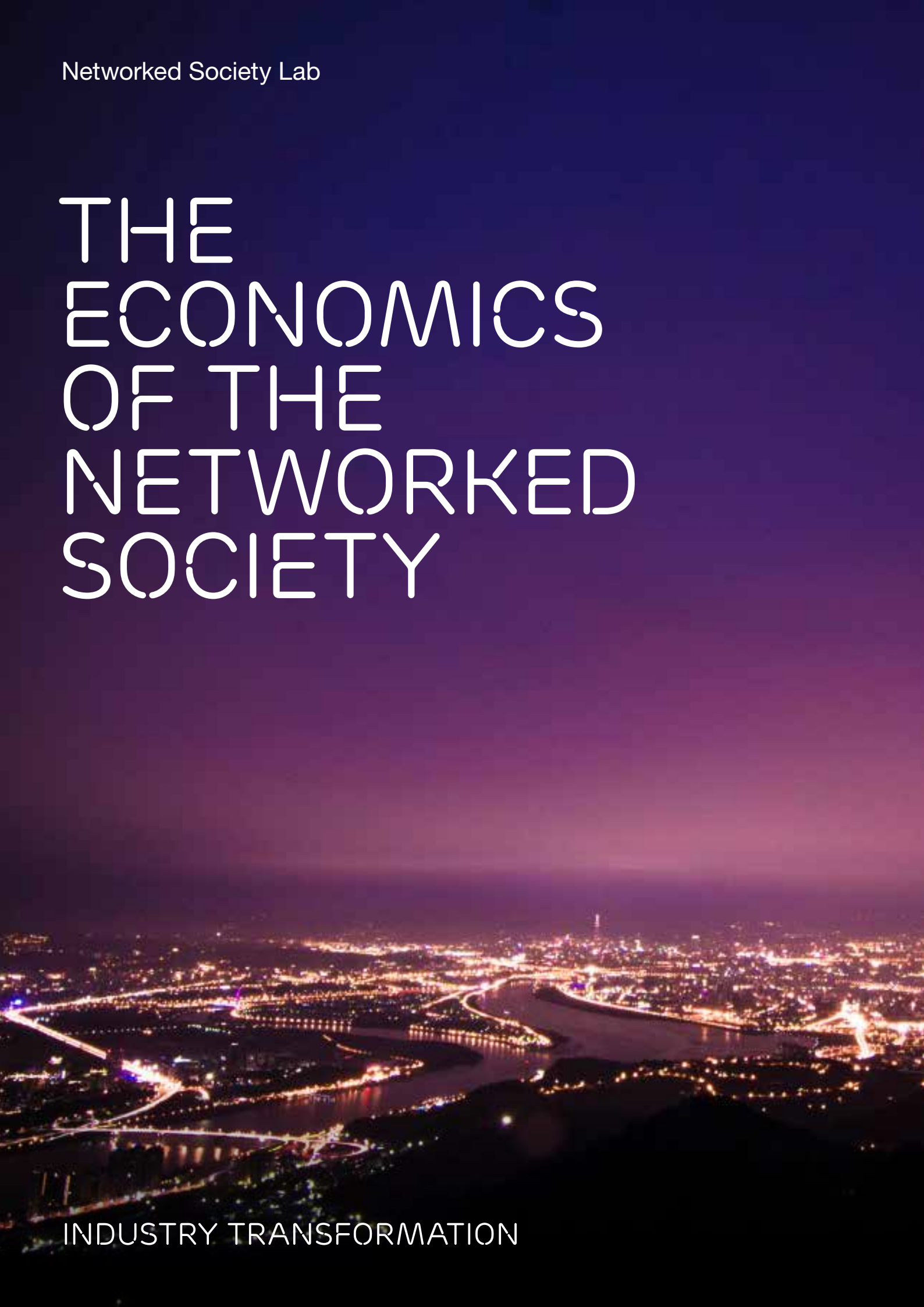
Networked Society Lab

THE ECONOMICS OF THE NETWORKED SOCIETY



INDUSTRY TRANSFORMATION

STRUCTURE OF THIS REPORT SERIES

This report represents the culmination of nearly a decade of research into various aspects of digital technology's emerging role in the economy and society and its impact on the environment. It would not have been possible without the support of many people and the vision outlined in the RCUK Digital Economy Program, which provided funding for a significant proportion of the work.

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This document is the fourth Working Paper of the Sustainable Society Network+

METHOD & SCOPE OF THE REPORT

METHOD

This document is developed using "safe operating boundaries for industrial structures", a method that combines systems analysis with traditional measurement methods as well as extensive interviews across various parts of an industry's value chain in order to try and understand the possible emergent characteristics of industrial structures and the role that digital technologies may play in creating innovation, disruptive or otherwise.

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SCOPE

This document is the last in a series of 'horizon scans' designed to generate greater understanding about when, where and how digital technologies may have an impact on existing industrial structures. These reports focused on disruptive innovation – innovation that may restructure existing power relations within an industry or create entry points for new players to enter the market.

This final report presents the final results of the industrial analysis across six industries and outlines some of the core fundamentals that can be identified as a result of digital disruption, or the "Economics of the Networked Society".

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Sustainable Society Network

GSoA INDI

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DISCLAIMER

All care has been taken in the preparation of this document, but no responsibility will be taken for decisions made on the basis of its contents.

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EXECUTIVE SUMMARY

> "…pre-2006, the only references that really matter are the economic concepts themselves."
>
> MD, Economics Consultancy

It is without question that our global economy has undergone some dramatic changes as a result of digital technologies. Multiple industries have faced new competitors that have applied the power of ICT to dramatically reshape the manner in which goods and services are delivered to end users. Despite digital disruption being a relatively new phenomenon, it is possible to gain insight into the emerging economics of the Networked Society.

In 2005, critical thresholds were simultaneously crossed in the various parts of the technology value chain. Initially, only ICT companies themselves felt the most dramatic impacts of these thresholds being crossed – for example, the service layer of the mobile industry was completely reformed with the introduction of the iPhone. Technology soon began tearing down more entrenched barriers between people, industries and systems. A Networked Society was born – one where technology would play a fundamental role in the development of economy and society.

Over the next few years, however, this Networked Society combined with the results of a heavily financialized economic system to create a challenge not just to the established structure of the technology industry, but also to the very foundations of our economic system as it has been understood since the beginning of the last century. This Networked Society demands that we re-examine some of the very fundamentals of economic theory in order to properly understand how "digital" is interacting with them.

Building on an in-depth analysis of six industries, this report outlines the "Economics of the Networked Society" and illustrates that companies need to think differently in the face of these challenges.
In short, we can see:

1. Digital technologies are no longer re-enforcing economies of scale as has previously been the case.

2. Digital technologies have redistributed the productive elements of the corporation across the economy. Factors of production have become modular and can be put together in new ways.

3. As a result, a new economic fundamental has emerged – economies of aggregation.

4. Computational capacity is a new asset class for companies and should be recognized on company reports.

5. ICT is playing a key role in the ongoing restructuring of the world economic system, rebalancing the spread of product and service development between global and local.

We are far from the end of this transition and are witnesses to what may be a relatively unique event in human history: the emergence of a new type of economic system. In this new system, value is measured by completely other means than pounds, dollars and cents, and the very notion of value itself is brought into question.

1. INTRODUCTION

Over the past decade, ICT has started to play a much larger role in society and has begun to challenge how our economic system is understood and structured. Technology no longer just improves the productivity and efficiencies of large-scale companies; instead it has started to tear down institutional barriers and place control of content into the hands of end users.[1] It also connects not just people but industrial systems and the physical environment in new ways that challenge the existing operating structure of many industries.

While there is often a focus on particular technologies, such as IoT or 5G, focusing solely on the latest technical advancements can be misleading: digital disruption is starting to redefine the manner in which the global economy operates.

Far beyond an individual technology, therefore, the current forces at work in our world require us to identify the economic fundamentals of this Networked Society so we are better equipped to build effective and appropriate strategies in an era defined by resource constraints, population increases and the restructuring of global power bases. Understanding these characteristics is also critical to designing the next generation of technologies and companies as technology and the economy become more deeply intertwined with one another.

This report investigates these aspects. It starts with an investigation of why this shift has happened now and why it is critical to re-assess the economic fundamentals of society. It then covers a brief review of the six industries studied within this research and concludes with the outline of the Economics of the Networked Society.

[1] Benkler, Y. (2006). The Wealth of Networks: How Social Production Transforms Markets and Freedom, Yale University Press.

1.1 SHIFTING ECONOMIC STATES

2005 marked a turning point for our society and the manner in which we organize the productive elements of our economy due to the application of ICT. From the first solutions in the 1960s, ICT had been used to improve efficiency and productivity in companies – it did not move the economic system to a new mode of operation but remained in its original attractor state, as illustrated in Figure 1.[2]

After 2005, however, several technical and financial thresholds were crossed simultaneously that created irrevocable symmetry, thus breaking power in a number of industries. Initially, these forces reformed the mobile industry and the manner in which companies stored and managed data in the computing industry. At an increasing rate, however, the crossing of these industrial thresholds is creating disruption across a broad number of industries. Combined together, these changes are exerting enough force on the economic system to push it towards a new stable state, as illustrated in Figure 2.

