Claudio Scardovi

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Big Data, Artificial Intelligence and the Rise of Green, "Cy-phy" Cities

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ISBN 978-3-030-68437-2 ISBN 978-3-030-68438-9 (eBook)
https://doi.org/10.1007/978-3-030-68438-9

This Springer imprint is published by the registered company Springer Nature Switzerland AG.
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Foreword

Cities are the subject of several sci-fi novels and movies. Usually artists imagine catastrophic scenarios for urban life; just think of the chiaroscuro description in the cult movie *Blade Runner* or the submerged Manhattan in Spielberg (and Kubrick) *Artificial Intelligence*. Alternatively, novels like Clifford Simak's *City* or Arthur Clarke's *The City and the Stars* explore futures like the ones mentioned in the book with "human-kind preservation plan in caves underground, or as a long-term project to colonize Mars." It is therefore very welcome to read a structured reflection on possible futures of cities, where technology helps sustainability, and, borrowing from the book's terminology, people evolve to cyborgs but remain free to determine their own destiny.

One of the many highlights of the book is thinking about sustainability in general, a very useful enterprise. Google Books Ngram Viewer shows a constant increase between 1950 and today in the use of the acronym ESG (environment, social, governance) and an even larger growth of the term "sustainability" that, as of today, is 35 times more popular than ESG. It has become an economic narrative in the sense advocated by Yale's Nobel Prize winner Bob Shiller. But what is exactly sustainability? We are not quite sure. Claudio, however, provides his own definition: "a sustainable city is one that is not just able to survive and protect the wealth and wellbeing of its citizens through extreme events, such as pandemics, wars and extreme climate change scenarios—but also one that is democratic and with a good form of government, free and meritocratic but also socially sensitive and compassionate."

To many people, you can call it a sustainable city or you can call it Heaven. But how do we find the Stairway to Heaven? While Led Zeppelin is not useful here, the book offers several ideas, revolving, in my opinion, on two fundamental themes: data (including new computational techniques, enlarged data storage capabilities, new ways to monitor real life and turn it into a Matrix like history) and institutions (including better ways to manage companies and governments, smart rules and regulations to limit negative and to foster positive externalities, effective schools to educate people of all ages to be proficient at wealth and technology management,

financial products that extend the list of shareholders of assets and cities themselves). Claudio Scardovi helps the reader in thinking about current and future developments in data and institutions, and in imagining what lies ahead. In its futuristic style and in its effort at inviting us to think of the next 10–20 years, his work reminds me of great books that I have enjoyed reading and have shaped my view of reality, like Shiller's *Irrational Exuberance* and Graeber's *Debt*.

Sustainable Cities is for everyone. Economics and finance students may find a way to apply their technical knowledge to a rigorous analysis of current trends. Novel lovers may find a fascinating writing style that talks about the way we live and produce. However, I would like to see managers, at the juncture between public and private organizations, read and use the book. Civil servants may find a new way to understand the relevance of their job and imagine ways to leverage their skills and jobs. Private managers may put their profit creation duties in perspective and better see the social purpose of what they do in an (increasing) interconnected reality. And I would like to see politicians and city administrators reflect on the goals they should set to the communities that serve. Most of all, I would like to see investors, especially institutional investors, read the book, rethink their way of defining risk and return, and view differently the final implications of their investments.

As the book suggests, big crises are big opportunities and require totally new frameworks. Important social arrangements that characterize our societies today, from the social security system to the governance of the international economy, were born out of the need to invent and change. But inertia is everywhere. Humans tend to rely on their comfort zone. Our brain is not made to spontaneously search for new solutions. In mathematics, we have used for ages local optimization rather than global optimization techniques. The book is an invitation to think of our current way of living and to reflect upon the deficiencies that COVID-19 has highlighted, and to act. It is quite possible that the level of challenges facing us requires totally new arrangements, for example in the coordination between public and private actors, which may well have to go beyond their current hide-and-seek mood to embrace joint efforts to solve joint problems.

The AC world requires a thorough intellectual and institutional framework and new benchmarks to judge what we do. In my view, thinking about *Sustainable Cities* requires how to turn cities from the current state of quasi-bankruptcy to lively sources of economic profit (not a bad word after all) in respect of all stakeholders, including our sons and their sons. Profit producing cities may be sustainable, but a loss-making city is, by definition, unsustainable. Competition forces every city to become an efficient data generation machine. We need new collective choices and private companies that exploit new data analysis to create valuable institutions and turn favelas into tech clusters and crowding into density. To sustain the span of issues, the study of mathematics and computer science must be completed by the study of ethics and psychology. The book contains phenomenal insights on how to do that.

