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Digitalization and Collective Value Creation

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Abstract: We discuss the spread and impact of digitalization as a disruptive technological change. We show how digitalization is intimately connected to globalization by first, being dependent on globalization for its impact, and second, enhancing the speed of globalization. Digitalization lowers barriers to funding, marketing, sales and distribution, and enables an increasing global flow of goods, services, and financial transactions. We discuss how digitalization also contributes to changing consumer habits and a blurring line between producers and consumers where the latter now have capabilities to build collective knowledge by they themselves becoming producers. Digital platforms are emerging, aggregating data and providing new business models where contact costs are approaching zero. These platforms wield strong economic power and the algorithms by which they operate also change incentives and transaction costs for producers and consumers. We sketch the patterns by which industries digitalize as being characterized by one or a few ‘platforms’ dominating a global market, but where such platforms also facilitate the emergence of more narrow niche businesses and products and allow new types of micro-multinationals to reach out to a larger global crowd and satisfy latent demand. These changes have already happened in media and music, and the principles seen in these industries can be seen as emerging in other sectors. We conclude by highlighting the potential of digitalization to enhance the value of collective goods. We particularly highlight the cases of health care and the energy, and discuss how digital technologies can contribute to collective value creation in these areas.

Digitalization and globalization

Digitalization can be defined as the use of digital technologies to change a business model and provide new revenue and value-producing opportunities. It is also the process of moving to a digital business. Digitalization is a technological force that enhances globalization in both economic and cultural ways. The effect of digitalisation on increased globalization can be seen in a number of areas, including digital goods, enhanced cross-border communication and globally distributed teams, electronic platforms, and optimized flows of goods and services. Together, such changes allow individuals and organizations to share information and knowledge more rapidly and seamlessly than any time before in human history, facilitating the growth of collective knowledge.¹

The effects of digitalization on economic and cultural globalization is however not uncontroversial, nor unidirectional. Given slower productivity growth, some people have been debating the extent to which digitalization is a hype or a real force.² Further, the relationship between digitalization and globalization is not necessarily unidirectional but may grow in tandem.

Globalization has been underway before and during the rise of the internet, enhanced by increased travel and cultural exchange in addition to political changes such the fall of the Soviet Union, China's rise as an economic power, and several important regional and global free trade agreements. In several respects, the long-term globalization following World War 2 has provided economic, regulatory, and cultural support for the digitalization of goods and services. For example, we now have a global language – English. Student exchanges are frequent on the high school and university levels alike. Expatriate workers and migrant workers are more common than ever, more than 250 million people today reside outside their country of birth. The EU's internal labour market has facilitated cultural exchange and is to date the most popular among the EU pillars.³ 44 million are engaged in cross-border online work using digital tools, and over 360 million participate in cross-border e-commerce.⁴ But economic exchange is but one of the tokens by which globalization and digitalization are interconnected. Almost one billion people around the world have one or several international social media connections, and those connections are being put to use in various ways.⁵ As a society, people, places and things are now becoming interconnected in a way that is radically changing the way we operate anything from trade and transport, to education and health care.

¹ While earlier technological innovations such as written language, the printing press, or the telegraph has also magnified the spread of knowledge, none of these have diffused as rapidly, nor allowing individuals to interact collectively on the same scale as digitally enabled technologies.

² Wolf, M. 2014. Same as It Ever Was: Why the Techno-optimists Are Wrong. *Foreign Affairs*. 94(4). July/August.

³ Barslund, M., & Busse, M. 2014. Making the Most of EU Labour Mobility. *Centre for European Policy Studies, Brussels*, ISBN 978-94-6138-407-2.

⁴ McKinsey & Co. 2016. Digital globalization: The new era of global flows. March 2016: McKinsey Global Institute.

⁵ Ibid.