While this is often referred to as "digital disruption" or digitization, it is actually the result of the interaction of a number of industrial thresholds, including financial ones. Within this document, we briefly review four main thresholds:

1. **Device processing speeds**
2. **Critical mass of end users with access to 'computational capacity'**
3. **Connectivity between previously closed systems – or use of open APIs**
4. **Increased levels of financialization in the global economy since the 1980s**

Figure 1: Use of ICT since the 1960s has not triggered the economic system to move to a new attractor state.

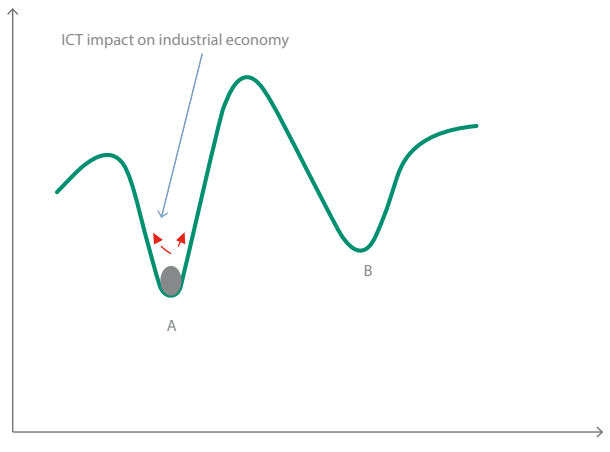
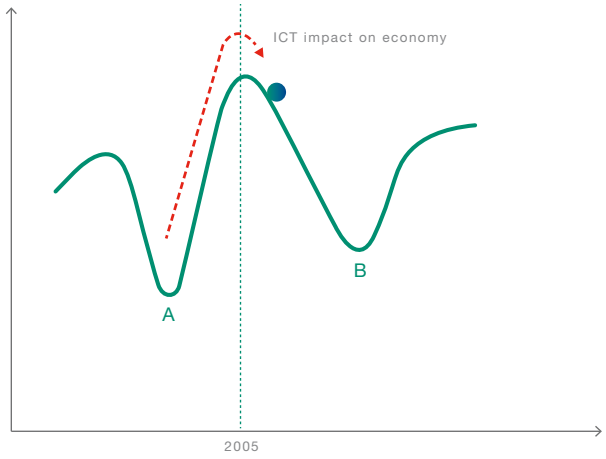


Figure 2: After crossing certain thresholds since 2005, digital technologies have started to push our economic system toward a new attractor state.



[2] We do not go into detail here on system attractor states other than to state that while systems are dynamic and changing continuously, they also tend towards a relatively stable state, which is labelled 'an attractor'. In order to move to a new stable state, a disturbance, noise or external influence is required.

1.2 DEVICE PROCESSING SPEEDS

The processing capacity of a device refers to the speed and number of operations its processor can handle in a given amount of time. Over the last few decades, processing capacity has both increased and dramatically reduced in cost. For several decades, the greatest impact of these increases were seen in the computing industry – chipset speeds increased dramatically in the PC market, finally leading to such cheaply available processors that cloud computing became a viable option.

The processing capacity of mobile devices remained limited for many years. At the very beginning of this century, however, mobile devices began to reach similar processing capacity to a mid-1990s web server.

While increased processing speeds in both mobile and computing environments would have likely improved the speeds of services and the overall productivity and efficiencies of several industries, this alone is unlikely to have challenged the established industrial structures since the beginning of the 20th century. In order to trigger a larger, systemic change, accessibility to this processing capacity is a key requirement – for many decades, it remained in the hands of large companies rather than individuals, but by 2007, a critical mass of end users had access due to the increasing speeds of mobile device chipsets.

Figure 3: MIPS in PC, 1974 – 2008[3]

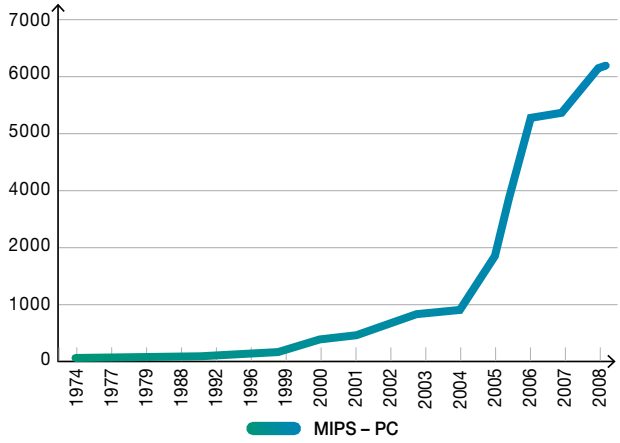
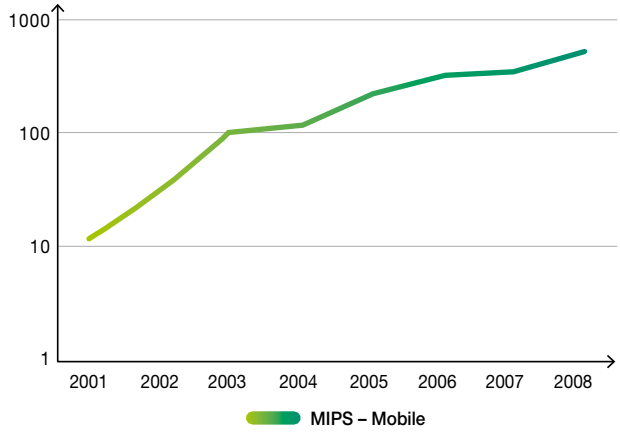


Figure 4: MIPS – Mobile: 2001 – 2008



[3] MIPS have now fallen out of use as a metric as it is increasingly difficult to accurately measure MIPS with CISC architectures, but are used here to illustrate the evolution from the 1960s.

1.3 CRITICAL MASS OF END USERS

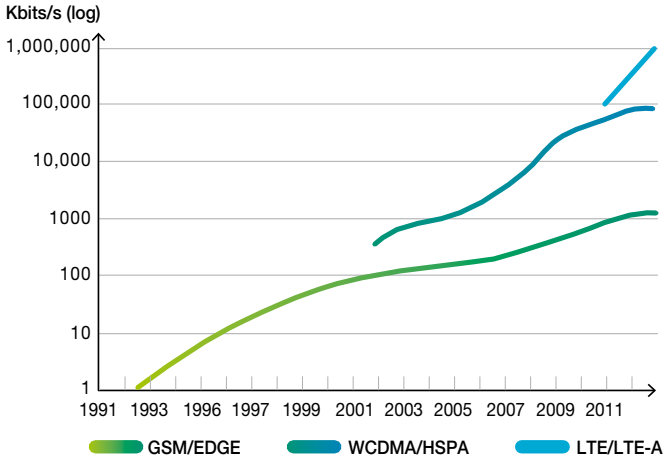
Over the last decade of the previous century, mobile devices became ubiquitous, not just in developed nations but in developing ones as well. Access to relatively cheap, high-speed mobile broadband provides access to processing capacity for a large number of end users globally. Two metrics form the basis of this threshold, therefore – the number of end users and the bandwidth with which they are able to access systems.

	2007[a]	2010[a]	2013[a,b]
World population	6.6 billion	6.9 billion	7.1 billion
Fixed broadband	5.20%	7.60%	9.80%
– Developing world	2.30%	4.20%	6.10%
– Developed world	18.00%	23.60%	27.20%
Mobile broadband	4.00%	11.30%	29.50%
– Developing world	0.80%	4.40%	19.80%
– Developed world	18.50%	42.90%	74.80%

[a] Per 100 inhabitants. [b] Estimate.

Source: International Telecommunications Union

Figure 5: Mobile Technology Speeds, 1991 – 2013



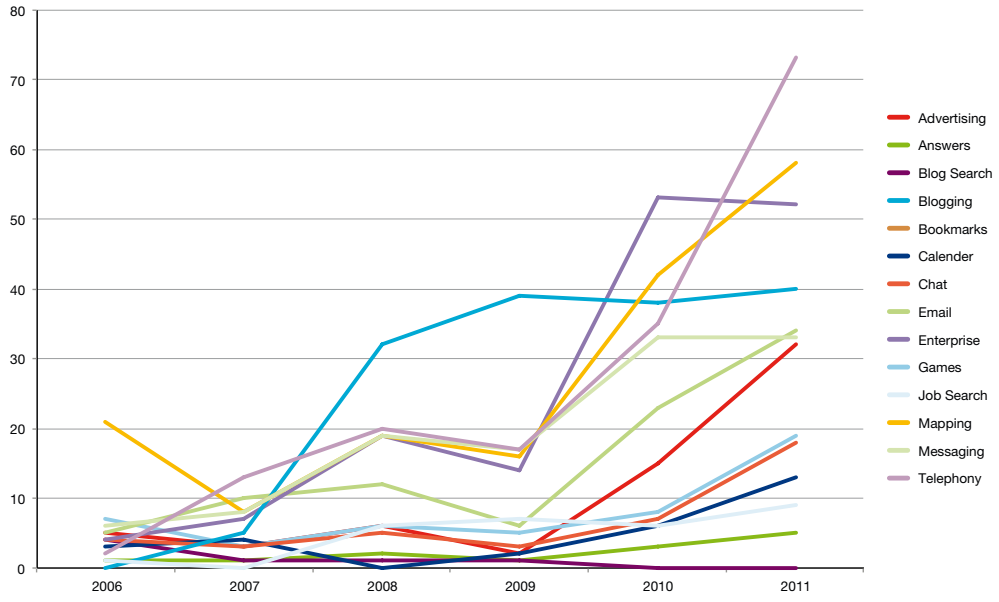
Once more than 50% of the developed world had access to mobile broadband, a critical mass had been reached that gave individuals and smaller companies access to processing capacity similar to that of large companies. As a result, they are now able to increasingly challenge the manner in which goods and services are created, managed and delivered across the world, harnessing local networks and sharing computing power – creating digital disruption within industrial structures where incumbents were still working solely according to economies of scale and globalized operations. The developing world is now rapidly catching up and set to overtake the developed world in use of mobile broadband at the same time as dramatic levels of innovation are opening up.

