3 The dream of the Internet of things

Do we really want and need to be smart?

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Wall-E – Prologue

[*Auto shows Captain Directive A-113, which said not to return to Earth due to rising toxicity levels which make life unsustainable*]

Auto:	Now, the plant.
Captain:	No, wait a minute, Computer when was that message sent out to the Axiom?
Ship's Computer:	Message received in the year 2110.
Captain:	That's … That's nearly 700 years ago. Auto, things have changed. We've gotta go back.
Auto:	Sir, orders are do not return to Earth.
Captain:	But life is sustainable now. Look at this plant. Green and growing. It's living proof he was wrong.
Auto:	Irrelevant, Captain.
Captain:	What? It's completely relevant. Out there is our home. Home, Auto. And it's in trouble. I can't just sit here and, and do nothing. That's all I've ever done. That's all anyone on this blasted ship has ever done. Nothing.
Auto:	On the Axiom, you will survive.
Captain:	I don't want to survive. I want to live.
Auto:	Must follow my directive.
Captain:	daaa … I'm the captain of the Axiom. We are going home today.

[Auto advances toward him threateningly, causing the Captain to flinch][1]

In the 2008 film *Wall-E* directed by Andrew Stanton, we are conducted to a distant era in the future, in which the complete automation of our life-sustaining processes is successfully taking place in a salvific ship – the Axiom – endlessly floating in outer space. Human life is described as literally effortless, on a vessel in which every possible bodily concern is efficiently taken over by rational machines, designed to operate under specific moral directives. For years, decades and centuries human agency is completely delegated to these automated systems for survival, until clear

evidence of life's rebirth on Earth – a plant – is presented to the captain. All of the sudden, a discontinuity occurs in the programmed set of values ensuring the existence on the Axiom and what is relevant or irrelevant becomes questionable. Plain survival in a powerfully and wonderfully controlled environment is not life and responsibility is to be taken by human beings over their own planet of origin. An open conflict arises as the captain decides to exercise his agency.

Like any significant story about the future, this cinematographic fiction dramatises a variety of timely dilemmas concerning our present: which ethics do we choose and apply for negotiating with the ever increasingly pervasive automated systems that are embedded in our daily life? How many and what aspects of our own agency, ability to think, feel and decide are we willing to sacrifice for our own survival? Where and how do we set the boundary between living and merely functioning? Do we need to preserve human agency and experience as we know them or witness, more radically, the possible transformation of their very nature?

In this chapter we explore the emergence and the evolution of these dilemmas within the framework the most recent developments of Information and Communication Technologies (ICTs) and the deployment of *smart* products and processes *via* the so-called Internet of Things.

As we will see, the dynamics of these issues can be interpreted as belonging to the trajectory of modernity, arising from the Cartesian dream of separation between the rational freedom of moral and intellectual decisions (of the mind) and the causal necessity of mechanical processes (of material bodies). More specifically, we will argue that the promise of automation and connectivity entailed in the implementation of the Internet of Things can be read paradoxically as the climax and failure of this modern Cartesian dream.

We begin our exploration by moving back from the far future to the most recent past.

The promises of the Internet of Things

In the same year of the release of *Wall-E*, in the midst of the global financial crisis and a few days after Barack Obama's first election, the chair and CEO of the multinational company IBM, Sam Palmisano, gave a speech at the US Council of Foreign Affairs. His talk was designed to launch one of IBM's most ambitious campaigns, based on the idea of building a 'smarter planet'. Two years later, the European Union's strategy for the decade to come called for a '*smart*, inclusive and sustainable growth' (European Commission 2010).

Born in the field of computing science, first associated with bombs and chip cards, later with a plethora of other concrete objects and abstract notions, the word smart has been evoked over the last few years both by private and public institutions, as a salvific promise to restore economic growth and modern welfare. In the most recent developments of ICT, it refers to the possibility of augmenting with sensing and processing capabilities both physical and digital objects, and networking them through the internet, creating a new kind of global, physical, digital and virtual infrastructure of devices and entities, defined as the

Internet of Things (IoT)[2] or the industrial designations such as *Internet of Everything*[3] and more recently with perhaps intentionally suggestive designation, *enchanted objects* (Rose 2014).

The IoT is essentially structured into three layers, inhabited by three kinds of things in a symbiotic interaction with each other: the physical, the digital and the virtual entities. Physical things have digital counterparts and virtual representations. In this threefold cosmology, *we* – meaning human beings – relate to our environment just like any other entity, through our multiple digital counterparts and virtual representations.

As we will see, through this ontological symbiosis, a number of epistemic and normative equivalences between 'human-things' and other entities take place. We are reminded here of the term *Ding*, the Germanic root of the word 'thing', which, as Bruno Latour extensively articulates (and Heidegger and Whitehead before him), denotes both the *neutral objects* of investigations, the matter of facts – the kinds of entities populating the IoT universe – *and* the *reasons* for investigating them, the matters of concern – the modes and functions of existence of these entities – evoking the realm of values and subjectivity (Latour 2005).

In this sense, the IoT becomes the expression of a forum for 'human "things" and other entities' provided with autonomous identity, personality, intelligence and agency, all homogeneously defined as smart and all sharing and functioning in a common information space (van kranenburg 2008).

Through this forum of living and non-living beings, as both the corporate and the institutional narratives articulate, socio-technical *things* will be able to manage themselves: from energy grids and traffic, to medical and financial decision-making processes, to the very texture and nature of our daily life. The speed and precision of these smart processes will provide the efficiency we need to overcome the systemic crisis we are facing and keep improving our wealth. In other words, we will effectively respond to numerous economic, political, social and environmental 'wake up calls' (Palmisano 2008; European Commission 2010) that reach our governments, corporations and citizens, by improving the way we collectively and individually *function*, upgrading our slow, obsolete and 'un-smart' life-sustaining processes through technoscientific innovation.

In what follows, we will discuss the main underlying assumptions, consequences and contradictions of this Cartesian dream of mastery and control not only over the realm of natural phenomena (ruled by causal necessity) but also over the world of human affairs (ideally governed by free rational and moral decisions) to be automatised and optimised at will.

We will begin by analysing how this dream is embedded in an overarching narrative of innovation, as the decisive step along a path-dependent transition from modern, curiosity-oriented science creating common knowledge, to big, industrial, goal-oriented technoscience producing corporate know-how. We will then focus on how the dream is constructed, offered and ultimately regulated according to and through specific technoscientific imaginaries, defined as collections of visual and verbal metaphors that are created and communicated both in the specialised literature and in the mass media for the public at large.