Globalization of digital goods

Measuring digital trade and its impact on globalisation is complex.⁶ However, the flow of cross-border data stemming from trade in digital goods constitutes a readily definable and easy-to-understand portion of growing international digital exchange. Music, books, videos, games and advertisement are examples of industries where goods are often distributed digitally. In such industries, digitalisation has radically impacted business models as well as market structure. Brick-and-Mortar chains such as Blockbuster and Borders have been replaced by Amazon, HBO, Netflix, and Spotify. Once digital disruptors, they are now major players with global reach, and often rapid growth. However, the same global players both enable and inspire new competition as well as business aimed at globally distributed niche consumers. For instance, automatized advertisement services such as Swedish Widespace allows companies to tailor advertisement directly to consumers and track consumer engagement. Splay is a network of Youtube stars, providing advertisement opportunities to brands, and entertainment to consumers. We see that digital goods simultaneously facilitate certain 'monocultures' (homogenization of mainstream demand) along with the proliferation of a host of global niches and micro-communities (heterogeneous demand).

Globally distributed electronic platforms

Digitalization also impacts new startups, when digitally enabled education, crowdfunding, e-commerce, and global access to talent are combined. Online platforms such as Kickstarter, Fundedbyme and Kivra provides funding and marketing for a large pool of small businesses varying from traditional trade of goods and services to high-tech innovators all over the world. Social media platforms enable global reach in marketing even for small companies, enabling them to become micro multinationals. E-commerce platforms like Amazon, Avito and Alibaba, digital payments through Paypal, Klarna and Stripe and sharing-platforms like Airbnb or Elance, provide individuals and entrepreneurs with low cost and global reach for selling their goods and services. The growth of globally accessible electronic platforms decreases the cost of international interactions and transactions, which in turn facilitates the creation of new markets and user communities of global scale.⁷ For instance, 90% of commercial sellers on eBay export to other countries, compared to less than 25% of traditional small businesses.⁸ Further, businesses selling through eBay are also more likely to export to many countries, and less likely to lose their export-destination relationships than

⁶ OECD (2013). *Measuring the Internet Economy: A Contribution to the Research Agenda*, *OECD Digital Economy Papers*, No. 226, OECD Publishing. <http://dx.doi.org/10.1787/5k43ggj6r8jf-en>

⁷ McKinsey & Co. 2016. *Digital globalization: The new era of global flows*. March 2016: McKinsey Global Institute.

⁸ Ibid.

traditional businesses.⁹ Globally accessible electronic platforms are enhancing globalization of people, transactions and businesses everywhere.

Globalized talent

Digitalization is also changing the flows of skills and people. One way this digitalisation is doing that is by enabling remote work across borders. For large multinational companies, costs and security concerns have hitherto been important factors driving the growth of globally distributed teams that work together remotely across borders. But access to, and cost of talent pushes startups as well as new NGO's and social movements to bring together talent from all over the world. Distributed teams are now often a default mode of organization in many sectors, for multinational corporations, for digital service providers, and for resource-constrained startups.¹⁰ Distributed teams can be cheaply organized using digital tools such as Dropbox, Box and Slack for remote collaboration, or Intercom and Zendesk for customer relationship management.¹¹ This development parallels the overarching trend of more and more people working as freelancers or work for an employer from their home. McKinsey & Co reports that 58% of U.S. companies expect to use more temporary arrangements at all levels, production, clerical, and managerial.¹² Freelancers work on-site, from their homes, and through co-working spaces such as US WeWork, which fills the human need for social interaction at work. These developments are amplified by digital services such as Krop, Guru and 99designs, which reduce the cost of contact and make it easy for individuals to find projects as well as contractors. Companies and organisations can now access a global pool of talent working in areas varying from programming and design to management, finance and legal services. Not only does this provide opportunities for increased cost efficiency, but it is perhaps primarily a driver for enabling economies of latent demand.¹³

Digitally improved products

Digitalization has a significant impact on physical goods and complex supply chains. Containers, trucks, cars, home appliances and other machinery today comes with embedded sensors, enabling optimization of flows from production to supply chain and service. This is changing traditional supply

⁹ Lendle, A., M. Olarrega, S. Schropp, P.-L. Vézina. 2013. eBay's anatomy. *Economics Letters*, 121(1): 115-120.

¹⁰ Oshri, I., Van Fenema, P., & Kotlarsky, J. 2008. Knowledge transfer in globally distributed teams: the role of transactive memory. *Information Systems Journal*, 18(6): 593-616.

