Are you ready for your "Digital Twin"?

Derrick de Kerckhove

Sommario

L'evoluzione verso sistemi sempre più autonomi che diventano sempre più integrati nella ns società e nella nostra vita, simbiotici, cambierà radicalmente il nostro modo di essere, aprendo nuove opportunità e ponendo nuove sfide. Un cambiamento che per impatto e dimensione potrebbe essere paragonato a quello che si è avuto nel Rinascimento. I Digital Twin in un certo senso sono sia una tecnologia abilitante sia un'icona di questo cambiamento.

L'articolo ne esplora le implicazioni e termina con un insieme di domande a cui forse non si riuscirà a dare risposte condivise ma che certamente stimoleranno la riflessione.

Among daily news about innovations in our non-stop collective creativity, two ground-breaking engineering concepts herald the new digital transformation. The first is called Symbiotic Autonomous Systems (SAS), a general category as well as a new evolutionary drive that brings together rapid advances in AI and Machine Learning applied to the worldwide accumulation of Big Data on everything. It will be the result of the concurrent evolution of machine augmentation and human augmentation converging on a symbiosis, that is, an intimate interpenetration between humans and machines or programs, a physical and mental co-existence in cyberspace. These engineering innovations will affect our bodies, our minds and the whole environment. Intelligent prosthetics, sophisticated robotics, decision-making algorithms, affective and sensitive digital assistants, and intelligent environments, well beyond today's idea of smart city, all this points to the formation not only of an entirely new way to occupy space and time, but also new experiences of one's perception and management of one's own selfhood.

Indeed, included among the considerations about SAS, the other life-changing innovation is the concept of "Digital Twin". It was conceived a few decades ago as an engineering instrument that would augment machines with a digital double to monitor complex and expensive motors, turbines, and also robots. A machine's Digital Twin includes not only real-time reporting as it functions, but also the history of its maintenance, perhaps the occasional break-downs and,
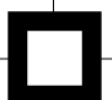
more importantly the source and coordinates of all parts suppliers and records of delivery and efficiency. In many cases, the digital twin allows to automate repairs just as it regulates normal functions. Today, however, the twinning concept is of interest not only to engineers, but also to town planners, military strategists, security systems operators, educators, trainers and a host of other complex operations managers. Planning is on course to extend and apply the concept to businesses, cities, regions and, why not, to whole countries. Digital Twin has made it to the top of Gartner's hype cycle last year and is not coming down quite yet because it is also destined to be applied to you and me. How come?

The idea of twinning you and me on line crowns thirty years of sketchy development that started with Apple's purely conceptual "Knowledge Navigator" (1987) and matured today on the market as Apple's Siri, Microsoft's Cortana, Samsung's Bixby, Google's Assistant, and particularly Amazon's Alexa, so far the most sophisticated one, in part because it integrates machine learning to learn about you as it manages, responds, sorts and stores your queries, and also because it is capable of expressing and responding to emotions. All these are great tools for daily use and the market's ambition is to make them your companions for life. The Digital Twin, however, is much more ambitious. It plans to represent you in every way and in all times, past, present and even future as it will be able to predict or propose moves on the basis of what it (he? she?) knows about you and what access it has to the world's databases and to top-notch analytics.

The truth is, we already have digital twins because we keep accumulating tons of data about ourselves, some deliberately in Facebook, Twitter and LinkedIn, others not quite so consciously in every move we take. Even mind-reading books are in store. It is entirely possible that eventually, as we read our novels on Kindle or Kobo, even our thoughts and our feelings will become data that will be grist to the mill for our digital twin:

> *"If Kindle was to be upgraded with face recognition software and biometric sensors, it would know how each sentence influenced your heart rate and blood pressure. It would know what made you laugh, what made you sad, what made you angry. Soon, books will read you while you are reading them." (Yuval Noah Harari)©*

Fresh off the press, so to speak, there is even news about simple headsets that can read your mind and either translate the sentences you form in your mind into speech, or send it to databases, ready to be analysed[1].

The proliferation of surveillance cameras in the public space of several countries, notably in China is adding accurate data about our whereabouts and our behavior. A recent study by Cornell University concretely demonstrates how machine learning can attack our privacy. The researchers applied basic algorithms (that is, less complex than those commercially used by, for example,

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[1] *(REF: January 29, 2019 from Science Daily: Engineers translate brain signals directly into speech: https://www.sciencedaily.com/releases/2019/01/190129081919.htm).*

Facebook and Google), to identify people with blurred, pixelated, and encrypted images. They were able to "show how to train artificial neural networks to identify faces, recognize objects and handwritten figures" with an accuracy of 71%. On the other hand, human accuracy was 0.19%. At this point, we can't win. So what's at stake is a change of civilization much more radical than anyone has predicted and for which we are evidently not prepared. A very real possibility is that even as we are emptying the contents of our private self in Big Data, something like a digital twin will take its place to help us negotiate daily life in the digital realm.

