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Information Systems and Employment: From Idealization to Understanding as Stepping Stone to Action – A Position Paper –

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Abstract

Digitization and its effect on employment has been discussed within the discipline of Information Systems (IS) for a long time. The net effect of digitization on job creation and job loss has never been clear. However, it seems obvious that today's IS and the accompanying digitization of data and processes may destroy jobs among knowledge workers just as automation replaced the need for manufacturing workers. In this position paper, we outline the effects and mechanisms underlying digitization-driven job destruction and propose a research program which addresses and prepares for the detrimental side of digitization.

Keywords: Information Systems, Digitization, Employment, Societal Consequences

1 Setting the Stage

Information systems (IS) and digitization are increasingly penetrating all areas of life and creating new ways of working, communicating, and cooperating. Connecting individuals, enterprises, devices, and governments and the so-called 'Internet of Things' creates massive amounts of digitized data and processes. Similar to the effect of machines in the era of industrialization, digitization is likely to lead to new opportunities, but also to new challenges. With processing, storage, and transmission of data available on a massive scale at extremely low cost, digitization changes almost all forms of human labor which are directly or indirectly associated with data and cognitive processes. Sophisticated software fosters machine-based interpretation of data enabling autonomous decision-making and a deeper integration of data in traditional value creation activities leading to consequences on work at the individual, organizational, and societal levels (see also Gerardo et al. 2013).

An extensive body of literature investigates the economics of digital goods or information goods (De Long, Fromkin 2000; Shapiro, Varian 1999; Stigler 1961; Zuboff 1988). Three consequences resulting from the economics of digital goods and the accompanying digitization set the stage for IS and digitization affecting employment:

- Centralized production ("winner-take-all economy" or "superstar economy"): In the case of digital goods with minimal distribution costs, economies of scale and hence centralization become even more extreme than with physical goods. 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 imposing marginal costs close to zero. Initial copy and network effects in the field of digitized industries lead to oligopolistic or even monopolistic structures where a few providers dominated the respective market. Following basic economic concepts, centralized production should lead to a 'winner-take-all economy' (Frank, Cook 1995) or a so called 'superstar economy' (Rosen 1981) with less employment, less capital assets, stronger inequality and an increasing divide between huge and miniature enterprises and an increasing inequality in income within and among countries.
- Increasing harmonized demand: The trend of centralized production of digital goods correlates with the globally harmonized demand without, however, any clear insight about causality. Market figures show that tastes and habits have become increasingly similar in many parts of the world and while local preferences are still important, global offerings based on large scale productions win demand. In a digital world of abundance and the dematerializing nature of digitization, harmonized demand has strong economic impacts leading to a decrease in production and transport and, subsequently, a decreased demand for labor. In the case of physical goods, harmonized tastes and habits imply 'producing' more of the same (scale economies).
- Eroding property rights: Enterprises with business models based on digital innovation or content complain about the erosion of property rights. The free flow of digital goods (their products), whether authorized or unauthorized, often leads to unwanted cheap or even free diffusion of products. Innovation and content owners

argue that creation is hindered, decreasing even further the demand for labor, when payments are limited or diverted to entities other than the owners.

The effects are evident at the individual, organizational and societal levels. At the individual work level, enterprise digitization raises significant opportunities (e.g., the ability to jettison often routine work, flexible work hours and a better reconciliation of work and social life) and controversial issues (e.g., challenges of being always online, including burnout), and scenarios of the so-called freelance economy where individuals struggle to obtain paid work (Koch et al. 2012).

At the organizational level, IS continues to reshape existing work and organizational structures with new forms of division of labor and cooperation in enterprises (Bresnahan et al. 2002; Malone et al. 2003; Orlikowski, Barley 2001). A growing disconnect between the work processes of specific locations (including factories or office buildings) or time (fixed, clocked working hours) enables spatially and temporally flexible working arrangements. The impact of digitization on the design of new forms of work does not end at corporate boundaries. On the contrary, IS and digitization offer 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.

Changes at the societal level follow developments on the individual and the organizational levels. Digitization allows machines to replace people for more and more activities with digitized system performance being more cost-effective and less error-prone than human decision makers (Acemoglu, Autor 2013). Previously, this substitution or automation happened mainly in routine activities with medium-level qualifications. Typical examples were routine activities such as the work of check-in agents at airport counters or accountants (Autor et al. 2003). With big data analytics and rapid advances in artificial intelligence, the machine-for-human substitution is about to diffuse into more domains with highly complex and cognitive activities requiring higher skill levels (Autor, Dorn 2013; Brynjolfsson, McAfee 2011).