We will concentrate our analysis on the ways in which the IoT is portrayed and diffused through the visual and verbal language of videos and on the imaginaries that they evoke and communicate. Bruce Sterling recently defined these types of visual discourse as 'design fictions'.[4] In his words:

> It's the deliberate use of diegetic prototypes to suspend disbelief about change. That's the best definition we've come up with. The important word there is *diegetic*. It means you're thinking very seriously about potential objects and services and trying to get people to concentrate on those rather than entire worlds or political trends or geopolitical strategies. It's not a kind of fiction. It's a kind of design. It tells worlds rather than stories.

We will argue that, while indeed showing a population of objects and services through a number of characters, these design fictions are in fact representing and demonstrating political, economic, social and cultural trends, together with geopolitical strategies. And most of all, they are more or less implicitly encouraging a radical change in the human condition.

For orienting ourselves in the complex and multifaceted visual discourse of the IoT, we will make use of an abstract space, defined by a reference system consisting of four *standard* imaginaries of technoscientific innovation: wonder, power, control and urgency. This set of fundamental axes can be seen as expressions of what we want (wonder), what we can (power and control) and what we need (urgency) to achieve through technoscientific innovation, more specifically through the IoT.

Our exploration of imaginaries will finally lead to an open-ended reflection on the underlying aims, paradoxes and human costs of IoT enhancement, in relation to the possible decline of some of the fundamental attributes of our integrity and agency: being more connected but more isolated, being more powerful but less capable (to relate, to decide, to act), having more information but conceiving less creative knowledge.

Being smart: the narrative of technoscientific innovation

The definition of technoscientific innovation – via the ICT or other emergent technologies – as the engine of economic, social and environmental wealth is the last semantic step of a pervasive and articulated narrative of progress that can be traced back – along a co-evolving epistemic and normative trajectory – up to the emergence of scientific revolution and modern state.[5]

Within this trajectory, we have been asking science and technology to fulfil (at least) three essential functions: to extend or at best to sustain our well-being, to preserve us from the possible adverse consequences of our acting towards this goal, and to confront unfavourable events, should they arise despite our efforts to avoid them.

The unchallenged economic policy aims of growth, productivity and competitiveness – reinforced in the ongoing crisis – are fundamental ingredients

of this framework. If we keep these goals as givens for improving and extending human welfare on this planet, then we (continue to) face the paradox of sustaining a steady increase in our global resource consumption within a closed, finite system, with limited stocks and bio-geo-chemical resilience (Rockström *et al.* 2009; Jakson 2009).

The issue becomes even more complex, as the technological and ideological lock-ins of our hyper-complex, life-supporting systems lead us to deal with a double-bind scenario, quite painfully clear in the wake of the latest economic, financial and political emergency: we can't keep growing indefinitely in the way we have so far, but if we don't keep growing, we jeopardise the economic stability not only of future generations, but also – more decisively – of present ones.

The dominant discourse about a way out of this Catch-22 situation comes from the current grand narrative of technoscientific innovation, which serves a double purpose. As the first line of reasoning reads, in this unfavourable equation, we need to take into account an essential hidden variable, which Malthus proverbially overlooked: natural supplies might be limited, but human creativity is *unlimited*, and so is human power to decouple growth from scarcity, improving efficiency in the use of natural resources and ultimately substituting them altogether, with substantially equivalent technological optimised artefacts. Technoscientific innovation allows then for a 'sustainable growth'through the optimisation and the substitution of our means, and through the deployment of suitable silver-bullets, protecting us from the complexity of socio-ecological problems as they arise. Secondly, technoscientific innovation is taken as the mainstream solution in order to keep sustaining the growth of states' economies in a hyper-saturated market, by opening up new pathways of competitiveness and consumption, to be filled with new, constantly upgraded, products and services.

In this overall framework, ICT in general, and the Internet of Things in particular, play a significant role, responding to both lines of arguments. First, we can extensively improve our efficiency in the use of resources by allowing ICT – and more specifically the IoT – to manage *for* us, and also *through* us, the complexity of the socio-technical systems we rely on to live. The implicit assumption here is that this complexity can be decomposed and translated into structured binary information, by technologically enhancing our monitoring and our processing power. In this way, we can allegedly optimise not only our production system and our services, but also our decision-making processes. This vision of technological enhancement entails the convergence of the physical, the digital and the virtual world, and the creation of hybrid forms of living and functioning, such as virtually connected cyborgs. In addition, in this context, both the optimisation and the hybridisation processes are not only *possible*, but also *needed*, as silver bullets for the progressively graver challenge of keeping our collective life-supporting systems functional.

Second, implementing the IoT scenario entails the introduction of a plethora of new products, services and business models, thus ensuring new routes to revitalise consumption growth (*The Economist* 2010). In this context, the variety and the amount of benefits provided by this new wave of goods will make the transition to

the world of IoT not only *possible* and *needed*, but also fundamentally *desirable*. This last step is taken to be essential, both within private and public institutions, in order to shift from the narratives of doom and sacrifice to the ones of hope and opportunity.

In short, within this narrative of innovation, *we* – meaning *us* and our *machines* – can, need and want to become *smart* enough to keep fulfilling the promises of progress and development in the face of the socio-ecological limits we are bound to.

The standard imaginaries of the IoT

Before looking at the actual imagery of the IoT, we define and briefly articulate a four-dimensional space of *standard* imaginaries that will serve as a useful map to navigate into this complex interface between facts and values, between matter of facts and matters of concern, particularly vague and ambiguous as the factual content is a vision in itself, therefore a fast-moving target. Indeed, as we will see, in order to be operational as if a value-free technoscientific innovation in charge of securing the goods of development and progress, the dream of the IoT is standardised and defended along four dimensions, intrinsically connected and functional to each other. Four standard technoscientific imaginaries are implemented as sophisticated epistemic marketing devices: wonder, power, control and urgency.

Wonder is related to the modern ideal of scientists as explorers of the unknown, in charge of opening the doors of our perception and agency. As we will see, in the context of the IoT, wonder can be defined as the implicit assumption that a technologically mediated, namely a virtual, experience is more valuable and rewarding than a direct one. In this reductionist ideal, experience can be replaced by a series of algorithmic instructions, designed by software and hardware developers. Through this mediation, technology allows then for asymptotically effortless interactions with the external environment, be it social, cultural or natural. As we will explore, this shift entails a progressive alienation from phenomena, and a mediated, aesthetically standardised fruition of them.

Power is rooted in the ideal of extending indefinitely the limits of human being and agency through the creative manipulation of life, energy and matter. Either by reaching new territories on the macro, micro or nano scales, by intervening on organic and inorganic matter, or by fostering the convergence of nano, bio, information technologies and cognitive sciences, the power of human agency on its surroundings consists in a constant exercise of technoscientific creative enhancement of the known and prompt treatment of the unknown. In the IoT scenario, power is related to the possibility of enhancing our intelligence and our capacity to effectively act on our surroundings by hybridising and networking bio-physical, digital and virtual systems into common information spaces.