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1.1 Towards "Other Normals"

In the words of the former President of the United States Barak Obama, no good crisis should be laid to waste as an opportunity for change. Should we judge present times on the basis of the deepness and extent of crisis we are all now living in, it would look like we do have now a great opportunity for change—in the way we work, live, across most geopolitical blocks and in the context of urban areas and global cities that are now looking like as "too crowded" to ensure "social distancing," and too interconnected, across geographical zones and value chains, to easily make up for any potential supply chain disruption led, for example, by the force of nature, a global war, or a simple pandemic. Since the start of the planning and writing of this book, lots of things have changed, for the author and for the world we all live in—with expected falls in the GDP of the European Countries and of the United States expected in the high double digit, and negative growth at global level as well, with a deep recession and with an uncertain shape and behavior (as "V," "U," or "L") to follow. COVID-19-led health and humanitarian crisis has in fact brutally reminded us of the extreme fragility of our world—that we had been taking for granted with its secular trends of international of commerce and finance, for its interconnectedness and specialization based on free-trade principles and as a "just in time," lean-managed with no slack attached, super-efficient and integrated global market for goods and services. A simple virus has shaken all that and accelerated the recognition of our, far from assured, sustainability, as humankind led set of civilizations. Pandemic has been taking us quite unexpectedly and wholly unprepared and is forcing entire countries and their main cities to rethink their future ways in likely radical different ways.

After the global financial crisis of 2008 (which was first financial and then economic), many had been talking of a "new normal" that we should have been aiming to achieve, born out of a re-basement of the (mostly) financial dimension of main global markets towards more concrete "real economy," with the emergency of

C. Scardovi, *Sustainable Cities*, https://doi.org/10.1007/978-3-030-68438-9_1

digital technology as the driving force of wealth creation and geopolitical supremacy. A bit more than 10 years later, well-known strategic consultants are now talking of a "next normal" that will redefine, 10 years later, which kind of next steady state we could settle in—as if life could flow linearly, with some crisis hiccups from time to time. In truth, in our view, a more proper naming to consider for this could be "other normal" or actually "other normals"—if we assume that what lies ahead is much less linear that we think or hope and that sustainability, survival even, is also far from being assured. Because there is a fair chance that many other "evolutionary crisis" will need to be faced by humanity in the near future, including pandemics, climate change, cold wars, and other events, we may not even be thinking of as yet. As stated by Mark Carney (The world after COVID-19 2020), the former Governor of the Central Bank of Canada and of the UK one, the very notion of value will change in the post COVID-19 world and not just for the implosion of stock markets—as there is a possibility that the gulf between what markets value and what people value will close. In the midst of the social and economic disgrace brought about by the pandemic, real opportunities are also revealed by this—in teleworking, for example, and e-health and distance learning.

According to Carney, a progressive (and risky?) acceleration is also taking shape across developed and developing economies: in the switch from moving atoms to shifting bits specifically, as digital and local lives expand and physical and global ones contract. In our other, post pandemic normal(s) ahead of us, everything will change, with resilience (or what Nassim Nicholas Taleb calls "anti-fragility") increasing its relevance over efficiency and with greater attention paid to managing tail risks (those of an existential nature specifically) that typically involve the entire world, are more difficult to predict by traditional risk management, and can be typically addressed only on a multilateral basis. Given such a critical and complex context, it may look a daunting task to discuss how people, companies, and institutions could react and raise this challenge of change. Or it could even appear as a frivolous task the discussion on how cities or companies should evolve to stay cool and relevant and become even stronger and successful. In fact, far from it, these many battles ahead of us—from pandemics to climate change, to geopolitical tensions and cold wars—will need to be fought in the urban areas and city of relevance and by the companies and institutions that have, in the citizens of reference, their anthropological foundation and object of ultimate ontological quest.

1.2 Second Sleep

All civilizations consider themselves invulnerable, writes Robert Harris. History warns us that none is—as the recent pandemic has reminded us all too well. Apparently, all innovation looks irreversible and mostly for the good of humanity, we could add. We may have start feeling that is not always the case. The street towards success, through technological disruptions as most straightforward shortcut—has often shown to be paved with bad intentions and even more awful results.

