Journal of Strategic Information Systems 24 (2015) 149–157

Contents lists available at ScienceDirect

Journal of Strategic Information Systems

journal homepage: www.elsevier.com/locate/jsis

Reflections on societal and business model transformation arising from digitization and big data analytics: A research agenda

Claudia Loebbecke [a,*], Arnold Picot [b]

[a] University of Cologne, Dept. of Media and Technology Management, Pohligstr. 1, 50969 Cologne, Germany
[b] Ludwig-Maximilian-University Munich, Ludwigstraße 28, 80539 Munich, Germany

ARTICLE INFO

Article history:
Available online 22 August 2015

Keywords:
Digitization
Big data analytics
Business transformation
Societal transformation
Information society

ABSTRACT

In the era of accelerating digitization and advanced big data analytics, harnessing quality data for designing and delivering state-of-the-art services will enable innovative business models and management approaches (Boyd and Crawford, 2012; Brynjolfsson and McAfee, 2014) and yield an array of consequences. Among other consequences, digitization and big data analytics reshape business models and impact employment amongst knowledge workers – just as automation did for manufacturing workers. This Viewpoint paper considers the mechanisms underlying how digitization and big data analytics drive the transformation of business and society and outlines the potential effects of digitization and big data analytics on employment – especially in the context of cognitive tasks. Its aim is to outline a critical research agenda to explore and conceptualize evident changes in business models and society arising from these technological advances.

Digitization and big data analytics

Today, digitization and big data analytics – or 'datification' (Galliers et al., 2015; Newell and Marabelli, 2015) – penetrate all areas of life and create new ways of working, communicating and cooperating. Connecting individuals, enterprises, devices and governments enables easier transactions, collaboration and social interaction and results in enormous accessible data sources (Shirky, 2008). Not only do humans turn into "walking data generators" (McAfee and Brynjolfsson (2012, p. 5) but, in addition, the interaction between objects – the so-called Internet of Things with sensors and IP-addresses – adds a multitude of data sources throughout organizations and society. Computers incorporated into products like cars, vacuum cleaners and video consoles create massive amounts of digitized data and processes.

This Viewpoint article focuses on the impact of digitization and big data analytics on business models and employment particularly in the context of cognitive tasks and the resulting societal transformation. This distinguishes our Viewpoint from a number of other recent publications (e.g., Markus, 2015; Newell and Marabelli, 2015; Yoo, 2010) who shed light on the desirable – but also the undesirable – consequences of digitization and big data analytics for individuals and society, and contributes further to the debate called for in Galliers et al. (2015).

Digitization originally describes the conversion of analog to digital information and processes in a technical sense (Negroponte, 1995). We, however, are primarily interested in changes of established patterns caused by the digital

* Corresponding author.

http://dx.doi.org/10.1016/j.jsis.2015.08.002
0963-8687/

transformation and complementary innovations in our economy and society. *Big data analytics* is typically characterized by a "focus on very large, unstructured and fast-moving data" (Davenport, 2014, p. 10). It can be viewed as an evolution of previous concepts and terminology, such as 'decision support', 'online analytical processing' and 'business intelligence' (Davenport, 2014; Power, 2002; Rouibah and Ould-Ali, 2002). We include the concept of big data analytics serving as a means to analyze and interpret any kind of digital information. Technical and analytical advancements in big data analytics, which – in large part – determine the functional scope of today's digital products and services, are crucial for the development of sophisticated artificial intelligence, cognitive computing capabilities and business intelligence.

With processing, storage and transmission of data available on a massive scale at extremely low cost, digitization has the capacity to change almost any form of human labor (and lifestyle) that is directly or indirectly associated with data and cognitive non-routine processes (e.g., Frey and Osborne, 2013; Rifkin, 2014). Increasingly, sophisticated software fosters machine-based interpretation of data. It thus enables (almost) autonomous decision-making and a deeper integration of big data applications in traditional value creation activities.

Organizations collect, mine, and exploit data that are increasingly available from an enormous variety of internal and external sources. For instance, it is reported that more than 175 billion search queries are conducted worldwide each month, including more than 115 billion that are conducted via Google (ComScore, 2013). This translates into more than 100 requests per searcher per month. Most queries are a window into someone's intention or interest. 'Google Trends' provides publicly available reports on the query volume of any search phrase providing those data by on a regional and a longitudinal basis. Similarly, data collected via cellphones, smart phones, 'apps', or sensors provide new opportunities for data gathering and radically innovative exploitation (e.g., Baesens et al., 2014; Michael and Michael, 2011; Newell and Marabelli, 2015).

Such data allow for 'predicting the present' as well as – contingent on certain assumptions – the future (Varian and Choi, 2009) and, hence, impact managerial and other cognitive processes. McAfee and Brynjolfsson (2012) point to data-driven managerial decision-making replacing the 'HiPPO' ('Highest Paid Person's Opinion'), which has tended to be the norm in the past. Thus, together digitization and big data analytics are likely to open up new opportunities while also leading to new challenges – in a manner similar to those that had to be confronted in the age of industrialization. This is not surprising in view of the exponential technical (Moore, 1965) and economic developments in IT and telecommunications, which follow typical patterns of 'general purpose technology' adoption (Bresnahan and Trajtenberg, 1995). While originating from purely technical innovations, widespread adoption is only realized by unlocking their full economic potential through complementary innovation. These new opportunities and challenges that arise from digitization and big data analytics are found on the individual, organizational and societal levels (Gerardo et al., 2013).

The academic, practitioner and popular literature describe and analyze complex and sometimes controversial issues concerning the consequences of enterprise digitization on individuals and work (Koch et al., 2012). These issues range from the benefits arising from the jettisoning of routine work, the growing availability of flexible work hours, and better work-social life balance, to the challenges of being always online (and risking 'burnout') and a 'freelance economy' where individuals have to struggle for paid work. The issues are broad and highly relevant demanding for critical research on issues such as consequences for privacy, control and dependence (Galliers et al., 2015).

