The future of work
given artificial forms of intelligence

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Abstract:
By focusing on the upsurge in automation owing to robots and artificial intelligence and on this trend's impact on jobs, a view is proposed of people being complementary to these new automated forms of production and value creation. Given the current capability of automation and considerations about the future, we are led to reconsider the role of human beings in the organization of work. The idea that we are all going to live by being creative while machines assume the chore of production is naive and probably false. In the universe now looming, anything that is automated becomes a commodity, its perceived value linked to emotions and interactions. This new view of work has implications for changing the internal organization of firms and their participation in networks.

This article focuses on the upsurge in the technology of automation, ranging from robots to artificial intelligence (AI), and its impact on jobs. Many reactions followed on Carl Frey and Michael Osborne's (2013) study on the future of employment, most of them conservative and cautious. Herein, I would like to present a vision of how work will change so as to make employees complementary to the new automated forms of production and value creation, a vision nonetheless in line with Frey and Osborne's analysis. By taking into account the current capacities of automation and the technological developments under way in laboratories, we are led to reconsider, as Michael Ballé and Eivin Reke (2020) have proposed, the role of human beings in the organization of work. This new vision of work foresees changes in the organization of firms, both internally and, too, as entities in a network. The automation stemming from AI is accelerating the shift toward an "iconomy" (VOLLE 2014), *i.e.*, an economy organized to benefit fully from information technology.[1]

This article starts by addressing the urgent question of how AI affects jobs. The job market is undergoing change as the cognitive technology developed in laboratories arrives in the places where goods and services are produced. After a brief analysis of the automation made possible by AI now and in the future, the question of changes in employment will be reviewed (STIEGLER 2015) while pointing out the future consequences on firms tomorrow. Seen as a community of shared interests around a societal objective and benefitting from an internal, transactional and collaborative efficiency superior to the open market's, firms will continue thriving in the complex world of tomorrow but within ecosystems that are going to evolve significantly.

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[1] This article has been translated from French by Noal Mellott (Omaha Beach, France). The translation into English has, with the editor's approval, completed a few bibliographical references. All websites were consulted in April 2021.

Artificial intelligence, automation and the destruction of jobs

A revolution that relies on human beings

The development of AI is a step forward in the ongoing progress made in automation. This progress has not been steady. There have been phases of rapid acceleration (*e.g.*, the development of deep learning over the last ten years) and phases when the possibilities offered by new forms of technology are being appropriated. The road to automation has not been smooth. The well-known announcement made by Foxcon in 2014 about replacing its 300,000 employees with a million robots has not come true. In contrast, Amazon's warehouses have been automated with KIVA robots, and the factories automated with a "very small number of humans" seem to be fully autonomous. These contrasts can be set down to the complications of automating tasks that are not repetitive. Automation often starts out more easily by targeting the jobs of experts than of generalists, as Brynjolfsson and McAfee (20105) have explained: "*The main lesson of 35 years of AI research is that the hard problems are easy and the easy problems are hard… As the new generation of intelligent devices appears, it will be the stock analysts and petrochemical engineers and parole board members who are in danger of being replaced by machines. The gardeners, receptionists, and cooks are secure in their jobs for decades to come.*"

AI is a "*learning loop with embedded humans*" (DAUGHERTY & WILSON 2018). The human role has many facets: organize the training of machines, take part in learning procedures, and tap the value added by algorithms. Apart from fully automated systems, most "smart" systems provide "assistance" for decision-making. As in the game of chess, the best "agent" for solving a problem or heading a process is a "centaur", a combination of people and machines. The codevelopment of the couple formed by a human agent and a machine assistant is a marvelous adventure for reinventing occupations and racing toward new competitive advantages. In a self-sustaining process, the amplification of the learning loop bestows even more advantages on first-comers. Another fundamental role played by people is to collect, classify and consolidate data.

More jobs destroyed than created

Since the study on the future of employment (FREY & OSBORNE 2013) announced that automation would jeopardize 47% of jobs in the United States, this issue has been intensely debated. Whereas several studies have come up with results of the same magnitude, others, such as the OECD's or McKinsey's, have made finer distinctions and been less pessimistic. One argument is that what will be affected are "tasks" (or parts of them) and not "jobs" as such. As experience has shown however, firms are able to redistribute tasks so as to effectively turn gains into lower labor costs, independently of any hypothesis about growth.

