The metamorphosis of objects and human subjects in the Internet of Things

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"All things appear and disappear because of the concurrence of causes and conditions. Nothing ever exists entirely alone; everything is in relation to everything else."

Gautama Siddhartha

Introduction

Where in prior times technique was referring to: "a method of accomplishing a desired aim", today we speak more of technology. Technology has long been presented as a set of techniques; today it has become more than a method to accomplish a desired aim. From now on, we live in 'the age of makers'. In times when there are more people with mobile phone access than toothbrushes, everyone has the ability to start up a million euro business from behind the kitchen table.

Technology does not only affect business any longer; it also affects culture, politics, society and every element we value in life. Maybe most important of all, it affects the human race as we know it today. For the reason technology will impact the way we have lived for ages, it is legitimate to ask whether there is an intersection where humans and objects will find a mutually beneficial coexistence, or whether one of these entities will rule over the other, or whether there will be an alliance between the human race and some sort of technology that represents a global connected world brain.

Will technology be, like in prior times, a collection of methods to accomplishing a desired aim, or will the human race be enslaved by technology and ruled by the artificial intelligence embedded in it?

1. Objects and technoculture

"New solutions beget new problems, which beget new solutions. This is the cycle of our species. We will always make things better. We will never make them best. We should not expect to anticipate all the consequences of our creations, or even most of them, good or bad. We have a different responsibility: to actively seek those consequences out, discover them as soon as possible, and, if they are bad, to do what creators do best: welcome them as new problems to solve."[1]

The distinction between *objects* and *subjects* is not a clear-cut line. Many epistemologists argue that the world is composed of objects, some being entities as diverse as mind, language, cultural and social entities, and others being independent of humans, such as galaxies, stones, quarks, and so on. We believe that objects and subjects should not be confused and that an object should be thought for-itself rather than as an opposing pole before or in front of a

[1] Kevin Ashton, How to Fly A Horse, Doubleday, 336 pages, 2015.

subject. This brings us to the ontological thesis that "*the being of objects [must be thought] unshackled from the gaze of humans in their being for-themselves.*"[2] The logic of the Internet of Things should reinforce this vision, as humans' cultural artifacts are likely to become in majority autopoietic machines (or objects) that produce their own elements and seek to maintain their organisation across time. By contrast, the domain of allopoietic machines, i.e. those referring to inanimate objects, is expected to shrink as more and more objects will be endowed with a unique name and address on the Internet[3].

Science fiction authors and artists such as Bruce Sterling[4] and Julian Bleecker[5] have presented an historical and futuristic view of objects undergoing a 'metamorphosis' through the process of techno-cultural transformation.

Both Sterling and Bleecker gave their respective visions of the evolution of things at about the same time the International Telecommunication Union (ITU) was 'resuscitating' the phrase "Internet of Things"[6]. Bruce Sterling proposed a history of human-made objects starting with *artifacts* (made and operated with just muscle), to *machines* and *products* (built for a customer/consumer society), to *gizmos* (the electronically enabled devices that exist today), to *spimes* (fabricated by digital means and built to be connected and managed by a global communication network), to *biots* (biologically engineered objects predicted to appear around 2070). Dominant techno-cultures do not abolish the previous ones but turn them into compost; consequently, the predicted spime-based techno-culture will not replace the artifacts, machines, products and gizmos that we have today, but will alter their forms or features. As an example, Sterling considers a bottle of wine and the way in which its barcode and link to a website denote that this bottle of wine is from the *gizmo* era: it's still a bottle of wine (based on semantic information), but one which contains particular informational affordances (based on semiotic information) based on the dominant techno-culture from which it emanates. The "biot" is an interesting concept that is not far from the one of "transhuman", i.e. human beings whose capacities are improved through advanced technology (cryonics, virtual reality, gene therapy, space colonisation, cybernetics, robotics, molecular manufacturing, mega-scale engineering, mind uploading, Artificial General Intelligence).

Table: The geological time scale of objects

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[2] Levi R . Bryant, The Democracy of Objects, Open Humanities Press, University of Michigan Library, Ann Arbor, 2011, p. 19.

[3] IPv6 offers a highly scalable address scheme. By providing more than 2 billions of billions addresses per square millimetre of the Earth surface, it can cover the needs of any present and future communicating device.

[4] Bruce Sterling, Shaping Things, Mediawork Pamphlet series: MIT Press, October 2005.

[5] Julian Bleecker, *A Manifesto for Networked Objects – Cohabiting with Pigeons, Arphids and Aibos in the Internet of Things*, February 2006, http://nearfuturelaboratory.com/files/WhyThingsMatter.pdf

[6] ITU Internet Report 2005: The Internet of Things, November 2005.

Object / Techno-culture	Object description	Era	People's role	Key technology
Artifacts	Simple artificial objects made and used by hand, and powered by muscle.	From beginning of mankind to the 1500s	Hunters, farmers	Wood, sail
Machines	Complex, precisely proportioned artifacts with many integral moving parts that have tapped some non-human, non-animal power source.	From the 1500s to World War I	Customers	Iron, steam
Products	Widely distributed, commercially available objects, anonymously and uniformly manufactured in massive quantities, using a planned division of labour, rapid non-artisanal, assembly-line techniques, operating over continental economies of scale, and supported by highly reliable transportation, finance and information systems.	From World War I to 1989	Consumers	Oil, electricity
Gizmos	Highly unstable, user-alterable, baroquely multi-featured objects (interfaces, not stand-alone objects), commonly programmable, with a brief life span.	From 1989 to 2035	End-users	Computer, Internet
Spimes	Manufactured objects whose informational support is so overwhelmingly extensive and rich that they are regarded as material instantiations of an immaterial system. Spimes begin and end as data; they are designed on screens, fabricated by digital means, and precisely tracked through space and time throughout their earthly sojourn.	From 2035 to 2070	Wranglers	Internet of Things, Big Data, 3D printing
Biots	Both object and person, a biot is somebody who is in a position to micromanage and design the processes that shape his own anatomy.	Around 2070	?	Cybernetics, biotechnology, cognition