1.4 CRITICAL MASS OF CONNECTIVITY

Application Programming Interfaces (APIs) were developed early on in the computing industry, which allowed developers to work separately on the same system. In addition, APIs were used to create third party applications on existing platforms. While APIs have been with us since the mainframe era, something unique started to happen in approximately 2005 – the first open API was developed and released. Open APIs applied the API concept to entire systems – creating a variety of large- and small-scale platforms such as Twitter or Facebook connected via the Internet. Developers could use open APIs to connect these systems together and to create innovative new products that were previously not possible – open APIs removed transaction costs and created new markets.[4]

More importantly, however, open APIs triggered a shift in our economic system as people began to realize that not all transactions needed to be mediated by large companies and their associated economies of scale. The increased levels of connectivity between previously closed systems in conjunction with increasing processing speeds meant that barriers to the creation of innovative products and services began to fall. A shift towards a new economic system became possible.

Figure 6: By 2010, an increasing number of systems were being connected together via open APIs.



[4] Mulligan, CEA.,(2011). The Communications Industries in the Era of Convergence, Routledge Studies in Global Competition, Routledge.

1.5 INCREASED FINANCIALIZATION

Scale, the notion that companies need to be large in both size and scope of activities in order to succeed, has been a foundational aspect of our economy since the early 19th century. Factories were the precursors to this, bringing "increasingly large numbers of workers directly under a single management."[5] Large-scale production required large-scale management and financing – ensuring economies of scale and scope became key features of the modern economic system. Financing became a large-scale activity, as well as production.

As outlined in the Financial Services report, since the 1980s the economic system has become increasingly financialized due to a number of regulatory decisions taken in the USA and UK. As this continued, companies were reduced to a "nexus of contracts."[6] The result of this has been the formation of large companies, as measured by traditional scale economies, but with significantly fewer employees.

As the processes of financialization have spread, an increasing number of workers have been forced to find new means by which to support themselves. Digital technologies have provided one means by which to achieve this, through the development of micro-companies and through individuals using digital technologies to participate in multiple platforms such as TaskRabbit or similar. As will be discussed in more detail later, this has significantly redefined the boundaries of the firm.

SUMMARY

The combined crossing of these thresholds has enabled the "disaggregation of the corporation," opening up the prospect of changing the manner in which our economy is organized. As Davis[7] outlines, "clever design, low cost, and good marketing were the essential elements; the rest could be hired out. The centripetal force that encouraged the concentration of corporate assets and employment was no longer operative,"[8] and now the concentration of capital and labor into large corporations can be replaced through the application of ICT.

[5] Davis, G. (2013). After the Corporation. Politics & Society, 41: 283.
[6] ibid
[7] ibid
[8] ibid

2. INDUSTRY REVIEW

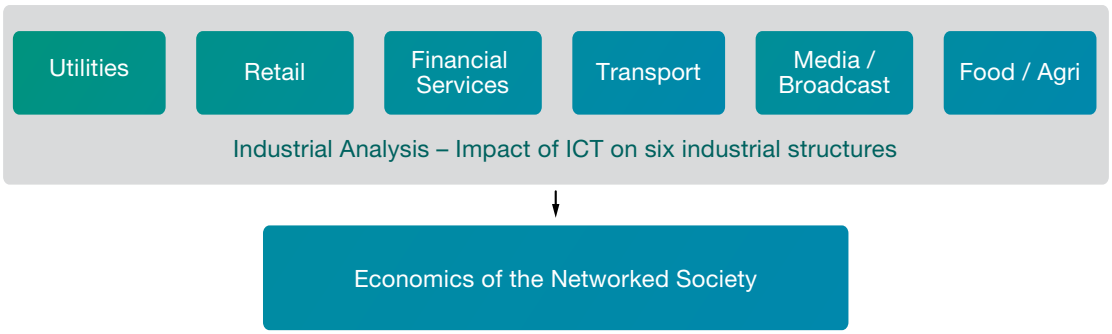
This report builds upon an extensive analysis of six industries: Utilities, Retail, Financial Services, Transport, Media and Broadcast, and Food and Agriculture. These were selected due to their size in the global economy and the possibilities for digital disruption based on the thresholds outlined in the previous section.

We investigated the role of the industrial disruption created by ICT from a systems perspective, analyzing how these new solutions are redefining roles in the industry, creating new value chains, and shaping new roles for ICT within various industries. The detailed results of these analyses have been published separately and are available at: http://www.ericsson.com/industry-transformation/

Through this analysis, several emerging economic principles became evident across all these industries. Together they can be viewed as an emerging economic basis for the Networked Society:

1. **Computational capacity has emerged** as a key factor in certain parts of the global economy.
2. This computational capacity – **and the ability to access it** – is redefining the notion of trust in our society, in particular with regards to institutional structures such as banks and governments.
3. **The notion of scale is being redefined,** challenging the basis of economic organization that has been dominant since the beginning of the last century.
4. **Productive elements of society are being redistributed,** which is beginning to redefine how the economy combines land, labor and capital.
5. **A rebalancing between global and local supply chains** is being enabled.

Figure 7: Reports Structure



2.1 COMPUTATIONAL CAPACITY AND NEW FORMS OF ORGANIZATION

COMPUTATIONAL CAPACITY AND NEW FORMS OF ORGANIZATION

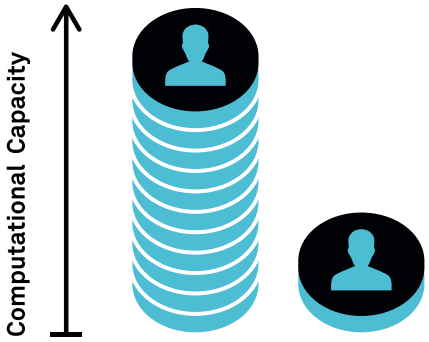
Across all six industries that were reviewed it is apparent that digital technologies are disrupting established industrial structures. Initially, this was limited to the cloud computing solutions of large companies such as Amazon, but as handset chipsets have increased in power, the ability to disrupt industries is now in the hands of individuals, not just large companies. "Computational capacity," or the combination of cheap processing, accessibility to it and analytical capabilities is redefining economic structures.

These three aspects combined allow companies and individuals to apply computational capacity in new ways to create symmetry-breaking power in long established industrial structures.

COMPUTATIONAL CAPACITY = PROCESSING + ACCESSIBILITY + ANALYTICS

Computational capacity may now be viewed as a key capability for a company in creating competitive advantage within the current global economy. Google created scale of computation in order to corner the world's search market, and Facebook used similar tactics to create scale of end users on its social media platform. Amazon, meanwhile, used computational capacity to redefine online shopping. This computational capacity is a core differentiator among different companies in the emerging economic structure:

Figure 8: Computational capacity can be used to compare companies in the same manner as market capitalization.



Computational capacity is now a corporate asset that is critical for creating scale in the Networked Society. We now have "large companies" according to user base and market cap, with comparatively small employee bases, but massive computational capacity that allows them to capture scale with end users. In some cases, computational capacity is now more important than capital or labor to such companies. Indeed, the need to raise capital is often secondary to the need to have access to scalable computational capacity and large user bases upon which analytics can be used to understand aggregated user behaviors.

2.1 COMPUTATIONAL CAPACITY AND NEW FORMS OF ORGANIZATION

"…it is certainly striking that these newly public companies are listing their shares on markets because they need to satisfy their early investors and employees who want to cash out, not because they need capital to grow their business."[9]

Company	Employees 2013	Market Cap 2013 USD (BN)	R&D Budget 2013 USD (BN)
Google	47,756	336.8	8
Facebook	6,337	145.96	1.4
Amazon	117,300	123.19	4.7
Apple	80,300	462.3	4.5
MSFT	128,076	292.3	10.4
Ericsson	117,655	35.34	4.853
Alca-Lu	48,628	4.64	2.86
Huawei	150,000	N/A	N/A
Samsung	275,133	180	13.4
Intel	107,600	107.5	10.6

It is critical to note, however, that computational capacity does not need to be located within one corporation. A key identifier of the new emerging economic structure is the distributed nature of operations – society is starting to work as a series of interconnected networks.[10] Computational capacity is therefore just as likely to be found across distributed networks. It should be made clear, however, that these networks are not technical ones – they are networks that connect individuals and productive elements of society together in new ways. The networks that define our world are no longer solely those built of copper and radio waves.