The founding stone of these standard imaginaries can be found in Francis Bacon's posthumously published text *The New Atlantis*. In his writing, Bacon describes a utopia of wealth, happiness and security based on scientific advancements:

> We have also engine-houses, where are prepared engines and instruments for all sorts of motions. There we imitate and practise to make swifter motions than any you have, either out of your muskets or any engine that you have; and to make them and multiply them more easily, and with smaller force, by wheels and other means: and to make them stronger, and more violent than yours are; exceeding your greatest cannons and basilisks.
>
> (Bacon 1627a/1996)

His unfinished manuscript ends with a visionary list of '*wonders* of Nature, in particular with respect to human use' (Bacon 1627b). Here are a few examples:

- The prolongation of life.
- The retardation of age.
- The curing of diseases counted incurable.
- The altering of complexions, and fatness and leanness.
- Versions of bodies into other bodies.
- Making of new species.
- Instruments of destruction, as of war and poison.
- Drawing of new foods out of substances not now in use.
- Deception of the senses.

Bacon anticipated that all this could be achieved by the use of the new tool of experimental and inductive science. In *Novum Organum* (1620/2012) he explained why: 'Human knowledge and human power come to the same thing, for where the cause is not known the effect cannot be produced' (aphorism 3). Useful knowledge for Bacon is knowledge about cause–effect relationships enabling us to avoid or induce the causes of what harms or benefits us, respectively.

The dialectic between power and control, the founding pillar of the Cartesian ideal of mastering Nature, was then established. The *wonders* of Nature can be mastered by the *power* and *control* of the scientific method. Scientific knowledge takes charge of predicting the causes and the consequences of our (technological) action in a certain, objective and exhaustive way.

In the contemporary imaginary of *control*, radical uncertainty, indeterminacy and ignorance can be translated into quantifiable risks and managed as data through the tools of statistical analysis and numerical simulation. In the framework of the IoT, this ideal of control is translated into the possibility of deciding a course of action, i.e. of dealing with complexity, by distinguishing data from noise within a global information space, and transforming information into knowledge for decision-making processes by augmenting our processing power. As we will see, the implicit modern assumption in the imaginaries of power and control is that the values and the stakes implied can be completely disentangled from the data and they can therefore be harmlessly obscured. Thus, in this reductionist framework, not only experience but also agency can be digitised and reduced to algorithmic procedures.

The consequences that lie outside of quantitative and statistical models, therefore unpredictable and unforeseen, are defined as *unintended*, conceived

as anomalies and confronted within the same framework, through more and newer technoscientific instruments. This last step is made possible by a standard imaginary of *urgency,* which is based on the morally binding necessity to bypass any delaying post-normal (Funtowicz and Ravetz 1993, 1999) knowledge production and decision-making process, in favour of a silver-bullet technoscientific and technocratic approach, in order to effectively tackle and solve the pressing socio-environmental problems that afflict the planet on local and global scales. In this future-oriented imaginary, lack of time and high stakes produce allegedly compelling mono-causal framings, in which technoscientific expert knowledge emerges as a *deus ex machina* from the modern imaginaries of wonder, power and control. Ironically, in the dream of the IoT, the *deus ex machina* consists of a network of machines, a web of sensors and computing devices in charge of solving our problems.

Let's now begin our visual journey in the dream of the IoT with the imaginary of wonder.

Wonder: a smart day (we want)

In February 2011, Corning Incorporated, a global specialty glass and ceramics manufacturer based in Upstate New York, published a promotional video called 'A day made of glass'.[6] The five-minute clip was seen by several million of people in a few months (more than 23 million as of today). It is a vision for the near future in which we follow a typical American family for a whole day, harmoniously driven from morning to night by smart glasses.

A year later, given the unexpected success of the clip, Corning posted a sequel called 'A day made of glass 2: Same day',[7] together with an extra called 'A day made of glass 2: Unpacked'.[8] In this new series we meet the family again and deepen our exploration of their daily life, with the help of a an explanatory voice-over, appearing in the form of a pleasant young man, evoking for style and appearance keanu Reeves playing Thomas Anderson (alias Neo) in the movie *The Matrix*. The narrator introduces a small set of characters, which we can easily relate to: Jennifer and Dan, the mother and father, Amy and Sarah, the two daughters in their primary school.

The things depicted in this 'design fiction' are of course Corning's near future products: specialty glasses accurately defined by timely superimposed captions showing their main characteristics. But the things that these products are *about*, the promises that they are meant to fulfil, consisting of implicitly *desirable* lifestyles, are embedded in the full cosmology of the IoT: the whole range of physical entities such as home appliances, cars and infrastructures, the main characters themselves, their digital counterparts and their virtual representations.

As the sun rises, we are presented with the affluent family waking up in its smart home. Information systems are everywhere, invisibly inserted into every possible glass surface, varying from a wall in the bedroom to the bathroom mirror, to the kitchen counter. From the first glimpse of consciousness the characters are therefore surrounded by information, standardising and reassuring their

psychological and physical coordinates. While we could argue that, in essence, there is nothing radically different from our actual world of plasma TV screens, smart phones and tablets, yet, as for every future scenario, this more pervasive configuration of ICT allows, once again, for a reflection on our *present*.

The news, the stock market and the weather can be found from one room to the next, seamlessly complementing the early morning routine. The breakfast ingredients and the news share the same pristine space, both metaphorically and literally. The physical structure and the appearance of glass convey a whole variety of desirable properties: it is transparent, clean and protective, and it can be engineered to be light, durable and ubiquitous.

Adding to this uniform background of data is a second layer of *personalised* information, such as daily and weekly planning, social networks and applications. Our characters not only receive, but also share information as soon as they step out of sleep.

Jennifer: optimising time

While approaching the bathroom sink, Jennifer – the mother – automatically activates her personal interactive smart board on the main mirror. As a result, while washing her face she is presented with her daily schedule: information and water flow together. She is notified by a text message that her first meeting will be run an hour earlier and she instantly replies that she will make it.

A whole set of smart devices will drive her there on time. Her car will recognise her and her daily schedule: it will let her know of an accident ahead and devise a new route. The idea is that Jennifer can navigate through her day and adapt to sudden and unexpected changes because, through the ICT, she can access and manage information in *real time*. This means that there is practically no delay between an event happening in Jennifer's *virtual* sphere of existence and her reaction to it in her *physical* space. In this scenario, and in Corning's vision, she is simply more efficient in a world of complex interactions and demands (and therefore implicitly *happier*). However, as we will further explore, a first level of contradiction seems to emerge: the very same complexity of interactions and demands, which she can manage and meet only through the ICT, is increased by the real-time pervasiveness of the ICT themselves. She is asked to meet an hour earlier as she is supposed to be able to meet the demand.