The problem for the moment, however, is that we do not have one but myriad little twins scattered in the world's databases. Most of these micro profiles of ourselves tailored by government and institutions such as PRISM or Google are fragmented by the uses they are meant for. The government doesn't need to know your diet, but only if you represent a threat to the community or if you are not paying your taxes. Google wants to know what you read and builds your profile based on your search pattern and also on the kind of company you keep since it insists that your Gmail activities be coordinated with the other services the mammoth search engine gives you. In fact, since we generally do not know how, or how much or in what way these micro-profiles are constructed and used, I have grouped the lot of them under the general banner of the "digital unconscious", everything that is known about that you don't know and that has more effect on your choices and motivations than whatever Freud told you about mom and dad.

The point, of course, of having a DT, is to gather all this data together in an orderly way in such manner as to, first, give you a measure of control over it, and second, to endow you with a sort of "digital you" that, having access to everything digital, on and off line, knows a lot more than you do and especially more than you know or remember about yourself.

So what could your DT do for you? Markus Steer, advisor with SAP, writing for Digitalist Magazine puts the emphasis on health and medical care:

> *"Already today, doctors and insurance companies not only collect information about past & present treatments & checkups (including diseases of direct family members), but also actual habits, as smoking, regular work-out or extreme sports. Technology makes it possible to combine the different sources of information and elaborate a transparent Digital Twin of the individual.*

The representation of an individual person, including personal data like weight, health data, activity tracking data, and medical treatment data can help to establish predictive alerts and guide people to healthier lifestyles. It will give better insights and transparency on the individual's health situation by offering more data points. Data shared with doctors will help define better preventive strategies and recovery plans and shrink health care costs.

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Adds Steer: "In the business world, employee training plays an important role in time to market. Workers can be trained in the digital world first, leading to tremendous resource optimization for on-site training."[1]

There is a lot more to speculate about digital twins, as it will become everybody's interface to navigate and negotiate for each one of us our relationships with the Internet and the whole digital universe, having access to current and integrated information about anything and everything. But there is one urgent question about our twin that brings us back to symbiotic autonomous systems (SAS). Indeed, how autonomous will it be? A major issue about the rapid development of ever more sophisticated technologies is that they are becoming autonomous. In fact, the more autonomy we yield to our machines, the less we can keep for ourselves. For a system to be autonomous, it has to:

- Have an independent agenda (goal, plans, policy and context)
- Demonstrate a capability to make independent decisions through deliberation
- Perform independent execution of actions

Says J.P. Morgan top AI expert, Manuela Veloso:

Systems already communicate wirelessly, drawing on data in the cloud, or [are] helped by remote teams. You can think of AI systems in constant symbiosis with everything else, with other information on the web, with other AI systems, with humans next to them, with remote humans. It becomes not a problem of developing self-contained AI systems, but an AI system that can recognize when it does not know, or when it needs more information, or when it thinks something with some probability but it's not sure. It's not that it can solve all the problems up front, but it can rely on all these other sources around.

The symbiosis comes from the fact that the boundaries between our auxiliary systems and our bodies and mind are continuously thinning down. Not only is technical evolution conceding autonomy to airplanes and automobiles, but to conversational robots and common digital assistants such as Alexa or Siri and soon intelligent environments and decision-making systems in medicine, law, finances and personal affairs.

The boundaries are fading largely because as people tend to delegate their basic cognitive faculties to such efficient services, our memory goes into our smartphone, our judgment and reasoning abilities are trusted to A.I. and even our imagination and creativity to automated designing, drawing, painting, writing (for poetry and standard letters, news, etc.). Even as we outsource our mental operations and allow our memory to be distributed in different databases, we are emptying ourselves of the contents and cognitive strategies that centuries of patient accumulation and refinement had included within the privacy of our psyche.

Our IEEE research team identified many legal and security, as well as ethical issues emerging from the rapid development of new generation expert systems that are already replacing human skills in labor and professional competence in law, medicine, business and arbitration.