Thus, in the remainder of this essay, we dig deeper into the effects of digitization and big data analytics on the organizational and societal levels and consider: *How do digitization and big data analytics re-shape business models and transform society?*

Underlying economic mechanisms

A large, well-established body of literature investigates the economics of digital and information goods (DeLong and Froomkin, 2000; Shapiro and Varian, 1999; Stigler, 1961). We briefly point to three mechanisms: (1) centralized production (the 'winner-takes-all' or 'superstar' economy), (2) increased harmonization of demand, and (3) erosion of property rights (the spread of 'The Commons').

- *Centralized Production*: By reducing marginal costs in markets with still significant first unit costs/fix costs, digitization further increases positive economies of scale, and – in turn – favors centralized production. Centralized production implies that the market falls into a few hands, leading to oligopolistic or even monopolistic structures where a few players dominate, and with traditional market boundaries blurring or falling altogether (Autor et al., 2006, 1998; Shirky, 2008). This leads to what has been termed a 'winner-takes-all' (Frank and Cook, 1995) or 'superstar' economy (Rosen, 1981). Such economies are characterized by less employment, less capital assets, stronger inequality and an increasing divide between large and small enterprises, as well as an increasing income inequality within and among countries. Minimal distribution costs for digital goods and services additionally foster economies of scale and hence further centralization. Only one copy of a digital good needs to be produced (composed, written or calculated) to meet global demand with copying and delivery via the Internet at marginal costs close to zero.
- *Increased Harmonization of Demand*: correlates with the trend of centralized production – without any clear insight about causality. We observe that tastes, habits and expectations (with regard, for example, to stores, restaurants, clothing, make-up, music, movies and even news) have become increasingly similar in many parts of the world. While local

preferences clearly still matter, global offerings are increasingly in demand. In the case of digital goods, large-scale production resulting from copying and delivery via the Internet and harmonized global demand requires less production and transport and hence less labor.[1]

- *Erosion of Property Rights*: Many organizations, especially those that are based on digital innovations or content, are concerned about the erosion of property rights. They argue that the free flow of digital goods – whether authorized or unauthorized – often leads to unwanted 'cheap or even free' diffusion of products, which may hinder the creation of new digital goods and services. The underlying problem has been described as the Tragedy of the Commons (Hardin, 1968); the costs individuals face for exploiting the commons are lower than the costs imposed on the group. Thus, individuals are incentivized to behave contrary to the group interest. New technologies and digitization foster the creation of commons. Mass amateurization then replaces professional production by organizations (Shirky, 2008).

Digitization and big data analytics: the re-shaping of business models

A "business model describes the rationale of how an organization creates, delivers and captures value" (Osterwalder and Pigneur, 2010, p. 14); it captures the core business logic of any firm. In practice, digitization and big data analytics challenge business models in many traditional industries. Not only do established firms frequently fail to embrace opportunities through digitization and big data analytics, they also struggle to adapt their business models to reflect the associated economic features and underlying mechanisms (Weill and Woerner, 2015; Westerman et al., 2014).

The literature on strategic IS (e.g., Bresnahan et al., 2002; Gable, 2010; Malone et al., 2003; Orlikowski and Barley, 2001; Picot et al., 2008; Tams et al., 2014) has discussed at length how IT continues to reshape existing work and organizational structures with new forms of division of labor and cooperation in enterprises. It often focuses on a growing disconnect of work processes from specific locations (including factory or office buildings) or times (fixed working hours) and how technology enables spatially and temporally flexible arrangements. With digitization and big data analytics cross-location teams emerge, and traditional hierarchical work structures dissolve and transform into increasingly flexible, in-house and networked structures across locations (e.g., Zammuto et al., 2007). Further, the impact on the design of new forms of work does not end at corporate boundaries, but offers new opportunities for the flexible integration of external freelancers or labor on the one hand and the organization and development of cooperation between enterprises on the other hand. An example of such IT-driven developments is the crowdsourcing (Majchrzak and Malhotra, 2013) of ideas, processes or financial funds, which offers a form of incorporating company-external resources far beyond traditional outsourcing – but likely with less corporate or even societal commitments (Malone et al., 2011).

Incremental enhancements of established business models based on digitization and big data analytics aim at optimizing existing processes to increase overall efficiency and quality of products and services. Increasing digitization dramatically reduces transaction costs for collecting information, communication and controlling activities. Through the easy access to an almost infinite pool of information and sophisticated big data analytics, firms may, for instance, analyze the interdependency of online and buying behavior of users to customize advertisements and thereby increase overall demand. For instance, comparing their inventory stock data and weather data, Wall Mart discovered that their customers frequently bought strawberry Pop Tarts (a sugary snack) in addition to flashlight and battery purchases, when a hurricane approached. This insight allowed them to adjust their stocks accordingly in advance of a hurricane and thereby better cater for their customers' 'needs' (Hays, 2004). Thus, incremental enhancements to established business models through increased digitization and big data analytics may replace less efficient business models (and thereby companies) in the long run. However, as Markus and Loebbecke (2013) argue, with an increasing level of standardization and widespread adoption across the economy, commoditized big data 'solutions' may not be sufficient for lasting competitive advantage – in like manner to common digitization efforts such as for ERP systems and the like.

Digitization and big data analytics have already led to the disruption of established business models (Weill and Woerner, 2015). A number of well-established firms are struggling to survive. Popular examples stem from the media and advertising industries; several other industries – including education – appear to be next in line (e.g., Shirky, 2012; Westerman et al., 2014). Innovative startups take advantage of low barriers to entry allowing for disrupting the business models of incumbent firms (e.g., Instagram and Kodak for capturing, storing and sharing photography, Lucas and Goh, 2009). They overtake existing markets or pursue unexplored business opportunities with new business models based on exploiting digital distribution channels, creating and serving new customer demand, establishing new forms of customer engagement and relationships, or any combination of the three (Lucas et al., 2013). Big data analytics in particular allows for complementing or even substituting labor for machines in the context of managerial, decision-oriented contributions to value creation.