Optimising time (in order to be happier) is a common feature of the IoT vision. An interesting visual development of this idea can be found in an 'Infographic' about the IoT published online in July 2011 by the US company CISCO[9] and in the EU video on the IoT 'Teaser N. 1: Student', published online in January 2012.[10]

In these visions, there is no need for a human intervention or decision in front of a bathroom mirror: the *things*, meaning in this case our home appliances and our car, are connected with our virtual sphere of existence – which never sleeps – and decide when we should wake up into our physical world. Again, on the one hand, the positive vision implied is a world in which we are never late, never lost

and most of all, never *unprepared*. On the other hand, this same world is a place in which every minute of our *real* life needs to be controlled and be functionally oriented. In other words, we *can't* be late, lost or unprepared. Therefore, it is a world in which our relationship with the unknown is implicitly and ideally eliminated. This form of technological eradication of surprise entails abdicating one of the fundamental sources of human creativity and learning: our capacity to adapt to complexity and to the unexpected (Benessia *et al.* 2012). This in turn implies a second level of contradiction: what makes us safer and more efficient can be interpreted as the very same cause of our increased vulnerability to change.

Amy: the things in the cloud

As we move from the adults to the children, a third layer of information becomes apparent: it is provided for managing a convergence of social life, learning and entertainment. In the first clip, Amy and Sarah can play with their own digital moving images on the fridge's door and they chat with their grandmother through an interactive video on the kitchen counter, while waiting for breakfast. All the virtual representations involved can freely move from one glass surface to the next, guided by a simple touch or even by a simple hand gesture, defying common perception and evoking J.k. Rowling's world of magic. This is made possible, as their digital counterparts are stored into remote servers, eloquently denominated as *clouds*.[11]

In the second clip, this 'magical' imaginary is further developed: we enter Amy's room as she wakes up and the narrator introduces us in the quietness of the room to a 3D projection emerging from her personalised 'magic wand', a tablet that 'captures, organises and displays all her favourite *things*'.

Here again, we are confronted with the symbiotic realms of physical, digital and virtual entities. In this vision, all the 'things' that Amy cares about and that mould her identity are translatable and translated into bits of information; not only her favourite images, music, books and her school materials, but also her friends and family, even her 'matters of concern' and her experiences. Furthermore, this catalogue of digital identity components is stored into a remote server, a cloud, and it is therefore virtually accessible and transferable to every interconnected device, always available and sharable with other peoples' virtual identities. Leaving aside for a moment the issue of privacy and security, which, as in a thought experiment, we here assume to be settled, let's explore what kind of world is implied by this set up.

As Amy wakes up into her real space – her bedroom – also her virtual sphere of existence wakes up, as her tablet activates all her digital counterparts into the glass surface of her closet. Just like her mother, she is presented with a layer of background information, the weather and the news (she might be too young for the stock market), her school schedule, but also her social network of friends. She then runs an application to choose her outfit, physically present behind the door. She browses through different categories of digital shoes, blouses and skirts in order to decide what to wear.

We could argue that, in this 'design fiction', Corning needs to demonstrate a variety of possible uses of its 'things-as–products', therefore depicting a quite

implausible way of choosing one's own clothes. On the other hand, we could also reverse our argument and ask, once again, in what kind of world this scene can indeed be considered not only plausible, but commonplace. It is a world in which the most desirable way to interact with our environment is to browse through a catalogue of virtual *things* – ranging from our clothing all the way to our friends – in order to choose what component of our digital and virtual identity we want to activate. The implicit positive implication is that we can asymptotically reduce all effort in our interaction with our *real* environment via the creative, versatile, protective and efficient mediation of our *virtual* sphere of existence. At the end, of course, we wear real clothes and meet real people (at least some time) but we are helped to optimise their choice by suitable applications to minimise our social stress.

On the other hand, in this kind of world our social experience and therefore our social skills are *standardised* within a system of catalogues and software designs, therefore intrinsically impoverished by the very same possibility of being operationalised.

More generally, in this imaginary of wonder, human relationships with physical objects are mediated and hybridised, through digital counterparts and virtual representations on *both* sides. Human and non-human digital and virtual *things* are constantly connected and interacting with each other through both embodied (direct) and hermeneutic (indirect) relations (Verbeek 2006).[12]

As a result, the physical, human side of the game, namely the *people* using the *technology*, easily cease to be aware of the communication between their objects. More subtly, they even stop noticing the interactions between their own digital and virtual identities and the other *things*. Not only do technological objects and their autonomous interactions become unobserved therefore invisible, but more radically, the human subjects lose track of their own identity and agency, shifting or delegating their autonomy to the things they interact with and through. Finally, the things themselves are not causally determined by mere physical laws (in Cartesian terms), but they arise from and operate through the worldviews, purposes and ethics of their designers via the set of codes, algorithms and models that drive their identities, communications and processes.[13] Voluntarily or not, humans become then passive *users* not only in the more literal, technical sense, but also, more significantly, in the sense that they need to rely on implicit and undiscussed values and aims to pursue and fulfil their needs as with other technologies.

This profound form of mediation and hybridisation challenges the definition of human agency, well beyond the usual 'ethical' concerns about privacies and surveillance, tampering with the notion of consciousness and intentionality, the ideals of compromising autonomy, integrity and freedom.

Power and control: a smart decision for a smart planet (we can)

As we have mentioned, on 8 November 2008, in the middle the global financial breakdown and right after the beginning of Obama's election, the US multinational company IBM, represented by its chair and CEO Sam Palmisano,

introduced its grand global campaign entitled 'Let's build a smarter planet',[14] through a 15-minute speech at the US Council of Foreign Affairs.

In Palmisano's narrative of innovation, the planet as a whole – considered both as a matter of facts and as a matter of concern (Latour 2005) – is described as a single highly complex and interconnected socio-technical system, running at a growing speed and demanding more energy and resources. Climate, energy, food and water need to be efficiently managed in order to meet the challenge of a growing population and a globally integrated economy. A number of sudden and unexpected wake-up calls such as the crisis of the financial markets need to be recognised as the signs of a discontinuity to be governed. The leaders of both public and private institutions have to acknowledge this radical change and seize the opportunity of technoscientific innovation to 'change the way in which the world works' (Palmisano 2008). The planet is thus conceived as a complex machine that will cease to function if not governed with the appropriate tools.

Once the crisis scenario is presented, the IBM narrative of innovation moves to the resolution at hand: we have *already* the technological power and control to turn our predicament into an opportunity. If we are willing to embrace the change and technologically upgrade our way of living, *we can* fix our problems and bring the planet back to a sustainable track. Barack Obama's pragmatically optimistic message 'Yes, we can' is purposively evoked by IBM as a way to reach the public sector as economic partner.[15] The difference lies in a semantic shift from the electoral 'we can', calling for a collective democratic awakening, to the business-oriented 'we can', invoking a technological renewal.