¹¹ It should be noted that as the cost of communicating over long distances is decreasing, the marginal value of physical interaction is *increasing*, so that the most productive firms and individuals increasingly chose to co-locate in clusters. Moretti, E., 2012. *The new geography of jobs*. Houghton Mifflin Harcourt.

¹² Miller, J. G., & Miller, M. 2012. The rise of the supertemp. *Harvard Business Review*, 51: 4-12.

¹³ Susskind & Susskind, 2015. *Future of Professions*

chains. For example, digitalisation change supply chains by providing real-time data of the flow of goods across different modes of transportation, as well as increasing automation of these modes.¹⁴ Logistics companies can already track and coordinate their ships, trucks, and containers across borders, letting customers track their parcels online. General Electric is an example of using this to improve their business, as they've changed one of their business models from selling airplane engines and later charging for the maintenance of them, to charging their customers for the value of optimizing air fleets. GE has also launched a platform called Predix, where other products and services can upload data, and a world of developers can develop services based on that data. Similar development can be seen in areas varying from energy to agriculture and health care. The use of sensors, big data analysis and artificial intelligence now allows complex networks of production and consumption to increase visibility and begin to be optimized on a scale that was not possible until technology development just recently made the technology cost efficient enough. As a result, entire business ecosystems are now changing; increasing in complexity, but also lowering the barriers for new actors to add value through data, services and new products.

Globally accessible collective knowledge

Wikipedia was one of the worlds' first really successful examples of knowledge-generating open platforms, but knowledge is now increasingly being made available to a global audience through both closed and open knowledge platforms as well as open source solutions for the creation of new goods and services. Open knowledge-platforms such as Patientslikeme allow people to share information and experiences on personal health as well as advanced treatment. The value of the data and people collected by Patientslikeme is acknowledged by companies such as AstraZeneca, now partnering with the platform for clinical studies. Github, an open source code repository, now has 14 millions developers sharing code and knowledge, and it is currently the largest host of source code in the world. More and more companies are using similar principles of open collaboration as a part of their business model. For example, Swedish Propellerhead Software – a niche producer of electronic music production tools – rapidly grew to number two worldwide and was able to gather a large customer base which started to produce new software and launch businesses through the open-source

¹⁴ SCDigest Supply Chain Digitization Benchmark Survey 2016

solutions provided by Propellerhead.¹⁵ Producers are co-creating new products, and consumers are becoming producers.

Non-profit and educational institutions are also contributing to globally accessible collective knowledge. Millions of people are regularly attending online courses – often in the form of Massive Open Online Courses (MOOCs) as a part of their higher education, or part of life-long learning.¹⁶ Massachusetts Institute of Technology (MIT) has opened the content of much of their traditional courses for the general public, making materials used in the teaching of MIT's subjects available on the Web. This allows anyone anywhere to access online lectures, course material, etc. By now, Coursera, HarvardX and MIT are all also experimenting with various ways of charging for awarding credits for such courses. Many smaller colleges and universities are taking advantage of such innovations to enhance their educational offering, and transition economies such as India are linking up to MOOCs and integrating this to scale up their institute of higher learning to large populations that previously had no access to such. The types of knowledge exchange solutions are part of the “sharing economy” where resources are distributed and shared, with value appropriability non-governed.¹⁷ On an individual level, pretty much everybody regularly use open knowledge without thinking much about it. A recent survey by Google showed that 91% of smartphone users turn to their smartphone for ideas while doing a given task¹⁸, which seen as a mass behaviour it's a relevant phenomenon in understanding the potential of digitalisation for global diffusion of knowledge. As a result of digitalisation, more people than ever before are now able to participate both in the creation and distribution of knowledge, and costs for finding and cocreating complex solutions to existing problems are decreasing.¹⁹

Distributed ecosystems based on platforms= new business models

Accepting the notion that digitalisation is reshaping almost all industries, common patterns can be seen in transformations that have already happened, and those that are beginning to emerge. It is clear that platforms with global impact lower transaction cost and barriers to financial investments, marketing and distribution of digital goods, services and knowledge.²⁰ Algorithms optimize and manage flows, and the patterns that algorithms take into account are often based on consumer

¹⁵ Autio, E., L. Dahlander, L. Frederiksen. 2013. Information Exposure, Opportunity Evaluation, and Entrepreneurial Action: An Investigation of an Online User Community. *Academy of Management Journal* 56(5) 1348-1371.