2 Five Mechanisms by which Information Systems and Digitization Affect Employment

- Losing jobs within physical (production) processes: Manufacturing robots and information kiosks are well known. Engineering efforts on advanced self-check-

out systems are on the horizon. Transparency and surveillance capacities of new digital technology (video, sensors, mobile connections) replace the need for physical presence of security personnel in public spaces such as airports, train stations, downtown areas. Driver-less vehicles (Simonite 2013) could substitute for thousands of taxi and truck drivers. Also, altered habits and consumption patterns such as the preference for video chat and other new forms of digital communication might reduce the need for and the affordability of face-to-face interaction thereby decreasing the need to travel and possibly affecting the number of non-digital travel-related jobs.

- Eliminating knowledge-based, cognitive work processes: Programs that accumulate knowledge into an algorithm or store it in a database will reduce the need for domain expertise; data scientists (short term) and apps (long term) will replace groups of knowledge workers. For instance, jobs in the fields of rehabilitation, medical diagnosis, para-legals, and educators could be at risk (Kelly, Hamm 2013; Leber 2013). Not only decision-making jobs would be affected: sommeliers could be replaced by apps analyzing the chemistry of wine (wine analytics)! The consequences of wine growing and retailing becoming more 'objectified' could be enormous. As digitization and big data analytics increase market transparency, they will lead to stronger and more effective price wars, lower margins, and, in the long run, less needed labor.
- Substituting an increasing share of the work of high-level decision makers with machine-supported decision making. McAfee and Brynjolfsson (2012) point to a management revolution driven by big data analytics where heavily technology-supported decision making first beats and later partially outweighs highly paid (human) decision makers. Kurzweil (2012) foresees machines outreaching the human brain, in the context of many decision tasks in the not too distant future. Subsequent substitutions or at least reductions of high-paid labor seem likely.
- Substituting professional jobs by 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, leads to so many small activity chunks that no organization can afford integrating them all. Resulting mass amateurization

translates de facto into less professional jobs (e.g., journalists replaced by bloggers).

- Substituting jobs in established industries by converting analogue to digital products and services: The introduction of a user-friendly tablet established a new market segment causing traditional physical magazines, books, and newspapers publishers to suffer from declining demand (Shirky 2008; Varian 2013). Digital products and services offer a superior performance and higher benefit to consumers and businesses in comparison to previous analogue products and services. Demand for analogue offerings subsequently decreases with established companies going out of business. About 2,000 Netflix employees offer more video hours to consumers than Blockbuster with up to 60,000 employees at its peak in 2004. The introduction and diffusion of Skype has put numerous jobs at telecom carriers at risk, both in the world of the analogue infrastructure and in the fixed and wireless IP world. The digital nature of the new offerings typically reduces production needs to just one unit, thereby requiring drastically less labor for scale production. Along those lines, educators will need to adapt to industry transformation and likely take on new roles in helping to organize and deliver a better understanding of e-learning opportunities across topics, persons, and age groups.

3 Discussion and Contribution

IS, Internet, and digitization have caused the revolution of our times. Many jobs, institutions and industries established today will not survive intact. "The more an institution or industry relies on information as its core product, the greater and more complete the change will be" (Shirky 2008: p.107). Due to the nature of knowledge work and cognitive processes, digitization should hit knowledge workers as hard as – and perhaps at an even faster pace -- than non-knowledge workers.

Digitization and big data analytics are exactly those technologies associated with the information processing tasks typically performed by knowledge workers whose high wages underlie economic incentives to speed up substitution. In this light, the argument that higher education and skill levels reduce the risk of unemployment (Autor, Dorn 2013) comes under pressure (Ford 2009). What can be codified, whether routine or rare instance, can be mastered by IS.

Ongoing digitization cannot be slowed down, stopped, or even reversed no matter what insights we gain from accumulated research efforts or what regulatory policies governmental agencies might impose. The technological (digitization) revolution is transformative; it changes the character of products, processes, marketplaces, and competition throughout the economy (Zysman 2006). As digitization becomes ubiquitous, both desirable and detrimental consequences become ubiquitous too. With various mechanisms at play outlined above, many current jobs will be substituted by IS and digitization including those requiring top education and skill levels.

However, as in the 1980's with the roll-out of manufacturing robots, and in the early 2000's 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' 1942). Today's IS and digitization will also open up avenues for totally new and thus unknown ways to live and cooperate in business and private (Lucas et al. 2013), thereby creating new work opportunities of either the employed or free-lance type, and facilitating many desirable changes such as increases in productivity and a growing consumer surplus.

As regards the net effect of IS and digitization on employment, we are not aware of any research describing the delta between jobs lost and newly created jobs following the 'current revolution'. Neither do we know how fast jobs will be substituted, when major substitution waves will occur and when opportunities will come up, nor when and how some workers in vulnerable categories might escape job loss.

Hence, with this position paper, we hope to raise awareness that we need to look beyond the idealized view of new IS, Internet and a hyper-connected world doing good to most of us and foster a multi-disciplinary discussion rooted in the IS discipline. A better understanding of the underlying mechanisms and the effects of digitization will allow us to systematically approach opportunities and challenges resulting from new organizational structures, business models and markets.

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