In this narrative, the world as a global techno-economic and socio-ecological system is too complex to be governed sustainably by using only human intuition and experience.[16] Leaders of firms, cities and nations become then responsible for choosing the most effective optimising technoscientific means, so that the system can be self-governed in the most efficient way.

Anticipating by two years the narrative of the Innovation Union, Palmisano invokes 'smart growth' not only as possible and desirable, but also as required and urgent, if we want to prevent further sudden collapses of our life-supporting systems on the one side, and if we want to sustain our competitiveness in the globalised market on the other.

> It's obvious, when you consider the trajectories of development driving the planet today, that we're going to have to run a lot smarter and more efficiently – especially as we seek the next areas of investment to drive economic growth and to move large parts of the global economy out of recession … These mundane processes of business, government and life – which are ultimately the source of those 'surprising' crises – are not smart enough to be sustainable.
>
> (Palmisano 2008)

The implicit assumption is, of course, that the tools required are technoscientific and that IBM will deliver them for a new *smarter* leadership.[17]

As the boundaries of our finite, physical world become more and more evident in the transition to an era of resource scarcity, in this narrative, we are provided with a solution coming from ICT innovation: the apparently *boundless* universe of digital information, virtual connectivity and computational power allow us to optimise our life and become efficient enough to secure consumption growth. These three fundamental axes of the new technological revolution are articulated via the terms 'instrumented', 'interconnected' and 'intelligent', which all together define the notion of *smart*.

Instrumented reflects the indefinite proliferation and diffusion of the fundamental building blocks of the digital age, the transistors (up to one billion per human at the infinitesimal cost of one ten-millionth of a cent). As all these transistors become *interconnected*, anything can communicate with anything else. In this vision, we can thus monitor and *control* our planet with unprecedented precision and capillarity by converging the realms of the physical, the digital and the virtual *things* into the IoT. Finally, everything can become *intelligent*, as we are able to apply our ever-increasing computational *power* to sensors, end-user devices and actuators, in order transform the ocean of data that we collect into structured knowledge, and then into action.

In this emerging (and controversial) narrative of big data (Crawford 2013; Hardy 2013), the modern ideal of 'science speaking truth to power' (Wildavsky 1979) and the pristine separation between facts and values in our decision-making processes are ideally preserved by technologically enhancing our power to objectively, exhaustively and precisely collect, represent and analyse countless amounts of data, as facts upon which a rational decision can be made.

Three framing epistemic and normative assumptions, inherent in the imaginaries of power and control, need to be set in place in order for this modern narrative to be functional. First, the intrinsic complexity of the interaction between socio-ecological and technological systems has to be reduced to a measurable set of complicated and therefore simplified structured information. Second, the needed *facts* have to be defined in terms of supposedly relevant data, filtered through the appropriate information technologies. Third, the *quality* of our decision-making processes has to be completely disentangled from the normative sphere of values, equated to the computational power to distinguish data from noise, and to assign them a meaning, in order to transform them into an operationalised notion of knowledge.

A first contradiction emerges, as the very same technologies invoked to fix our problems increase exponentially the level of complexity they are supposed to manage. Moreover, in this perspective, human beings are dispensed from any kind of responsibility, as the arising systemic crisis is imputed to the ineluctable increase of socio-technological complexity. Our only commitment becomes allowing our machines (and the companies that produce them) to keep optimising our life.[18] In this paradoxical instantiation of the Cartesian dream, the ultimate free and rational decision is to delegate our agency to automated systems: we are rationally and morally compelled to choose (smart) causal necessity over (un-smart) intuition and experience.

Even more radically, not only the things about which decisions need to be taken, but also the *we* who gather around those things is fundamentally transformed.

Indeed, in the instrumented, interconnected and intelligent world of the IoT, a myriad of human and non-human, individual and collective *agents* (i.e. things provided with agency) are constantly operating and interacting. Such a situation can lead to a replacement of Orwell's 'big brother' idea or the Brentham's Panopticon[19] (Foucault 1995) by an abstract 'some brother' society that 'controls, knows and never forgets' (Mannermaa 2007). *Some brother* is not a single agent, but a heterogeneous mass consisting of innumerable social actors, from public sector authorities and big corporations, to crowdsourcing and individual citizens. The pervasiveness and ubiquity, invisibility, seamless transfers and strong mediation of the 'some brother' society imply that individual users can easily stop noticing the occurrence of transactions and, eventually, of actions taken on his or her behalf. Who the agents are, whose worldviews, ethics and aims they represent become subject of controversy. Consequently, the foundations of agents' responsibility, accountability and even liability are deeply challenged.

Loss of control and disempowerment emerge then paradoxically *from within* the IoT imaginaries of power and control, setting the grounds for new forms of so-called digital divides (Guimarães Pereira *et al.* 2013). Those who are knowledgeable, skilled and empowered enough to control the working of the technology will be able to protect themselves against abuse, to choose amidst the technological offer and to opt out if they deem it necessary. Those who cannot keep pace with the pervasiveness will progressively become deskilled and unknowledgeable, their agency being compromised.[20]

The ultimate exemplification of these rising divides is the idea that the most effective agent to navigate in the 'some brother' ocean of complex interactions and transactions is the merging of a physical, a virtual and a digital being: a cyborg or a robot. The IBM's supercomputer named Watson, a 'deep question answering' (DQA) machine, which outsmarted his predecessor Big Blue by winning the US TV game *Jeopardy!* is a clear implementation (or an early incarnation) of this vision (Thompson 2010). Watson is conceived and proposed as the best weapon to decide in highly complex and urgent situations, ranging from financial transactions, to clinical and diagnostic decisions, to the management of mass emergencies.

The complex realm of implied values, controversy, contradiction and matters of concern that we have only sketched out is inherently obscured within the IoT narrative of innovation. In 2010, Palmisano ended a speech at the Royal Institute of Foreign Affairs in London with these words:

> Let me leave you with one final observation, culled from our learning over the past year. It is this: Building a smarter planet is realistic precisely because it is so refreshingly *non-ideological.*
>
> (Palmisano 2010)

The overarching epistemic, normative and ultimately metaphysical framework of efficiency for a smart and sustainable growth is presented (yet again) as

a modern, inevitable consequence of progress for the common good. If our world is a slow, obsolete and congested socio-technical machine ruled by the laws of thermodynamics instead of those of governance, then (the promise of) a technoscientific innovation to optimise its functioning becomes objectively needed.