For example, IBM has already introduced Watson into the legal field, to cope with the complex structure of legal knowledge contained in the federal statutes, regulations, treaties, contracts and jurisprudence. Some algorithms are already being used to determine prison sentences. If we start trusting algorithms to make decisions, who will have the final word on important decisions? Will it be humans, or algorithms? One problem with algorithms is that, different from both expert systems and standard neural networks that can be analysed for how they process data, they begin being clearly traceable, but very quickly they escape the control of the programmers. AI has "a mind of its own", not necessarily a mal-intentioned one, but, at some point, depending on how much autonomy is given to it, a mind that can get off the track, sooner or later. Manuela Veloso is fully aware of this problem:

> *"So we are working on the ability for these AI systems to explain themselves, while they learn, while they improve, in order to provide explanations with different levels of detail. We want to interact with these robots in ways that make us humans eventually trust AI systems more. You would like to be able to say, "Why are you saying that?" or "Why are you recommending this?" Providing that explanation is a lot of the research that I am doing now, and I believe robots being able to do that will lead to better understanding and trust in these AI systems."[2]*

Another problem is that algorithms being extremely efficient and having access to infinitely more data, they beat humans at a growing number of life/death, or less dramatic estimates, diagnoses, legal rights and wrongs, financial advising etc. They also replace brain and brawn for not so menial jobs. It is said that by 2030, 45 % of the present workforce in advanced economies is going to be taken by algorithms and robots.

So beside jobs, what are the potential victims of algorithms?

Autonomy: the more decisions are made by machines, the less freedom of decision and movement is left for people;

Individual property and control of thought: we are no longer exclusive owners of our thinking because I.A. is perfectly capable of retracing it, even in real time;

Psychological interiority: I'm emptying myself, first because instead of building my inner self, I pour my self in social media, then because the machine is acquiring expanding and extending my internal cognitive functions, including memory, intelligence and imagination;

Reputation: the era of ubiquitous public and private surveillance and one-way transparency puts us naked in the street.

And so on. The real question is how do humans behave under such condition of vulnerability.

Not only does the adoption of aggressive new technologies always raise ethical questions, some of them such as the appearance of the printing press, or now the digitization of human culture, demand a radically new ethical order. The Renaissance witnessed a brutal redefinition of what was meant to be human

during the painful transition between a predominantly oral and communal religious authority to an individualistic humanist social and political order. The spread of alphabetic literacy individualized people by providing them with a private – and relatively easy – access to language. By learning to read silently, they could privatize not only their control over language, but also interiorize their conscious activities and become private persons.   This fact changed their relationship to themselves, to their beliefs and to other people, family, friends and foes. While transiting from the so-called culture of "shame" to that of "guilt", the object of their personal responsibility shifted from "the other" to the "self". This is also the origin of puritanism, that is the deep sense of one's responsibility to one's destiny in this world and in whatever other realm they believed in.

And this, fundamentally is what is changing, not to say reversing today. As people are ever more exposed to continuous monitoring by automated electronic systems, and while, in some countries, behavior itself is controlled by algorithms, responsibility shifts away from the self to the now almost self-organizing whole social order, including - and perhaps eventually prioritizing – the care of the environment.

Shouldn't symbiotic autonomous systems always be developed with their after-effects on people and the environment in mind? Shouldn't large scale predictive analytics be applied to each innovation before implementation? Even as algorithms and A.I. take the lead in introducing a generalized symbiosis between individuals and the environment itself, shouldn't an ethical dimension be consciously included in their programming?

Among the most urgent questions, is how SAS need to take account of the epistemological change that is going on right now because of technology. People are being emptied of their psychological content but hardly noticing it because they labor under the illusion that, apart from additions to our technical capabilities, human nature, their own in particular, is the same as it always was. "Human nature" changed before and it is changing again, so much so that the unrecognized transition from humans developing from within to projecting (or rather letting go of) one's identity on line externally could bring one to doubt that there is such thing as human nature at all. For example, is it not conceivable that the evolution of our "digital twins" will eventually become the next modality whereby people negotiate their relationships with SAS and the total environment, as opposed to what westerners at least still consider the activity and the exclusive property of internal memory, intelligence and judgment? Assuming symbiosis is completed within the next thirty years, will humans still benefit from any capacity to resist intellectually, let alone politically or even emotionally?

Although it is suggested in our latest White Paper that one among the ways to offset the complete take-over of human decision-making by A.I. and algorithms, would be to genetically modify the human genome to increase its intelligence on a par with Artificial General Intelligence (AGI), the predictable future is that humans will become increasingly vulnerable to SAS' domination without allowing enough time to evolve that sort of recourse. We cannot stop the exponential growth and sophistication of our machines, but we can decide to infuse them *algorithmethically* with genuine human survival and environmental priorities

and monitor and control worldwide how they are applied. An ethical taskforce of SAS projections would want to address the particulars of that issue and that will be a large part of our next issue.