Digitization and big data analytics: societal transformation

The widespread adoption of IT and the roll-out of digitization and big data analytics have not only facilitated many desirable changes (Lucas et al., 2013), but have also posed issues that require addressing (Boyd and Crawford, 2012). On the societal level, significant changes follow those on the individual and organizational levels.

[1] In the case of physical goods, harmonized tastes and habits imply 'producing' more of the same (scale economies).

Desirable societal changes

We see desirable societal effects concerning the growth of employment, increased productivity, and increased consumer surplus. For example:

- The IT industry has long espoused *growth of employment* as its organizing vision (Swanson and Ramiller, 1997) due to ever-faster innovation and new business models. New jobs were created with the roll-out of broadband networks and so-called 'multimedia' in the EU (Ducatel and Millard, 1996; Enck and Reynolds, 2009). New IT-based business opportunities came to life offering citizens an astonishing portfolio of new services (Brynjolfsson and Saunders, 2010).
- To many, productivity is the "most important determinant of a country's standard of living" (Brynjolfsson and Saunders, 2010, p. 2). Its growth points to a worker's labor being more valuable and the goods produced being relatively less costly (Bartel et al., 2007; Brynjolfsson and Saunders, 2010; Jorgenson, 2001). Most of the *productivity increase* seen in organizations nowadays originates – directly or indirectly – from digitization and big data analytics (Weill and Woerner, 2015).[2]
- Consumer surplus is a "measure that may help us determine the value of technological innovation in our economy" (Brynjolfsson, 1996; Brynjolfsson et al., 2003). In today's digital world, we experience a phenomenon reflected as *increased consumer surplus* – consumers can buy more value with less money today than was the case a hundred years ago (Brynjolfsson and Saunders, 2010, pp. 109–110).

Critical societal changes

However, critical changes on the societal level cannot be ignored. As digitized, big data based systems are perceived to be more cost-effective and less error-prone than humans (Acemoglu and Autor, 2013), machines are replacing people for more and more cognitive activities. Early on, such substitution or automation happened mainly in routine activities requiring low- or medium-level qualifications and skills. Typical examples included the work of check-in agents at airport counters or accountants (Autor et al., 2003). Today, big data analytics and the rapid advances in artificial intelligence drive 'machine-for-human' substitution to diffuse into domains that are highly complex requiring cognitive activities that have traditionally required high skill levels (Autor and Dorn, 2013; Brynjolfsson and McAfee, 2014, 2011; Frey and Osborne, 2013).

Technology replacing human labor has been evident in a number of industry sectors and has long been covered in economic debates. Highly reputed scientists have pointed at this development over the years. Nearly two centuries ago, Ricardo (1821) theorized that technology causes unemployment when equilibrium wages fall below the level needed for subsistence and resulting in workers not taking on those jobs. In the 1930s, Keynes (1936) foresaw that new technologies would lead to less need for human labor. Leontief (1983) stated that "the role of humans as the most important factor of production is bound to diminish in the same way that the role of horses in agricultural production was first diminished and then eliminated by the introduction of tractors" (cited in Brynjolfsson and McAfee, 2011, p. 6). According to Rifkin (1995) – almost 20 years ago – we were "entering a new phase in world history – one in which fewer and fewer workers [would] be needed to produce the goods and services for the global population."

Social observers have made similar observations. Ford (2009) foresaw that labor costs would comprise an ever smaller component of manufacturers' cost structures as IT developments and automation progressed. Similar to Leontief, he noted that agriculture had become heavily automated in the United States and argued that the manufacturing sector would follow that path. Bekman et al. (1998) and Heathcote et al. (2010) point to technical change favoring skilled over unskilled labor by increasing its relative productivity and its relative demand. Autor and Dorn (2013), as well as Levy and Murnane (2013), point to significant losses of middle class jobs partly as a result of digitization. Further, the latter showed how technological change created tremendous dislocations in labor markets, especially in relation to the elimination of routine cognitive as well as manual tasks, which were the 'bread and butter' engagements for generations of high school graduates. They predicted that computers would ultimately perform nearly all "tasks for which logical rules or a statistical model lay out a path to a solution, including complicated tasks that have been simplified by imposing structure" (Levy and Murnane, 2013, p. 30). Kurzweil (2012) predicted that computers would take over many knowledge jobs. Taking these assessments together, one may predict that what today still seems to require human brain power will be done by machines in the near future.

We distinguish five mechanisms by which digitization and big data analytics complement and replace labor differentially across industry sectors and work processes:

- *Substituting labor within physical (production) processes.* Manufacturing robots and information kiosks are well known. Engineering efforts on state-of-the-art self-check-out systems are on the horizon. As telecommunication operators replace people-operated telecom switches with IP-based and software-defined networks, they not only replace legacy technology, but also significantly reduce the number of workers needed for providing an efficient infrastructure. Digital technologies providing transparency and surveillance capacities (video, sensors, mobile connections) replace physically present security personnel in public spaces such as airports, train stations and downtown areas. Video chat and other

[2] For a different perspective, see Cowen (2011), Gordon (2012), Miller and Atkinson (2013), TED (2013), and Torgovnick (2013).

forms of digital communication alter consumption habits and reduce face-to-face interaction – thereby decreasing travel volume and thus destroying non-digital travel-related jobs. Eventually, driverless vehicles (e.g., Simonite, 2013) could substitute for thousands of taxi and truck drivers.