I support the Frey-Osborne hypothesis because the arguments against it rely on a too conservative analysis of what to expect from progress in AI. For readers who need to be convinced that a new wave of automation is flooding toward us, I refer them to McAfee and Brynjolfsson's *The Second Machine Age* (2015): "*Computers and robots are acquiring our ordinary skills at an extraordinary rate.*" The fact that the world is changing so fast before our very eyes should lead us to be quite cautious with respect to the aforementioned studies on employment. As Neil Jacobstein of Singularity Education Group pointed out in 2016, these studies have been based on a continuity in the types of tasks performed (an assumption that makes it possible to analyze the future potential for automation), a sort of "everything being equal" that is probably valid in the short run (a few years) but is much more questionable over a longer period (a few decades).

The new employment scene

To understand the consequences of the gradual rollout of new forms of AI in firms, I would like to refer to an article (LUND *et al.* 2012) that divides jobs into three categories: production, transactions and interactions. The first two are going to be massively affected by automation: most jobs in production will be replaced with robots, whereas jobs involving transactions will be heavily reduced as AI comes into use, even though this will take a little more time. Over a longer period, there will remain the jobs involving interactions. Most of tomorrow's jobs will be characterized by exchanges with an emotional dimension between people — exchanges that lie beyond the reach of automation but will benefit from a new "smart environment". For example, the jobs of gardener, masseur or plumber will become technological, collaborative, social occupations since AI will take over certain activities while enabling the person to concentrate on what is essential (such as the meaning and pleasure of a garden).

In this looming universe, everything automated will become a commodity, while the perception of value will be related to emotions and interactions. Interaction jobs will not emerge from new fields awaiting creation; instead, most of them will lie in continuity with the interaction jobs that now exist. Health, well-being, law and order, education and entertainment will still be major sources of employment in the coming decades. Gardeners will probably use robots, but will be selling an "experience", telling a story. A major part of these jobs will be in the quaternary sector of the economy, which is developing new services incorporating goods or the temporary provision of goods or persons or combinations thereof. Logically, the evolution toward a quaternary economy is strongly related to the progress made in information and communications technology (DEBONNEUIL 2017). ICT will make it possible to offer truly customized services there where they are demanded (including in the management of the men and women who provide these short-term, temporary services).

Anticipating AI's future

What AI already knows how to do

Before a few futurological remarks about what new, enhanced forms of AI might be found in firms tomorrow, let us recall AI's omnipresence in current software, a point made in the report by the Academy of Technologies (ADT 2018). According to Peter Domingos (2015), "*People worry that computers will get too smart and take over the world, but the real problem is that they're too stupid and they've already taken over the world.*"

AI is everywhere. In the interfaces of our smartphones, it "assists" us in making decisions and interacting. Since it is essential to e-commerce, it is the focus of attention of the giants of the Web. AI has accelerated the productivity of processes, starting with the supply chain. The Web giants, like Amazon and Alibaba, are not simply champions of online sales sites. They are, above all, the champions of the supply chain who use big data to learn as much as possible about their clients. AI lies at the core of digital manufacturing and "Industry 4.0", for which it will serve to reinvent products and manufacturing processes (SCHAEFFER & SOVIE 2019). At present, AI solves, or helps solve, precise, narrow, specialized problems.

In contrast, the AI toolkit is huge enough to be used to tackle problems of various sorts (ADT 2018). The application of AI to data processing (for recommending or facilitating searches, for example) is a key to the growth of online platforms (CASEAU 2020). The advances made by AI are found in many forms of automation, such as robotic process automation (RPA) or chatbots. We are already in the habit of using our smartphones as a cognitive "crutch". This form of assistance will grow.

What is in the pipeline…

Prominent in AI's progress over the past ten years have been deep neural networks. This progress has moved over a threshold, namely the recognition of images, sounds and shapes in general. M. Ford (2018) helps us understand this breakthrough along with some of the hard questions now waiting for answers. The brain can apparently be better described by Marvin Minsky's phrase "*a society of minds*" than by "neural network". A substantial part of AI research concentrates on integrating multiple forms of learning algorithms. The spectacular successes of DeepMind (from AlphaZero to AlphaFold) provide examples of the abundance of AI methods and techniques of hybridization or integration. While we are putting to use the findings of deep learning on image, sound or text recognition, we can predict that the "elementary bricks" stemming from it will be used in new, more complex AI architectures. The consequences of this "revolution of the 2010s" are going to spread out over the two coming decades