In Robert Harris' most recent novel, *The Second Sleep* (The second sleep 2019), humanity is waking up again, after an unspecified apocalypse that has hit humankind. It's 1468, and a young priest arrives in a remote village in the British countryside, with the land around that is strewn with ancient artifacts—coins, fragments of glass and plastics (certainly a banal error of the history scholar and author of bestselling novels). In fact, as the thriller unfolds, other artifacts are found, including several strangely shaped rectangular prothesis with a visible screen on one side, the size of a hand, with a half-bitten apple printed on that, that ancients used to consult almost as single source of truth. In a middle-age scenario where humanity seems to have lost event, the faintest memory of the glorious technology it was once able to master, even the observation of electricity, is compared to the work of evil and something that, if pursued, would bring back the advent of the beast and the apocalypse itself. Plastic remains are just odd testimonies of the once upon a time power that men (and women) were able to exert on nature itself—before the un-linear beginning of the end started taking place, in an uncontrollable way. Whether the apocalypse happened because of a global cyberattack (able to block and destroy anything digital), or for all-in nuclear warfare, or for the now more fashionable scenario of total destruction brought about by climate change or by an antibiotic-resistant pandemic virus (coronavirus or else), it is not known in the story—and it does not really matter anyway. The main point of the thriller is about the fragility and inherent unsustainability of the system we have built.

As we still strive to exit the COVID-19 emergency, and the following economic and financial conundrum that will put our countries, developed and underdeveloped, under the huge strains of uncontrolled public debt, unsustainable equity wipe outs, and extended unemployment and poverty, we have ventured, in the previous paragraph and following the hint of Mark Carney, that digital could save us from most of this. We could all become more digital (and local) and less physical (and global) to increase our resilience to this crisis or to the next ones. In fact, we believe this could (luckily) be just a half-truth. Digital and local resilience will certainly become more relevant and shift a bit of lights away from atoms towards bites. However, even as we restart to operate in an unlocked-down environment, we will need to feed things like digital surveillance and e-health check monitoring with the flow of offline information and then feedback intelligence to the physical world, to support its safety and improved resilience. In turn, as the pandemic crisis will stabilize, we could find us in a new world (another normal) where the digital and physical dimensions enmesh and are closely intertwined and—also thanks to that—where the local and global dimension will find a new way of coexisting, synergically and sustainably. This could happen as we could become abler, for example, to reinterpret meta-needs such as "mobility" (once the exclusive realm of categories and industry labels such as "transportation" or "automotive") as a mix of the cyber and physical ones (as we leverage augmented reality and 3D videoconferencing, but also "bullet-trains" travelling in air-vacuumed tunnels) or meta-tools such as "supply chain" (once the focus of global pooling and specialization, lean inventories, and just-in-time production-to-distribution approaches) as a mix of cyber and physical as well (as we adopt 3D printing, with global specialization managed as digital).

The search for another (or other) sustainable normals could then require new, creative ways to mix digital and physical bites and atoms and potentially lead to a different ontological interpretation of most of our business and leisure activities—more based on and driven by a stakeholder-based model of capitalism and development—something Michael Sanders has dubbed as the shift from a market economy to a market society, where everything gest value, in a fair, transparent, and efficient way and hence requiring some kind of market for that (a market for valuing data and information, e.g., as we will later discuss). This ontological challenge, and the very concept of evolving towards a more intertwined and well-balanced development of our cyber-physical dimensions, may appear very vague and ambitious—a good topic for philosophical discussion but not really top priority for policy makers and business managers. In fact, the definition and execution of this challenge goes back to the very down-to-hearth and mundane settings of cities and companies. Whatever other normal we will be able to achieve, it will need to be designed, fought, and realized at the level of the cities—starting from the main ones that are hosting over half of the global population. And, on top of the public institutions' concerns and active promotion of these ideas, everything will likely happen (or not happen) because of the behavior of private companies that are called to redevelop cities, across their digital and physical dimensions, reinterpreting most old categories (e.g., from transportation to mobility, from global supply chains to global-local ones). Not only the relative competitiveness of cities and companies will be determined by this, but also the very sustainability of our social and economic environments will depend on this challenge.

1.3 If Smart Is Not Enough

Cities, as we discussed in our previous work (Finance and real-estate wealth-being 2020), were already becoming the center of our ways to approach, manage, and realize our transformation towards new ways of working and living that were able to maximize our overall wealth and well-being. These was happening, we argued, because of large programs of urban regeneration, "smart city" technological investments, and the planning of unique and attractive propositions for cities and neighborhood that were being rethought around new multiple centralities, with built-in local and global resilience, cyber and physical diffusion. This challenge is still valid, but with a pace of change that need to rapidly accelerate if we want to be able to adapt and survive to the coronavirus pandemic, climate change, the new cold wars, and else. For this, however, being "smartly digital" may just not be enough. Everything is, in fact, becoming digital and driven by data captured when surfing online. Hyper-connectivity and 5G technologies are able to reduce our digital data latency periods to close to zero. And the development of quantum computing offers almost limitless problem crunching capabilities. Also, the evolution of artificial intelligence self and deep learning techniques approaching a GAI (general artificial intelligence) are all indications of the many disruptions to come—with a faster and