- *Eliminating knowledge-based, cognitive work processes.* Data scientists (in the short term) and elaborate software algorithms (long term) will replace groups of knowledge workers. As it will be rather easy to program accumulated knowledge into an algorithm or store it in a database or an 'app', this will reduce the need for (multiple) domain experts, who have traditionally gained advantage from their understanding of theory or context (Tsoukas and Vladimirou, 2001). Weather forecasts are a highly cognitive task requiring remarkable domain expertise paired with algorithmic power. However, common weather 'apps' provide well packaged and easily 'readable' domain expertise, allowing billions of consumers to access and exploit the expertise of a very few cognitive workers at the touch of a smart phone screen. On a much larger employment scale, jobs in the fields of rehabilitation, medical diagnosis, para-legals finding and summarizing relevant case law, and educators all seem to be at risk (Kelly and Hamm, 2013; Leber, 2013). And there are indirect labor effects as well. For instance, sommeliers being replaced by wine analytics (Henschen, 2012) would only cause a small employment effect. However, the consequences of wine growing and retailing becoming more 'objectified' could be significant when digitization and big data analytics increase market transparency, and thus lead to price wars, lower margins, and hence in the long run, the need for less labor.[3]
- *Substituting an increasing share of the work of high-level decision makers* by machine-supported decision-making. In the 1980s and 1990s, similar suggestions under the labels of Decision Support Systems or Executive Support Systems (Rockart and DeLong, 1988; Scott Morton, 1995) were perhaps premature; the end of the last century did not see major employment impacts at the executive level. However, with ongoing digitization and big data analytics, this may change. McAfee and Brynjolfsson (2012) point to a management revolution driven by big data analytics where heavily technology-supported decision-making takes over from (highly paid) decision makers. Kurzweil (2012) foresees machines outperforming the human brain in the context of many decision tasks in the not-too-distant future. Subsequent substitutions or at least reductions in the number of highly-paid jobs such as these seem likely.
- *Mass amateurization* (Shirky, 2008). While small decreases in transaction costs make hierarchy less severe and allow organizations to integrate many activities (Coase, 1937), large decreases in transaction costs – as in digital processes and goods – lead to many small activity chunks that no organization can afford being integrated. Resulting mass amateurization translates de facto into fewer professional jobs, with, for example, journalists being replaced by bloggers.
- *Providing new digital products and services increasingly replacing their physical/analog forerunners* . Digital products and services emerge as substitutes for established offerings. They offer superior performance and higher benefits to consumers and businesses than their physical/analog counterparts (e.g., digital photography, video-on-demand, Skype). For example, the introduction of a user-friendly tablet established a new market segment causing the publishers of traditional 'physical' magazines, books, and newspapers to suffer from declining demand (Shirky, 2008; Varian, 2013). The reduction in demand goes hand in hand with drastically reduced labor needs for new offerings due to the nature of digital goods: offering digital goods and services typically reduces production needs to just one unit, hence requiring considerably less labor for scale production.

Discussion

We still do not know whether a seemingly unavoidable loss of considerable numbers of well-established jobs will be outweighed by newly created jobs.[4] Neither can we assert any causal relationship between digitization and (un)employment (see also the 'Jevons' Paradox' or 'Rebound Effect' in Jevons (1866); cited after Alcott (2005)). Perhaps, artificial intelligence replacing human cognitive work could be naturally limited (Autor, 2014; Newell and Marabelli, 2015). It remains to be seen, whether artificial intelligence will also be able to cope with judgments based on tacit knowledge (Polanyi, 1958; Tsoukas and Vladimirou, 2001). Indeed, it seems that: *Either* one perceives digitization and big data analytics as yet another 'revolution' which we simply have to respond to: "... either the revolutionaries are put down, or some of those institutions are altered, replaced, or destroyed" (Shirky, 2008, p. 107). *Or* one considers technological developments such as digitization and big data analytics as incremental innovations, suggesting a higher likelihood that established players stay in the game, at least for a time.

We align with the first view – but note the critical consequences it implies. Considering the potential and the impact of digitization and big data analytics, we are convinced that many jobs, institutions and industries that are established today will not survive intact. We follow Shirky (2008, p. 107) in that "the more an institution or industry relies on information as its core product, the greater and more complete the change will be". Due to the nature of knowledge work and cognitive processes, we expect digitization and big data analytics to hit knowledge-based business models and cognitive workers as hard as – and perhaps even faster – than non-knowledge business models and manual workers. Digitization and big data analytics are associated with the autonomous information processing tasks typically performed by firms and knowledge workers – whose high profits and wages provide economic incentives to even speed up substitution.

[3] A different line of argument (e.g., Brynjolfsson et al., 2010; Gao and Hitt, 2012) underscores consumer benefits resulting from 'long tail' offerings; however it does not compares the number of jobs to be gained or lost from the parallel occurrence of a 'Bertrand Competition' versus increased product variety.

[4] As in the 1980s with the roll-out of manufacturing robots, and in the early 2000s with the massive diffusion of 'the Internet', it seems impossible to predict whether the current technological wave will destroy or create more jobs (see Schumpeter's 'creative destruction'; Schumpeter, 1942).

Digitization and big data analytics cannot be slowed down, let alone stopped or reversed – no matter what insights we gain from accumulated research efforts or how we regulate business and society. The technological (digitization) revolution is transformative; it changes the character of products, processes, marketplaces, and competition throughout the economy (Zysman, 2006). As digitization and big data analytics become ubiquitous, desirable and detrimental, consequences will become ubiquitous too. With various mechanisms at play, many current business models and jobs will be substituted – including those processes, skills and jobs that currently require top education and skill levels.

Admittedly, we do not know how fast current business models will be re-shaped and/or jobs will be replaced, when major substitution waves will occur, and when resultant opportunities will arise. Fundamental changes associated with digitization and big data analytics might also open up avenues for totally new and so far unknown ways to live and cooperate in our business and private lives (Rifkin, 2014). Who would have predicted fifteen years ago that social media would create a major job market today? New work opportunities – employed or free-lance – will undoubtedly arise, and even if digitization and big data analytics result in a net loss of jobs, welfare does not necessarily need to be negatively affected by the change. After all, substituting capital for labor increases productivity and thus drives prosperity even though structural changes and frictions in labor markets will be profound and call for proactively coping strategies.