¹⁶ Stadin, E. 2016. Öppna nätkurser för tusentals: Utvecklingen av moocar i Europa FORES Policy paper 2016:1.

¹⁷ Felländer, A., Ingram, C. & Teigland, R. 2015. Sharing Economy; Embracing Change with Cation. Entreprenörskapsforum.

¹⁸ Google/Ipsos, Consumers in the Micro-Moment study, March 2015. Based on the online population n=9598.

¹⁹ Ballantyne, P. 2014. Challenge Prizes: A practice guide NESTA.

²⁰ Choudary, S.P., Van Alstyne, M.W., Parker, G.G., 2016. Platform Revolution: How Networked Markets Are Transforming the Economy—And How to Make Them Work for You. New York: WW Norton & Company.

behaviour data. Further, digitalization facilitates collective value creation in many sectors. The consequences have reshaped the structure of affected industries, their competitive conditions, and consumer experiences.

The first industries to display this pattern were news and entertainment, where digitalisation has made news and content more readily available to consumers. Cost of distribution plummeted and consumers today have access to more news, music and content than ever before. In parallel, a handful of platform actors have become pivotal to anyone seeking to reach out or build a business in these sectors. Social media platforms and search engines now dictate the terms for most of that industry, and that their algorithms have profound impact on consumption patterns. In this digital ecosystem, geographic boundaries no longer dictate competitive conditions in an industry, reach and relevance of individuals and organizations to a globally widespread audience does. This has had a profound impact on providers of digital content everywhere. The Wall Street Journal or Vogue are two examples of content providers that have benefited from a growing audience of connected English speaking consumers, quite likely at the expense of more local content providers such as national papers in non-English speaking regions. This is in itself an interesting phenomenon, since it is likely to add to the globalisation of ideas and behavior in a connected population. At the same time, we have seen numerous examples of how small actors have used these platforms to gain access to large audiences, and in turn, build their own business. Often in niches that previously didn't exist, or could not easily be capitalized.

We've seen a similar development in the mobile phone industry. The biggest innovation of Apple related to the iPhone was the app store. It allowed masses of developers to contribute value to Apples' customers by building mobile apps. Consumers benefited immensely from this new rich ecosystem of mobile services that the app store enabled, and it has radically changed behaviour and businesses all over the world. This innovation was key to helping Apple achieve a remarkable success; Apple pushed an entire industry from a situation where five major mobile phone manufacturers (Nokia, Sony Ericsson, Motorola, Samsung and LG) collectively controlled 90% of the industry's profits, to a situation where Apple dominated completely. In 2015, the iPhone alone represented 92% of the industry's profits.

What characterizes companies that have successfully achieved a platform position, is that the unique resources they have access to is massive amounts of platform participants; both producers and consumers. And they manage to do so, not necessarily by having access to unique resources or production systems

In sum, digitalization so far has led to rapid oligopolization of industries across borders where large platforms such as Apple's Appstore, Google and Facebook dictate competitive conditions.²¹ But at the same time, digitalization has also facilitated the emergence of more narrow 'niche' markets where formerly hobbyists or rather unprofitable companies can reach out to a larger global crowd and satisfy former latent demand.²²

These types of digital-induced changes are now beginning to show up in industries such as transportation, energy and health. Emerging digital platforms indicate a change in the nature of competition²³ due to lower barriers and access to a global audience, combined with the use of consumer behaviour data for optimization. These sectors are crucial for the transformation to a more sustainable society since they are sectors which infrastructure and potentially also production and distribution are characterized as public goods. In the last part of this chapter we therefore dwell on the cases of transportation, energy and health, and what digitalization could mean for higher value creation of public goods.

Transportation

Transportation in the industrialised world is wasteful. An average city today devotes about 50% of its space to roads and parking facilities, yet the average European car is used for driving only 5% of the time.²⁴ At the same time, transport constitutes 30% of our fossil emissions. Transportation of goods as well as people is pivotal to achieve a vision of a fossil free society. Digitalisation is needed to address both the changes in behaviour that's needed, and to optimize use of available resources.