Source: from Bruce Sterling

Julian Bleecker's engineering vision complements the one of science fiction design agent Bruce Sterling. He argues that once things are connected to the Internet, "*they can only but become enrolled as active, worldly participants by knitting together, facilitating and contributing to networks of social exchange and discourse, and rearranging the rules of occupancy and patterns of mobility within the physical world.*" In other words, things are destined to become "*first-class citizens with which we will interact and communicate*". Bleecker considers "*there's one thing Spimes will do, they will most certainly 'blog'*", from which he coins the term "Blogjects" – objects that blog. Blogjects have three characteristics: they track and trace where they are and where they have been; they have self-contained histories of their encounters and experiences; and they have some form of agency.

To some extent, the metamorphosis of objects[7] mirrors in the context of the economy what fifty years ago French writer André Malraux called the "metamorphosis of gods" in the context of art – every object is on one hand appearance, the "voice" of impermanence, the symbol of temporal scattering and, on the other hand, truth, the "voice" of the ever-living[8]. Objects are not only marketable goods that fulfil an immediate or short-term need; they also carry a transcendent truth that expresses the ultimate meaning of a technoculture (not to say a civilisation). For example, Bruce Sterling considered that the information-rich environment of spimes would enable human beings to live sustainably with their "intelligently self-disassembling" objects. Whether Sterling's vision comes true or not, it is likely that spimes will not only be the ephemeral materialisation of Internet-enabled data but also the reflection of a culture based on a form of coexistence between humans and objects. The Internet of Things constitutes the highest form of that coexistence by enabling communications among humans, between humans and objects, and among all kinds of network-connected objects outfitted with sensors and other smart devices. In the IoT era, every "thing" tends to be a technology product – Sterling's spime concept epitomizes this evolution of objects from the physical world to the digital world – but at the same time the shift from dumb devices such as fridges, thermostats, watches and other everyday objects into smarter devices that allow the interchange of data about people and can report on their status or be controlled remotely generates a new culture and social order, a new vision of the world, a new sense. As Boo Keun Yoon, Chief Executive of Samsung, said recently "*The Internet of things has the potential to transform our society, economy and how we live our lives*."[9]

Interestingly, the word "thing" derives from Old Norse *stōrthing*, which means a meeting or assembly (whether political or judicial)[10]. The Icelandic Parliament is still called Althing (Alþingi). Over the ages, "things" have gradually evolved from meetings to matter. Today, we use the term "thing" to refer to objects: a "thing" is a single object, whether material or immaterial. The word "object" derives from Medieval Latin *objectum*, which means a thing thrown, hence put, before, hence presented to one's attention. This strolling through the origins of terms has its importance because both words "thing" and "object" have always been about community and politics: they have to do with negotiation, interceding, reconciling. The Internet of Things as an expanding network of connected devices throughout our

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7 This expression has been borrowed from Frédéric Kaplan, La métamorphose des objets, Fyp Editions, 2nd edition, November 2012. Kaplan describes the "objects-interfaces", i.e. "*those objects which, without taking the form of today's computers, may be used tomorrow to access our digital data and represent them in an unprecedented manner: tables, chairs, shelves, chests of drawers, lamps and other interactive furniture, augmented mirrors, personal robots, connected gadgets, wearable clothes, jewels and accessories…*"

8 Such analogy of course quickly reaches its limit: art objects have an intrinsic worth in their own right while economic objects have value for the companies that sell them and aspire to use them for building sustainable relationships with customers.

9 Keynote speech at the Consumer Electronics Show (CES) in Las Vegas, 6 January 2015.

10 Source: Eric Partridge, Origins: An Etymological Dictionary of Modern English, p. 713.

communities, cities, buildings, homes, bodies, etc. heralds a new political pact, or even social contract, between industry, representing private property, and government, representing the public interest. The etymology of "thing" and "object" refers us to the ongoing, though largely invisible, negotiation whose stakes are nothing less than the nature of democracy in the digital age – a new data-driven technoculture is emerging, built on the intensive and almost real-time reporting of our behaviours, habits, tastes and beliefs, seamlessly transmitted by the "smart" devices we own, use, wear, interact with, and which give us some measure of value. As digital is at the heart of change, we begin to realise that networked populism is challenging cyclical political swings, non-state actors are challenging recognised states, state fragmentation is challenging regional alliances, e-citizenship is challenging sovereignty, "pirate" movements are challenging dissidents, and ghost armies and drones are challenging conventional forces.

2. Objects and information

"Objets inanimés, avez-vous donc une âme?"[11]

Any "object" can be analysed from five interdependent perspectives – or interpretation levels of the information it holds: it is *un-meaningful* (a message) by the mere fact it exists or not, *cybernetic* (a signal) by the need that it meets, *semantic* (a discourse) by the technology that it contains, *semiotic* (a symbol) by the social status or any system of signs that it reflects and, as it reflects the relations in society, *relational* by the meaning it has for the person for whom – supplier or user – it is an object[12]. As shown by Jacques Attali[13], "*The economic history of industrial systems is the one of the slow rise of the use of cybernetic information, then semantic information, then semiotic information, and finally relational information, for an identical quantity of energy. But this is contrary to History: with development, the quantity of energy consumed increases very rapidly and to varying degrees from one country to another, by an increased use of semantic information. In other words, the energy consumed is more and more informed, but the consumption of energy is more and more significant. It is as if a mechanism was hindering the evolution of social complexity towards an increased use of information. This mechanism is the interdiction of the rise of information to its ultimate level, the one where it is unlimited, unconditional, i.e. the one of the relation.*" This thesis is interesting because if it is true, it means that social innovation is blocked each time it creates the conditions of wellbeing without generating a revenue stream. Since only scarcity and marketable products (and services) create value, the goal of industrial systems is actually to channel the aspirations of humans towards new markets through their behaviour as consumers of cybernetic and semantic information, and not as creators of relational information.