Research (see next section) and education will have to pave the avenue of such strategies. Even if major parts of traditional work will be carried out by automated systems, we have – on all levels of education – the obligation to educate people in a way that the probability of becoming digital losers is minimized. This implies, besides providing substantive knowledge and orientation in relevant technical, cognitive and social fields, focusing on those competencies that, for the time being, digitized and automated systems cannot perform – such as specific manual or intellectual expertise (tacit knowledge), social interaction and compassion, team work and conflict management, ethical judgment and responsibility, self-management, historical consciousness, and cultural understanding.

A research agenda

Clearly, a lot is at stake and our current understanding is limited – otherwise we would not see so many seemingly contradictory viewpoints, analyses and political recommendations. This gap calls for extensive research in IS and neighboring disciplines – ideally developing theories that will allow us to appropriately tackle the next technological wave (Markus, 2015). A better understanding of the underlying mechanisms and the effects of digitization and big data analytics allows us to systematically approach any resulting opportunities and challenges from an IS perspective. Hence, we conclude by suggesting three research streams, viz.:

(1) Macro- and/or micro-economic empirical studies of digitization and big data analytics driven changes in business models and the accompanying societal employment effects – with (a) business model(s) or (un)employment as the dependent variable. Data-driven insights on the sector or even (inter)national level are required in the form of detailed case studies to increase awareness and understanding among scientists, politicians and the citizenry (Loebbecke and Krcmar, 2014). Which business models, jobs or activities will be at risk of being disrupted or substituted due to digitization and big data analytics? The underlying economic mechanisms are well understood; the orders of magnitude and the timing (beginning point and duration) of business disruption and labor substitution effects are still unclear and demand profound data-driven analyses. Such a research stream demands interdisciplinary efforts combining economic and management experts with colleagues offering a profound understanding of the changes resulting from technological developments and embedded functionality disruptions.

(2) Pursuit of a systems approach to understanding the net effects of digitization and big data analytics driven labor substitution. In this stream of research, (un)employment would be the independent variable. In what way could increasing consumer surpluses make up for detrimental consequences of lost employment? How could we design a society where less labor for equal or growing prosperity might be positive – and not negative as is commonly assumed? For centuries, people have celebrated the opportunity to work less and enjoy technology-supported comfort. How should this change our view of the loss of jobs?

In contrast to Luhmann's (1993) view on systems theory, which sees technology only as a part of the environment of social systems, this research stream may well assert that digitization and big data analytics are an increasingly fundamental and constitutive element of society. Digitization and big data analytics are shaped by people; technology is a human-made, cultural artifact leading to new and often unexplored ways of use. Collected and produced data may be used or even exploited differently from its original purpose – leading to unwanted privacy breaches, control, or dependencies – as noted by Newell and Marabelli (2015). According to Luhmann (1993), in such instances, technology 'fires back' (i.e., acts on users and social systems in sometimes unforeseen and surprising ways). The recursive relationship between technology brought about by humans and human behavior shaped by technology (Orlikowski and Scott, 2008) warrants significantly more attention.

Studies may investigate this recursive relationship and extend Latour's (2005) actor-network theory in which the 'actor' concept refers to any "thing that does modify a state of affairs by making a difference" (Latours, 2005, p. 71). Instead of taking IT, digitization and big data analytics as fixed constraints on any interaction, research could investigate how digitization – as an actor – affects our understanding of social relationships. Recent events surrounding privacy strikingly illustrate this perspective. Latour (2010, p. 153) stated "change the instruments and you will change the entire social theory that goes with them."

Such a systems approach requires the pursuit of interdisciplinary research at the intersection of IS, engineering, organization and social studies. Likely, it would require going beyond studying the features and functionalities of digitization and big data analytics. Studies would have to dig deeper into economic theory and incentive systems that seem to underlie at least a good part of the employment related consequences of digitization.

(3) *Policy research working toward suggesting a portfolio of key action points and long term systemic policies* (for various policy options, see Shen et al., 2007). The objective behind such research would be less theory-oriented, but rather aim at helping policy makers to pro-actively tackle the challenge of needing less people to provide well-being to the many. Generated insights would help jobs and industries facing the risk of substitution not to fall into the same trap as many industries have done (e.g., riders of horses when the automobile appeared; musicians, music publishers and music sales agents when MP3 transformed the industry; travel agents when online reservation systems emerged). While it is difficult to actively manage / mediate the sociopolitical repercussions of digitization (Castells, 2001, 1996; Newman and Zysman, 2006), this research stream would likely suggest regulatory actions aiming at a radically different digital society – beneficial to citizens and companies (Lessig, 1999; Osterman and Shulman, 2011).

One specific action point in the IS-related policy research stream concerns intellectual property rights. Brynjolfsson and Saunders (2010) as well as Lessig (1999) demand an updated intellectual property regime to "maximize total social welfare by encouraging innovation by producers while allowing as many people as possible to benefit from innovation at the lowest possible price". Alternatively, property rights could be seen as artificially increasing the sales price and thereby decrease consumer surplus – a measure so happily celebrated to point to success and welfare in the digital age. In this line of argument, technical and legal barriers raised for establishing and maintaining property rights impose a proportionally high extra cost burden onto a low cost (digital) business. Thus they help lawyers and regulators rather than the creative performers (Caves, 2002; Knee et al., 2009). Independent research into the pros and cons of different property right regimes would certainly strongly affect the employment situation of any society.