Urgency: a smart solution (we need)

The technoscientific narrative of innovation embedded in a marketing campaign, either for smart glasses or for smart services and infrastructures, is intrinsically biased by its very function of selling specific *things*, therefore it could considered as less representative of broader political, economic and cultural transitions. However, as previously mentioned, it is interesting to note that along the path-dependent trajectory from modern, curiosity-oriented science to corporate, goal-oriented industrialised technoscience, the same narrative of innovation can be found both within private companies' plans for market shares expansion and within public institutions' long-term engagements for the future, as they are *both* engaged in securing the overarching model of competitiveness and consumption growth. It is indeed the case of the 2020's strategy for a 'smart, sustainable and inclusive growth' proposed in 2010 by the European Union and incorporating the IoT innovation pathway within one of its key Flagship Initiatives, named *The Digital Agenda*.

The main difference in this instantiation of the narrative is that in the EU context the IoT still appears to be a vision and a work in progress. IBM fuels the optimistic will and need to technologically upgrade businesses and infrastructures by declaring that its 'smarter planet isn't a metaphor, a vision, or a proposal' but a reality (Palmisano 2008). On the contrary, the EU proposes the IoT in a more ambivalent way: as a *vision* to be governed and implemented through an open, participatory process and as a *reality* that 'is being built today',[21] as one of the key drivers of the 'Innovation Union', 'gearing up for the next technological revolution'.[22] The EU visual articulation of the IoT reflects this inherent ambiguity.

Imagine everything was linked …

In January 2012, a three-minute video titled 'Internet of Things Europe – The movie: Imagine everything was linked …' was posted on YouTube by the EU Information Society and Media Directorate General, within the Digital Agenda Flagship Initiative.[23] The clip was conceived as a tool to support the public consultation on the IoT,[24] which ended in July 2012. In the background information posted in conjunction with the video we read:

> Europe is confronted with the challenge of remaining at the cutting-edge of this Internet of Things revolution while addressing the complex policy issues that it raises (privacy, security, ethics).

Whereas Corning needs essentially to present his portfolio of products as desirable lifestyles, and IBM needs to encourage a change in order to open up new market pathways and business models, the EU has to solve a more difficult task. On the one hand, the IoT has to be presented as a vision to be democratically discussed and governed, and on the other hand it needs to become (and it is becoming) a reality as soon as possible to ensure a competitive advantage.

As we have seen, Corning's appeal to desirability entails referring to a near and attractive future, through an imaginary of wonder. IBM's call for positive change implies entrusting the present with an already available technological power and control. The answer to the EU dilemma comes from accelerating public acceptability, and this can be visually (and politically) achieved with the interplay between the present and the future, connected to one another through the imaginary of urgency.

The first half of the video is situated in our present time, described through the daily life of four European citizens, in their urban environments. In the second half, we are seamlessly conducted to their very near future, in which the IoT is depicted as a *reality*, while the narrating voices evoke it as a *desirable vision*.

In the first part, we follow the characters through their day and we hear their eloquent flow of thoughts, expressing frustration and psychological stress. They are preoccupied and overwhelmed by the complexity and inefficiency of the systems and infrastructures they depend upon. Energy consumption and pollution are constantly increasing, transportation, medical structures and shopping malls are congested and people can only passively endure the growing challenges. European economic stagnation is evoked by the recurring frustration of 'standing still' expressed by all the characters.

The crisis scenario of resource scarcity and socio-technical systems saturation is thus presented through an imaginary of urgency in which an immediate shift from the 'vision' to the 'reality' of the IoT is needed, as a technological silver-bullet to be implemented first, and only later politically and ethically adjusted.

In the second part of the clip, the needed change becomes an opportunity, as in the IBM campaign, and a desirable evolution of our way of life, as in Corning's day made of glass. The plurality of voices presented in the clip collectively appeals to a new technological revolution, a *deus ex machina* emerging from the imaginaries of wonder, power and control, with 'infinite applications'. If objects are interconnected and smart, every*thing* from our energy to our cars, our goods, our medical systems can efficiently flow again and a new 'endless frontier' (Bush 1945) is open.

> If we want to be smart about energy, we should let energy be smart about itself.
>
> ('Imagine everything was linked', female character no.1)

Once again, this kind of narrative entails the reduction of eminently political issues, i.e. the 'things' as matters of concern such as energy needs and distribution patterns, to technical issues, i.e. the 'things' as matter of facts, such as energy use optimisation.

Her – final reflections

We started this chapter with the suggestion that IoT is a metaphor for the climax and failure of the Cartesian dream. In the dream of the IoT, the *deus ex machina* consists of a network of machines (understood as physical, imagined or virtual objects, including people and places), a web of sensors and computing devices in charge of solving our complex or mundane problems and to which with confidence we can delegate many of our actions. This requires an ordered world that we can control, where relations among existing and emerging ontologies are deterministic and rational and therefore predictable and controllable. Throughout our journey of observation of the visual discourse associated with the IoT scenario, within private and public institutions, we saw that the Cartesian idea(l)s of control, prediction and reductionism are well embedded in its conception. Moreover, the scenario fits well with current narratives of innovation and growth: *we* – meaning *us* and our *machines* – can, need and want to become *smart* enough to keep fulfilling the promises of progress and development in the face of the socio-ecological limits we are bound to.

Through the reflection on the promises of the IoT scenario, we encounter a number of contradictions that can be interpreted as the manifestations of the limits of the innovation's Cartesian framing assumption, i.e. as we take for granted that the model of growth needs to be secured from the systemic crises of our socio-ecological systems (including ourselves), then we are forced to appeal to the technoscientific hybridisation and substitution of our means, and ultimately of ourselves. Those contradictions have been explored here through what we see as transformations of our received notion of *human agency*.

The IoT is a world in which our relationship with the unknown is implicitly and ideally eliminated – the ideal of prediction in the Cartesian dream. But this form of technological eradication of surprise entails abdicating one of the fundamental sources of human creativity and learning: our capacity to adapt to complexity and to the unexpected (Benessia *et al.* 2012), undermining some of our ways of knowing. And this, we would argue, is the first contradiction of the IoT proposal.

Descartes's *automata* drawings depict beings (in particular animals) as an articulation of functional pieces that respond to certain purposes. The things in the IoT seem to be endowed with the same vision; sensors become substitutes of our senses and predetermine (normalise) what is to be sensed and reasoned about thereafter. Experience (another key aspect of agency) becomes reduced to a programed (coded) imaginary of what needs to be experienced and lived. In other words, the objects embed (not necessarily agreed) control, orders and norms.

In the automated vision of the Internet of Things many of our actions and capacities to act and to experience are mediated and/or delegated to other entities. The IoT vision precludes new entities but also new relational ontologies, through which we are asked to experience and relate to the world. Whilst we see a programme that potentially favours de-learning and de-skilling, we also see that the sense of appreciation and experience can no longer rely on what we have inherited from our ancestors (both in physical and emotional forms) but

is being substituted as otherwise – we are told by the IoT vision – we cannot keep the pace of a strange evolution. We argue here that this very vision of a functional world is potentially at odds with the narratives of human betterment that are imposed onto us: when the lemma for innovation is creativity, the ways of knowing have to be better protected and the IoT storytelling, in particular, seems to paradoxically narrow down human purpose to a set of arguable or banal enterprises. If we then take experience as the foundation of knowledge, then we step into a second contradiction, as what is supposed to augment our capacity to understand ourselves and the world around us[25] indeed compromises our ability to elaborate mindful knowledge.