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[11] Alphonse de Lamartine, Harmonies poétiques et religieuses.

[12] Based on research of mathematicians, logicians, semioticians, linguists and philosophers involved in information theory, in particular Ferdinand de Saussure, Claude E. Shannon, Roland Barthes, Charles Sanders Peirce, and Charles W. Morris.

[13] Jacques Attali, La Parole et l'Outil (*The Word and the Tool*), Paris, P.U.F., 1975.

However, as the digital economy promotes *networked* communication (e.g. social networks) rather than *beamed* communication (e.g. television), it creates new opportunities for establishing and strengthening social relations, and hence supports the *relational* dimension of objects, whether those are marketable or not. Though there exists today no consensus on a non-*homo economicus* kind of model, some authors[14] begin to argue that digital technologies (e.g. social media platforms, 3D printing) now enable more flexible ways of organisation where consumers are turned into *prosumers* able to organise projects in a bottom-up way. Should this trend be confirmed, it would mean that access to things would become more important than their ownership. Why should I buy a car when I can get precisely the one I want by simply using a certain application and a 3D printer? Digital technologies reflect, in this respect, not an incremental but a disruptive innovation in the history of industrial systems.

The IoT will considerably reinforce that trend by changing the nature of objects and hence of social relations. It represents the third "all-changing" revolutionary force, after the Industrial Revolution (i.e. the transition to new manufacturing processes) of 1760 – 1870 and the Digital Revolution (i.e. the change from analog, mechanical and electronic technology to digital technology) that started in the 1950's. The IoT is a fast-emerging scenario in which – as we have already noted before – all kinds of objects communicate, take autonomous decisions and actions on their own without human interaction. From a technology point of view, the IoT is developing at the confluence of new advancements related to the Internet, wireless solutions, and smart devices: firstly, with the latest Internet Protocol, named IPv6, it is now possible to assign a unique identifier to almost every "thing" on the planet; secondly, once identified, these "things" can communicate with other "things" as wireless technology enables a seamless flow of information between the Body Area Network (e.g. smart cloth), the Local Area Network (e.g. smart meter as a home interface), the Wide Area Network (e.g. smart bike, car, train or drone), and the Very Wide Area Network (e.g. smart city)[15]; thirdly, smart devices such as sensors and actuators allow for these "things" to become "alive", thus giving objects some attributes of human subjects.

The combination of identification, communication and sensing are the key enablers of the "metamorphosis" of objects into subjects of intentionality. Besides the pure technological prowess, the metamorphosed objects are characterized by (1) their self-organisation (the rich amount of data that IoT-enabled objects generate, thanks to sensors, and receive, thanks to wireless, endows them with self-functionality, such as self-management, self-healing and self-configuration)[16], (2) their "intelligence", which becomes both *localised* (i.e. distributed at network edges, hence close to the action) and *virtualised* (i.e. in software-defined central

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[14] Dirk Helbing, "*Economics 2.0 : The Natural Step Towards A Self-Regulating, Participatory Market Society*", 7 June 2013, https://www1.ethz.ch/soms/socionomy8.

[15] Source: Rob van Kranenburg, *Personal notes from IoT philosophy in York*, July 2014, http://www.theinternetofthings.eu/rob-van-kranenburg-personal-notes-iot-philosophy-york

[16] Source: Dr Ovidiu Vermesan, Dr Peter Friess (Editors), Internet of Things – From Research and Innovation to Market Deployment, River Publishers, Aalborg, 2014.

systems that remotely and automatically operate local devices), and (3) their capability to make sense through advanced analytics of the explosion of data (Big Data) which is generated by object-to-object communications.

However, it is premature to consider that the IoT will break the barrier that until now has hindered the rise of information from the semantic level to the semiotic and relational levels. The IoT is about the collection of *more* data and *new* data and the interchange of that data, including data about people, but it is not about more and better relationships between people. Some would argue that we have built so far an Internet of Things but not an Internet of People. The IoT allows a phenomenal extension of the community of objects as intermediaries in social interaction; it doesn't necessarily support, far from it, direct social interaction in the form of conversations, dialogues, cooperation, co-creation and the like.

If we must admit that both autopoietic and allopoietic objects (or machines) undergo actualisations through *information*, there is still a major difference between them insofar as allopoietic objects can only undergo actualisation through information, whereas autopoietic objects, i.e. those of the IoT age, can be actualised in a particular way through information but can also actualise themselves in particular ways through their own agency. This characteristic brings up the unprecedented challenge of a non-human super-intelligence.

3. Towards super-intelligent objects

"It is not because everything is connected that it also includes the notion of intelligence. It is necessary to think about both in a separate but interconnected manner. The example of a fridge built to emit a signal when there is no milk is not representative of what we are aiming at with intelligence and of what is going on in the scientific world (...) Instead of speaking about the machine versus the human or about immortality of the human, we should address humanity and AI-enabled machines as a global ambient hyper-connected super-intelligent system where technology and humans interconnect and cooperate." [17]

A major ongoing development concerns the combined evolution of the Internet of Things and Artificial Intelligence. This development portends the biggest challenge of humanity: will the parallel development of Artificial Intelligence – the ability of machines to mimic human "intelligent" behaviour – and the Internet of Things – countless objects with uniquely identifiable, embedded devices that can wirelessly be connected to the Internet – imply the end of civilisation as we know it? Will our autopoietic machines, which are capable of taking action on their own without human intervention, send out hostile orders to the chips we've affixed to our everyday objects?