Overall, future research should take the opportunity of aiming at longer term, country-independent insights on how to *happily* live with digitization, big data analytics and possibly reduced need for labor (Smith and Anderson, 2014). Here, IS researchers need to play an active role in the research agenda moving forward. They cannot simply sit on the sidelines and just describe a specific development. Instead, we argue that they should aim to identify the strategic issues arising from the accelerated diffusion of and disruption through digitization and big data analytics. Thereby, the outcomes of such research should show in what ways one might be able to cope with upcoming changes and challenges and how ICT systems could be built and used in sustainable and beneficial ways for humankind. Thus, in this Viewpoint paper we have attempted to uncover societal and business model transformation arising from digitization and big data analytics by identifying key emerging issues that we as an academic community can help to address.

References

Acemoglu, D., Autor, D., 2013. Skills, tasks and technologies: implications for employment and earnings. In: Card, D., Ashenfelter, O. (Eds.), Handbook of Labor Economics, vol. 4B. Elsevier, Amsterdam, pp. 1043–1171.

Alcott, B., 2005. Jevons' paradox. Ecological Economics 54 (1), 9–21.

Autor, D., 2014. Polanyi's paradox and the shape of employment growth. Paper presented at the Kansas City's economic policy symposium on "Re-Evaluating Labor Market Dynamics", Jackson Hole, WY.

Autor, D., Dorn, D., 2013. The growth of low-skill service jobs and the polarization of the US labor market. American Economic Review 103 (5), 1553–1597.

Autor, D., Katz, L., Kearney, M., 2006. The polarization of the US labor market. American Economic Review 96 (2), 189–194.

Autor, D., Katz, L., Krueger, A., 1998. Computing inequality: have computers changed the labor market? Quarterly Journal of Economics 113 (4), 1169–1214.

Autor, D., Levy, F., Murnane, R., 2003. The skill content of recent technological change: an empirical exploration. Quarterly Journal of Economics 118 (4), 1279–1333.

Baesens, B., Bapna, R., Marsden, J., Vanthienen, J., Zhao, J., 2014. Transformational issues of big data and analytics in networked business. MIS Quarterly 38 (2), 629–631.

Bartel, A., Ichniowski, C., Shaw, K., 2007. How does information technology affect productivity? Plant-level comparisons of product innovation, process improvement, and worker skills. Quarterly Journal of Economics 122 (4), 1721–1758.

Bekman, E., Bound, J., Machin, S., 1998. Implications of skill-biased technological change: international evidence. Quarterly Journal of Economics 113 (4), 1245–1279.

Boyd, D., Crawford, K., 2012. Critical questions for big data. Information, Communication and Society 15 (5), 662–679.

Bresnahan, T., Brynjolfsson, E., Hitt, L., 2002. Information technology, work organization and the demand for skilled labor: firm-level evidence. Quarterly Journal of Economics 117 (1), 339–376.

Bresnahan, T., Trajtenberg, M., 1995. General purpose technologies: 'Engines of Growth'? Journal of Econometrics 65 (1), 83–108.

Brynjolfsson, E., 1996. The contribution of information technology to consumer welfare. Information Systems Research 7 (3), 281–300.

Brynjolfsson, E., Hu, Y. (Jeffrey), Smith, M., 2010. Long tails vs. superstars: the effect of information technology on product variety and sales concentration patterns. Information Systems Research 21 (4), 736–747.

Brynjolfsson, E., McAfee, A., 2014. The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies. W.W. Norton, New York, NY.

Brynjolfsson, E., McAfee, A., 2011. Race against the Machine. Digital Frontier Press, Lexington, MA.

Brynjolfsson, E., Saunders, A., 2010. Wired for Innovation. How Information Technology is Reshaping the Economy. The MIT Press, Cambridge, MA.

Brynjolfsson, E., Yu, J., Smith, M., 2003. Consumer surplus in the digital economy: estimating the value of increased product variety at online booksellers. Management Science 49 (11), 1580–1596.