Within the transport sector, new actors are leading the way and appear to aim for platform positions in a new ecosystem of transportation services. Companies such as Waze and Uber demonstrate the transformative power of digitally distributed services, quickly reaching a global audience. As an enabler of the 'gig economy', Uber is often used as the most typical example of the new breed of platform businesses and their impact on traditional markets.²⁵ But as part of a growing number of transport services, Uber is also one of the actors that create alternatives to the growing number of

²¹ Power, D., & Hallencruetz, D. (2007). Competitiveness, local production systems, and global commodity chains in the music industry: Entering the U.S. market. *Regional Studies*, 41(3), 377-389.

²² Lopes, P. D. (1992). Innovation and diversity in the popular music industry, 1969-1990. *American Sociological Review*, 57(1), 56-71., and Ahrens, S. & Kreidenweiss, A. (2012). Industry-wide business model innovation: The case of the Swedish music industry. (Master's Thesis, Stockholm School of Economics).

²³ Van Alstyne, Parker & Choudary (HBR april 2016), Pipelines, Platforms and the New Rules of Strategy

²⁴ Ellen McArthur Foundation, 2015. Growth within; a circular economy vision for a competitive Europe

²⁵ Laurell, C., & Sandström, C. 2016. Analysing uber in social media - Disruptive technology or institutional disruption? *International Journal of Innovation Management*, 20(5): DOI: <http://dx.doi.org/10.1142/S1363919616400132>

city people who value convenience of usage higher than convenience of ownership. Waze, a collaborative tool for route planning and collective information sharing is now used by as much as 10-15% of the population in large, densely populated cities such as Los Angeles and New York, and the service is impacting transportation patterns there. At the same time, Tesla is challenging the car industry by building electric vehicles, but also by building cars that are continuously updated, meaning their customers purchase a car but a digital service related not only to maintenance but even advanced functionality such as autonomous driving algorithms and continuously updated security functions. Previous examples from the telecom industry, shows how quickly such experiences impact consumer expectations on what a product should deliver.

However, while single actors provide relevant innovations, a sustainable transport system will require various means of transport to be integrated into services for consumers. In order to enable this, nations such as Holland and UK are currently using digitalisation to innovate its transport sector by providing open national platforms for data and digital services.²⁶ Such platforms enable new actors to build services that make travelling easier by creating route plans that integrate various forms of transport.

A transport system that is fully integrated in that way also highlight the need for a new type of actor; one that has mandate over algorithms that steer incentives in choice of route as well as means of transport. Dynamic pricing could be applied to trips, taking into account supply and demand for parking as well as road accessibility. An interesting established solution of road accessibility is digital startup Waze, now used by up to 10% of all drivers in major US cities. By showing *how* traffic actually flows in real-time, Waze is also generating data used by public authorities when planning for new infrastructure. But private startups are not the only actor of relevance. For example, Dutch authorities are aiming for another solution; one where the transport data is treated as Public goods.

Energy

With renewable energy solutions becoming increasingly cost effective and storage solutions beginning to catch up, consensus around the basics of tomorrow's energy systems is starting to emerge. Energy systems are expected to become an increasingly complex mix of small- and large scale producers where distributed systems of energy production as well as energy storage become predominant standards.²⁷ Large groups of consumers will be "prosumers", partly passively through

²⁶ www.plannerstack.org

²⁷ Luo, X., Wang, J., Dooner, M., & Clarke, J. 2015. Overview of current development in electrical energy storage technologies and the application potential in power system operation. *Applied Energy*, 137: 511-536.

using products where smart energy harvesting solutions are an inherent part of the product, but also actively by providing and storing renewable energy.²⁸

Actors such as General Electric with their Predix platform and Tesla with their electronic cars now combining electric vehicles with solar energy solutions and storage appear to be actors aiming for platform positions in a new ecosystem where energy and transportation are intimately connected, and where small scale producers and storage solutions are key to an overall system of optimized production and access. In Holland, Germany and the US, hospitals and high-tech companies such as Apple and Facebook are increasing their own investments in becoming self-sufficient in energy production, and Apple are even beginning to sell their surplus. At the same time, companies such as Sonnenbatterie in Germany and Open Utility in the UK are enabling small scale producers and consumers to trade energy directly with each other, and in some places consumers are simply taking things into their own hands.²⁹

