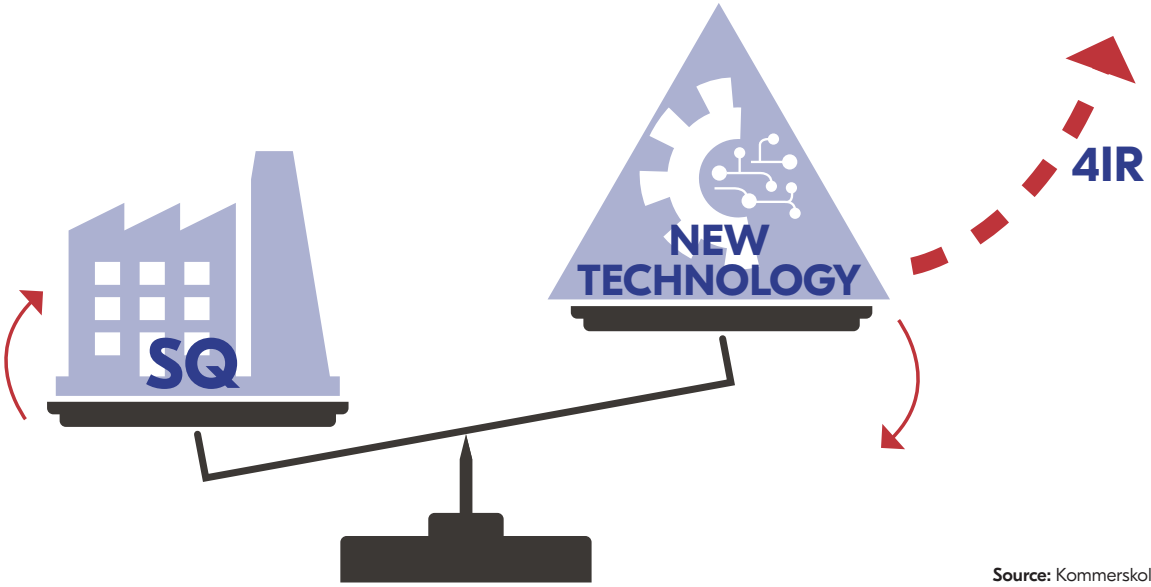
Our interviewees see the 4IR as an evolution, where new technologies are a continuation of older technologies. They describe it as a stream of new technologies that they try out and implement at a steady pace. Companies try hundreds of new products to determine what works in the market. Those that gain traction with customers change the marketplace one small step at a time. There is no direct and overwhelming impact on existing production processes. In short, it is an evolution, not a revolution.

So far, only a small minority of all companies are fully engaged in the 4IR. They use many or most of the new technologies that are available, reaping the benefits. These "lighthouses" are of all sizes, and they exist in both developed and developing countries. Nevertheless, even among these companies, there are large discrepancies in how far they have come, the technologies they use, and the benefits they reap. [9]

In our interviews, one representative of a large multinational tooling company said, "name the technology and I'll tell you how we use it". Other interviewees are using many new technologies but still struggle to reap the full benefits.

Nevertheless, the large majority of companies are far away from using new technology at scale. Some are piloting technologies; others have adopted a few solutions to a limited extent, for example, cloud solutions. Over time, technologies will mature and spread to more companies, evolving the global production and trade landscape. When the diffusion of new technologies reaches a tipping point, the world will witness profound changes. [10] This follows the path of earlier industrial revolutions and will probably take decades [11].

Figure 4: The current state of affairs: tipping towards the 4th Industrial Revolution



Source: Kommerskollegium

Business example 1

Recipes and cookbooks – installing the manufacturing line in 5 minutes with a smartphone

Sandvik has gathered a large amount of knowledge/data from extensive R&D and decades of application experience to develop new offers, so-called Knowledge as a Service (KaaS). They have turned this information into so-called recipes, which are small files that a company can download on an iPad and use to set up a new production process. Installation and fine-tuning now takes minutes instead of hours or even days. This gives customers (SMEs and large companies) more flexibility and better cost-control.

The companies gather the recipes on platforms in so-called cookbooks, which are easily accessible online. This makes it possible to share knowledge between equipment suppliers, manufacturers and subcontractors.

For example, a small firm that obtains an order to drill a certain type of hole in a specific material can buy a recipe and easily adapt their machine to the specific needs of the order. The next day, they can easily change their machine to execute a different order.

This large group can already reap the benefits and enjoy a revolution. Many can now obtain access to new, smart products and solutions – easily acquired on platforms. Hence, without adapting new technologies into their production, 4IR can revolutionise their ability to improve their production and offers. Business example 1 shows how small companies around the world now can access solutions in a very different way, thereby creating new opportunities for them.

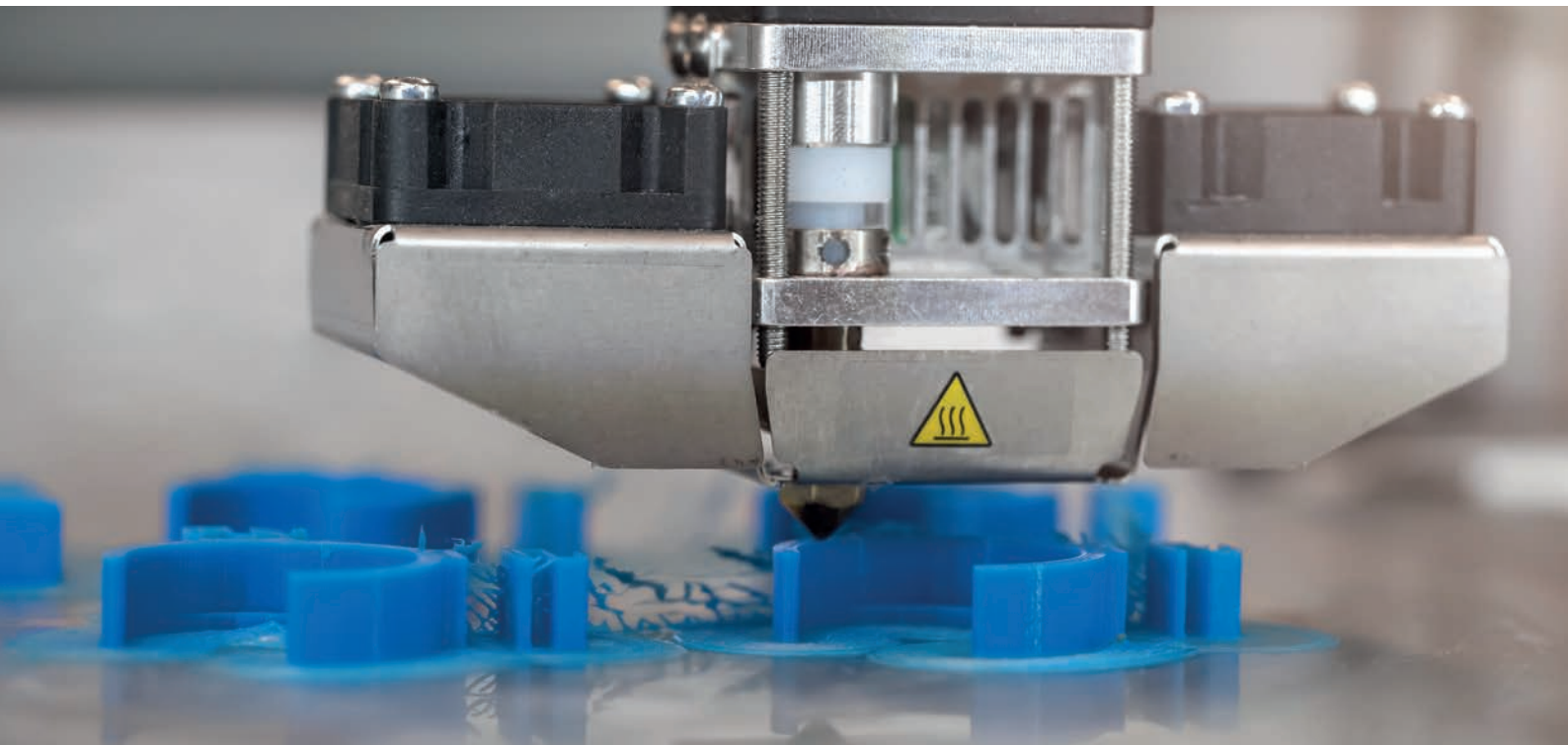
One company estimated that 80 percent of their potential future market for machine tools and recipes consists of SMEs that they have a difficult time reaching using conventional methods. This long tail of smaller customers value easy setup procedures and low investment costs.