Castells, M., 2001. The Internet Galaxy – Reflections on the Internet, Business and Society. Oxford University Press, Oxford, New York.
Castells, M., 1996. The Information Age: Economy, Society, and Culture: The Rise of the Network Society, vol. 1. Blackwell, Publishers, Malden, MA.
Caves, R., 2002. Creative Industries: Contracts between Art and Commerce. Harvard University Press, Cambridge, MA.
Coase, R., 1937. The nature of the firm. Economica 4 (16), 386–405.
Comscore, 2013. Search Report, Comscore, Reston, VA, US. <www.statista.com/chart/898/number-of-searches-handled-by-search-engines-worldwide> (retrieved 13.11.14).
Cowen, T., 2011. The Great Stagnation: How America Ate All the Low-Hanging Fruit of Modern History, Got Sick, and Will (Eventually) Feel Better. Dutton/Penguin, New York, NY.
Davenport, T., 2014. Big Data @ Work. Harvard University Press, Cambridge, MA.
DeLong, J., Froomkin, A., 2000. Speculative microeconomics for tomorrow's economy. In: Kahin, B., Varian, H. (Eds.), Internet Publishing and Beyond: The Economics of Digital Information and Intellectual Property. MIT Press, Cambridge, MA, pp. 6–44.
Ducatel, K., Millard, J., 1996. Employment and innovation in advanced communications technologies: strategies for growth and the growth of employment. Futures 28 (2), 121–138.
Enck, J., Reynolds, T., 2009. Network Developments in Support of Innovation and User Needs, No. 164, OECD Publishing.
Ford, M., 2009. The Lights in the Tunnel. Automation, Accelerating Technology and the Economy of the Future. Acculant Publishing, Wayne, PA.
Frank, R., Cook, P., 1995. The Winner-Take-All Society: Why the Few at the Top Get So Much More Than the Rest of Us. Penguin, New York, NY.
Frey, C., Osborne, M., 2013. The Future of Employment: How susceptible are Jobs to Computerisation. Oxford University Programme on the Impacts of Future Technology.
Gable, G., 2010. Strategic information systems research: an archival analysis. Journal of Strategic Information Systems 19 (1), 3–16.
Galliers, R., Newell, S., Shanks, G., Topi, H., 2015. Call for papers for the special issue: the challenges and opportunities of 'datification'; Strategic impacts of 'big' (and 'small') and real time data – for society and for organizational decision makers. Journal of Strategic Information Systems 24, II–III.
Gao, G., Hitt, L., 2012. IT and trademarks: implications for product variety. Management Science 58 (6), 1211–1226.
Gerardo, A., Okhuysen, D., Lepak, K., Ashcraft, G., Labianca, Smith, V., Steensma, K., 2013. Theories of work and working today. Academy of Management Review 38 (4), 491–502.
Gordon, R., 2012. Is US Economic Growth Over? Faltering Innovation Confronts the Six Headwinds, NBER Working Paper No. 18315, National Bureau of Economic Research.
Hardin, G., 1968. The tragedy of the commons. Science 162 (13), 1243–1248.
Hays, C., 2004. What Wal-Mart Knows About Customers' Habits, New York Times (Nov 14). <www.nytimes.com/2004/11/14/business/yourmoney/14wal.html?_r=0> (retrieved 20.06.15).
Heathcote, J., Storesletten, K., Violante, G., 2010. The macroeconomic implications of rising wage inequality in the United States. Journal of Political Economy 118 (4), 681–722.
Henschen, D., 2012. How Gallo Brings Analytics Into The Winemaking Craft, InformationWeek.com. <www.informationweek.com/it-leadership/how-gallo-brings-analytics-into-the-winemaking-craft/d/d-id/1106133?> (retrieved 21.07.15).
Jevons, W., 1866. The Coal Question. Macmillan and Co, London.
Jorgenson, D., 2001. Information technology and the U.S. economy. American Economic Review 91 (1), 1–32.
Kelly, J., Hamm, S., 2013. Smart Machines: IBM's Watson and the Era of Cognitive Computing. Columbia University Press, New York, NY.
Keynes, J., 1936. The General Theory of Employment. Interest and Money, Macmillan, London.
Knee, J., Greewald, B., Seave, A., 2009. The Curse of the Mogul. Penguin Group, New York, NY.
Koch, H., Gonzalez, E., Leidner, D., 2012. Bridging the work/social divide: the emotional response to organizational social networking sites. European Journal of Information Systems 21 (6), 699–717.
Kurzweil, R., 2012. How to Create a Mind. The Secret of Human Thought Revealed. Viking Adult, New York, NY.
Latour, B., 2010. Tarde's idea of quantification. In: Candea, M. (Ed.), The Social after Gabriel Tarde: Debates and Assessments. Routledge, Abingdon, pp. 145–162.
Latour, B., 2005. Reassembling the Social, an Introduction to Actor-Network-Theory. Oxford University Press, Oxford.
Leber, J., 2013. The avatar will see you now. MIT Technological Review 116, 22–23.
Leontief, W., 1983. Technological advance, economic growth, and the distribution of income. Population and Development Review 9 (3), 403–410.
Lessig, L., 1999. Internet regulation through architectural modification. Harvard Law Review 112 (7), 1634–1657.
Levy, F., Murnane, R., 2013. Dancing with Robots: Human Skills for Computerized Work, Third Way Next. Fresh Thinking.
Loebbecke, C., Krcmar, H., 2014. Information Systems and Employment: From Idealization to Understanding as Stepping Stone to Action, UK Academy for Information Systems Conference (UKAIS), Oxford, UK.
Lucas, H., Agarwal, R., Clemons, E., El Sawy, O., Weber, B., 2013. Impactful research on transformational information technology: an opportunity to inform new audiences. MIS Quarterly 37 (2), 371–382.
Lucas, H., Goh, J., 2009. Disruptive technology: how Kodak missed the digital photography revolution. Journal of Strategic Information Systems 18 (1), 46–55.
Luhmann, N., 1993. Risk: A Sociological Theory. Walter de Gruyter, Berlin.
Majchrzak, A., Malhotra, A., 2013. Towards an information systems perspective and research agenda on crowdsourcing for innovation. Journal of Strategic Information Systems 22 (4), 257–268.
Malone, T., Crowston, K., Herman, G., 2003. Organizing Business Knowledge: The MIT Process Handbook. MIT Press, Cambridge, MA.
Malone, T., Laubacher, R., Johns, T., 2011. The big idea: the age of hyperspecialization. Harvard Business Review 89 (7/8), 1–11.
Markus, L., 2015. New games, new rules, new scoreboards: the potential consequences of big data. Journal of Information Technology 30 (1), 58–59.
Markus, L., Loebbecke, C., 2013. Commoditized digital processes and business community platforms: new opportunities and challenges for digital business strategies. MIS Quarterly 37 (2), 649–653.
McAfee, A., Brynjolfsson, E., 2012. Big data: the management revolution. Harvard Business Review 90 (10), 60–68.
Michael, K., Michael, M., 2011. The social and behavioural implications of location-based services. Journal of Location Based Services 5 (3–4), 121–137.
Miller, B., Atkinson, R., 2013. Are Robots Taking Our Jobs, or Making Them? The Information Technology & Innovation Foundation, Washington, D.C. <www2.itif.org/2013-are-robots-taking-jobs.pdf> (retrieved 19.11.13).
Moore, G., 1965. Cramming more components onto integrated circuits. Electronics 38, 114–117.
Negroponte, N., 1995. Being Digital. Vintage Books, New York, NY.
Newell, S., Marabelli, M., 2015. Strategic opportunities (and challenges) of algorithmic decision-making: a call for action on the long-term societal effects of 'Datification'. Journal of Strategic Information Systems 24 (1), 3–14.
Newman, A., Zysman, J., 2006. Transforming politics in the digital era. In: Zysman, A., Newman, A. (Eds.), How Revolutionary was the Digital Revolution? Stanford University Press, Stanford, CA, pp. 391–414.
Orlikowski, W., Barley, S., 2001. Technology and institutions: what can research on information technology and research on organizations learn from each other? MIS Quarterly 25 (2), 145–165.
Orlikowski, W., Scott, S., 2008. Sociomateriality: challenging the separation of technology, work and organization. The Academy of Management Annals 2 (1), 433–474.
Osterman, P., Shulman, B., 2011. Good Jobs America Making Work Better for Everyone. Russell Sage Foundation, New York, NY.
Osterwalder, A., Pigneur, Y., 2010. Business Model Generation. A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons, Hoboken, NJ.