The progress made in processing natural language, as evidenced by the performance of robot translators or writers, might seem superficial, since it involves transformations based on examples more than comprehension. This accounts for the current deficiencies of chatbots. Nonetheless, the second revolution — progress in processing language semantically — is in sight. Deep neural network tools (DNN, a perfect illustration being GPT-3) are capable of remarkable feats in producing human-like texts, even though this form of AI has no understanding of the texts it manipulates. Given, however, the enormous quantity of data for input and the abundance and complexity of the output, a start can be made at using these tools as elementary bricks embedding a "form of understanding". In this approach, the massive accumulation of data will become a "substitute for experience". Once structured and reified, everything that GPT-3 can tell us about a concept (*e.g.*, a cat) becomes a substitute for comprehension of the concept. This first step in the processing of language by neural networks probably signals the start of the real revolution that will, in the coming years, take the form of "cognitive assistants" capable of understanding texts as well as concepts.

Less visible because they concern systems instead of interfaces, the new forms of AI for processing data will enable firms to re-optimize their business processes in a complex, unpredictable environment. A change is under way owing to the use of big data, new algorithms and data analytics: it is becoming possible to optimize without predicting (CASEAU 2020). The previous generation of AI sought to extract models as a representation of how we understand the world (processes and environment), and we could then use these models for our own cognitive purposes. When the world changes, these representations and the tools used to make them have to be overhauled. The next generation of AI will involve adaptive software development with "black boxes" (*e.g.*, with deep learning). The models being used will no longer be explicit but will take the form of transitional, continuously updated objects.

The future of firms and employment

Firms will still exist.

According to a frequent idea in predictions about the world of work, firms will be deconstructed and a new structure built around market positions and freelance workers, a prediction that refers to a well-known theory on transaction costs (COASE 1937). Since technology is making transactions (communications, exchanges, records, etc.) more fluid, the more technology advances, the less it needs a specific entity as such. There will be a movement from the "firm 2.0" to "extended firms", an then on to a "network of agents". In my opinion, this analysis is mistaken.

There will still be firms (in the usual sense and not just as brands or trademarks) in the coming decades. I see several reasons for this. The digital realm corresponds to an economy with fixed costs, a fact that leads to concentration and the creation of monopolies, as clearly explained by the theorists of an "iconomie" (VOLLE 2014). Tomorrow's world will be more complex, and complexity is not favorable to hyperspecialization. Complexity is not conducive to abstraction, or to analyzing a phenomenon by breaking down into units, as is necessary to talk about "market positions". It increases transaction costs, levying a sort of "communications tax" that increases insofar as we try to make analytically break down phenomena. The Web giants have reacted by trying to minimize transaction costs through the recruitment of skilled, qualified employees assigned to multifaceted work teams. We might even say that the tasks best suited for "disintermediation" on the platforms are those that will be the first to be automated, as progress is made (See the previous section). The maximal complexity that a firm can handle increases at a rate conditioned by the lowering of the elementary transaction costs due to its technology.

Another trendy utopia is "anytime, anywhere, any device" (ATAWAD). This vision seeks to release us from place and time: we can work anytime and anywhere, at the pace we choose. On the contrary, complexity means work has to be synchronized and with strong interactions — to be "colocated". This requirement is not absolute or constant, evidence of this being the development of "telecommuting" during the Covid-19 epidemic. Nonetheless, the major source of value creation now comes from teams working together. Since colocation is not scalable, this approach necessarily implies a specific form of organization — a distributed network — as ever more importance is given to cooperation and new forms of ICT.

Tomorrow's networked firms

My vision of employment is related to a multiscale network, ranging from the big multinationals that now exist to self-employed entrepreneurs. In this network, polarization (the consolidation of the big platforms and the multiplication of "pico-firms") will continue and even be amplified. Firms will still exist twenty or thirty years from now. The"uberization" of work will not have dissolved the concept of the firm. Globalization and digitization tend toward concentration. In an addition to the aforementioned argument about the economics of fixed costs for economies of scale, network effects (especially in two-sided markets and the ecosystems that take shape around platforms) will endow the biggest player (often, but not necessarily, the first-comer) with major advantages. The concentration of platforms will make their ecosystems grow, thus potentially creating opportunities for many a local business. Let us take as example the AI developed and showcased by Google. If crowned with success, it will, for sure, strongly stimulate Google's growth; but it will also open new, potential fields for business at a pace faster than Google itself can handle. This means that a growing share of value will be created "on the edge", as other businesses use the technology made available by Google to solve other problems than those for which the technology was initially intended. The same trend can be observed in the growth of iOS as a platform for mobile devices. As new features are added on the iPhone's platform (I am thinking of Siri), the possibilities made available to the community of mobile applications increase faster than what Apple can reap for its own services.