2.2 A convergence of technologies enables the 4IR

The 4IR is the convergence of new evolving technologies, rather than a single breakthrough. The convergence of these technologies "magnifies the power of each" [12] and is driving today's developments. This convergence has just only started.

The technologies in question includes a variety of new digital technologies, processes, advanced materials and new energy generation and storage (Figure 3).

These technologies are not equally advanced. Some technologies have found commercial applications. Other technologies are only used



by companies in experimental applications and some technologies are still in the basic or applied research stage. All are developing rapidly. [13] However, one has to keep in mind that the actual outcome is uncertain, as some technologies will flourish while others will disappear. [14]

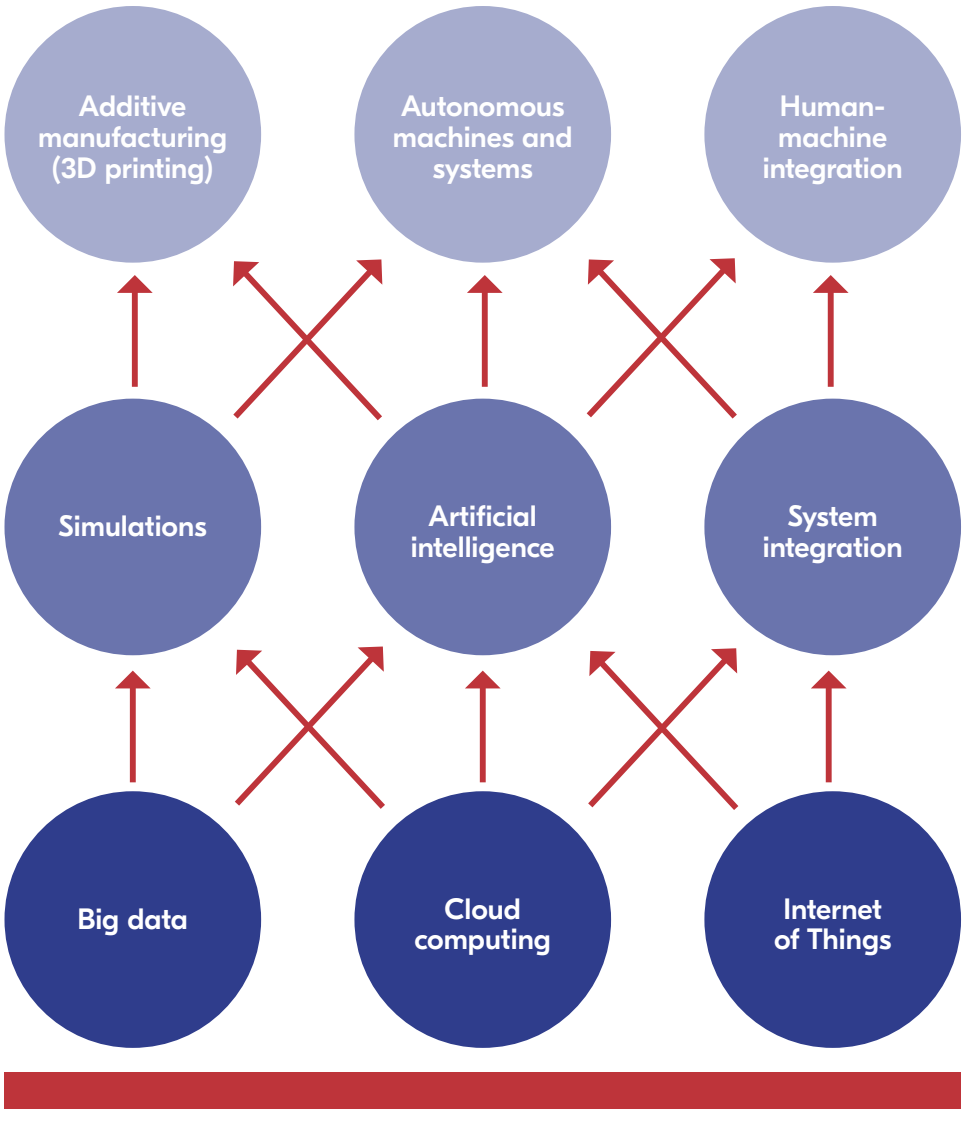
Figure 5 explains how new digital technologies are based on a combination of other technologies. For instance, in artificial intelligence (AI), for example, pattern recognition is enabled by machine sensors ("Internet of Things") collecting very large amounts of data, which is stored and analysed ("big data") using cloud computing. In turn, AI makes it possible to feed other machines with information about the problems they need to solve. Combined with other solutions (e.g., simulations and system integration), those machines can become autonomous.

The development will not be the same in all industries at the same time. Instead, different sectors will focus on different technologies, or combinations of technologies. Likewise, companies will use different technologies in different parts of the value chain. [15]

Several of our interviewed companies generally seek to automate their production, where technology runs the production globally. Beyond this, a pharma company also eyes new technologies to develop better and personalised medicines, including enabling better understanding of how medical substances function at the molecular level.

Figure 5: A combination of technologies leads to larger changes

Note: The technologies at the bottom enable those on top, as indicated by the arrows.



Source: Kommerskollegium based on OECD (2017a)

3 How new technologies impact production processes

This chapter sets out to describe new business models based on the opportunities that new digital technologies present. Digital solutions can lead to automated physical and digital processes and, in turn, allow for the dispersion of computer-driven production. In addition, the 4IR will lead to mass customisation and personalisation, accelerated servicification, increased specialisation, and the disintegration of global value chains.

3.1 New technologies create new opportunities as well as new demands from customers

In the previous chapter are examples of how the interviewed companies are viewing new technologies to give them a competitive advantage by improving the production process and/or the business offer.

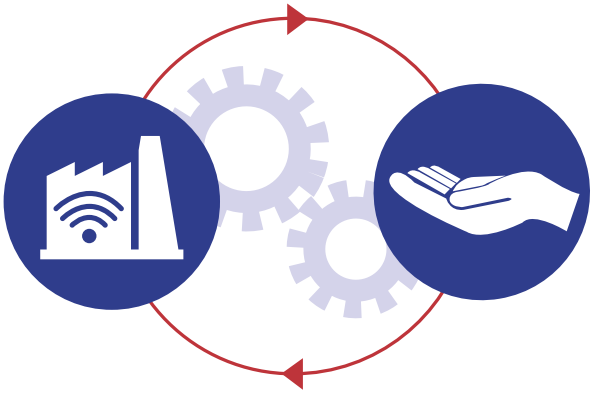
- The production process is about seeking cost advantages. The interviewed companies want to use technology to increase efficiency, agility, and cutting costs. However, it is also about redesigning the process to be able to offer customised products.
- The offer is about a differentiation advantage, which is making the company's business offer different from competitors. The interviewees look for increased sales and revenue with the help of superior goods or services, including better customer experience.

At the same time, customers also see the advantages that technologies can give them. This increases the demand for solutions adapted to their specific needs.[16] The interviewees all agreed that the 4IR is very customer-centric.

Together these two – mutually reinforcing – drivers push companies to change how they carry out production and what they offer customers. This follows the development in earlier industrial revolutions.[17]

This push-and-pull changes the production landscape and we have identified five major trends, as follows: i) automation of processes, ii) a move towards mass customisation, iii) accelerated servicification, iv) increased specialisation, and v) a disintegration of GVCs. We will analyse these trends in the following chapters.

Figure 6: Technologies creating new opportunities and new demands



Source: Kommerskollegium

3.2 New opportunity: automated processes in manufacturing

All our interviewees explained that their company views new technologies as an opportunity to automate processes, where technologies will actually lead production and make production decisions. Production will be self-orchestrated. Automation will be a leading force in the next decades and a central change in the production process.[18]

Automation will not only involve what we usually perceive as industrial robots with flexible arms. Instead, it will include all types of automated tasks, both physical and digital. A robot may be a self-driving car as well as an algorithm that foresees what types of disruptions may occur in the manufacturing process. Business example 2 illustrates that automation is more than robotics.

The technological development is making hardware- and software-based robots more capable. This makes it possible for more companies to automate an ever-broader set of tasks.[19] Technologies are starting to become mature enough to make compelling business cases out of their applications. Automation systems can work together and solve problems in all parts of the value chain, not just in individual links of the chain.[20]

To automate decision-making in all parts of the value chain is a clear example of technology truly moving into the core of business. This will be the final step towards fully automated production.