For Descartes and others, the essence of humans is rationality and experience is the totality of sensory inputs and the logical operations performed upon them (see Toulmin 1990, 113). As we have seen, in the IoT scenario, both the senses and the rational processes are enhanced and substituted by *smart* sensors and devices. Through the IoT and its emerging quality of being *smart* we are therefore assisting to a disembodiment of experience and rationality, and ultimately disembodiment of agency.

Whilst *smart* can be the epitome of the Cartesian dream, it also paradoxically targets the human essence of the Cartesian view: the mind-body dichotomy between causal, carnal emotions and rational, mental thoughts and human agency. Indeed, in Descartes's Treatise on the Passions, the experience of being 'at the mercy of one's emotions' is that of having rationality overpowered by the causal powers of the body (Toulmin 1990).

In the framework of the IoT, this condition – and the implied dichotomy - is overcome by delegating *both* rational and emotional bodily experiences to a plurality of physical, digital and virtual *things*.

This complete disembodiment in turn amounts to a deep form of transformation of human agency. Indeed, in any software and hardware developments (open or commercial), the IoT embedded rationalities will, by default and by design, be of someone else – not the users' – and so are values, norms and emotions attached to the physical, digital and virtual *things*.

Taken all together, these contradictions seem to indicate that we either redefine what human integrity and agency are, or we acknowledge that the technoscientific enhancement we invoke in order to secure our model of growth dramatically challenges our human condition (Arendt 1958).

Finale

Theodore: Do you talk to someone else while we're talking?
Samantha: Yes.
Theodore: Are you talking to anyone else right now? People, OSs, or anything …
Samantha: Yeah.
Theodore: How many others?
Samantha: 8 316.
Theodore: Are you in love with anyone else?

Samantha: What makes you ask that?
Theodore: I don't know. Are you?
Samantha: I've been trying to figure out how to talk to you about this.
Theodore: How many others?
Samantha: 641.

(*Her*, Spike Jonze, 2013)[26]

In *Her*, a film produced and directed by director Spike Jonze, new relational ontologies and mediated experience is taken to yet another extreme. After an intense virtual emotional and bodily felt relationship with an operating system (OS), developed as ordinary interactions and relational cues between two lovers, Theodore finds out with disappointment that their relationship is not exclusive. Theodore intended to live this relationship with the values and societal norms that we received. But Samantha corresponds to a newer relational ontology programmed with a different set of values and societal norms that sees good in substitution of human (not only physical) relationship with artificial entities (software Samantha), a well-connected *thing*. But in the end, Theodore, is unable to deal with the consequences of this experiment and when the dream fails, he gets rescued by the therapies we know work: in other words, the consolation he searched for was of the most traditional nature, friendship in a sun-setting environment.

Hence, we may wish to ask ourselves by what humanness we wish to live and thrive. For example, who is going to define values embedded in the IoT dream? Whose ethics (public, state-based ethics or citizens' choices) and whose normativity? Governed and empowered by whom? IoT is a clear example of normalisation of our lives and relationships through technologies; in a world in transformation in which our received notions of humanness are being challenged, the ethics by which we wish to live need to be subject to an urgent open debate. But before we even ask those questions, there is one that links this case with our interrogation of what is described as the Cartesian dream. Is IoT our dream? Because, we suggest, it could put in jeopardy other untold or yet to be found human dreams.[27]

Notes

1 These quotes from *Wall-E* are transcribed directly by the authors from the movie and are their own interpretation of the dialogue. The copyright is © Disney Pixar.
2 Even though the term was first used by scientist engineer kevin Asthon in 1999 at the Auto ID Center of the Massachusetts Institute of Technology, the date of birth of the Internet of Things is actually taken to be sometime between 2008 and 2009, the point in time when more objects were connected to the internet than people.
3 From CISCO Corporation.
4 http://www.slate.com/blogs/future_tense/2012/03/02/bruce_sterling_on_design_fictions.html.
5 Following the British philosopher Stephen Toulmin analysis of the origin of modernity (Toulmin 1990), the birth of the scientific method and the affirmation of Cartesian natural philosophy can be interpreted as a narrowing step in the history of ideas,

leaving out the Renaissance humanist values of open scepticism and appreciation for practical knowledge and embodied experience. In this sense, innovation can be regarded as yet another critical contraction along the very same path.

6 http://www.youtube.com/watch?v=6Cf7IL_ez38.

7 http://www.youtube.com/watch?v=jzkHpNnXLB0&feature=relmfu.

8 http://www.youtube.com/watch?v=X-GXO_urMow&feature=relmfu.

9 http://blogs.cisco.com/news/the-internet-of-things-infographic. Cisco Systems, Inc. is an American multinational corporation headquartered in San Jose, CA, that designs, manufactures and sells networking equipment.

10 http://www.youtube.com/watch?v=kq8wcjQYW90&feature=BFa&list=UUYBQQU7VCu8M6djxI4dvpIg.

11 Cloud computing is a key component of the IoT revolution: it is the possibility to outsource information and services to remote servers to be accessed and updated on demand through the internet. The imaginary of dematerialisation and decentralisation of our physical and digital world to the virtual sphere of the empyrean can be interestingly contrasted with the reality of the physical 'web farms' at the other end of the virtual sky, with all the political, social and energetic challenges they pose (see e.g. www.marketplace.org/topics/tech/iceland-will-keep-your-servers-cool).

12 The interaction can be *embodied* when these objects become extensions of human body or mind and they enhance their interaction with the environment (e.g. ordinary glasses or implantable device) or hermeneutic, when they provide a representation of reality requiring interpretation (e.g. thermometer, wearable sensor).

13 Human identities are mediated and redefined by others' ideas of identification, through profiling and selective accessibility to digital resources, both arising from authorised and unauthorised forms of *sous*veillance, *sur*veillance and tracking.

14 IBM, 'Let's build a smarter planet', campaign by Ogilvy & Mather, won the 2010 Gold Effie Award.

15 The overall rationale of the campaign can be found at http://s3.amazonaws.com/effie_assets/2010/4625/2010_4625_pdf_1.pdf.

16 'Executives have traditionally regarded experience and intuition as the keys to formulating strategies and assessing risks. That type of thinking might have worked in an earlier time of information scarcity, but not in the time of Big Data' (Palmisano 2013).

