The Future of Management in a World of Electronic Brains

Xavier Ferràs-Hernández[1]

Editor's Introduction

Do you like scary movies? If so, you will like reading the following essay. Do you know what The Singularity is? It's the hypothetical point in the future at which artificial intelligence = human intelligence. Do you have any idea when it might occur? Sooner than you might think! AI theorists and researchers now place the date of the singularity as less than a generation away (average estimated year is around 2040). Now that's scary. Are there any capabilities that people possess that might allow us to compete with rising machine superintelligence that will probably achieve the singularity on the near-term horizon? Umm, maybe. Xavier Ferràs Hernández, thinks there are, and he works pretty hard to convince you that we might still have some hope. But, then, he could be wrong . . . . If he is, well, then, Mr. or Ms. management theorist, we might not need you for very much longer. That's also pretty scary, don't you think? So, if you like things that can give you the willies, even in the daylight, well this scary essay is made just for you.

Abstract
Artificial Intelligence (AI) is surpassing humans in data processing and computational power. But it also progresses in strategic thinking, creativity, and social interaction skills, bearing almost human cognitive abilities. How long does it take to see digital CEOs running corporations? Will management become a commodity developed by electronic brains?

The progressing maturity of Artificial Intelligence (AI) is generating a revolution similar to the one witnessed during the rise of the Internet. Increasing layers of autonomous intelligence are being incorporated into every electronic device. In his final days as U.S. President, Barak Obama, concerned with the impact of this disruptive technology, organized a national conference ("Frontiers") to discuss the deep implications of AI at the philosophical, social, and economic levels. According to the White House (Executive Office of the President, White House, 2016), AI is at a turning point, because of the convergence of three mutually reinforcing forces: the availability of big data (massive data from companies, governments, and social networks), the burgeoning self-learning capacities of machines (machine learning), and the ever-increasing power of computers.

AI is formed by a new generation of machines capable of (a) interacting with the environment, gathering information from outside (including from natural language) or from other computer systems; (b) interpreting this information, recognizing patterns, inducing rules, or predicting events; (c) generating results, answering questions; or giving instructions to other systems; and (d) evaluating the results of their actions and improving their decision systems to achieve specific objectives. Like many other technologies (genomics, advanced materials, 3D-printing, or the "Internet of things"),

AI is in an era of accelerating progress. In the now distant past is the stunning defeat of Garry Kasparov (world chess champion) by an IBM algorithm (Deep Blue), in 1997. In 2011, a new IBM machine, Watson, beat the two best human players in a live broadcast TV contest ("Jeopardy"), by solving riddles, answering ambiguous questions, and interacting in natural language and voice like a human. IBM Watson demonstrated human-like cognitive skills. In a new epic match, in 2016, a Google system beat the Korean world champion of Go (an Asian strategy game considered much more complex than chess, because the number of mathematical combinations of possible plays exceeds the number of atoms in the universe). In February 2017, AI overcame a new milestone by beating four of the world's top poker players in a series of 20 matches in Pittsburgh, proving that machines can also win in games with incomplete information, bluffing and anticipating the bluffs of its adversaries.

AI is increasingly able to take decisions in complex situations. Digital machines are replacing all kinds of human

[1]Universitat de Vic Universitat Central de Catalunya, Barcelona, Spain

Corresponding Author:
Xavier Ferràs-Hernández, Universitat de Vic Universitat Central de Catalunya, Sagrada Família, 7, 08500 Vic, Barcelona, Spain.
Email: xavier.ferras@uvic.cat

tasks, whether repetitive or specific, manual or cognitive. If the Internet opened the door to an era of exorbitant information, cognitive computing will make it into a new era of prodigious intelligence. Nevertheless, there is a worrying dark side of this potent force. Alarming news continuously emerges about the potential substitution of jobs by machines, with huge implications for modern capitalist society. Robots are eliminating jobs in factories, warehouses, and customer service centers at an accelerating pace. The future of work will be shaped by digital automation, which makes possible a scenario of hyper-productive corporations *without employees*. But with increasing of AI capabilities, the future could *also be free of human management*, as well: warehouses with autonomous forklifts transporting stocks, manufacturing plants operated with flexible robots without a single human present (machines will operate silently in the dark: robots do not need light), logistic chains transporting goods through self-driven vehicles, and clients in the front-office interacting with touchscreens and intelligent electronic assistants, able to hold conversations in natural language.