As stated, all interviewed companies view automation as a way to improve the end-to-end production process. With the help of, among other things, sensors, robotics, and AI, production at these companies can become more flexible and cost efficient. The interviewees expect i) better forecasted demand and production planning, ii) quick increases or decreases in output, iii) the achievement of better and consistent quality, iv) the avoidance of errors and unexpected events, as well as improved dependability, v) increased yield, vi) the creation of better after-market solutions, and vii) improved distribution. This is in line with the literature.[21]

Business example 2

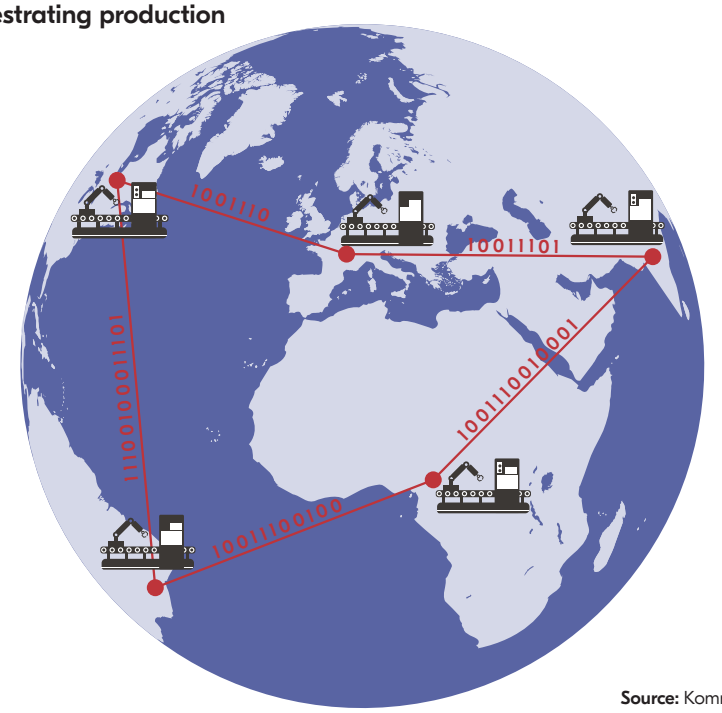
Automation – more than big robots

Stora Enso, a global provider of renewable solutions in packaging, biomaterials, wooden constructions and paper, has introduced software-based robots (Robotic Process Automation, RPA) within its operations to perform routine tasks that employees perform today. One example is the testing of a solution called "LAWbot" to complement the manual review of legal contracts, automatically referring them to OK for signing or escalating them for further handling.

Stora Enso's RPA forms part of their digitalisation strategy. This frees up time for employees to perform more analytical and development work. In 2019, over 60 robots will be operational.

Figure 7: Dispersion of self-orchestrating production

Note: Companies can disperse production and move it closer to markets. Automated processes will run production and the dispersed units will communicate to execute orders.



Source: Kommerskollegium

Another key interest is that technology will allow companies to spread out production. Companies can produce their products in smaller, more specialised and flexible units that are closer to the market. IT systems and -processes and large amounts of data flow ensure that firms can coordinate and control the dispersion of production. [22]

This "networked manufacturing" allows companies to move manufacturing away from low-cost countries and to focus on single/few production facilities. Sometimes, firms can perform the production of half-finished products in low-cost countries, while they perform the finishing close to customers. [23]

This possibility to move production will have concrete effects on trade. We will return to this in chapter 4. First, we will discuss how manufacturing companies handle customer demands in the 4IR.

3.3 Customer-centric production leading to mass customisation and personalisation

In the 4IR, customers will increasingly demand products adapted to their specific needs and demand can be volatile. With the help of new technologies, companies will be able to meet this need through mass customisation.

Mass customisation allows a company to design certain features of a product to meet specific customer needs while still keeping costs closer to that of mass-produced products. Mass customisation can also be about adapting products to local or regional demands (sometimes referred to as regionalisation or localisation). [24]

Technologies (such as 3D-modelling and –printing, robotics, visual simulation, and flexible production systems) that companies can use for mass customisation already exists. Some

Business example 3

Stora Enso's customised offerings increasing customer centricity

Stora Enso has gone from primarily selling paper to a more diversified portfolio of products. For example, they now offer packaging solutions customised to the buyers' needs and can adapt the cardboard materials' properties and the sizes and shapes of the packaging units to the customer's specifications. Stora Enso's strategy is to match products much more closely to each customer's requirements, thereby increasing revenues, customer centricity, and loyalty.

companies use some of these solutions, notably flexible production systems, to make small batches for mass customisation.[25] For example, truck producer Scania told us that all their trucks are adapted to the specific needs of the customer and no two orders of trucks are the same. However, many times, these technologies are not yet ready to allow for mass customisation entirely.[26] Mass customisation is nothing new, but digital technologies will make it easier for companies to perform this at scale without impairing the quality.

Mass customisation will affect where production takes place. With the help of, among other things, automated manufacturing methods, it will be profitable to move production closer to customers, spreading out production geographically.

The 4IR will even allow for the personalisation of products, that is, tailoring a single product to specific individuals. However, this will probably not be as common as mass customisation in the industrial sector. The product segment where personalisation will be most common is consumer products.[27]

Personalisation in this way will indirectly affect industrial companies, as they will see an increased demand for equipment and software that helps B2C-companies offer personalised goods. Like above, personalisation in the final consumer segment will require a re-orientation of value chains towards the end customer.

> "The fourth industrial revolution is about moving the max."
>
> *Digital Strategy and Architecture, ABB*

...including software customisation

Companies can deliver a different type of mass customisation and personalisation with the help of data and software. Instead of customising the physical properties of the goods, some interviewed companies achieve a customer-centric product with the help of software.

Business example 4 shows how Scania can use software to offer individual maintenance plans. The interviewees indicated that companies could use the same approach for many other industrial goods in the future, such as pumps, drills, or robots (see also business example 5 in the next chapter). For example, a company could develop software-guided machine performance. Staying with vehicles as an example, a company can allow customers the possibility to change the settings during operation. The driver can use the economy settings on the flat motorways and then add extra power for climbing mountain roads. The freight company pays a supplement for the extra power only during the time it uses the extra power.

There are great benefits achieved from this approach, such as companies can produce fewer versions of their product without losing the ability to adapt the product to individual customers' needs. This reduces the time and money spent on the R&D of new models and updates of existing models, and reduces inventory and logistics costs.

This and the other business example also illustrate the effects on the production function. Here, Scania is changing its production function from one based on capital and labour to one based on a third factor, i.e., information. This is about more than cost saving. It means that Scania, and other companies using similar methods will make different decisions and compete differently in the market over time. As information becomes a main input and currency of their activity, they will increasingly care about managing the optimal accumulation of information, rather than selling cars and engines or machine tools.

The customer can increase their production capacity without investing in new equipment. In fact, using technology this way – to connect and optimise existing machinery – will mean that the 4IR will have a relatively higher impact with comparatively less change in equipment compared with earlier revolutions.[28]

Business example 4

Scania vehicles have individual maintenance plans

Scania gives customers the option to have vehicles serviced based on flexible maintenance plans. Instead of service based on set mileage, Scania calls in vehicles for service when the operating data indicate that vehicle needs maintenance. This means the vehicle receives exactly the maintenance it needs and, in most cases, spends less time idle at the workshop.

3.4 Customer-centric production leading to accelerated servicification

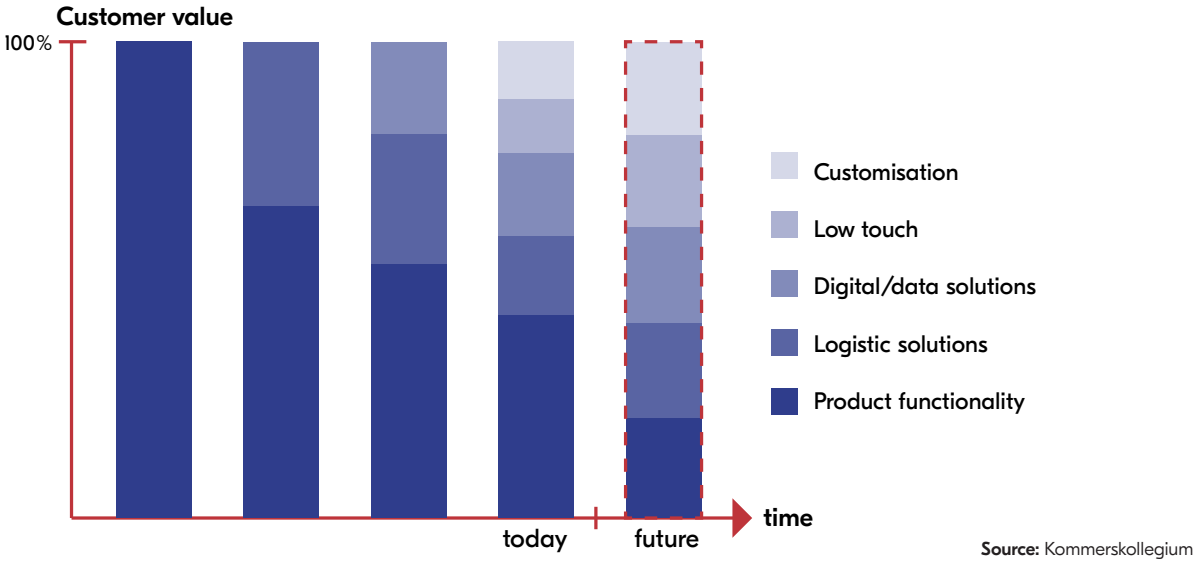
Servicification is a term describing the situation where companies buy, produce, and sell increasingly more services. [29] The 4IR is set to further servicification, both by increasing the pace and by moving companies to higher levels of services offers.