For example, regarding the potential social injustice that would occur in giving access to human augmentation by technological or biological means, one could invoke regulation obtaining in sport competition, but it isn't quite the same thing to prevent doping in a cycling event and to impede school and career privileges to enhanced humans. How does one regulate for social justice in income and means disparities in a livable SAS environment? And, at the same time, can we allow regulation to stand in the way of the full realization of enhanced human potential. Observing the rapid proliferation of Brain Computer Interface (BCI) and slower but continuous advance of Computer Brain Interface (CBI) technologies, it appears that connecting brains to the internet and eventually accessing directly and pertinently its enormous contents is almost a foregone conclusion, if not seamlessly at first, perhaps via tweaking our digital twin. Wouldn't then be a need to prevent intentional or accidental harm through thoughtless activity by re-programming the Internet itself?

Finally, SAS predicts the gradual evolving of super-organisms consisting of the task-oriented association of indefinite numbers of components, human and algorithmic. This prediction is congruent with observations above regarding how humans may become more and more defenseless about how SAS takes over all important decision-making. Should such a possibility be left to teleological self-organization or should it become the object of an international political decision-making?

Perhaps the biggest problem with algorithms is that they are about to keep all of us under strict control. I have called that datacracy. What I mean by it is that data surveillance that is presently practiced, for example, in Singapore, can quickly turn into total control by data with political and institutional leverage. When I say 'practiced' I mean, openly done, with public assent, just as the social credits project in China, effectuate the same, if not higher level of control, in full knowledge of the population, and, according to surveys and interviews reports, not even grudgingly.

This is the difference between the west and the east here. In the west, business and government do more or less the same things, but discreetly and more on the side of business than that of government (except, of course in neo-totalitarian countries). And all of it pretty well under cover. You would think, after so many revelations by so many whistleblowers, that people should probably begin to get the idea. In matter of fact, they probably do but don't really care; they realize it cannot be stopped. It's destiny. In the east, on the other hand, community spirit and a desire to share a safe and prosperous environment with everyone overrides the priorities of the individual.

Ultimately, algorithms might get rid of government altogether. In a full-fledged Symbiotic Autonomous Environment, all parameters are taken under consideration, even those that measure and locate where and how we treat animals, or how much recycling we may or may not have done. The new ethics, if however, we eventually develop it, will have to be grounded in protecting the

environment. In a mature datacracy, we do not turn into servo-mechanisms of 'The Machine', we do not serve an oligarchy of power-hungry technological monarchs, we do not rise against each other for whatever advantage we can gain. In a mature datacracy, humans leave machines do their job, which is to take care of our problems, all of them at once and all the time. That is what an environmentally aware general AI can eventually accomplish. But we are still a fair bit away from that…

Since this paper is destined to close the present issue of Mondo Digitale, I want to conclude with an invitation to reflect on some basic questions we might need to ask ourselves even as we begin a new industry of digital twins.

What format could/should industry devise for our digital twin (augmented Digital Assistant applications – different 'skins' – long term – occasional/permanent)?

Could our DT become a fashion item or an art form?

How many DTs should a single person be allowed (secure identifiers – formal ownership contractual policy)?

What content should DTs integrate (lifelogging **–** punctual **–** real-time/continuous updating – open or restricted database access)?

What kind of connectivity would be most useful (to owner - to other twins)?

What software capability should be programmed into our DT (various levels Data Analytics – descriptive – predictive - prescriptive)?

What kind of regulation – if any – should DTs be subject to (responsibility – accountability –

What level of autonomy should the DT be granted (unsupervised **–** supervised – accountable)?

What order of ethical priorities should be mandatory for developing and using DTs (ethical behavior – manners – being answerable)

What legal status should DTs be granted?

What should be done with one's DT after one's demise?

What roadmap should be considered for developing DTs?

Biography

Derrick de Kerckhove, sociologo, giornalista e direttore scientifico di Media Duemila. Ha diretto dal 1983 al 2008 il McLuhan Program in Culture & Technology dell'Università di Toronto.

È autore di "La pelle della cultura e dell'intelligenza connessa" ("The Skin of Culture and Connected Intelligence") e Professore Universitario nel Dipartimento di lingua francese all'Università di Toronto. Già docente presso il Dipartimento di Scienze Sociali dell'Università degli Studi di Napoli Federico II dove è stato titolare degli insegnamenti di "Sociologia della cultura digitale" e di

"Marketing e nuovi media". È supervisor di ricerca presso il PhD Planetary Collegium T-Node. È membro dello Steering Board della Symbiotic Autonomous Systems Initiative e co autore dei due White Paper prodotti.

Email: dekerckh@gmail.com