[9] Davis, G. (2013). After the Corporation, Politics & Society, 41: 283.

[10] Castells, Manuel. (1996, second edition, 2000). The Rise of the Network Society, The Information Age: Economy, Society and Culture Vol. I, Cambridge, MA.

2.1 COMPUTATIONAL CAPACITY AND NEW FORMS OF ORGANIZATION

Probably the best example of this is Apple. Apple used computational capacity to create symmetry-breaking power in the mobile industry. By placing processing power in the hands of individuals as a network of end users and developers rather than in the centralized service creation centers of the mobile network operators, Apple completely redefined how services were delivered through apps and other platform services. In less than a decade, the traditional service layer of the mobile industry was decimated.

Having access to cloud computing, mobile devices and data science tools is not relevant without the analytical ability to use them appropriately. For example, within the Retail Report (ref), we see the use of Twitter by SMEs in order to create a real-time supply chain management system. While handsets had been capable of providing such solutions for several years, it was only with the addition of easy, high quality photography and the ability to “tweet” it to those looking for products that true digital disruption was enabled. Twitter, by its near real-time nature, allows end users to rapidly share supply chain requirements across a large network that can dynamically respond to requests. Through this computational capacity, individuals were able to create localized supply chains for their goods and services that can compete with systems implemented by SAP or Oracle.

2.2 COMPUTATIONAL CAPACITY AND THE REDEFINITION OF TRUST

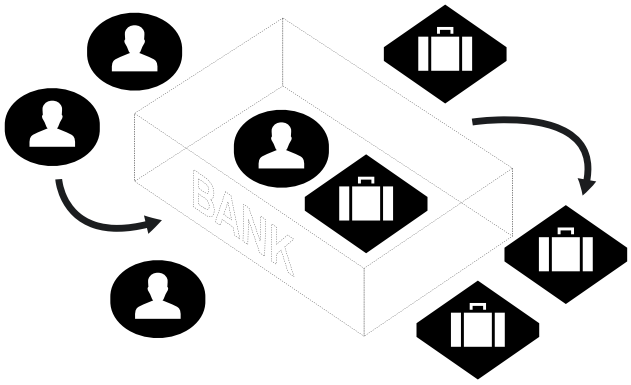
Computational capacity has helped to redefine trust in our economy. Both economic and organizational theory has illustrated that "compared to trust, price and authority are relatively ineffective means of dealing with knowledge-based assets."[11] As digital technologies have proliferated in society and as end users have been able to access increasing levels of computational capacity at consistently lower prices, high-trust institutions have started to proliferate,[12] and this is challenging the established structure of various parts of our economic system.

The most obvious example of this has been the creation of the distributed ledger, which forms the basis of solutions such as Bitcoin. Trust – and the manner in which it is handled in society – is critical to the foundations of both economy and society. Traditionally, as illustrated in the finance report, this trust has been vested in governments for most of the capitalist era: Central banking authorities have been responsible for creating the trust that underpins our legal, financial and government systems.

For example, banks are the traditional institutions for managing financial services. Barriers to creating trust were extremely high. In order to start a bank you had to be accredited by a central authority, have access to enough capital to provide services and have complex ICT systems in place to manage your ledger.

Through sharing computational capacity, however, cryptocurrencies such as bitcoin have allowed the redefinition of the notion of trust. Trust is created by all of the people involved in the network, not by a central authority.

Figure 9: Traditional banking system



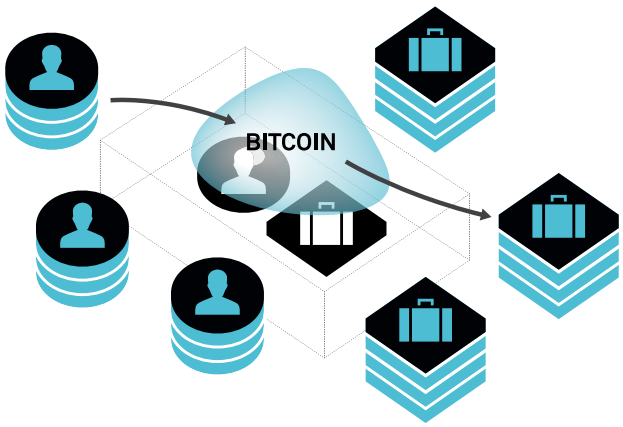
Digital technologies have therefore enabled a modern form of trust to emerge – one in which trust is generated by all people who hold a small part of the whole. No single person or authority is responsible for providing "trust" – all are responsible for creating it together. This allows the possibility of bypassing existing banking systems altogether, but more importantly, this form of digitally-enabled trust challenges many different aspects of our established social order, as illustrated in Figure 10.

[11] Adler, P. (March–April 2001). Market, Hierarchy, and Trust: The Knowledge Economy and the Future of Capitalism, Organisational Science, Vol. 12, No. 2, pp. 215–234.

[12] Adler, P. (March–April 2001). Market, Hierarchy, and Trust: The Knowledge Economy and the Future of Capitalism, Organisational Science, Vol. 12, No. 2, pp. 215–234.

2.2 COMPUTATIONAL CAPACITY AND THE REDEFINITION OF TRUST

Figure 10: Computational capacity creates a new basis for provision of trust.



The emergence of computational capacity – i.e. the combination of both bandwidth and cloud computing – may "ultimately challenge the foundations of our capitalist form of society while simultaneously creating the foundations of a new, post-capitalist form."[13] Increasingly, therefore, digital technologies are helping to redistribute the balance of power between large companies, individuals and smaller companies.

[13] Adler, P. (March–April 2001). Market, Hierarchy, and Trust: The Knowledge Economy and the Future of Capitalism, Organisational Science, Vol. 12, No. 2, pp. 215–234.

2.3 REDISTRIBUTION OF THE POWER OF SCALE

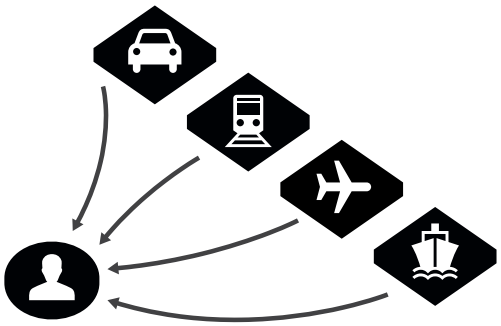
Platforms have been one of the most commonly used frameworks for analyzing digital technologies in recent years. A platform is something that an entity develops that third parties are able to build upon. Examples include shopping centers, which create a physical platform bringing together the land and the capital required to develop the overall building and determining which shops are able to rent in order to sell goods and services.

Operating systems are another example. Microsoft developed MS Windows allowing 3rd party developers to create innovate applications on top and sell them to end users of the Windows platform.

In the modern economy, solutions like Twitter are also platforms. Twitter invested large amounts of capital and time into developing the platform which was then opened up to developers to create services via an Open API or “data hose”.

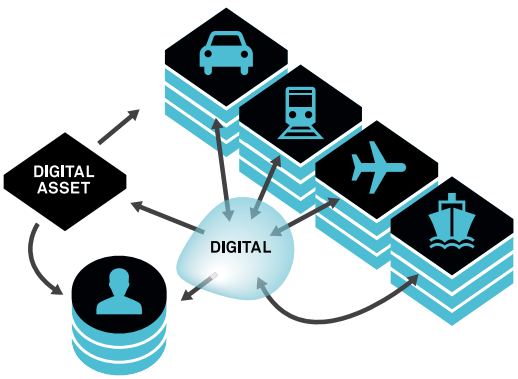
The proliferation of Open APIs has helped to create new services that link together many existing platforms where end users are now able use websites that pull in multiple results from various platforms:

Figure 11: Traditionally, end users need to spend time and energy searching options.



Open APIs, in conjunction with access to computational capacity, has provided small firms and end users with access to scaling capabilities that were previously only accessible by large corporations.

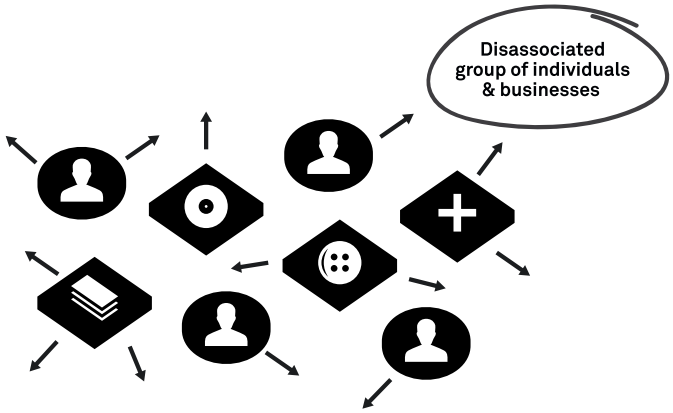
Figure 12: End users can now utilize computational capacity to search more effectively.