As customer preferences and expectations change, so does the need to change the offer and the production method. Hence, manufacturing companies drive servicification by using technology-based solutions in all parts of the production, i.e., offering smart products and changing into services based business models.

All interviewed companies are moving towards more services offers and services based business models. Everything can be a service, which is known as XaaS (anything as a service) [30]. The literature supports this point [31], while cautioning that many companies underestimate the difficulties in building successful business models on the back of technological solutions [32].

A key point from the interviewed companies is that just getting smart is not enough. The solutions must be easy to use, so-called "low touch" [33], and a challenge is to ensure that your customer

Figure 8: Illustration of the changes in what creates value for customers over time



Source: Kommerskollegium

experience is better than that of your competitor. According to the interviewees, everyone can offer great solutions, but the ones that can make it most user-friendly will win.

For companies, this will be an added dimension in regard to customer value and what is essential when competing for customers. Figure 8 explains how customers have moved from attaching value to functionality only to increasingly demanding digital solutions – including customisation and low touch.

Companies also use new technologies and digital solutions to move to higher levels of servicification. In Kommerskollegium (2012), we concluded that most companies offer at least basic services and aftermarket services (Figure 9). However, our interviews showed how companies are using the technologies of the 4IR to expand their services offer and move higher up in Figure 9.

The companies interviewed provided us with several examples of such services. One example given was how companies work with customers to optimise the layout and efficiency of their factory floors. Other examples include actively running customers' processes by remotely optimising the sold product capacity, many times directly when buyers use the tools in production. We also see how companies can use software to run equipment, processes, and products sold by other companies, or at least allow the different systems to talk to each other (see business example 5).

Business example 5

ABB ties 10 000 systems together

Industrial automation systems existed 10 years ago, the difference being the increase in the number of systems running in parallel. It is common for a factory to have up to 10 000 small and large systems from 500 different suppliers. Small systems are systems embedded in devices and machines, large systems being control-, maintenance-, ERP-systems, etc. A challenge is to make these systems work together and to use the large amounts of data to optimise manufacturing and predict risks and failures.

ABB's solutions aim to enable companies to efficiently integrate and run a multitude of robots and systems from different manufacturers. They build automation systems on behalf of customers running, e.g., power plants and industrial complexes.

One of ABB's projects is to build collaboration centres to facilitate a closer collaboration with their customer in the operation of automation systems. ABB plans to keep the centres manned and running 24/7.

Figure 9: Levels of servicification

Level of servicification

CATEGORY	AIM
Competitors process services	Run competitors' services and processes
Process services	Run customers' processes
Development services	Adaption to customer needs
Customer support services	Product and user efficiency
After market services	Guarantee continued function
Basic services	Increased consumer satisfaction

Source: Kommerskollegium (2012)

Business example 6

Platooning Scania trucks

Scania is testing technology truck for platooning. Platooning is connected trucks running in convoys, which automatically hold distance to each other. A future scenario might be that a human drives only the first vehicle in the platoon. Several vehicles follow behind under the guidance of automation systems. Technology can improve reliability and safety since the computerized systems are better at coordinating acceleration, braking, and steering than humans. Platooning may improve the flexibility of freight logistics since trucks can join for parts of the route, and then disconnected to take different roads. It may lead to manifold benefits: lower fuel consumption and less carbon dioxide emissions, improved road safety, a better working environment for drivers, and higher profitability.

Servicification can allow companies to blend automation with manual labour. Business example 6 explains the platooning of trucks, a technology that will allow drivers to take a break and focus on other tasks, such as planning assignments or communicating with customers.

3.5 Customer-centric production leading to increased specialisation of companies

Generally, large companies have a competitive advantage over SMEs, but this can change more in favour of SMEs when they obtain access to new technologies at low investment costs. The recipes and cookbooks in Business example 1, chapter 2.1, are examples of how SMEs can obtain simple access to new solutions.

Some interviewees explained that SMEs will start playing in the same division as large corporations. They will have smaller resources but the same high level of value added. Since production leans towards customisation, with shorter series, it will not always be profitable for large companies to execute orders. This is because their machinery has optimised processes. It will be increasingly attractive to sub-contract to smaller suppliers who already have suitable equipment and can accept production runs on short notice. These SMEs offer "manufacturing as a service"[34] and outsourcing has become more competitive.[35]

Another reason why large and smaller companies will use networks to collaborate is the way that premium products acquire their high value. Companies must certify approximately 10–20 percent of the assembly, based on strict requirements. Large companies do this assembly, which accounts for a large share of the total value added. Large companies can contract out the remaining assembly without certification to smaller companies.

The interviewees explained that there are already aggregators on the market that connect large companies with small-scale suppliers, i.e., an intermediary that facilitates the contracting out of manufacturing orders. More such platforms will appear, and this is likely to increase subcontracting considerably. Crowdsourcing platforms are also growing, allowing new partners to enter the market .

The development above will lead to an increasing specialisation of SMEs with in-depth knowledge about materials, products and processes in every sector and market segment. Over time, our interviewees explained that these SMEs will become attractive suppliers on their own and start to compete directly with large companies. This is already happening and "companies at the cutting edge are now local, not global"[37].

Nevertheless, the situation might differ in different sectors. In pharmaceuticals, for example, as an interviewee explained, the newcomers are big tech-companies that capture the entire end-to-end value chain and swallow start-ups.

Business example 7

Sandvik as an aggregator

An interesting example is uFab, a Sandvik product that makes it easier for smaller companies to submit tenders and obtain an improved hit rate at an accurate price level. It contributes to making each order more profitable and allows SMEs to grow consistently.