In other words, will IoT be, like in the past, another disruptive moment, similar to the harnessing of steam, the production of electricity or the splitting of the atom, just the

[17] Conversation with Dirk Beenaert, Adviser for "Cross-cutting Innovation" at European Commission's DG CNECT.

continuous collection of new methods to accomplishing a desired aim, or will the human race be enslaved by technology and ruled by the artificial intelligence it created?

We already know today that robots, machines and systems – the autopoietic objects created by man – have increasingly the ability to learn from each other[18], to discover things[19], to learn emotions[20], to kill[21], to teach themselves and make smart guesses[22], to help people[23], to drive bikes[24], to hear, listen, see, smell, feel and touch.

As smart objects, in particular AI-based systems and advanced robots, are becoming more capable and can be used in more application domains, be it in industry or service sectors, the legal challenges are likely to increase. A first challenge is the issue of liability. In case of a problem related to the "behaviour" of an autonomous system, the question arises who is ultimately legally responsible and up to what level? The second challenge concerns health and safety in the more intense interaction between humans and smart objects. An example is the case of the 22-year-old worker who was killed by a stationary robot at a Volkswagen production plant in July 2015[25]. The third challenge is about the ownership and exploitation of the data collected and used by smart objects. On one hand, many autonomous systems such as self-driving cars need to continuously monitor their environments with sensors in order to operate properly, and some of this data will be stored in an event data recorder for insurance and liability reasons. On the other hand, in the context of Industry 4.0 and connected manufacturing environments (the "sensing enterprise"), smart machines monitor their environment, potentially including the workers and their performance. If workers could "opt-

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[18] For example, the MIT Laboratory for Information and Decision Systems has developed an algorithm in which distributed agents such as robots exploring a building collect data and analyse it independently; pairs of agents, such as robots passing each other in the hall, then exchange analyses.

[19] Supercomputers such as KnIT, endowed with the ability to read 100,000 papers in two hours, make scientific discoveries that scientists can't: https://www.newscientist.com/article/mg22329844-000-supercomputers-make-discoveries-that-scientists-cant/

[20] http://singularityhub.com/2014/09/02/have-digital-devices-ruined-your-ability-to-read-emotions-no-worries-an-app-for-that-is-on-the-way/; http://phys.org/news/2015-08-human-emotions-artificial-intelligence.html

[21] http://www.bbc.com/news/technology-27343076

[22] http://www.kurzweilai.net/can-robots-be-trusted-to-know-right-from-wrong

[23] See the AlterEgo European project, which aims at producing a robotic-based clinical method able to enhance social interaction of patients suffering from social disorders.

[24] Robots like Aero-X hovercraft (http://aerofex.com/theaerox/) and Hoverbike quadcopter (http://www.hover-bike.com/MA/the-hoverbike/how-you-can-own-it/) will be capable of quasi unlimited outdoor uses such as helping military and search & rescue crews navigate over rough terrain or being used by scientists for aerial survey and to monitor wildlife.

[25] http://www.theguardian.com/world/2015/jul/02/robot-kills-worker-at-volkswagen-plant-in-germany

out", i.e. refuse to give their consent to being monitored, the use of the data to adapt the manufacturing process would be challenged, which brings up the question of the ownership of the data generated in the course of a manufacturing process. The height of this issue jumped out in October 2015 when it became obvious with the Volkswagen diesel emissions scandal that the machines of the Internet of Things era could lie: the company didn't manufacture a faulty car; they just programmed it to cheat intelligently! Technical standards have to be precisely defined in order to be fair, but this makes them easy to detect and defeat because they assume a mechanical and neutral universe, not one in which objects get their software updated with new "lies" every time regulatory bodies come up with a new test.

There is even a fourth challenge, of a different nature, which is in fact a philosophical question linked to morality. If there is no way to prove that one entity is "conscious" and another is not, in other words if consciousness is not a scientifically testable proposition, then empirism, i.e. sensitive impressions and scientific experimentation of phenomena (Locke, Hume) are of no help to resolve the philosophical question of the rights of AI-enabled robots and autonomous systems. As Ray Kurzweil wrote: "Artificial intelligences will demand rights, and because of our ability to empathise, we will be inclined to grant them"[26].

Therefore, as the Internet of Things generates objects of various kinds that are increasingly endowed with the capacity to better perceive and interpret their environment, interact with humans, learn new behaviours and execute actions autonomously without human intervention, it becomes urgent to clarify and adapt the legislative framework which was developed for a different, more predictable and controlled technology.

Beyond the actual regulatory response, which can certainly be given, notably in Europe, for each of the challenges outlined before, it must be clear that our vision is not one of human beings seen as suboptimal biological systems whose fate would be to be eventually outperformed by smart objects, notably autonomous robots and machines; it is not one where the advent of the "anthropocene", if it became in 2016 a formally defined geological unit within the Geological Time Scale, would be rapidly made obsolete by a new epoch – the one of machines.

