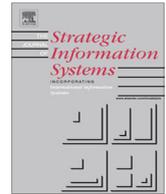




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# Reflections on societal and business model transformation arising from digitization and big data analytics: A research agenda



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## 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.

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## 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

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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

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