And, what about the management decision centers? With intelligent automation, managers at various levels may be redundant too; we could well have data processing networks making decisions and sending electronic instructions to the corporate structure, 24 hr a day. Who better than an intelligent algorithm to analyze data (with a computational power considerably superior to that of the human brain), and to take decisions in marketing, human resources, operations, or finance? We could even have a future digital CEO (just an algorithm) that would continuously analyze all interesting information on the news, review customer comments on social networks, and supervise internal production indicators. This electronic CEO would give out proper orders to the manufacturing plant to maximize corporate results. The entire management could be replaced by a digital machine that would learn from itself and become more productive with every passing day. The future of capitalism seems to belong to companies that buy, process, sell, make profits, and reward shareholders without the need for human decision-making. If self-driven vehicles are already at our doors, we can as well envisage *self-driven companies* in the not-too-distant future.

Given this backdrop, many questions arise that reach beyond just the economic implications of this phenomenon. For management theory, the question is, "How will AI affect the practice of management itself?" The management profession is intensively interwoven with human relations, and therefore is considered as a part of *social science*—a science that studies interactions among individuals in an organizational context, with individuals at various levels being submitted to pressures and incentives to achieve corporate goals. The impact of management as a scientific discipline in the last decades has undoubtedly been decisive for economic development. Peter Drucker (1986) stated that the main

legacy of the 20th century was precisely the emergence of management as a social science. "Management may be the most important innovation of the twentieth century." This was the first century where people worked mostly in organizations. Management became necessary insofar as organizations gained sway in the economy and society. But if management is the "art of doing things through people" (definition attributed to the writer Mary Parker Follette), what will survive of it in an economy where organizational decisions can be taken by intelligent machines using human-like algorithms that make them superior to humans themselves?

Strategy and Research Activities: The Role of Intuition

Consider a firm's value chain, right from the original sources of value creation to customer front-end; let's analyze the initial phases, that is, strategy and R&D. What will remain of the processes of strategy formulation and design, or of R&D processes in a world governed by AI? Cognitive areas in which there is still human superiority are those related to *intuition* (the ability to understand and act without the need for conscious reasoning). Scientific research, especially the most basic research, is deeply intuitive. Can machines learn how to conduct scientific research? In the quantitative sense of the term, they can; actually, machine ability to detect emerging patterns from data or observations has already been developed. Technically, today a machine could do a lot, right just from observing a phenomenon (e.g., repeated dropping of steel balls), capturing data from it (speed and force), and inducing the Law of Gravity. But moving forward on the frontier of knowledge requires a unique aspect: "intuition," which *is needed to surmise the correct path*, to concentrate resources in the best possible way among multiple choices (and discard the others) in contexts of uncertainty and ambiguity. The key to scientific progress is not only to induce laws from data, but to *intuit which data could be used to induce laws not discovered yet*. The key is to ask the proper questions, not merely to answer them. It is a matter of arriving at the right direction of investigation, often with the same kind of intuition we need to choose a wife or a husband: It's that inner voice that tells us right versus wrong. According to Einstein, "the intuitive mind is a sacred gift, and the rational mind is a faithful servant." Intuitive decision-making, which appeals to a mental process beyond rational thinking, is the one that will be most difficult to replicate by a machine.

Intuition is a key success factor in modern strategic management. Since Mintzberg (1994) wrote his famous book *The Rise and Fall of Strategic Planning*, we know that strategic planning is almost an oxymoron: In times of accelerated change, can a strategy really be planned? The age of AI is also the age of extended uncertainty and ambiguity. Paradoxically, the more computational power we have, the more turbulence we face in social, political, and economic

environments. Does rational planning make sense in a VUCA world (Volatile, Uncertain, Complex, and Ambiguous)? In VUCA situations, strategic planning is replaced by a kind of "strategic intuition," a fluid and dynamic adaptation to the environment. Good organizations in this context develop skills similar to those of martial arts masters, a kind of dynamic intuition of the adversary's movements, anticipation of attacks, and fluid adaptation to circumstances (Duggan, 2013). Machines, in this regard, still lack competitive advantages. Intuition is also related to creative thinking and art (Kemp, 2006). Military strategists, senior managers, scientists, painters, or poets have proposed singular, unique, and exclusive creations inspired by intuition. Brilliant outputs are those which, by their elegance and harmony, have been perceived as "beautiful." Although robots are beginning to show evidence of artistic abilities (in 2016, in an epic Go competition against the human champion, the Google system Alpha Go unexpectedly made some surprising and brilliant movements, characterized as "beautiful" by specialized journalists), it is still difficult to replace humans in ideating truly creative solutions. Conclusions drawn from the conference organized by President Obama states, "while AI detects patterns and creates predictions, it still cannot replicate social or general intelligence, creativity or human judgment (the ability to take decisions in a context of uncertainty)." Strategic decisions (especially those that are more creative, differential, and unexpected) and scientific exploration (beyond the frontiers of knowledge), are predictably one of the last reserves of human management, though perhaps not for long.