Since 2014, internationally recognised experts from the world of technology and science have issued dire warnings against the threat of smart machines. In May 2014, Stephen Hawking wrote: "*Whereas the short-term impact of AI depends on who controls it, the long-term impact depends on whether it can be controlled at all.*" Some months later, in December, he reportedly told the BBC: "*Once humans develop artificial intelligence, it would take off on its own and re-design itself at an ever increasing rate. The development of full artificial intelligence could spell the end of the human race.*" In October, high-tech entrepreneur Elon Musk, the man who re-invented the car (Tesla Motors), payment (PayPal) and space travel (SpaceX and also the project of building a second Internet in space and one day use it to

[26] Answer to TIME, 11/09/2015: http://www.kurzweilai.net/time-question-everything-will-robots-need-rights-robots-will-demand-rights-and-we-will-grant-them

connect people on Mars to the Web), expressed his view that artificial intelligence (AI) posed a threat to humans. Calling AI development "summoning the demon", he said: *"We need to be super careful with AI. Potentially more dangerous than nukes. (...) If I were to guess at what our biggest existential threat is, it's that we need to be very careful with artificial intelligence. I'm increasingly inclined to think that there should be some regulatory oversight, maybe at the national and international level just to make sure that we don't do something very foolish. (...) The risk of something seriously dangerous happening is in the five-year timeframe. 10 years at most."*[27] In January 2015, Microsoft's co-founder and former CEO Bill Gates said[28]: "*I am in the camp that is concerned about super intelligence… First, the machines will do a lot of jobs for us and not be superintelligent. That should be positive if we manage it well. A few decades after that, though, the intelligence is strong enough to be a concern… I don't understand why some people are not concerned.*" Earlier in the month, a growing list of researchers and professors, including Musk and Hawking, had signed an open letter that proposed proper safeguards be put in place to research and develop such superintelligence without humans losing control: "*We recommend expanded research aimed at ensuring that increasingly capable AI systems are robust and beneficial: our AI systems must do what we want them to do. (...) This research is by necessity interdisciplinary, because it involves both society and AI. It ranges from economics, law and philosophy to computer security, formal methods and, of course, various branches of AI itself.*"

What transpires behind the prophecies of these well-known scientists and entrepreneurs is the fateful idea that AI-enabled objects like robots may not wait to be "assigned" vital responsibilities for society to demonstrate their nuisance; they may just "seize" such responsibilities. Philosopher Nick Bostrom developed the argument[29] that the first superintelligence to be created will have decisive first-mover advantage and will undoubtedly shape the world according to its "preferences", notwithstanding any resistance that humans would put up, with the possibility that these preferences involve the complete destruction of human life. Even if such a catastrophic scenario is very unlikely to happen in the near future, it is nevertheless important to be aware of its plausibility and hence not to minimise the AI existential risk argument. "So we need a mature robo-ethic that accepts AI is neither a massive irrational threat like Ebola nor a manageable issue like farmed animals but something of a third type."[30]

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[27] Tweet on 2 August 2014. Answer to a question from the audience at the Massachusetts Institute of Technology's AeroAstro Centennial Symposium celebrating the 100th anniversary of the University's Aeronautics and Astronautics Department on 24 October 2014. Comment since deleted on an AI post at Edge.org on 16 November 2014.

[28] During his third Reddit AMA ('Ask Me Anything'), 28/01/2015.

[29] Nick Bostrom, Superintelligence, OUP Oxford, 352 pages, July 2014.

[30] Conversation with Robert Madelin, "Senior Adviser for Innovation" in the European Political Strategy Centre (EPSC), on the risks of Artificial Intelligence.

It seems therefore that we live in a pivotal time in human history insofar as the actions we collectively take will determine the future of the human species. The global threats posed by climate change, war, terrorism, and worsening economic inequality are exacerbated by the exponential surge of smart connected objects of all kinds, which we are not able to control – on the contrary, these "creatures" are likely to control us, or even stamp us out.

However, in December 2015 Elon Musk and a group of Silicon Valley investors and technology companies announced the establishment of a new organisation, to be named OpenAI, based in San Francisco. Its long-range goal will be to create an "artificial general intelligence," a machine capable of performing any intellectual task that a human being can. The focus is on building technologies that augment rather than replace humans. In other words, Artificial Intelligence should be an extension of individual human wills and as broadly and evenly distributed as possible.

Therefore, in line with Sarah Spiekermann[31], we believe that the future of the Internet of Things should be conceived around the vision of an Ethical Machine: machines complement humans in those areas where humans are suboptimal; machines don't replace humans nor they are designed in such a way that they might replace them; the 'ethical machine' adapts to each individual and supports that individual in its unique quest for happiness and excellence; ethical machines embed ethics by design in full respect of humanity's fundamental values and rights; the ethical machine recognises the power of our senses and helps us leverage them. This is indeed a major challenge for humanity, and also a necessary focus, because "if ethics can't be built into a machine, then we'll be creating super-intelligent psychopaths, creatures without moral compasses, and we won't be their masters for long."[32] It is one where would be preserved human values and rights against "a technological environment based on personalised, individual and unique experiences"[33].

In this context, the work of Sebastian Deterding, a researcher-designer working on playful, persuasive and gameful design[34], deserves to be praised and further developed. For him, the role of designers today is essential: what vision of the "good life"[35] do the systems that we design propose? We tend to focus on the tip of the iceberg, on the requirements of the customers, but not on those of the users, on the aspirations and drives of users, but not on

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[31] Sarah Spiekermann, "*About the 'Idea of Man' in System Design – An enlightened version of the Internet of Things?*" in Architecting the Internet of Things, Springer Verlag, 2010, p. 25-34. See also Sarah Spiekermann's blog on The Ethical Machine: http://derstandard.at/r1326504100796/Die-ethische-Maschine

[32] James Barrat, Our Final Invention: Artificial Intelligence and the End of the Human Era, Thomas Dunne Books, October 2013.

[33] Source : Le Monde Diplomatique, « *Résister à l'uberisation du monde* », September 2015, page 22.