2.3 REDISTRIBUTION OF THE POWER OF SCALE

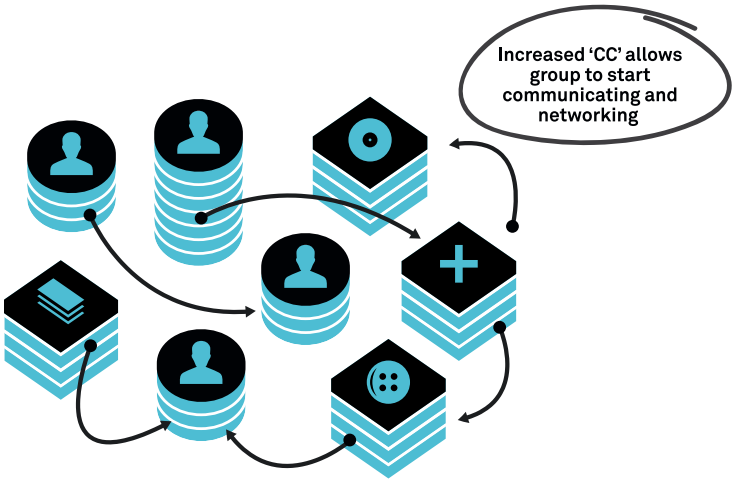
Digital technology has therefore changed the balance of power with regard to scale within the economy. Individuals are now able to coordinate with one another through digital technologies in dynamic strategic networks without needing the structure of a firm to negotiate prices on the market. Through the aggregation of resources and efforts, individuals are now able to manage transaction costs much more efficiently, enabled by computational capacity.

Figure 13: Originally individuals were unable to coordinate effectively.



With computational capacity, individuals are able to act as a distributed network of economic nodes. Due to bandwidth, processing capacity and open APIs, a new form of economy is emerging: individuals are able to work together as a strategic network (dynamic), something between the homo economics and reciprocans, as discussed in Section 3.

Figure 14: Increased computational capacity has enabled the creation of new modes of economic organization.



2.4 ASSET PLATFORMS

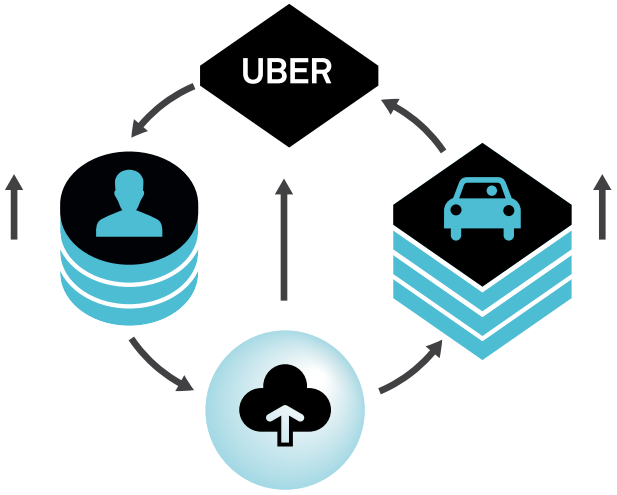
Another key aspect revealed in all six industrial reports was the use of digital technologies to disrupt some industrial structures through the innovative combination of digital technologies to organize other people's physical assets. These are perhaps the most well-known "digital disruptors" in industries today. These technologies are often referred to as "platforms" – as though they are similar in form and function to the solutions described above – but this is potentially highly misleading and does not capture fully what is happening in the economy.

Instead of creating a platform upon which others can innovate, Uber has developed technology that allows it to aggregate other people's resources and time for its own profit. Uber is therefore better viewed as an aggregating entity – there is very little marginal cost for them to add another end user to their system, but they are able to capture increasing revenues from it. It is instead creating a matching system – not a platform – by coordinating supply and demand of physical assets and human labor by aggregating them together in a digitally enabled form.

In contrast to other solutions, such as carpooling or bike schemes which have purchased and distributed physical assets and use digital technologies to enable people to book them, these solutions allow companies to earn profits from end user's physical assets with no investment in physical infrastructure other than some basic digital assets. These asset platforms are able to combine productive elements of the economy together in new ways.

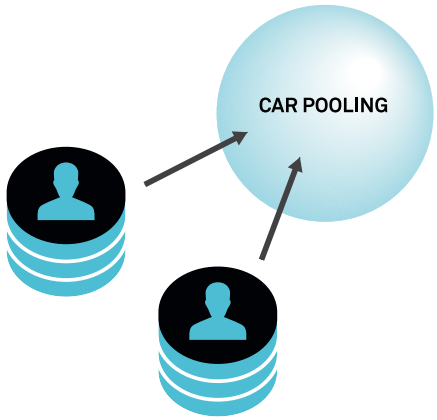
This raises interesting challenges not just to regulation, as has already been seen in many countries, but also to our understanding of how the productive elements of the economy are distributed, combined and allocated, as will be discussed in Section 4.

Figure 15: Uber's digital assets allow them to control people, time and other people's physical assets for significant financial gain.



2.4 ASSET PLATFORMS

Figure 16: Carpooling allows people to share assets in a mutually profitable manner.



In previous eras of economic development, those who were able to exercise control over the most important elements of the economy (in varying stages – land, labor and capital) were able to amass dominant power and control over not just money, but people and the manner in which services were produced. Computational capacity has redefined the traditional manner by which these are combined – factors of production can be viewed as having become modular. Computational capacity also raises key questions about the future of employment. Those with access to large amounts are able to exert control over those with limited access in a way that has previously been impossible. Computational capacity is changing the foundations of the corporation and how production is managed across the economy.

Computational capacity has raised another set of issues which our current regulatory environments are struggling to address, as illustrated in all the industrial reports: companies with sufficient access to computational capacity are able to put individuals to work for them in the same manner as those who used to have control over land or capital. In some cases, the ability of Uber and similar companies to harness other people's assets and labor with little capital investment of its own may be viewed by some as a new form of exploitation in which people face such a hollowed-out job market due to digital disruption[14] that they are forced to work for extremely low wages in a variety of jobs.[15] We are therefore entering an era in which computational capacity may emerge as one of the most important secondary factors of production and might erode workers' rights and the provision of safety nets[16] if not carefully managed through regulation.

[14] http://www.reforminstitutet.se/fler-nya-jobb-trots-automatisering/

[15] Singer, N. (August 16, 2014). Check App. Accept Job. Repeat. In the Sharing Economy, Workers Find Both Freedom and Uncertainty, NY Times,.

[16] Davis, G. (2013). After the Corporation, Politics & Society 41: 283.

2.5 REBALANCING OF GLOBAL AND LOCAL PRODUCTIVE CAPACITY

While globalization is not new, the recent internationalization of economic activity has been dramatic. Workers' roles across the globe have been recast by the decisions of large-scale companies to relocate centers of production over the past four decades.

When ICT was introduced in the early 1960s, it was initially used to improve the speed and efficiency of business processes, removing human error from things like payroll. ICT continued to be applied in this way – most companies active in the ICT space were created to help companies manage, store and manipulate data and did so through to the 1990s. With the increasing penetration of the Internet, companies began applying ICT to interact with companies and suppliers across proprietary systems, again using ICT to increase productivity. ICT was therefore applied within well-established industrial boundaries – it increased productivity and was used to ensure companies maintained a competitive edge, but did not redefine how the economy worked.

Since the 1960s ICT has been used, in effect, to reinforce economies of scale and the processes of internationalization. Starting in the 1960s, APIs were used in a variety of ways, allowing programming teams to divide labor and work on software in global teams on a 24-hour basis. Over time, however, digital technologies have provided individuals access to the same computational capacity as corporations, allowing them to connect locally and regionally, similar to the way corporations did globally. It is this force that has enabled new organizational forms to emerge. This evolution is outlined in table in the next page.

2.5 REBALANCING OF GLOBAL AND LOCAL PRODUCTIVE CAPACITY

Table 2: Eras of Technology, adapted from[17]

ERA	ECONOMICS OF ICT AND API USAGE	IMPACT
1960s – 1970s	ICT is used to automate simple business processes APIs are used by companies for the division of labor internally	Different programming teams can use each other's codes (code re-use).
Late 1970s – Early 2000s	ICT used to fuel globalization of production, in particular supply chains and value networks. APIs used to internationalize business processes	Different teams located in different parts of the world can use each other's codes. System integration becomes a key issue for companies' internally R&D
Late 2005 – Onwards	ICT increasingly used to connect digital and physical worlds Open APIs used to reduce transaction costs and create new markets Aggregative effects increase across the economy driven by ICT and Open APIs	External parties can access data and system functions connected via the Internet System integration becomes a key issue for companies' externally R&D Individuals gain access to similar computational capacity as companies in the mid-1990s precipitate a redefinition of productive elements in the global economy Factors of production become modular

Digital technologies now provide an alternative to the current heavily globalized economy[18] in which corporations with global scale are balanced with local production and local employment. One example is the emergence of digital technologies that are designed to provide solutions for 'last mile logistics' for local shops, as discussed in the retail report.