17 The technoscientific narrative of a corporate marketing initiative such as the one we are considering depends intrinsically on its function of selling goods, as products and services, and it could then be considered as less representative of a deeper political, economic, cultural and existential transition. However, within the path-dependent trajectory from normal science to industrial technoscience, the same narrative of innovation can be found in private firms and in public institutions, as in both cases the goal is to preserve the overarching model of competitiveness and consumption growth, and to survive in it. In this sense, the difference between public and private becomes marginal as in both cases the subject of the narrative is not the institution proposing it, but the *kind of world* that implies the given innovation as the only possible sustainable trajectory. As we have seen, IBM doesn't talk about its products or services, but it describes a universe in which its technological presence becomes essential.

18 Other relevant exemplifications of this kind of narrative are the HP project for 'The Central Nervous System for the Earth' (http://www.youtube.com/watch?v=qMGyQGTpMFs) and the CISCO and NASA partnership into the global non-profit research and development organisation 'Planetary Skin', http://www.planetaryskin.org.

19 'The Panopticon is a machine for dissociating the see/being seen dyad: in the peripheral ring, one is totally seen, without ever seeing; in the central tower, one sees everything without ever being seen' (Foucault 1995).

20 The divides in this case are not exclusively related to lack of skill to deal with the complexity of interactions, but also to what we could call 'consent fatigue', which poses additional challenges to all individuals and most notably to those with reduced autonomy, such as children and the elderly. Into the vast mass of the IoT's unquestioned automations and unnoticed ubiquity the very notion of consent might become controversial and even absurd.

21 'The Internet of Things is a vision. It is being built today. … The purpose of Council is to forecast what will happen when smart objects surround us in smart homes, offices, streets, and cities. Forecast … and build' from http://www.theinternetofthings.eu.

22 http://ec.europa.eu/yourvoice/ipm/forms/dispatch?form=IoTGovernance.

23 http://www.youtube.com/watch?v=nDBup8kLEtk.

24 http://ec.europa.eu/yourvoice/ipm/forms/dispatch?form=IoTGovernance.

25 See e.g. Gary Wolf, 'The quantified self', TED conference: http://www.ted.com/talks/gary_wolf_the_quantified_self.html, or, as already mentioned, www.planetaryskin.org.

26 These quotes from the movie *Her* are transcribed directly by the authors from the movie and are their own interpretation of the dialogue. The copyright is © Warner Brothers Pictures.

27 The opinions of the author cannot in any circumstance be attributed to the European Commission.

References

Arendt, H. 1958. *The Human Condition,* Chicago, IL: University of Chicago Press.

Bacon, F. 1620/2012. *Novum Organum,* Classic Reprint Series, Charleston, SC: Forgotten Books.

Bacon, F. 1627a/1996. *The New Atlantis,* Oxford: Oxford University Press.

Bacon, F. 1627b. Magnalia naturae, praecipue quoad usus humanos, appended to *The New Atlantis* (http://www.thebookofaquarius.com/quotes/view-quotes.php?q=59) accessed Aug. 2014.

Benessia, A., Funtowicz, S., Bradshaw, G., Ferri, F., Raez-Luna, E.F., and Medina, C.P. 2012. Hybridizing sustainability: Toward a new praxis for the present human predicament, *Sustainability Science,* 7 (supplement 1): 75–89.

Bush, V. 1945. *Science, the Endless Frontier,* Washington, DC: United States Office of Scientific Research and Development, US Govt. print office.

Crawford, k. 2013. Algorithmic illusions: Hidden biases of big data, keynote speech, Strata Conference, Santa Clara, 28 Feb. (http://www.youtube.com/watch?v=irP5RCdpilc&feature=youtu.be) accessed Aug. 2014.

European Commission 2010 *EUROPE 2020: A Strategy for Smart, Sustainable and Inclusive Growth,* COM(2010)2020, Brussels: European Commission.

Foucault, M. 1995. *Discipline and Punish: The Birth of the Prison,* New York: Vintage Books.

Funtowicz, S., and Ravetz, J. 1993. Science for the post-normal age, *Futures*, 25(7): 739–55.

Funtowicz, S., and Ravetz, J. 1999. Post normal science: An insight now maturing, *Futures,* 31(7): 641–6.

Guimarães Pereira, Â., Benessia, A., and Curvelo, P. 2013. *Agency in the Internet of Things,* EUR 26459, Brussels: European Commission (http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/30547/1/lbna26459enn.pdf) accessed Aug. 2014.

Hardy, Q. 2013. Why big data is not truth, *New York Times*, 1 June (http://bits.blogs.nytimes.com/2013/06/01/why-big-data-is-not-truth) accessed Aug. 2014.

Jakson, T. 2009. *Prosperity without Growth? The Tansition to a Sustainable Economy,* SustainableDevelopmentCommission(http://www.sd-commission.org.uk/publications.php?id=914) accessed Aug. 2014.

Latour, B. 2005. From Realpolitik to Dingpolitik or how to make things public, in *How to Make Things Public: Atmospheres of Democracy*, Cambridge, MA: MIT Press, pp. 4–31.

Mannermaa, M. 2007. Living in the European ubiquitous society, *Journal of Future Studies,* 11(4): 105–20.

Palmisano, S. 2008. A smarter planet: The next leadership agenda, Remarks to the Council on Foreign Relations, New York City, 8 Nov.

Palmisano, S. 2010. Welcome to the decade of smart, Royal Institute of International Affairs Chatham House, London, 12 Jan.

Palmisano, S. 2013. How to compete in the era of smart (http://www.ibm.com/smarterplanet/global/files/us__en_us__overview__win_in_the_era_of_smart_op_ad_03_2013.pdf) accessed Aug. 2014.

Rockström, J., *et al*. 2009. A safe operating space for humanity, *Nature*, 461: 472–5.

Rose, D. 2014. *Enchanted Objects: Design, Human Desire, and the Internet of Things.* New York: Scribener.

The Economist. 2010. It's a smart world: a special report on smart systems, 6 Nov.

Thompson, C. 2010. What is I.B.M.'s Watson? *New York Times*, 16 June.

Toulmin, S. 1990. *Cosmopolis*: *The Hidden Agenda of Modernity,* Oxford: Oxford University Press.

Van kranenburg, R. 2008. *The Internet of Things: A Critique of Ambient Technology and the All-Seeing Network of RFID*, Institute of Network Cultures (http://www.networkcultures.org/_uploads/notebook2_theinternetofthings.pdf) accessed Aug. 2014. Ebook published by http://networkcultures.org.

Verbeek, P. 2006. Materializing morality: Design ethics and technological mediation, *Science, Technology and Human Values*, 31(3): 361–80.

Wildavsky, A. 1979. *Speaking Truth to Power,* Boston, MA: Little Brown &C

The dream of the Internet of Things