[34] http://fr.slideshare.net/dings/designing-the-good-life-ethics-and-user-experience-design?ref=http://codingconduct.cc/

[35] 'Good life' is a translation of Aristotle's *Eudaimonia*, which means also "flourishing", "well-being".

their lasting needs, on the most wealthy and educated fraction of the users, but not on all the others. We are more concerned with controlling the symptoms than with addressing the causes at their roots. Designers seek to "materialize morality" (morality is embedded in the objects that we design). But how to be sure that objects reinvent the meaning of life?

4. Towards a Super Human

"A society which contains millions of millions of mechanical slaves and a mere two thousand million humans will reveal the characteristics of its proletarian majority (...) In order to make use of their mechanical slaves men are obliged to get to know them and to imitate their habits and laws. (...) We are learning the laws and the jargon of our slaves, so that we can give them orders. And so, gradually and imperceptibly, we are renouncing our human qualities and our own laws. The first symptom of this dehumanisation is contempt for the human being. Modern man assesses by technical standards his own value and that of his fellow men; they are replaceable component parts. (...) Society is now created for technological, rather than for human, requirements. And that's where tragedy begins".[36]

The issue of a "Super Human" is not new. In his later writing period, somewhere between 1883-1887 Nietzsche also filled the work with nature metaphors, almost in the spirit of pre-Socratic naturalist philosophy, which invoke animals, earth, air, fire, water, celestial bodies, plants, all in the service of describing the spiritual development of Zarathustra, a solitary, reflective, exceedingly strong-willed, sage-like, laughing and dancing voice of heroic self-mastery. Accompanied by a proud, sharp-eyed eagle and a wise snake, Zarathustra envisions a mode of psychologically healthier being beyond the common human condition. Nietzsche refers to this higher mode of being as "Super Human" (Übermensch), and associates the doctrine of eternal recurrence — a doctrine for only the healthiest who can love life in its entirety — with this spiritual standpoint, in relation to which all-too-often downhearted, all-too-commonly-human attitudes stand as a mere bridge to be crossed and overcome. He argues that the natural fear of being overwhelmed by a superior foe becomes internalised as a self-generated sense of guilt, which brings the individual conscience to place stern limits on the normal exercise of human desire. According to Nietzsche, the submission by the human race of its freedom to the vain demands of an imaginary god constitutes a fundamental self-betrayal. By fear of living by unleashing the full potential of their own wills, human beings invent religion as a way of explaining – but also in fact generating – their perpetual sense of being downtrodden in life.

Every technology humans have developed has been an extension of their senses and capabilities: the spear and the arrow extended the arm, the telescope extended the eye, the headphone extended the ear, and more recently the Kissenger messaging device, which

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[36] C. Virgil Gheorghiu, The Twenty-Fifth Hour, Knopf, English Edition 1950. A poet, Trajan Koruga, utters the quoted text in the book. 65 years later, it is foreseen that by 2020 the world population of humans will reach around 7.7 billion and the one of connected things 26 billion units (Gartner), 30 billion units (IDC), 33 billion units (Strategy Analytics) or 50 billion units (for an installed base of approximately 212 billion devices – Cisco).

comprises a pair of pressure-sensitive soft plastic lips that contain pressure sensors and actuators, extends the mouth… At the same time, as we have seen, the metamorphosis of objects alters the human technoculture, i.e. the way we live. The 4th Edition of European Robotics Week showed that robotics provides solutions to many of the current and future societal challenges, such as working in certain sectors that pose a hazard to human health or taking care of disabled and elderly people.

This notwithstanding, if the prediction of Trajan, the character of The Twenty-Fifth Hour, comes true, human beings will be tuned to a known standard. They will look like assembly lines and seek standardised performance, set targets, use productivity and efficiency as the defining marks of success in the life's journey. What is known today as the "Quantified Self" is a vivid illustration of this evolution.

The Quantified-Self is the process of measuring, logging and potentially sharing various metrics related to our physical and mental health over an extended period of time, in most cases by using a separate sensing device that has sensors built into it and that communicates the data recorded via wireless connections. In general, the data is used to drive personal behavioural change, such as staying fit or losing weight. Obviously, such ubiquitous self-tracking which consists for individuals to seek self-knowledge through numbers, raises big concerns over the ethical boundaries of the practice relating to data ownership, terms of use and rights of exploitation, personal privacy, and the potential emergence of discriminatory social and employment practices.

The role played by the Quantified Self in the digital society is probably irresistible. First, because of the technology: electronic sensors are getting smaller and better. Second, because of the rise of new behaviours: people like to carry powerful smart devices. Third, because of the new techno-culture: social media make it seem normal to share everything. Personal data are ideally suited to a social life of sharing. And fourth, we begin to get an inkling of the rise of a global super-intelligence known as the cloud. We want "*to look outward to the cloud, as well as inward toward the psyche, in our quest to figure ourselves out.*"[37]

The reliance of human beings on digital devices has gained importance around 2010, marking a disruptive transformation in our relationship with objects. As put it Steve Johnson, "*As we turn more of our decision-making over to the devices, they will evolve into our personal confidants and counsellors, determining everything from the time we wake up and clothes we wear to the music we listen to and route we take to work.*"[38] The first threat is that people get more and more addicted to numbers. "*A fetish for numbers is the defining trait of the modern manager. Corporate executives facing down hostile shareholders load their pockets full of numbers. So do politicians on the hustings, doctors counselling patients and fans abusing*

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[37] Gary Wolf, *The Data-Driven Life*, op. cit.

[38] Steve Johnson: *Will our smart gadgets become trusted or oppressive companions?*, in San Jose Mercury News, 17 January 2015.

their local sports franchise on talk radio."[39] The second threat concerns indeed the absolute dependence of people on their smart objects. Numbers are infiltrating the last redoubts of the self: sleep, exercise, location, alertness, food, mood, productivity, spiritual well-being and so forth are being tracked and measured, shared and displayed.