3.6 Customer-centric production leading to the disintegration of some global value chains

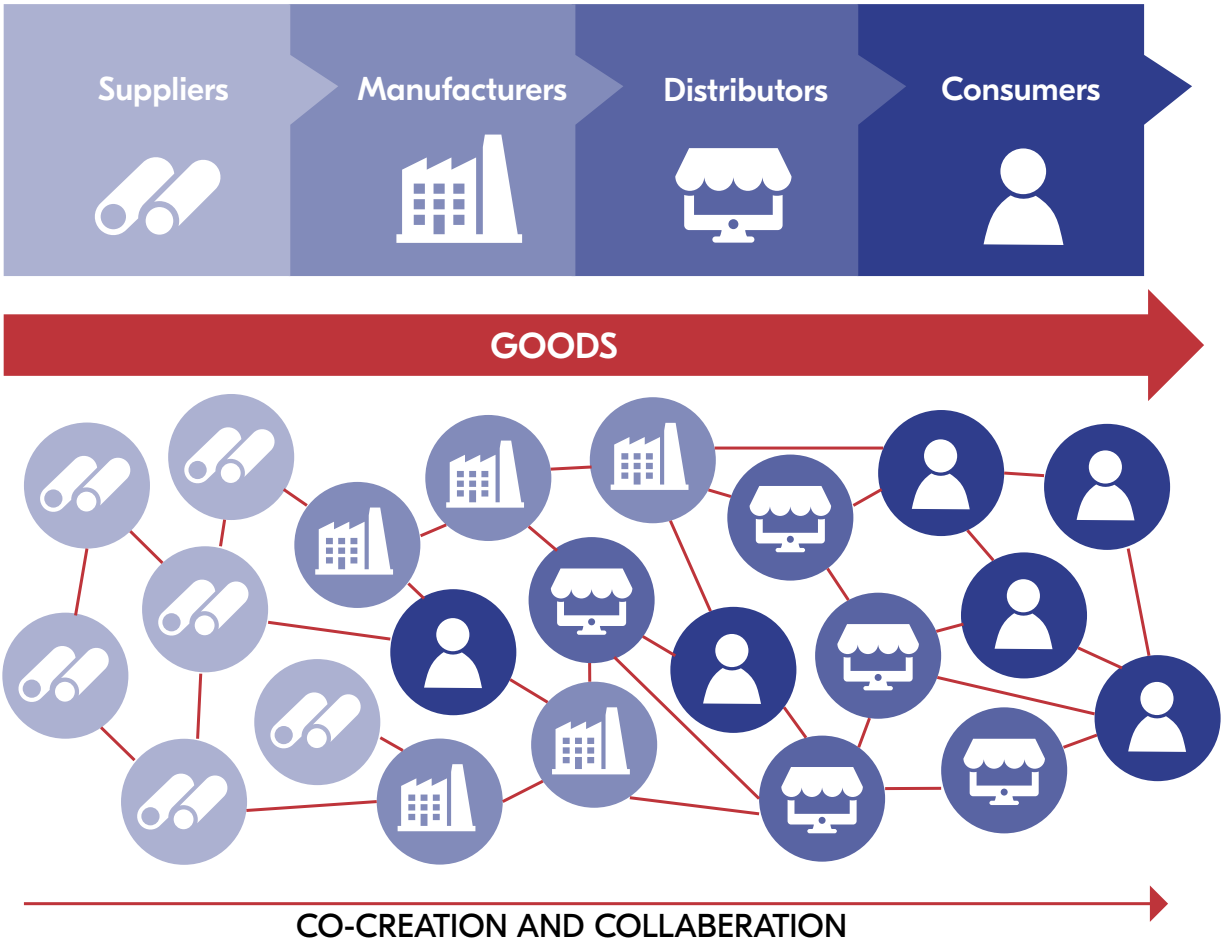
The previous chapter exemplified a change in the way companies organise their production. With fast technological development and ever-increasing customer demands, companies are starting to realise that they cannot work as stand-alone entities with a traditional GVC (even if the GVC is spread out in networked manufacturing). Instead, they become part of a business ecosystem, which is a more fluid construct characterised by a web of connected companies.[38] IT systems and processes and data flows help firms organise their operations.

Ecosystems will never fully replace GVCs, as it is not a model that fits all businesses[39]. Instead, we might also see more globalised GVCs especially service GVCs. In some sectors, like the auto-sector, there will be different types of inter-related GVCs, both regional and global. However, here, we focus on ecosystems, as it is more of a break from how many traditionally describe production.

> "We use the word competition less and less"
>
> *Director StratEx, Sandvik Machining Solutions*

Companies create and capture new value through both collaboration and competition with partners, customers, and even competitors. Ecosystems give participating companies a more flexible opportunity to decide whom to work with in the different stages of the production process, depending on needs.[40] When companies can work with others and build on their solutions, disruption will be faster.

Figure 10: From a linear and static GVC to a fluid and complex ecosystem



Source: Kommerskollegium based on Kelly and Marchese (2015)

Companies can use an ecosystem approach that spans their entire production chain, fully moving away from the GVC-approach. It can even lead to the creation of "umbrella companies", where the companies own no facilities at all and never touch the product. [41] Alternatively, companies can work in an ecosystem in a specific part of the production chain, notably the R&D-stage.

One company interviewed for this report viewed ecosystems as a clear path forward for their entire business. They stated that it is impossible to produce everything in-house. Most of the companies, however, only worked with a start-up community and used different collaborations to develop new products or services.

A related development is the emergence of "Global innovation networks" (GINs), where companies are starting to move innovation and R&D away from their headquarters to open the processes with greater collaboration and engagement with outside partners. Companies are establishing new interdisciplinary and cross-sectoral arrangements with suppliers, customers, universities, and government institutions.

> "Being part of an ecosystem is essential"
>
> *IS/IT Director, Astra Zeneca Nordic-Baltic*

GINs are global in nature, and multinational corporations play a key role in driving this type of international innovation, although they are not the sole driver. Through GINs, companies seek to leverage foreign knowledge, technology, and human capital. [42]

4 How new technologies impact trade and global value chains

Digital technologies will affect trade. A central way this will happen is through automation and the possibility of dispersed, self-orchestrated production. This can lead to less measured trade, changes to the GVC setup and participation, as well as changed trade flows. New technologies will allow many SMEs to enter the supply chain and participate in production.

The basic premise in this report is that the 4IR will change trade. Technologies will affect trade in the following three ways:

1. Improve trade logistics and lower transaction costs.
2. Change the actual content of what firms trade – moving from goods to services and data.
3. Change production processes and the location of production. [43]

These changes are already visible, with servicification, data flows, and GVCs being more knowledge-intense and manufacturing GVCs becoming regional.[44] Overall, even though manufacturing is going to be important for a long time, global flows of goods are already in decline, while flows of services and data are increasing.[45] The technologies of the 4IR will amplify these trends and, in addition, have a more varied and complex effect.[46]

4.1 Trade logistics and lower transaction costs

Emerging technologies have already reduced international trade costs, and this trend is probably set to continue. Technologies also help speed up delivery times and facilitate the management of complex supply chains.[47] Together, technologies can increase trade and facilitate the move towards global, self-orchestrated factories.

Examples of how different technologies can improve trade logistics and lower transaction costs include using AI and autonomous vehicles to reduce transport costs, for example, a study estimates that autonomous vehicles can half logistics costs by 2030.[48] Other examples include using smart robots and AI to reduce the cost of storage and inventory, and IoT and blockchain can facilitate border crossing.[49] 3D printing[50] and digital solutions can even replace physical movement and make transportation and logistics costs irrelevant. Overall, technologies can reduce the shipping and customs processing times by 16–28 percent.[51]

Technologies can lower costs in both developed and developing countries and increase global trade. Especially SMEs and firms in developing countries are set to benefit from this development and help these countries increase their share of world trade.[52]

4.2 The new content of trade

The content of what is being traded changes in the 4IR and, consequently, trade flows and patterns. The most visible change is the development of new physical products. New and improved products become available as technology helps companies create totally new products, make "dumb" products smart, and improve existing products (e.g., 3D printing a product allows companies to produce the same product but with

superior properties). New products are emerging in all ends of the supply chain; for example, new technologies create new raw material. Hence, the "ink" in 3D printing can be a new product never traded before.[53]

In connection to this, one interviewee stated that "when the product changes, the sourcing changes" – meaning that new products not only lead to new final products being traded but also changes in the trade in inputs. With firms developing new goods at an ever-increasing speed, this will mean a continuously changing trade flow.[54]

New technology not only creates possibilities, it also forces companies to change their products. As customer preferences and expectations change, so does the need to modify the product to avoid marginalisation by faster competitors. The interviewees stressed that in the 4IR, product life cycles will be shorter and the speed that companies need to introduce new superior products will be faster.

New goods are probably more visible, but our interviews show that new services are probably a more fundamental outcome of the 4IR. Technological changes will accelerate the shift from goods to services trade, thereby changing trade flows. Already, the service trade is growing twice as fast as the trade of goods (2010–17), both in relative and absolute terms. However, of course, they grow from different starting levels.[55]

Services are at the heart of the 4IR. The importance of services in trade comes in many different ways. New digital technologies create new ways of delivering services across borders. At the same time, services form the rapidly growing infrastructure that enables the online trade of services and goods.[56] Services, such as 5G wireless networks, virtual reality, and augmented reality, may all increase the service trade. Ultra-fast 5G wireless networks open new possibilities for delivering services globally.[57] The lack of a proper digital infrastructure already hinders the interviewed companies to introduce new solutions to the markets.

The most prominent change is not trade in certain services but the apparent accelerated servicification that we described in chapter 3.4. New technologies are pushing companies to improve the service content in all parts of the value chain, both as an input in production and the offers – digital solutions are often the basis for these services.

Finally, one should note that, even though services and data flows will grow, production that is more efficient would lead to more production. If firms can produce goods more economically, this will increase the demand for goods in both developed and developing countries – thereby increasing the trade of goods.

4.3 Production process/ location and trade

Perhaps the most faceted effect of new technologies and trade relates to how technologies can affect the production process and location. The impact on trade flows of new processes and locations is likely to be significant. New processes and locations will change GVC, trade flows, and trade participation.