Picot, A., Reichwald, R., Wigand, R., 2008. Information, Organization and Management. Springer, Berlin-Heidelberg.
Polanyi, M., 1958. Personal Knowledge: Towards a Post-Critical Philosophy. University of Chicago Press, Chicago, IL.
Power, D., 2002. Decisions Support Systems: Concepts and Resources for Managers. Quorum Books, Westport, CT.
Ricardo, D., 1821. On the Principles of Political Economy and Taxation. John Murray, London.
Rifkin, J., 2014. The Zero Marginal Cost Society: The Internet of Things, the Collaborative Commons, and the Eclipse of Capitalism. Palgrave Macmillan, New York, NY.
Rifkin, J., 1995. The End of Work: The Decline of the Global Labor Force and the Dawn of the Post-Market Era. Tarcher Penguin Group, New York, NY.
Rockart, J., DeLong, D., 1988. Executive Support Systems: The Emergence of Top Management Computer Use, Business One Irwin.
Rosen, S., 1981. The economics of superstars. American Economic Review 71 (5), 845–858.
Rouibah, K., Ould-Ali, S., 2002. Puzzle: a concept and prototype for linking business intelligence to business strategy. Journal of Strategic Information Systems 11 (2), 133–152.
Schumpeter, J., 1942. Capitalism, Socialism, and Democracy, second ed. Harper, New York, NY.
Scott Morton, M., 1995. Information Technology and the Corporation of the 1990s: Research Studies. Oxford University Press, New York, NY.
Shapiro, C., Varian, H., 1999. Information Rules: A Strategic Guide to the Network Economy. Harvard Business School Press, Cambridge, MA.
Shen, Y., Straub, D., Trauth, E., 2007. Public ICT policy initiatives and deployment: theories, stakeholders, success factors, and regulatory tools. In: Palvia, Palvia, S., Harris, A. (Eds.), Managing Global Information Technology: Strategies and Challenges. Ivy League Publishing, Marietta, GA, pp. 151–166.
Shirky, C., 2012. Napster, Udacity, and the Academy. <www.shirky.com/weblog/2012/11/napster-udacity-and-the-academy> (retrieved 23.09.14).
Shirky, C., 2008. Here Comes Everybody: How Change Happens when People Come together. Penguin Books, London.
Simonite, T., 2013. Data shows Google's Robot Cars are Smoother, Safer Drivers than You or I, MIT Technology Review. <www.technologyreview.com/news/520746/data-shows-googles-robot-cars-are-smoother-safer-drivers-than-you-or-i> (retrieved 21.11.13).
Smith, A., Anderson, J., 2014. AI, Robotics, and the Future of Jobs, Pew Research Center. <www.pewinternet.org/files/2014/08/Future-of-AI-Robotics-and-Jobs.pdf> (retrieved 14.09.15).
Stigler, G., 1961. The economics of information. Journal of Political Economy 69 (3), 213–225.
Swanson, E., Ramiller, N., 1997. The organizing vision in information systems innovation. Organization Science 8 (5), 458–474.
Tams, S., Grover, V., Thatcher, J., 2014. Modern information technology in an old workforce: toward a strategic research agenda. Journal of Strategic Information Systems 23 (4), 284–304.
TED, 2013. Closing Statement from TED Debates. <www.ted.com/conversations/17918/is_america_past_its_prime_di.html> (retrieved 13.11.14).
Torgovnick, K., 2013. The Future of Work and Innovation: Robert Gordon and Erik Brynjolfsson debate at TED 2013. <http://blog.ted.com/2013/04/23/the-future-of-work-and-innovation-robert-gordon-and-erik-brynjolfsson-debate-at-ted2013/> (retrieved 13.11.14).
Tsoukas, H., Vladimirou, E., 2001. What is organizational knowledge? Journal of Management Studies 38 (7), 973–993.
Varian, H., 2013. The Economics of the Newspaper Business, Speech given at Awards Ceremony of the Annual Italian Journalism Award, Sept 25. <www.journalismfestival.com/news/hal-varian-on-the-economics-of-the-newspaper-business> (retrieved 13.11.12).
Varian, H., Choi, H., 2009. Predicting the Present with Google Trends, Google Research Blog. <ssrn.com/abstract=1659302> (retrieved 13.11.14).
Weill, P., Woerner, S., 2015. Thriving in an increasingly digital ecosystem. MIT Sloan Management Review 56 (4), 27–34.
Westerman, G., Bonnet, D., McAfee, A., 2014. Leading Digital – Turning Technology into Business Transformation. HBR Press, Boston, MA.
Yoo, Y., 2010. Computing in everyday life: a call for research on experiential computing. MIS Quarterly 34 (2), 213–231.
Zammuto, R., Griffith, T., Majchrzak, A., Dougherty, D., Faraj, S., 2007. Information technology and the changing fabric of organization. Organization Science 18 (5), 749–762.
Zysman, J., 2006. Creating value in a digital era: how do wealthy nations stay wealthy? In: Zysman, A., Newman, A. (Eds.), How Revolutionary was the Digital Revolution? Stanford University Press, Stanford, CA, pp. 23–54.