A decade after the Nano-Bio-Info-Cogno (NBIC) report[40], some experts in companies and research organisations don't hesitate to predict that there will be a day when human beings are able to use science to cheat death. For example, Humai, an Australian startup is working on a way to transfer a person's consciousness into an artificial body after they've died[41]. Using artificial intelligence and nanotechnology, data of conversational styles, behavioural patterns, thought processes and other body-related information will be stored into an artificial body with the brain of a deceased human. In the same way, Ray Kurzweil, Director of Engineering at Google, heading up a team that seeks to develop machine intelligence and natural language understanding, predicts that humans will become hybrids in the 2030s[42]. Our brain, which is composed of 100 billion cells (neurons), will be able to connect via nanobots, made from DNA strands, directly to the cloud, where there will be thousands of computers that will augment our existing intelligence. Biology and the digital world will be merged into one discipline, in line with the NBIC vision. Already today, there are emerging disciplines, in particular Brain-Computer Interfaces, Neuroprosthetics and Optogenetics, which allow to augment or repair human cognition, thus opening way for many novel applications regarding seeing, hearing, feeling pain, hunger, memory, anxiety, etc. These applications will challenge what it means to be human or, when our neocerebella become connected to the cloud, what it means and implies to be "Super Human".

Forming a sort of spin-off of the NBIC convergence, a philosophy in favour of a radical transformation of Humanity – Transhumanism – is truly dreaming to change Man. The term "transhumanism" was coined in 1957 by Sir Julian Sorell Huxley, the evolutionary biologist and Aldous Huxley's brother. Huxley has more clearly than anyone after him given the definition of "transhumanism"[43]:

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[39] Gary Wolf, *The Data-Driven Life*, in New York Times, 28 April 2010.

[40] The idea of "enhancing" humans via advanced technology imposed itself in the public conversation in 2003 with the publication of the US National Science Foundation's report on "Converging Technologies for Improving Human Performance". This was the NSF-DOC-sponsored NBIC report exploring the multidisciplinary scientific field at the crossroads of nanotechnologies (N), biotechnologies (B), information technology (I) and cognitive sciences (C). The goal was to assess the potential impact of NBIC technologies on improving human capabilities at the microscopic, individual, group and societal levels.

[41] http://www.techspot.com/news/62932-new-startup-aims-transfer-people-consciousness-artificial-bodies.html

[42] Ray Kurzweil, http://singularityhub.com/2015/01/26/ray-kurzweils-mind-boggling-predictions-for-the-next-25-years/

[43] In *New Bottles for New Wine*, London: Chatto & Windus, 1957, pp. 13-17.

"The first thing that the human species has to do to prepare itself for the cosmic office to which it finds itself appointed is to explore human nature, to find out what are the possibilities open to it (including, of course, its limitations, whether inherent or imposed by the facts of external nature). We have pretty well finished the geographical exploration of the earth; we have pushed the scientific exploration of nature, both lifeless and living, to a point at which its main outlines have become clear; but the exploration of human nature and its possibilities has scarcely begun. A vast New World of uncharted possibilities awaits its Columbus (...) The human species can, if it wishes, transcend itself – not just sporadically, an individual here in one way, an individual there in another way, but in its entirety, as humanity. We need a name for this new belief. Perhaps transhumanism will serve: man remaining man, but transcending himself, by realizing new possibilities of and for his human nature. 'I believe in transhumanism': once there are enough people who can truly say that, the human species will be on the threshold of a new kind of existence, as different from ours as ours is from that of Pekin man. It will at last be consciously fulfilling its real destiny."

Transhumanists view human nature as a work-in-progress, not as the endpoint of evolution. They envision that responsible use of science and technology will allow to "enhance" the human being to the condition of a post-human being with vastly greater capacities than present human beings have. Transhumanism has three goals: eternal life; enhanced physical, intellectual and psychological capabilities (beyond what humans are naturally capable of); and artificial intelligence. Nobody today disputes the idea that within a few years a brain-computer interface will allow us to download our memories to a PC and at the same time upload new memories. The next generation of humans will consider it the norm to live through a series of disruptive technologies that frequently change their lives. After all, what seems unnatural to the children of today is anything that isn't digital. To them, the smartphone is already an extension of the brain; mind uploading, bionic implants, and powered exoskeletons – consisting actually in "wrapping a robot around a person"[44] – will just be a natural course.

What seems new is that transhumanism technologies are more and more spectacular and transgressive. Long ago, Marshall McLuhan was saying: "Man becomes, as it were, the sex organs of the machine world" – here we are. Without being aware of it, but simply because they would like to overcome ageing, pain and even death, humans become trans-humans, namely "Technologically Modified Humans". As humans evolved the ability to imitate one another, we got to exchange *memes* (tunes, ideas, catch-phrases, beliefs, patterns of behaviour) along with our *genes*. The Oxford English Dictionary has recently defined "meme" – a term coined by Richard Dawkins in 1976 – as "an element of a culture that may be considered to be passed on by non-genetic means, esp. imitation". With transhumanism, we are witnessing a new stage in species evolution: the rise of *temes* – technological memes, i.e. digital information stored, copied, varied and selected by machines[45], which can be

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[44] Source : Nate Harding, chief executive and co-founder of Ekso Bionics, at CES 2015 in Las Vegas.

[45] Susan Blackmore, The Third Replicator, in The New York Times, 22 August 2010, http://opinionator.blogs.nytimes.com/2010/08/22/the-third-replicator/

generated directly by these machines or indirectly by the technologies that are wrapped around human bodies to enhance their capabilities.