The energy sector is highly regulated, and countries have chosen different paths as to how much this development should be encouraged. Regardless of that, it's clear that cost of renewables as well as energy storage is dropping, and that is has an impact on consumer expectations and behaviour. In a scenario where companies with technology aiming directly at consumers, such as Tesla and Sonnenbatterie, have a big impact, it's clear that companies on markets where energy prosumers are empowered early have a head start. Perhaps there are parallels to previous experiences of what enabling a population to become early adopters of internet and social media has meant in terms of innovative companies as well as creating a mature and relevant market for companies that push ahead.

Health

The health sector is another sector that's crucial for achieving sustainable societies and where digital transformation is beginning to change prevailing practices and solutions. The need for increased quality and efficiency in health care is an increasing challenge for all countries, be it because of increasing costs due to longer life time and increasingly complex health conditions or because of a growing need for quality health care in rural areas. There is significant value about to be created by

SETIS. 2014. Set plan: Energy Integrated Roadmap. SETIS (Strategic Energy Technologies Information System). European Commission.<https://setis.ec.europa.eu>

²⁸ Gerhardt, W.2008. Prosumers: A New Growth Opportunity. Cisco Internet Business Solutions Group (IBSG).
<http://www.cisco.com/go/ibsg>

²⁹ <http://www.npr.org/sections/alltechconsidered/2016/07/04/482958497/how-blockchain-helps-brooklyn-dwellers-use-neighbors-solar-energy>

those who manage provide scalable efficient solutions. Any digital solutions will require data, and digital platforms for distribution. Data aggregators such as patientslikeme.com, Apple's research kit and the GE Predix platform already make valuable health data available to researchers and innovators. Digitally distributed health services as well as medtech innovations are growing, varying from tools for remote x-ray analysis to early diagnosis of Alzheimer's and regular primary health care services such as kry.se and mindoktor.se in Sweden.³⁰ In Singapore, most citizens regularly schedule doctors' appointments and handle their recipes through the social media platform Wechat. In China, policy makers envision using digitally distributed health services as a way to increase availability for large groups in society. At the same time, modern travel habits have helped increase a global trend towards health related tourism varying from dental care to specialized cancer treatment and surgery. Nationally, this development is slowed down by issues related to technical legacy, integration cost and sometimes outdated regulations. The issue of data interoperability between systems and continuous development of regulation is therefore of high priority in most countries. This is an area where Sweden is currently lagging behind forerunners such as Denmark and Singapore. But there's also a strong international aspect to this, and with legal and institutional constraints currently hampering the flow of data across border, digitally-enabled health services may benefit even the more if regulatory framework were updated.

Data produced by individuals is becoming more valuable to both researchers and consumer oriented innovative companies, and patterns seen through big data are key to optimizing both flows in health care and clinical studies. We are yet in the early stages, but large amounts of data is starting to flow between various digital services and between actors in both the public and private sector. Current examples highlight the increasing possible to offer health related services as digitally distributed services, as well as blended services where cost and effort for a physical meeting makes it worthwhile to travel. Our forecast is that the increasing specialization among advanced treatments, together with globalization of knowledgeable consumers means that digitalization of health care will lead to a growing global market for high-quality and specialized health services as well as digitally distributed services across borders for more simple ailments and services, all in a way that maximise the value of both online and physical services. But most importantly, countries that now act in a way that enables the broad landscape of international innovators to benefit their health care system by providing solutions to it while maintaining quality control, will see considerable benefits in both improved efficiency and quality of health. Such markets are also more likely to create the winners' in tomorrow's ecosystem of digital health systems. However, it's unclear if countries will prevent the

³⁰ Black, A. D., Car, J., Pagliari, C., Anandan, C., Cresswell, K., Bokun, T., McKinstry, B., Procter, R., Majeed, A., & Sheikh, A. 2011. The impact of eHealth on the quality and safety of health care: a systematic overview. *PLoS Med*, 8(1): e1000387.

emergence of globally dominant players with power over both data, platforms and algorithms such as have been seen in media and the phone industry.