Operations Management and Strategy Implementation

Machines are clearly superior in mass data interpretation, pattern identification, error prevention, and subsystem coordination. Management processes intensive in logic, statistics, and rational decision-making all soon will be performed much better by intelligent algorithms (superior to humans in brute computational power). This obviously would be the case in the fields of operations management, wherein decisions and policies related to stock management, procurement, supply chain, production planning, quality control, and distribution logistics require a high level of mathematical reasoning. This is also the case in financial management. Once the strategy is defined and the corporate objectives are set, the precise implementation of the strategy may be performed by machines (either to minimize stocks in the warehouse or to prevent cash-flow failures). The digital, data-driven enterprise paradigm, brilliantly represented by the new Industry 4.0 models, is already being widely implemented in practice. Under these models, not only will the process lines be robotized, but management of operations is also sensitized to being taken over by robots.

Human Interaction and Influence

As noted, management (as we currently conceive it) is an activity intensive in human relationships. The essential point is that it is a *social* activity that requires the understanding and interpretation of *emotions* (your own emotions and those of others). It is an activity that needs interaction among people, recognition of individual needs, and the use of this recognition to guide teams toward the achievement of defined goals. The managerial interaction with individuals in business contexts has the objective of *influencing* them. This kind of emotional management applies to social interactions, either internal (team building) or external (market-oriented activities). Leadership is an example of a very human activity. *Can a robot be a leader*?' MIT researchers show that it would not be difficult for people to receive robot instructions (Gombolay, Gutierrez, Clarke, Sturla, & Shah, 2015). People could accept a robot as a boss. But it is one thing to give cold instructions to a human teammate, and quite another is to lead people, to have the emotional ability to guide a team in VUCA situations. To do so, trust must be created and emotional skills are needed.

So, although AI has a great ability to determine the key characteristics of a product to be launched in a particular market, or to diagnose some types of cancer, AI still lacks the emotional skills to successfully complete interactions with people (creating brands with emotional values, persuading a customer, negotiating a major contract, or communicating a serious illness in a medical process). Machines also cannot assume functions of institutional representation. Could a machine act as institutional representative of a company? Could it have legal responsibilities?[1] Or even, could a machine be the *owner* of a business or, say, a patent? Processes that incorporate persuasion, leadership, institutional relations, or ownership will likely be more resistant to the invasion of AI.

The Smiley Line: Areas of Machine or Human Management Advantage

Figure 1 summarizes my argument in a single model. The curve (the "Smiley Line") represents the skills, kinds of intelligence, and management styles required at each point in a company's value chain. In the initial steps (upper left of the image), areas of strategic thinking, research and development, the necessary management skills are related to intuition and creativity. The management style in these domains should be flexible and adaptive. It is an area of human management advantage.

In the intermediate zones of the value chain (basically, operations management, logistics, manufacturing, finance, and quality control), the necessary skills are related to data processing and optimization. The type of reasoning is rational, and the style of management is oriented to planning and
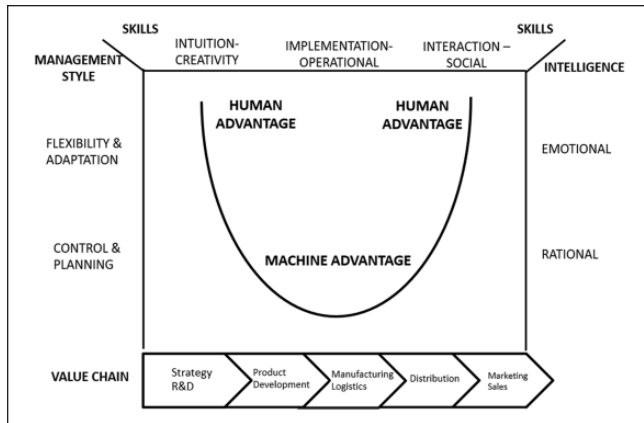
Figure 1. Human versus machine advantage in the value chain.

control. This is the zone where machine management can (and in some cases, already has) beat human management.