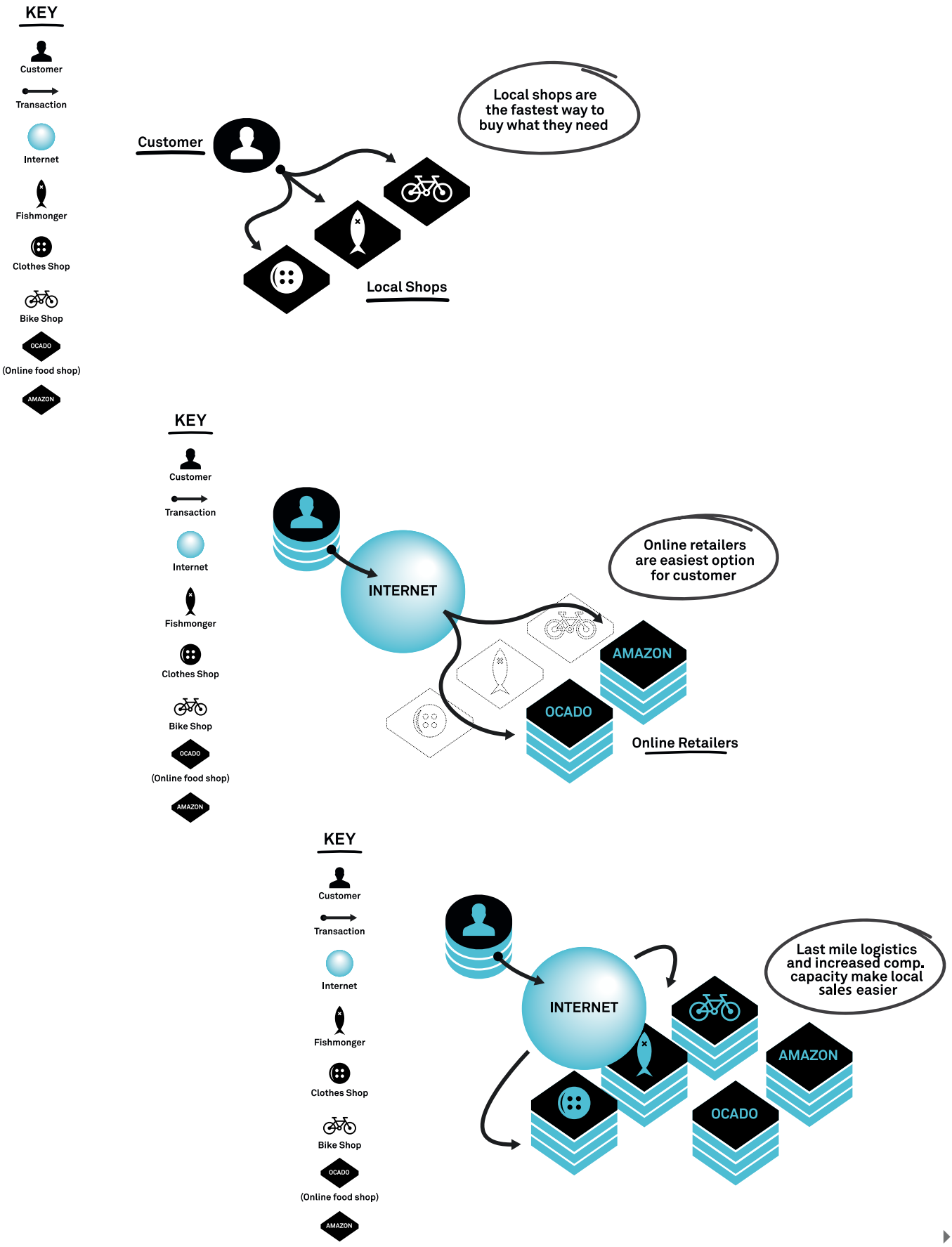
Local shops have faced a dual onslaught from large-scale supercenters and online retailers. Online retailers were able to provide the convenience that end users craved through applying ICT to create vast economies of scale. Last mile logistics, however, have allowed individuals to provide aggregation services for local shops. For example, it is possible to order locally from a range of shops and have goods delivered to your office – a service designed to make local shops as easy to use as large online retailers. This is enabled by computational capacity and increasing mobile broadband, allowing changes to be made to deliveries even after they've left dispatch (Figure 17).

[17] Mulligan, CEA. (2011). The Communications Industries in the Era of Convergence, Routledge Studies in Global Competition, Routledge.

[18] Davis, G. (2013), After the Corporation, Politics & Society, 41: 283.

2.5 REBALANCING OF GLOBAL AND LOCAL PRODUCTIVE CAPACITY

Figure 17: The evolution of computational capacity from online retail though to local production and last-mile logistics.



2.5 REBALANCING OF GLOBAL AND LOCAL PRODUCTIVE CAPACITY

It is clear that digital technologies are challenging our understanding of how the economy is structured. We can now view computational capacity as an extra element for analyzing a company in the emerging Networked Society. Traditionally companies have been analyzed by what product they made and their market capitalization. Now, another element may be added: computational capacity.

Computational capacity has become so embedded into our society and economy that it is now creating new organizational forms in our economic structure.

In the next section, we analyze how to understand the emerging basis of the economic structures in the Networked Society.

3. ECONOMIC REVIEW

This section provides an extremely brief overview of the economic principles we refer to in the rest of the report, with a focus on:

1. **The role of the economy and markets**
2. **Factors of production**
3. **The role of the individual in economic life**
4. **The role of the corporation in economic life**

THE ROLE OF THE ECONOMIC SYSTEM AND MARKETS

Taken in its simplest form, we may view the economic system as bringing together different productive elements of society – traditionally land, labor and capital – in the delivery of basic human needs.

Only in very recent decades have the organizational structures that we see today become commonly accepted. In fact, the "shareholder-owned corporations that were the central pillars of many economies in the twentieth century … are actually relatively odd organizations, even in a globalized era."[19]

In 1890, for example, there were fewer than a dozen manufacturers listed on the major U.S. stock exchanges.[20] The majority of these public corporations were railroads, and even the largest manufacturers were organized as private partnerships.[21] Within 15 years, Wall Street had created a small handful of oligopolistic corporations traded on the stock market and able to serve on a national scale.[22] Over time, our global economy came to be dominated by economies of scale. In order to be successful, companies needed to be large, have access to large amounts of capital, command large workforces and be able to deliver internationally at short notice.

As mentioned, previous technological developments served to reinforce economies of scale and scope, allowing large companies to do more at lower cost – often at the expense of labor. Goods became ever cheaper, and companies housed 24-hour operations and had fewer employees. Productivity improvements were viewed very narrowly by businesses operating with this mindset. They mainly focused on ways to ensure as low a cost per unit as possible and to set as low prices as possible to ensure 'competitiveness' on the market.

FACTORS OF PRODUCTION

Factors of production are those inputs used in the production of goods or services in the attempt to make an economic profit. Land, labor and capital are the three primary factors of production; entrepreneurship is also considered a factor in some economic schools. All three are required in combination to produce a commodity. Materials and energy are often referred to as secondary factors of production.

[19] Davis, G. (2013). After the Corporation, Politics & Society, 41: 283.

[20] Roy, W. (1997). Socializing Capital: The Rise of the Large Industrial Corporation in America, Princeton University Press.

[21] Ibid.

[22] Davis, G. (2013). After the Corporation, Politics & Society, 41: 283.

ROLE OF THE INDIVIDUAL IN THE ECONOMY

Throughout the recent history of economic thought, there have been two main concepts for the behavior of humans within the economic system – homo economicus and homo reciprocans.

Economic Perspectives of human behaviour:

Homo Economicus	Economic theory has often viewed humans as rational and narrowly self-interested actors that are able to make rational assessments in order to maximize utility as a consumer or producer. Specifically, this concept refers to a person who acts rationally based on complete knowledge in the pursuit of self-interest and the desire for wealth.
Homo Reciprocans	The homo reciprocans concept states that human beings interact with a propensity to cooperate, that they will compromise in order to achieve a balance between what is best for them and what is best for the environment in wich they function.

As will be discussed further on, digital technology enables another perspective on human beings in economic systems – one in which people are able to balance the needs of narrow self-interest with those of the community and environment within which they function.

ROLE OF THE CORPORATION IN MODERN SOCIETY

Within the economic system, groups of individuals have tended to work together – most commonly in the form of a firm or corporation – in order to manage what are known as transaction costs:

Digital technologies have tended to be viewed as innovations that allow factors of production to be brought closer together:

> "Outside of the firm, price movements direct production, which is coordinated through a series of exchange transactions on the market ... Within the firm ... is substituted the entrepreneur-coordinator, who directs production."[23]

As will be illustrated, this actually no longer holds. Since the thresholds outlined in Section 1 were crossed between 2005 and 2007, digital technologies are now

> "Inventions that tend to bring factors of production nearer together, by lessening spatial distribution, tend to increase the size of the firm. Changes like the telephone and the telegraph that tend to reduce the cost of organizing spatially will tend to increase the size of the firm."[23]

[23] Coase, R.H. (November, 1937). The Nature of the Firm, Economica.