Security and integrity

Since the impacts of digitalization mentioned above are based on services using data, issues related to security and integrity are crucial and worthy to highlight. An in-depth discussion of these topics are out of scope for this chapter. While already aware of the dangers of misuse of data, most people today share information about their behaviour as well as opinions and location in exchange for increased relevance and more efficient service in areas varying from route planning to advertisement. This can be seen as naïve and dangerous. However, taking into account the growing amount of options and messages that already bombard individuals using digital devices, using data in exchange for better relevance and less friction can also be seen as rational. It is clear that digitalization raising issues concerning security and integrity for individuals as well as corporation. The rapidly expanding digitalisation of health and transportation highlights that in exchange for personal data, individuals may also benefit from collective goods such as environmental-friendly energy transportation, decreased traffic congestion, and more accessible health care services. A key challenge of our time is therefore to find ways to enable individuals, organisations and countries to reap the benefits that digitalisation can give, while doing so in a secure manner that also protects society and individuals from the potential dangers of massively accessible data. 'Integrity' is a concept that has meaning in a cultural context. As a society, we need to find out what a functional concept of integrity is in a world full of, and fuelled by, data. This is no easy task, and is being addressed by policy makers as well as companies aiming to find a good balance between value and risk.

Conclusions - leveraging collective goods

The examples of transport, energy and health care highlight the potential of digitalization to redefine and enhance the production and consumption of collective goods. Collective goods are those judged as having 'collective value' in that individuals cannot be effectively excluded from use and where use by one individual does not reduce availability to others, such as the natural environment, central public infrastructure, and in practice also basic education and healthcare. Our chapter has focused specifically on the potential of digital technologies to enhance value creation, sharing, and increased productivity in health care and among environmental-friendly technologies. Examples from other industries of how digitalization may enhance the production and consumption of collective goods could be found or envisioned. While digitalization offers the potential for radically higher value

creation in the production and distribution of public goods, measuring the impact of digitally enabled public goods remains in its infancy since productivity could be underestimated due to macroeconomic models not being able to gauge all new types of value creation.³¹

A central question for legislators and policymakers are the extent to whether these changes are all for good, and for whom? The emerging global ecosystem standard as seen in computers, software, mobile handsets and cars highlight that speed-to-market and economies of scale may lead to a limited number of global actors such as Google handling services that were before handled by nationally or regionally separated actors. In the cases of energy or health care, one can easily expect regional as well as national utility companies or health care providers being replaced by multinational companies. Legislators in EU and in national governments need to consider what steps can be taken that enable a large variety of companies and citizens in their respective constituencies to make the leap towards digitalization and not be left behind. Since many digital businesses are based on collective value creation through big data, legislators should consider how to maximize the delivery of collective goods for sustainable development; be it by themselves or through private companies operating by authorized standard of data transportation, maintenance, integrity, and openness. Research on the impact of open data sharing in relation to all these areas so far has been scarce, but a study comparing available reports conclude that the findings indicate that government data openness positively affects the formation of knowledge bases in a country and that the level of knowledge base of a country positively affects the global competitiveness of a country.³²

Further, authorities would benefit from finding ways to enable innovative products to add value to public systems through platform logic rather than through complicated and often inefficient public procurement of 'stand-alone' systems. Today, public procurement in the EU and its member states operate in regional and organizational silos with expensive transaction costs and 'lock-in' effects.³³

The development we sketch is still at its nascent stage and expected to increase exponentially in the next few decades. However, it's clear that government initiatives in these areas are relevant now, and will have a big impact on innovation and public sector quality and efficiency in the decade to come.

³¹ Felländer, A., Fölster S., & Ingram, C. 2016. Det datadrivna samhället. Stockholm: Digitaliseringskommissionen.

³² Lee, J.-N., Ham, J., & Choi, B. 2016. Effect of Government Data Openness on a Knowledge-based Economy. *Procedia Computer Science*, 91: 158-167

³³ Osborne, S. P., & Brown, L. 2013. *Handbook of Innovation in Public Services*. Cheltenham: Edward Elgar.

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