In the final zone of the value chain (marketing activities, sales, and interaction with the environment), the necessary skills are related to socialization and emotional intelligence. It is true that an important substitution of customer experience systems by robots is taking place, but I want to focus on how management (decision-making) processes can be affected by AI, not on what jobs can be replaced. And the creation of brand values, customer interaction, trust generation, marketing policies, corporate communication, or institutional relationships have important emotional and persuasive (human) components.

Yet, it will not be long until we have digital machines with almost human cognitive abilities in our offices, or even in our pockets. Algorithms are gaining more and more strategic thinking capabilities. They show growing initiative and intuition. AI is expanding into creativity and artistic realms too. Digital systems are starting to express emotions, and to interact with humans in a human fashion. AI is subject to Moore's law (according to which the computational power of processors doubles approximately every 2 years). This is an exponential law. The "smiley line" will become more open in the immediate future. The space reserved for human management, even under an optimistic scenario, will be confined only to the extremes of the value chain.

Conclusion

Here's a worrisome projection: Because of the recent progress in machine abilities to replicate ever more human-like capabilities, even the last bastions of people's distinctive abilities (intuition, emotion, etc.) look to be under AI threat in the not-too-distant future. Is it therefore reasonable to conclude that management will be killed by AI? Probably (unless people purposely preclude it). Just as graphic design programs now allow anyone, even those without specific manual skills, to make precise designs, today AI could allow any company, without experienced management skills, to successfully

compete in the market. If this is so, the company with the best strategy, marketing, or supply chain will be the one with the most powerful AI systems, without the need for human intervention. In this context, where management would be a commodity provided by digital machines, will business schools (the cathedrals of management) be necessary? Will consultants be necessary? Will managers themselves be necessary? Are machines likely to take over the organizational world? Again, probably (unless people intentionally try to prevent the apparently inevitable). Are machines likely then to take over the running of the world?

Declaration of Conflicting Interests

Funding

Note

1. What if an autonomous decision of a machine creates losses, damage, or even a death? Currently, there are intense moral discussions about machine decisions. For example, a driverless vehicle may be involved in an unexpected situation where, in tenths of a second, it has to decide whether to run over a child crossing the street, or to divert the car and crash into another car coming in the opposite direction, killing all the passengers. A human reacts "instinctively," but a high speed processor can carefully evaluate the consecuences in half a second, and make a thoughtful, "rational," decision about who dies.

References

Drucker, P (1986). *Management: Tasks, responsibilities and practices*. New York, NY: Truman Talley Books.
Duggan, W. (2013). *Strategic intuition: The creative spark in human achievement*. New York, NY: Columbia University Press.
Executive Office of the President, White House. (2016). *Artificial intelligence, automation, and the economy*. Retrieved from https://obamawhitehouse.archives.gov/sites/whitehouse.gov/files/documents/Artificial-Intelligence-Automation-Economy.PDF
Gombolay, M. C., Gutierrez, R. A., Clarke, S. G., Sturla, G. F., & Shah, J. A. (2015). Decision-making authority, team efficiency and human worker satisfaction in mixed human–robot teams. *Autonomous Robots*, *39*, 293-312.
Kemp, M. (2006). Seen and unseen: Art, science, and intuition from Leonardo to the Hubble telescope. Oxford University Press
Mintzberg, H. (1994). The fall and rise of strategic planning. *Harvard Business Review*, *72*(1), 107-114.

Author Biography

Xavier Ferràs-Hernández has a PhD in management sciences from the University of Barcelona and an MBA from ESADE, and is a telecommunications engineer from the Polytechnic University of

Catalonia. He is currently dean of the Faculty of Business and Communication at the University of Vic (Central University of Catalonia), and visiting professor at ESADE Business School (Barcelona). He was director of the ACC10 Centre for Business Innovation (Catalan Agency for Competitiveness), and was responsible for technology transfer policies, R&D, and development of clusters in Catalonia, and coordinator of the Technological Strategic Plan for Catalonia (2001-2004). He was member of the steering committee of the Catalonia Research and Innovation Plan (2005-2008), and member of the executive boards of BAIE (aerospace cluster), Biocat (biotechnology cluster), CTM technological centre (advanced materials), Barcelona Media tech centre (audio-visual), CTAE tech centre (aerospace), the Microsoft Productivity Centre, the Catalan Foundation for Research, the i-CERCA Foundation (Research Centres of the Catalan Government), Invertec (Venture Capital Company), and Creafutur (institute of market foresight). He previously worked in the automobile industry and as professor of electrical engineering. He was also a speaker at more than 100 national and international conferences on strategy, innovation, and technology management.