[24] Coase, R.H. (November 1937). The Nature of the Firm, Economica.

acting to decrease the size of the firm.

Islands of productive capacity across the globe can be combined together without the coordination of large-scale corporate enterprises. These are unlikely to replace all existing large-scale industries, but will instead come to rest alongside them as we undergo a transition to the new economic structure. As a result, the organizational structures by which we deliver basic human needs (within the economic system) are changing.

More importantly, digital technologies are challenging the role of the corporation within the economy itself. Davis[23] defined four different roles of the corporation:

- **Production of goods and services**
- **Employment**
- **Provision of social welfare services**
- **Vessel for individual retirement savings**

For the purposes of this report, we investigate the role of digital technologies on the production of goods and services and employment. The remaining two, while important, are functions mainly associated with U.S. corporations and so are not necessarily representative of global companies. For example, within the E.U., it is the state, rather than corporations, that provides social welfare.

[23] Davis, G. (2013). After the Corporation, Politics & Society, 41: 283.

4. THE ECONOMICS OF THE NETWORKED SOCIETY

While much has been written on digital technologies and their impact on industry and society, little attention has been focused on analyzing ICT's impact on the underlying assumptions that have formed the basis of our economic system since the beginning of the last century.

Section 2 outlined how ICT has removed the need for large-scale capital investment in many cases. A company previously needed to be large to survive and attract sufficient financial resources. In fact, ICT itself was often prohibitively expensive for smaller companies and only large corporations had the financial resources to buy and implement them effectively. In today's economy, broad-scale access to technology by small companies and even individuals has created a situation where significantly lower capital investments are required as new means of financing, such as crowdfunding, take hold.

In addition, where ICT has traditionally reinforced economies of scale by allowing large companies to streamline operations and expand the scope of operations across the globe, economic capacity is now often based on connectivity and the ability of smaller companies and individuals to participate in a variety of economic networks, both locally and globally. As a result, the limit of organizational capacity may no longer be the boundary of the firm, but the ability of individuals and small companies to manage their connections across dynamic strategic networks.

Digital technology therefore has helped overcome coordination failure and transaction costs between individuals and is removing the necessity for scale within our economy. Increasingly, however, ICT is now helping economic actors to redistribute control over factors of production. This is starting to have a big impact on a large number of industrial structures, opening the possiblity that we will return to an economy similar in form to the early 20th century. In other words, an ecomomy characterized by a number of diverse organizational forms – from those requiring large-scale engineering capabilities, such as telecommunications, oil and gas, etc... to smaller companies and individuals that are able to earn sustainable livings due to ICT.

Within this section, we present five main areas where ICT is changing how our economy has been structured for over a century:

- **Modular factors of production**
- **Rebalancing economies of scale**
- **Economies of aggregation**
- **Dynamic strategic networks**
- **Balancing local and global production**

4.1 MODULAR FACTORS OF PRODUCTION

Slowly but surely, digital technologies have helped create modular factors of production, where small companies and individuals alike are able to achieve scale production at short notice and with relatively limited resources. This ability has come from the increased demands on corporations in the last part of the 20th century to focus on core competencies and outsource readily repeatable activities as well as computational capacity.

"Dozens of companies like Apple, Ericsson, and Sony sold their factories to generic manufacturers so that they could focus on their 'core competence' of design and brand management." This basic model has spread quite broadly to cover essentially all of the computer and electronics industry – from consumer goods like branded clothing and pet food to pharmaceutical products.[24, 25] As a result, the corporation of the late 21st century was "hollowed out" and capable of exerting massive control over large supply chains.[26] Power was exerted through the cascade effect where large brand names such as Nike controlled vast supply networks through purchasing power.[27]

An interesting side effect of this process was that it suddenly became extremely easy to access manufacturing capability, even for smaller companies. Production had become modular enough for small companies as well as large companies such as Ericsson and Apple to outsource the manufacturing of hardware to Malaysia and China. Small companies and individuals are now able to have a great product idea, produce it and go to market quickly. Many electrical engineering departments in universities even outsource the manufacture of student projects to foreign countries, preferring to instead develop students' design skills.

For software, it is even easier, as everything can be found online – from relatively cheap prices to incorporate a company, to crowdsourcing the required capital and hiring coding teams. It is no longer necessary to have access to large amounts of capital – if you have an idea for a product or service to launch, it is easier than ever to do so.

[24] Nolan, P., Zhang, J., and Liu, C. (2008). The global business revolution, the cascade effect, and the challenge for firms from developing countries, Cambridge Journal of Economics.

[25] Davis, G. (2013). After the Corporation, Politics & Society, 41: 283.

[26] Gereffi, G., Korzeniewicz, M. (1994). Commodity Chains and Global Capitalism, Contributions in Economics and Economic History, Praeger.

[27] Nolan, P., Zhang, J., and Liu, C. (2008). The global business revolution, the cascade effect, and the challenge for firms from developing countries, Cambridge Journal of Economics.

4.1 MODULAR FACTORS OF PRODUCTION

To a certain extent, the factors of production – in particular labor and capital – have been modularized by the ubiquitous availability of digital technologies. Labor and production costs become increasingly irrelevant to the formulation of prices. Increasingly, value may be measured in digital terminology, rather than in dollars and cents. Where productivity improvements are not about reducing costs, but rather about increasing processing capacity and increasing transmission capacity, companies may begin to exchange these as units of value, rather than pounds, dollars, euros or other currency.

Production has become modular across nearly every industry, allowing both large and small firms to contract out the manufacture and distribution of physical goods. This modularization would not have been possible without computational capacity. Digital technologies, by allowing the allocation of these modular resources differently across time and space, have removed the need for large-scale intermediaries – or corporations – that have managed scale operations for over a century.

The impact of ICT on the factors of production is illustrated in Table 3.

Table 3: ICT and modular factors of production

FACTOR OF PRODUCTION	IMPACT OF ICT
Capital	Previously, wealth – and the social connections required to accumulate capital for entrepreneurship – were concentrated in a certain number of hands. While digital technology has not redistributed wealth or social connections themselves, it has made access to capital for new ventures as simple as accessing a website. Even accessing other people's physical assets is now as simple as an API call.
Labor	Access to labor has become significantly easier – entrepreneurs are able to "plug" different skillsets into and out of projects as the need arises. They also don't need to provide traditional contracts for these services – they can be accessed in aggregate from around the world.
Land	As M2M and IoT solutions become more deeply embedded in the urban environment, land will also become modularized, with people able to access it – and earn money from it – via computational capacity.

4.2 REBALANCING ECONOMIES OF SCALE

Our current reliance on the large-scale companies, which became prevalent in the early 20th century, is therefore being challenged by digital technologies. By disrupting the manner in which productive elements of the economy can be put together, very few companies now really need the large-scale capital investment to the same extent as previously required. This means that "many alternative organizational forms become possible." Industries such as "oil refining and distribution, airplane manufacture, and large-scale telecoms networks" are now the only ones remaining that are "typically done on a scale that requires investment large enough to entail listing on a stock market (or being state owned)."[28] We may even view development as no longer "a process of capital accumulation but rather as a process of organizational change."[29]

"The massive expansion of a sector of 'generic' manufacturers and distributors in China and elsewhere allows enterprises to scale rapidly and collapse even more rapidly while employing relatively few people. The scale of these collapses is therefore less dramatic than previous corporate collapses." Nowhere is this clearer than in the technology industry itself – "surprisingly few people actually work in the high-visibility success stories of the tech economy."[30]

"The combined global workforces of Google (32,467), Apple (63,300), Facebook (4,000), Microsoft (90,000), Cisco (71,825), and Amazon.com (56,200) – 317,792 as of the end of 2011 – are smaller than the US workforce of Kroger (339,000)."[31]

Scale therefore starts to mean many different things to different people. While we can draw parallels to what happened in Adam Smith's era, there is little in the way of a road-map to take us through these uncharted waters. Companies talk about geographic scale for smart cities (coverage) or scale of users (how many people are on Facebook), not necessarily about producing more goods at a lower unit cost. Scale becomes the ability to shift energy demands in space and time.

One thing is clear: while the era of big infrastructure is still with us, it is likely coming to an end. Only those industries that still require large-scale financing will continue to work along these lines. We may, therefore, be returning to a pre-20th century form of industrial organization, one with many small and medium companies alongside the extremely large ones. For other industries, production and employment can be organized at a much more local level. Indeed, they have to be in order to save the planet from impending resource constraints.

[28] Davis, G. (2013), After the Corporation, Politics & Society, 41: 283.

[29] Hoff, K., Stiglitz, J. (2001). Modern Economic Theory and Development, Frontiers of development economics: The future in perspective, Vol. 389 Oxford University Press.