Technological developments will gradually change the production factors and lead to a shift in the relative prices of, e.g., capital and labour.[58] Low-cost labour has never been the sole factor behind a decision regarding where to establish production and, in the 4IR, this will be even less of an issue. Instead, proximity to the market and closeness to customers will more likely be key factors influencing the possible movement of production. Specialisation between different production plants can also become important.[59] Even more, companies will be "footloose" meaning that they move production around in order to ensure optimum efficiency[60].

However, both World Bank (2019) and WTO (2018) note that, so far, there is little empirical evidence of so-called "reshoring". They conclude that, based on different simulations, it is not definite that the reorganisation of tasks, notably production location, will occur.

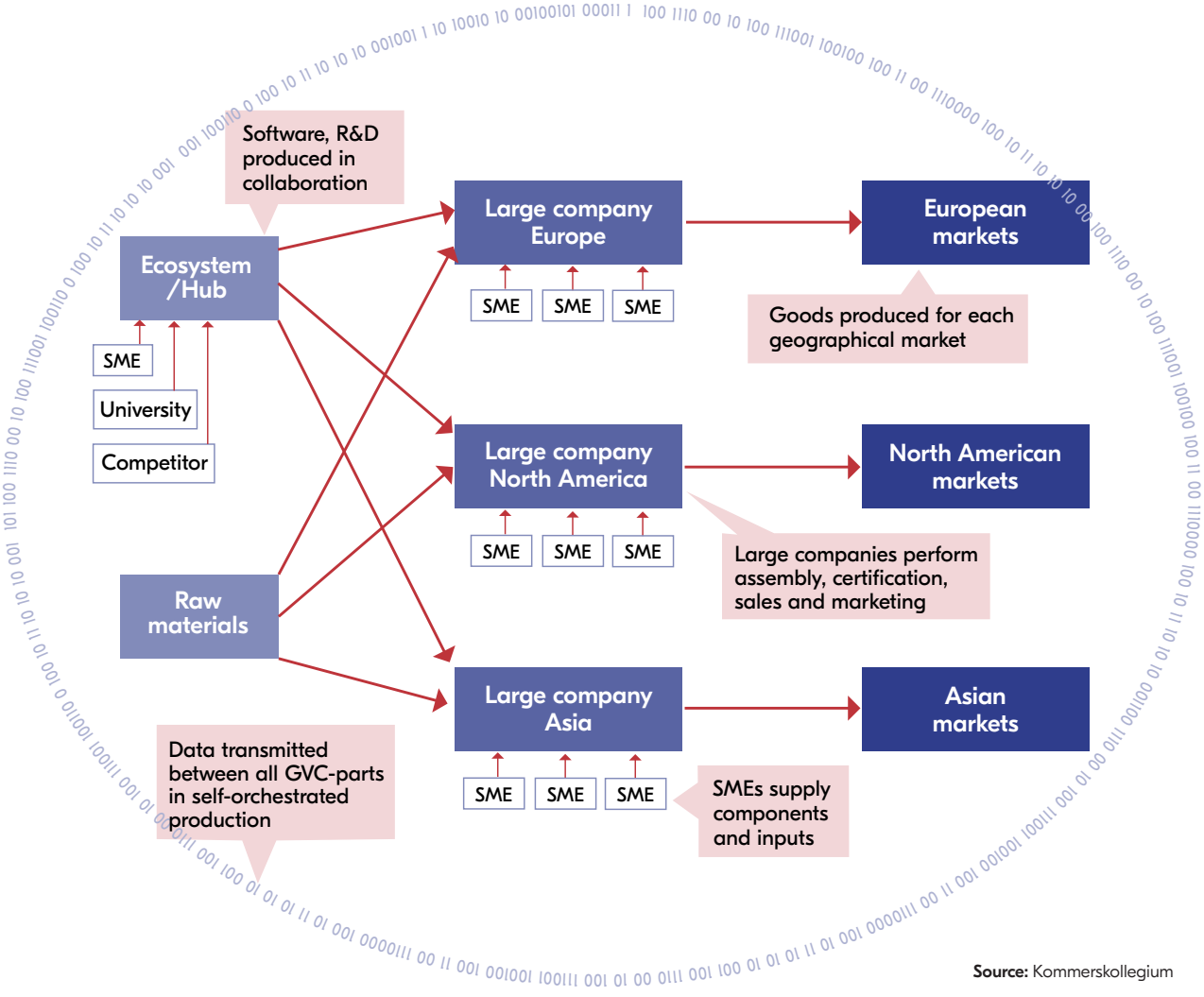
Nevertheless, presuming that the movement of production locations occurs as envisaged, we will see several trade related effects. Box 1 summarises the overall effects.

Box 1

Trade effects from moved production locations

1. Less measured trade.
2. Changed GVC set-up
3. Changed trade flows
4. Changed trade participation

Figure 11: Dispersed production



Source: Kommerskollegium

Less trade

The most prominent effect is actually less measured trade. MGI (2019) estimates that trade will decrease by four trillion US$ by 2030 due to production moving closer to customers. One interpretation of this trade slowdown is that trade is not decreasing but merely changing faces.

Changed GVC set-up

Figure 11 shows how a company can split production between, in this instance, three locations and serve these local markets from there. In a more traditional GVC-model, final assembly takes place in one location and manufacturers ship their products to consumers globally.

When spreading production out in the 4IR, companies will look at different factors. Currently, endowments, market size, connectivity, and stable institutions are important. Other factors such as good logistics and open trade policies are also essential and are both means to obtain good connectivity and market size.[61]

In addition, the interviewed companies said that firms are going to place great emphasis on the quality of the digital infrastructure, which automation and other digitally based technologies rely upon[62]. In fact, the quality of the digital infrastructure might become a new source of comparative advantage. In close connection is the energy infrastructure, as digital-intense sectors are large energy consumers. The interviewees also highlighted the cost of robots and other technologies when making establishment decisions.

The skill-level is another essential factor. When companies can handle production design, manufacturing, logistics and sales online on cloud platforms, companies can locate operations to places where the best experts are available.

Box 2

Furniture production and the cost of robots in the USA and Kenya

In the case of furniture manufactured in Kenya, it is estimated that robots in the US will become cheaper than US labour in the year 2023, and robots in Kenya will become cheaper than Kenyan labour only a decade later, in 2034. This would mean that automation in Kenya would be cost-effective by 2030. For furniture companies, this could suggest continued production in Kenya but with the help of robots.

However, if Kenya fails to digitally up-grade and close the digital divide, then US robots in the furniture industry will become cheaper than Kenyan labour in 2033. This suggests a move of furniture production away from Kenya.

Source: Banga and te Velde (2018)

The factors presented above are a summary of what companies in the 4IR will generally value. In a sense, they are traditional factors that make up countries' competitive advantages but with changed relative importance.