The idea that we are all going to live on our creativeness while machines will be occupied with production is naive and probably false. Multinational firms need new talents, in particular creators and designers, but in smaller numbers than the jobs destroyed by automation. Meanwhile, on the edge, where service opportunities exist for adjusting to a community's or an individual's needs, a much more extended and fertile pattern is emerging that can be described as "fractal" or "multiscale". In this world of interactions, opportunities for talent arise at various levels. Unlike the customer's "digital experience", it is hard to move interaction services. In any case, relocating them

entails a cost. "Craftsmen of mass personalization" can become active on various geographic scales depending on their talent. This renaissance of the neighborhood craftsman could be boosted by the priority now being given to the local over the global, in reaction to globalization and in the fight against global warming.

Conclusion

To conclude, I would like to emphasize four ideas that are important for understanding the impact of new forms of AI on the operation of firms:

● AI is not an isolated technique. It is a tool, a software solution.

● AI is built and rolled out through collaboration between people and machines.

● AI has many forms. There is a wide variety of methods that gain if they are combined, either through hybridization or by being assembled in a "system of systems", a network.

● AI is a "shock absorber of complexity". The more it is developed, the more it will enable tomorrow's firms to tackle and develop new fields of value creation.

References

ADT [Académie des Technologies] (2018) *Renouveau de l'Intelligence Artificielle et de l'Apprentissage*, report, March (Paris: Académie des Technologies) 102p., available via
http://academie-technologies-prod.s3.amazonaws.com/2018/06/01/14/25/31/28/IA_Web.pdf.

BALLÉ M. & REKE E. (2020) "Do we still need people?", *LindedIn*, blog dated 10 August 2020:
https://www.linkedin.com/pulse/do-we-still-need-people-michael-ball%C3%A9?articleId=6698591682499358721.

CASEAU Y. (2020) *L'approche Lean de la transformation digitale. Du client au code et du code au client* (Paris: Dunod).

COASE R. (1937) "The nature of the firm", *Economica*, 4(16), pp. 386-405; doi:10.1111/j.1468-0335.1937.tb00002.x.

DAUGHERTY P. & WILSON H.J. (2018) *Human+Machine: Reimagining Work in the Age of AI* (Boston, MA: Harvard Business Review Press).

DEBONNEUIL M. (2017) *La révolution quaternaire. Créer 4 millions d'emplois, c'est possible!* (Paris: Éditions de l'Observatoire).

DOMINGOS P. (2015) *The Master Algorithm: How the Quest for the Ultimate Learning Machine Will Remake Our World* (NewYork: Basic Books).

FORD M. (2018) *Architects of Intelligence: The Truth about AI from the people Building It* (Birmingham, UK: Packt Publishing).

FREY C.B. & OSBORNE M. (2013) "The future of employment", working paper (Oxford, UK: Oxford Martin School Programme on Technology and Employment) 79p., available via
https://www.oxfordmartin.ox.ac.uk/downloads/academic/future-of-employment.pdf.

LUND S., MANYIKA J. & RAMASWAMY S. (2012) "Preparing for a new era of work", *McKinsey Quaterly*, 1 November, available at
https://www.mckinsey.com/business-functions/organization/our-insights/preparing-for-a-new-era-of-work.

McAFEE A. & BRYNJOLFSSON E. (2015) *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies* (New York: Norton).

SCHAEFFER E. & SOVIE D. (2019) *Reinventing the Product: How to Transform your Business and Create Value in the Digital Age* (London: Kogan Page).

STIEGLER B. (2015) *L'emploi est mort, vive le travail*! (Paris: Fayard/Mille et une Nuits).

VOLLE M. (2014) *Iconomie* (Paris: Xerfi/Economica), available via http://www.volle.com/travaux/iconomie.pdf.