[30] Davis, G. (2013). After the Corporation, Politics & Society, 41: 283.

[31] Davis, G. (2013). After the Corporation, Politics & Society, 41: 283.

4.3 ECONOMIES OF AGGREGATION

A common theme across all of the industrial reports has been the use of aggregative techniques to exploit the newly available computational capacity.

Far from being just about the use of digital technologies to aggregate large datasets from a large variety of sources, we can see something completely new emerging within our economy. We can identify new types of DH Robertson's "islands of conscious power in this ocean of unconscious co-operation like lumps of butter coagulating in a pail of buttermilk"[32] and they are challenging our notion of scale and economic organization – new lumps of butter are coagulating in the form of dynamic strategic networks.

As discussed, economies of scale and economies of scope are some of the most dominant industrial concepts within the economic system. Economies of scale have enabled enterprises to achieve cost advantages due to size, output or scale of operation; costs per unit of output decrease with increasing scale as fixed costs are spread out over more units of output.

With the crossing of the thresholds reviewed in Section 1, digital technologies have enabled a new form of collaboration within the economy, where it is possible to retain an individual identity but also possible to act together in networks. In this new generation of dynamic strategic networks, the aggregate ability to deliver a good or service means that individuals are able to coordinate with one another without needing a "boundary of the firm" to do so. Digital technologies have removed the transaction costs of individuals doing business with one another and in some cases also remove the need for economies of scale and scope. Individuals are now able to combine resources without establishing contracts with one another. Through the proliferation of high-trust institutional forms[33] enabled by digital technologies, increasing numbers of people are able to overcome coordination problems traditionally found in the market. Individuals can coordinate with one another as though they are a firm, without establishing the traditional structure of the firm around them.

An important point of contrast to economies of scale is that the unit price remains the same or increases with these forms for economic organization. Labor and production costs become increasingly irrelevant to the formation of prices; the ability to aggregate and apply computational capacity increases instead.

We define these as economies of aggregation.

In order to take advantage of these economies, individuals participate in dynamic strategic networks.

[32] Quoted in Coase, R.H. (November, 1937). The Nature of the Firm, Economica.

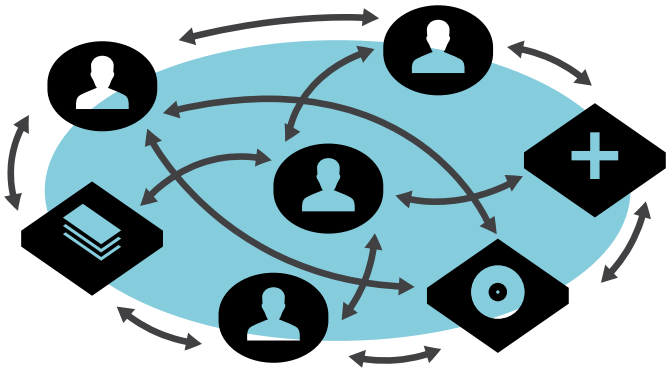
[33] Adler, P. (March–April 2001). Market, Hierarchy, and Trust: The Knowledge Economy and the Future of Capitalism, Organisational Science, Vol. 12, No. 2, pp. 215–234.

4.4 DYNAMIC STRATEGIC NETWORKS

Individuals are no longer disassociated groups of individuals and businesses; they are able to communicate with each other in an enhanced way. More importantly, they are able to work together to create scale that can compete with traditional large-scale industrial structures by managing transaction costs in new ways. This is achieved by the application of digital technologies to create dynamic strategic networks.

As has been discussed, ICT has now begun to modularize the factors of production. Now that we have what are essentially islands of productive capacity connected in a strategic network of thinly connected nodes. "The building blocks for organizations [are] littered around the societal landscape; it takes only a little entrepreneurial energy to assemble them into a structure."[34] Among the most common emerging forms are dynamic strategic networks in which individuals form short-term supply networks together, in order to deliver a service or product to a customer.

Figure 18: Computational capacity creates dynamic strategic networks of individual entrepreneurs.



[34] Davis, G. (2013). After the Corporation, Politics & Society, 41: 283.

4.4 DYNAMIC STRATEGIC NETWORKS

Strategic networks have long been associated with a variety of organizational forms within the economy – from farmers who align in order to ensure a supply of organic lamb to restaurants in regional Italy to strategic networks of companies within an industrial structure. Such networks have generally been static over a period of time.

Through digital technologies, however, these strategic networks can now become dynamic, opening up the potential for completely new forms of economic life compared to those of the last century. Individual entrepreneurs are now able to find, connect and create a supply chain network of other individual entrepreneurs with small to non-existent transaction costs and – crucially – without needing the boundaries of the firm to do so. Instead of homo economicus or homo reciprocans, people are able to become a hybrid of the two – able to act both with individual self-interest, but also as members of a community.

An important aspect of these dynamic strategic networks is their ability to help entrepreneurs manage risk more appropriately. These networks enable them to develop and apply their products, services and knowledge in a manner that can provide a buffer or protection for their projects. By leveraging the networks of other entrepreneurs, an individual can agree to deliver a much larger-scale project than before. Effectively, individuals are able to develop flexible pathways by which to manage this risk.

"All of these tendencies indicate a reversal, or at least a countertendency, of the generations-long trend toward aggregation and economic concentration at the national and global level."[35] Instead, digital technologies have created the opportunity for aggregation and concentration at the local level.

It is unlikely that corporations will cease to exist altogether, but they will come to co-exist with dynamic strategic networks of individual entrepreneurs. At the same time as companies will need to re-adjust to these new economic forms, individuals will need to explore new means by which to participate in the emerging economy in order to capture wealth.

[35] Davis, G. (2013). After the Corporation, Politics & Society, 41: 283.

4.5 BALANCING LOCAL AND GLOBAL PRODUCTION

As digital technologies have allowed the reallocation of the factors of production across the world and placed them directly in the hands of individuals rather than firms, the redistribution of the nexus of production becomes possible. Rather than needing to be large to survive, individuals are now able to apply economies of aggregation within strategic networks to permit the creation of localized supply chains that can be used to compete with globalized production.

As previously discussed, certain industries will always need scale of capital and operations in order to continue to deliver services. It is clear, however, that a new equilibrium is being sought between these local and global networks of production. This will not replace the globalized networks of supply but rather localized production networks will start to co-exist alongside large-scale supply chains.

Local supply networks are enabled by high-end production technologies. In the same way that semiconductors have become simultaneously cheaper and faster, so too have many manufacturing technologies, e.g., a typical CNC tool costs 5% of what it did 20 years ago. 3D scanning and printing meanwhile will offer new opportunities for re-localizing manufacturing activities.

In contrast to previous eras of localized production, however, these solutions will be able to download, modify and apply schematics and instructions from global networks or communities of practice. Localized production will be combined with global intellectual capacity as economies of aggregation and economies of scale start to function together within our economic system.

5. CONCLUSIONS

This report outlined some of the basic fundamentals of the "Economics of the Networked Society," bringing together six in-depth analyses. The combined forces of semiconductor speeds, open APIs, mobile broad-band speeds and financialization have created computational capacity.

These forces are working together to tear down barriers between people, objects and sub-systems of the internet. They are creating new types of platforms and allowing people to connect in unique and innovative ways. Through this, they are digitizing many industries and redefining the way we work, socialize, play and gather wealth. Through the modularization of the factors of production, individuals and smaller companies are able access capital, labor and increasingly, land, much more easily.

More importantly, however, these technologies are now giving rise to a redefinition of some aspects of the economic system. Previously, ICT reinforced economies of scale and the boundaries of the firm. Now, digital solutions are providing a means to reduce the size of the firm and allow individuals to manage transaction costs more effectively – often without the boundary of a firm. Individuals are now able to work together in dynamic strategic networks, applying economies of aggregation, rather than economies of scale. Powered by mobile technologies, 3D printing and manufacturing in these economies allow smaller, often localized supply chains to compete with globalized production chains, enabling end users to take control and power over supply chains. This does not mean that globalized supply chains will come to an end, but that they will start to co-exist alongside localized ones.

This is far from the final evolution of the Networked Society; in fact, it is just the beginning. We can expect many more far-reaching changes to our economy, society and environment as a result of the forces that were unleashed in 2005. As a result, ours is a generation with many responsibilities – not the least of which is to use digital technologies to balance local and global, large and small, while ensuring that workers retain their rights and the possibility for wealth creation.

Ericsson is the driving force behind the Networked Society – a world leader in communications technology and services. Our long-term relationships with every major telecom operator in the world allow people, businesses and societies to fulfill their potential and create a more sustainable future.

Our services, software and infrastructure – especially in mobility, broadband and the cloud – are enabling the telecom industry and other sectors to do better business, increase efficiency, improve the user experience and capture new opportunities.

With approximately 115,000 professionals and customers in 180 countries, we combine global scale with technology and services leadership. We support networks that connect more than 2.5 billion subscribers. Forty percent of the world's mobile traffic is carried over Ericsson networks. And our investments in research and development ensure that our solutions – and our customers – stay in front.

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