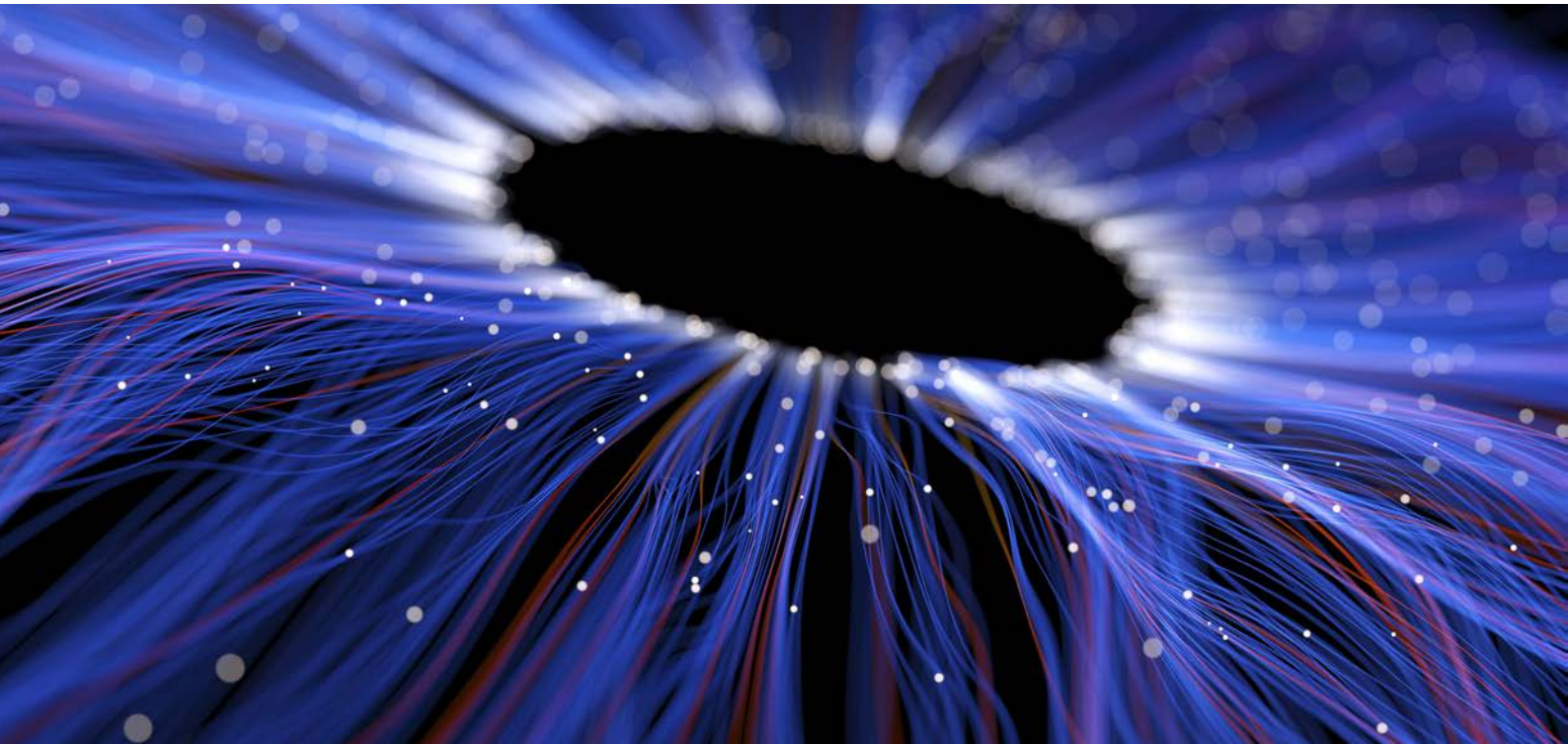
However, there are also new issues that companies will value. In a data-rich and algorithm-driven world, a country's comparative advantage will also include issues such as personal data protection and web content restriction regulation,[63] as well as the protection of algorithms and source codes and the ability to move data.[64]

The use of automation and other technologies does not mean that production will only move to industrial countries. Companies will look at spreading out production, including to today's low-cost labour countries. We expect more manufacturing in industrial countries. This might not mean less manufacturing in developing countries, since companies will produce the quantities needed for the markets there. Overall, with rising living standards, increased demand, and better infrastructures, manufacturing operations in developing countries can well increase.

It is not only being close to markets and customers that matters. Increasingly, companies want to be close to innovation centres, or "hubs". Hubs are areas with interconnected companies, specialised suppliers, and institutions, such as technical universities. Silicon Valley is probably the most well-known hub that exists globally. These hubs might become more frequent, according to the interviewed companies, as they become centres of coopetition, collaboration, and standard setting. Again, this will affect the GVC set-up.

Changed trade flows

As GVCs change, so does the movement of the inputs that companies use in production. Figure 11 exemplifies how raw material producers will need to ship their material differently, as the receiving company has dispersed production. In 3D printing, the raw material (the "ink") can



replace numerous inputs. Hereby the "ink" will remove all these inputs from the trade flow.[65]

Likewise, the trade in the components and inputs going into the production in question will change. It is likely that many suppliers of components will produce them regionally. The reasoning about SMEs being more flexible as suppliers of large companies (chapter 3.5) supports the notion that the company in question will increasingly source components locally. The impact on trade flows might become very significant.

Changed trade participation

Trade participation will change, for both countries and firms. For countries, trade participation will change as the new GVC setup will make receiving countries importers of imports and exporters of the product now produced in that same country.

For companies, often SMEs, new technologies allow them to enter the supply chain and participate in production. Producing goods or services that will enter another company's GVC is an important way for firms to enter trade. An industrial company switching to 3D printing might involve an external firm specialised in designing CAD-files.[66] Several of the companies interviewed explained how they now work with new, often small, companies that deliver, e.g., robotic solutions. An interviewed company merges these solutions with their own product offer.

How companies decide to organise how they collaborate with external partners will affect trade participation, as well as the GVC set-up. Firms that move towards ecosystems, or organising their R&D into global innovation networks, will frequently rearrange their GVC by moving tasks and changing who they work with. The more flexible an enterprise is in regard to reorganisation, the more their trade participation and GVC setup will change.

Far from all companies using new technology to enter trade are new firms. Instead, there will be a variation of new and old companies taking advantage of new opportunities. In Kommerskollegium (2016), we stated that the producers of the 3D printing "ink" are a mix of old and new companies. Perhaps the most famous example of "old" companies considering new technology as a way to enter new fields are big tech-companies moving into the field of autonomous vehicles. Other examples include Amazon buying online pharmacies in the UK.

While the previous paragraph talked about large existing companies, the 4IR is clearly an opportunity for many SMEs to specialise and participate in trade. Vadcar (2015) concludes that "new technologies help strengthen the rise of small players in international trade".

Being able to automate processes or offer customised products is about trade participation. Adopting new technologies can improve the production and the offer, thereby giving companies a competitive opportunity. Over time, there will legions of local companies participating in trade. However, they will be "low-profile agents", which will probably not be evident in statistics. Nevertheless, they will start replacing bigger firms as traders and transmitters of ideas and capital over time.[67]

A conclusion from our interviews is that it is easier for large companies to change technologies. SMEs will also automate their production and raise their productivity levels but, as a group, probably to a lesser extent and at a later stage. There will be a large spread among SMEs and there will even be a large group of cutting-edge SMEs. Those that invest in, e.g., automation are more likely to increase their trade participation.

In short, technological opportunities have lowered the threshold to enter trade. Many SMEs have already stepped over this threshold and more will follow. However, taking the step is generally more difficult for SMEs than for large companies. One central reason is that the benefits of automation have to be even more certain for small companies. Uncertainty about which direction the 4IR will take is a barrier for companies entering the 4IR.

5 Barriers hindering the 4IR

A large number of obstacles hinder the diffusion and adoption of new technologies. Obstacles affect SMEs more but large companies can also find transformation difficult. Many times, public sector support is needed, as well as public-private collaboration.

So far, this report has described how companies are embracing the new opportunities of the 4IR but also that the world is just entering this new development phase. Technologies are starting to diffuse, but this does not happen overnight. In fact, there are still a large number of concerns to address.[68] Table 1 summarises the concerns that our interviewees think companies and governments need to address for the 4IR to take off.

A large number of concerns are especially relevant for SMEs. A key concern is the possibility to shift the production method. It is a costly process and companies must be certain that their investment will bear fruit. It is early in the 4IR and companies await proof that certain technologies will deliver what they promise and become permanent. It is not an option for many SMEs to invest in a technology just to find that another solution takes its place. The market must set before many companies can afford a move to the 4IR.

Large multinationals are often not as vulnerable, but transformation is still not easy. For example, it is not enough that a single company introduces new solutions for maximum gains. Rather, it is essential that the entire value chain start using the new technologies, including tier 1 and 2 suppliers. A 4IR-transformation will not be more efficient than the weakest link in the value chain.[69]

The value chain starts with raw material. Many times, the production relies on specific raw materials, especially rare earth elements, which are located in a limited number of countries. Access to these materials will be essential for production and competitiveness. For companies, this will be a key concern in the future. It can have a large impact on the ability to produce and trade – and, of course, in the end, on trade flows.

Many companies, especially SMEs[70] , find it difficult to change without help from other companies or from the public sector. They search for public support programs, or public-private-partnerships, to help them investigate and invest in new technologies. Even interviewed multinationals find public programs essential for their ability to develop and implement new technologies such as AI. More fundamentally, the interviewees see public initiatives as a way to open companies' eyes, highlight available opportunities, and create pressure to change – and to help each other.

The public sector need to initiate some initiatives to tackle the barriers that individual companies cannot handle on their own. This mainly concerns infrastructure issues, both the digital and physical infrastructure (for example, improved transport solutions).

Another area where firms need the public sector is the legal field. Various legal concerns acts as barriers. This includes how current laws, ranging from WTO-disciplines to GDPR, apply to new solutions. Other examples are very concrete, for example, autonomous vehicles and rules regulating resting times for truck drivers.