If techno-optimist and blogger Tim Urban is right and we are moving from Artificial Narrow Intelligence (ANI, as today) to Artificial General Intelligence (AGI, as humans have) to Artificial Super Intelligence (ASI enhancing and surpassing humans)[46], we should compare ANI, AGI and ASI with the total collective intelligence of humanity, not just with one human brain. Creativity, invention, innovation comes as much from the interaction between people and teams as from individuals. But AI-enabled machines have an advantage since they can be more easily linked together (Global Brain) with easier working towards the same goal[47].

This brings about the idea of "singularity" - a concept that is promoted by a group of scientists and technologists who are nurturing a discourse around the impact technology will have or is already having on humanity. Vernor Vinge, a mathematician and computer scientist, predicted in 1993 that mankind will develop a "superhuman intelligence" before 2030. In 2005, Ray Kurzweil defined the singularity as "a future period during which the pace of technological change will be so rapid, its impact so deep, that human life will be irreversibly transformed. Although neither utopian nor dystopian, this epoch will transform the concepts that we rely on to give meaning to our lives, from our business models to the cycle of human life, including death itself." Going far beyond passing the Turing test, singularity includes superhuman intelligence, self-awareness among such superhumanly intelligent machines, and cyborg or other computer-human biological interface.

The concepts which we have outlined here – NBIC, transhumanism, singularity, quantified self, etc. – share a lot of features in common, even if each one has its gurus, thought leaders, outstanding marketers, and fringe practitioners. They all point out to the convergence between Artificial Intelligence and the Internet of Things and hence to a world where smart connected objects of all kinds will co-habit with humans to create a global hyper-connected and super-intelligent ecosystem.

Conclusion

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[46] Tim Urban, The AI Revolution: The Road to Superintelligence, 22 January 2015, http://waitbutwhy.com/2015/01/artificial-intelligence-revolution-1.html *"An AI system at a certain level—let's say human village idiot – is programmed with the goal of improving its own intelligence. Once it does, it's smarter – maybe at this point it's at Einstein's level – so now when it works to improve its intelligence, with an Einstein-level intellect, it has an easier time and it can make bigger leaps. These leaps make it much smarter than any human, allowing it to make even bigger leaps. As the leaps grow larger and happen more rapidly, the AGI soars upwards in intelligence and soon reaches the superintelligent level of an ASI system. This is called an Intelligence Explosion, and it's the ultimate example of The Law of Accelerating Returns."*

[47] Source: our inspiring discussions with Dirk Beernaert, Adviser at European Commission's DG CONNECT.

"The purpose of looking at the future is to disturb the present"[48]

The question arises whether our lives in the future will be the ones we want or the ones our IoT-enabled machines will want. Will we move towards a humanisation of technology or towards a techno-fication of the human race?

In other words, is there an intersection where IoT-enabled humans and objects will find a mutually beneficial coexistence?

The distinction between "technology that transforms humans into machines" and "technology that transforms machines into thinking organisms" is artificial and to some extent misleading; but it may be used for the sake of simplification and convenience. Technology is going to surround all of us insofar as, like in Philips' Ambient Intelligence (AmI) vision, "people living easily in digital environments in which the electronics are sensitive to people's needs, personalised to their requirements, anticipatory of their behaviour and responsive to their presence."

Psychologist Susan Blackmore gave the following forecast in 2010: "*There is enormous scope for teme machines to grow, evolve and create ever more extraordinary digital worlds, some aided by humans and others independent of them. We are still needed, not least to run the power stations, but as the temes proliferate, using ever more energy and resources, our own role becomes ever less significant, even though we set the whole new evolutionary process in motion in the first place.*"

Is it an optimistic or a pessimistic view? A tragedy or a blessing? In fact, we don't know, or not yet, because much depends on the way transhumanism will be implemented. The important point here is that we humans don't choose any more where innovation takes us. We like to think that we are the designers, developers and controllers of an emerging world in which we are going to be enhanced by technology while our machines will be smart to perform tasks for us, but in reality technology has already become an organism powered by the same forces of natural selection that made us. We assume that we are in control of our destiny because technology is shaped from our human experience. However, shouldn't we ask ourselves if we are not just the puppets to natural selection, which uses our hands and our brains to pursue its own logic?

If we presume that combined advances in Nano-Bio-Info-Cogno will deeply affect the nature of human beings and of objects, it is legitimate to launch a call for a global conversation on the ethics of these developments. As argued by Andrew Feenberg[49], we should not accept

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[48] French philosopher, manager and civil servant Gaston Berger (1896-1960), who proposed the use of the word *prospective* to emphasize the importance of a future oriented attitude.

[49] Andrew Feenberg, "*From Essentialism to Constructivism: Philosophy of Technology at the Crossroads*", http://www-rohan.sdsu.edu/faculty/feenberg/talk4.html. "*The shared technical heritage provides what might be called a 'practical universality' that has imposed itself on a planetary scale (…) and is the place on which destinies can be worked out.*"

without discussion that our modern society becomes merely the "untranscendable horizon of technical possibilities" nor we should forego inventions and innovations as such and conceive the illusion that any country, or Europe, could follow an entirely independent path of development. "*The worry seems to be that perfected robots, instead of being proud to serve their creators, will rebel, resisting their subservient status and eliminating or enslaving us.*"[50]

But even if a social consensus were reached on the development of new technological systems based on an ethics-by-design approach, key questions would still arise. First, whose ethics? The definitions of "right" and "wrong" can be challenged by different individuals, groups or communities. Second, since the computer has been programmed to perform certain actions at pre-defined decision points, who can guarantee that it will not meet our demands for "happiness" or "power" by taking unethical decisions?

The next few decades will be rich of both inspiring opportunities and unprecedented ethical challenges.

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[50] Margaret Atwood, *Are Humans Necessary?*, International New York Times, 4 December 2014.