Table 1: Collection of barriers to adopting technology (according to interviewees)

Concern: adoption of technologies	Concern: lack of public support
• Tech-market has not set • Lock in effect – hard to choose early • Too much hype • Change of production method with squeezed assets • Internal business climate – hard to change the internal business culture and organisation • Business case and proof-of-concept	• Public support – public/private partnerships missing • Lack of competence/skills • 5G and lack of digital infrastructure
Concern: control	**Concern: legal developments**
• Control of data and data ownership plus machine-privacy (hinder backward engineering) • IP-rights and IP-control (e.g., 3D printing) • Cooperation problems, including with start-ups	• Legal concerns, including liability in connected systems, unclear contractual status, international regulations and national over-regulations, special interests drives regulation • Lack of standards • Privacy concerns – GDPR and the effects on companies
Concern: production and sales	**Concern: other**
• Lack of access to raw materials, including transparency and traceability • Independent industrial platforms: works in silos and lack of neutral options • Fragmented markets	• Cybersecurity – both real and perceived (afraid of scandal) • AI – ethical concerns

A related set of concerns relates to uncertainties in the contractual relationship between companies, for example, control of produced data and liability in connected systems. Many times, the companies themselves need to solve this on a contractual basis, but public initiatives (laws or guidelines) can be helpful.

6 Concluding discussion

> "We're still in the first minutes of the first day of the Internet revolution"
>
> *Scott Cook, CEO Intuit*

The world is entering a new era, the 4IR. The 4IR is not merely a continuation of the third digital revolution. What sets the 4IR apart is the following:

- Technology and digital solutions change from being support functions to being in the core of manufacturing processes and business models.
- It is not only about new digital solutions but also about new processes and materials.
- The speed of transformation and disruption will be faster.
- The transformation will have a more profound impact on businesses and society.

The 4IR is more than advances in technology; it is about a more fundamental change in production and trade. We have so far only witnessed the beginning of a transformative journey.

Countries need to understand these changes. The 4IR will be a world of both opportunities and challenges. So far, we have discussed opportunities. However, with changes come challenges.

The most discussed challenge is the effect new technologies, especially automation, will have on employment. Automating tasks implies effects on labour markets, including making some jobs obsolete. At the same time, new technologies create new jobs and occupations. Likewise, moving production will mean lost jobs in one place and new jobs elsewhere. The 4IR will imply labour-market changes, a challenge that companies and governments must address.

Another example is the exponential digitalisation of production and trade – a development that has both good and bad sides. Our explanation of 4IR above can be summarised as the integration of IT systems and processes and data flows both horizontally and vertically. Horizontally, by integrating customers, suppliers, external partners, including other companies, and vertically, by integrating all parts of production from R&D and design, through assembly, to sales and beyond.[71]

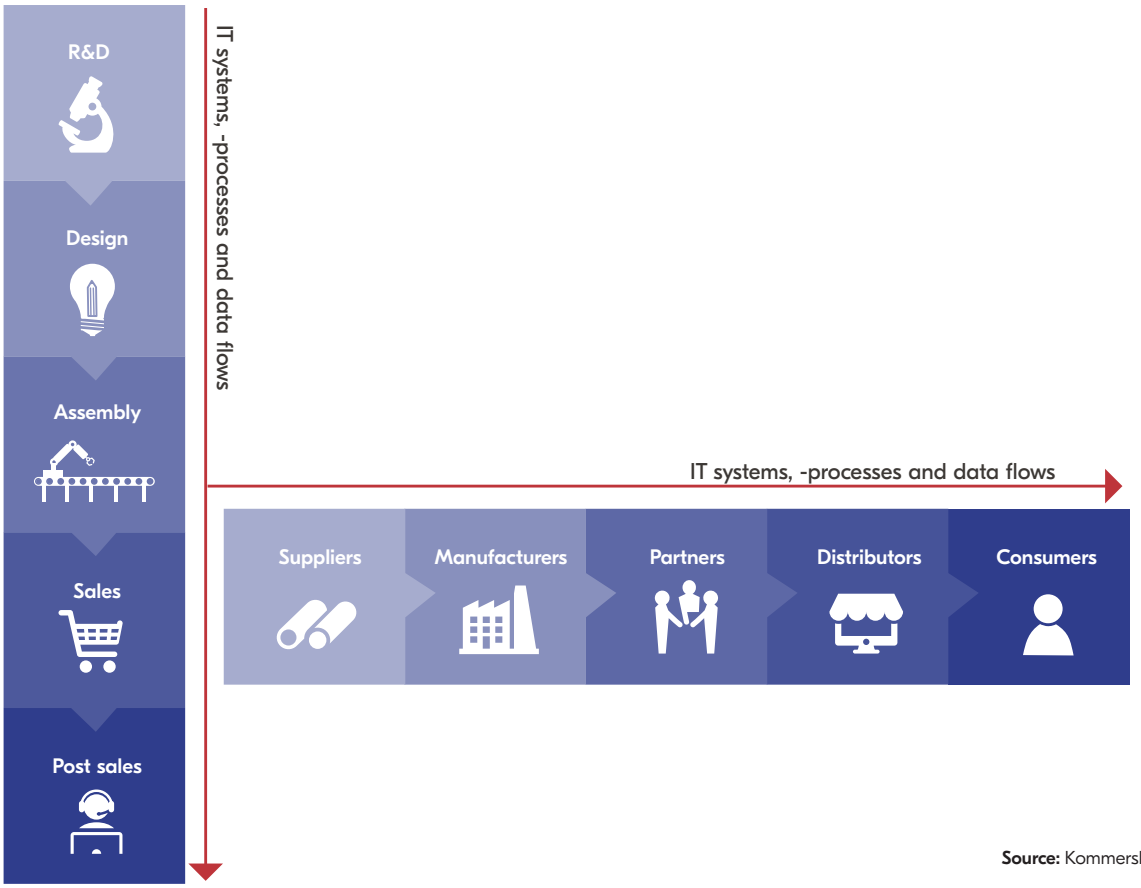
Digitalisation creates concerns. For example, digital technologies are vulnerable to cyber security attacks and the mishandling of personal and sensitive information by companies. Furthermore, digitalisation and new solutions can be both environmentally friendly and cause negative environmental effects. The environmental effects of 3D printing are, for example, uncertain – especially since the "ink" can be very toxic to produce and cannot be recycled. [72] Digitalisation also means electricity consumption, and the production of digital technologies is a strain on the environment.

These are just examples of the challenges. While it is not in the scope of this report to discuss all possible risks and concerns, it is important to stress the broader aspects of new technologies.

The same is true for trade regulation and policy. Table 1, chapter 5, includes concerns regarding trade regulation developments. To start with, there is a need for trade officials and policy makers to further their knowledge of how the 4IR affects their companies and economies.

Next, we have to look into what hinders technological use and diffusion – and if and how trade regulation facilitates or hinders the development of the 4IR.

Figure 12: Horizontal and vertical integration of IT systems, IT processes, and data flows



Source: Kommerskollegium

Regarding those that hinder it, we can safely conclude that, globally, there are many domestic legal and non-legal barriers hindering technological use and diffusion. For example, the ECIPE "Digital Trade Estimates Project" maps the barriers to digital trade.[73] This restrictiveness index shows the legal barriers to digital trade. Even the absence of legislation can act as a barrier, for example, not having legislation for the protection of personal information might hinder trade.[74]

Other barriers are more traditional and these barriers do not always relate to digital solutions. For example, restrictions on the movement of natural persons can be large barriers for companies wanting to attract people skilled in the latest technologies. In addition, there are many non-regulatory barriers, including inadequate digital and energy infrastructures, as well as stable institutions.

Countries should then change the trade regime to fit the new reality. They should not just look at export markets – more importantly, many countries need to see how they must change internally to create an enabling environment where they can reap the benefits from the 4IR. Trade regulation can be a tool to use – if viewed as a force to start an internal transformation.

To address these barriers, it is possible that countries need to revisit the rules that govern the trade between them. In Kommerskollegium (2016), we concluded that 3D printing questions some WTO rules and that some issues are not yet adequately covered by the existing rules.

The 4IR strengthens those conclusions. For example, the dispersion of production means that investment related issues ought to become increasingly important to regulate. Additionally, the dispersion of production, more smart goods and services, as well as intensified inter-firm cooperation will make the seamless flow of data more essential. The 4IR is also about the digitalisation of knowledge, making IPR-issues crucial.

Countries are starting to recognise they might need to update trade rules. Mostly, this happens in preferential trade agreements, and we are starting to see countries addressing issues relating to the 4IR.[75] Even the WTO has now launched plurilateral negotiations on e-commerce. While we welcome these developments, they are only beginning to touch on some issues.

Trade policy officials and regulators must see that change is coming – and act on it.

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Box 6803, S-113 86 Stockholm, Sweden
Phone +46 8 690 48 00 • E-mail registrator@kommers.se
www.kommers.se