faster frequency: disjointly from economic cycles, agnostic vis-à-vis geopolitical areas, indifferent with respect to prevailing economic systems. All these disruptions will bring more and more radical dislocations across markets and societies with further polarization between winners and losers, transformed and left behind—ultimately impacting in a very negative way on the sustainability of our civilization. In fact, as it all becomes more and more digital, hyperconnected, super-computable, and intelligence-augmented, it also becomes more and more fragile, prone to devastating disequilibria, and subject to the nonlinear unfolding of terminal events driven by potential facts such as a cyber hack, a human-in-the-loop error, and uncontrolled and malevolent GAI or a simple virus breaking out of the bottle.

All main cities in the world, as Harris reminds us in his novel, are just six meals away from starvation, as all their food chain is fully integrated but geographically dispersed, digitally interconnected and managed with money as a mean of exchange—most of this just digitally based: something that could disappear entirely and become irretrievable and useless, should, for example, electric energy disappear. A simple black out would disrupt the food chain and lead to chaos and unrest, city wars, and migrations back to rural areas. It could disrupt the very fabric of society and harm the civilization developed and matured so far. With it, most of our technology and knowledge of all kind (now mostly digital based, with little remaining printed on paper) would also disappear, forever. In a society where high-tech artifacts are becoming omnipresent and quasi-indispensable, and where individuals have become addicted to the use of their handheld, screen-based prothesis (mobile pads and phones that they consult almost as the single point of truth), everything is becoming "smart." In fact, our way of working and living is becoming so "smartphone" centric (where the smartphone also acts as hub of connectivity and data gathering for many other devices and wearables—from PC to watches, from glasses to bracelets) that we all live, or pretend to live, smart lives. We are all smart persons that work in a smart way and in smart offices, in smart buildings and (of course) in cities that have the aspiration to become "smart cities"—something important and worth paying for. Smart cities are based on digital technologies that fully embrace a new paradigm seeking to capture information in a big data platform (BDP) in a granular way and across their territory, developing analysis on this to provide a number of basic utility services—from mobility to safety, public and private, to residents and tourists, for companies and the administrator of the public good. It all then becomes "smart": smart living and smart mobility, smart safety, and smart public services (reading from the leaflet of one of this smart city programs being pitch by consultants and TMT companies, but also by big digital ones—the likes of Google and Microsoft—not to mention bank real estate developers).

Smart city ambitions are at the heart of large urban regeneration programs and new developments and have a prominent place in the strategic plan of global metropolis like Singapore and Seoul, Toronto and New York, Paris and London, and Berlin and Milan, but also in smaller ones, such as Bergamo or Firenze, to name a few in Italy. Having a "smart city" approach is then becoming a key (or the main?) component of the value proposition of a "battle among cities" that is developing more and more across borders and with the aim to become one of the most attractive

places to stay. This search for a total "wealth-being" attractiveness (where the living well proposition is matching the living in a place great for work and business opportunity) is driving most of this, as in an increasingly (digitally and physically) interconnected world, the place that—for its very specific and unique value proposition—becomes the most attractive and sought after will tend to "win it all." The best capital markets city, or sky resort one, the best luxury and fashion metropolis, or senior living one—they will increasingly polarize the capture of attention and, hence, time, interest, and money. This "wealth-being-fullness" will then be reflected in the price of the land and of real estate, and, as real estate as an asset class is making up more than the sum of equities, bonds, and gold at global level, it will reflect in the overall financial wealth of the people and institutions owning this. This financial wealth effect will then attract new investments and drive greater and greater consumption cycles, hence increasing, if not the quality of life, the perceived "good life" of the people living there. A most extended definition of "smart city" could be based on its ubiquitous, high-volume information flows that are continuously happening at the intersection of habitation and computing, and, according to Carlo Ratti (The city of tomorrow 2018), it is dominated by three key elements. The first, "instrumentation," refers to the omnipresent array of sensors measuring environment conditions and movements. The second, "analytics," is connected to its algorithms that use massive amounts of urban data to find patterns and formulate predictions. And, third, it relates to its "actuators," e.g., its digitally controlled devices that can respond to data in real time and impact the physical space—anything from occupancy-sensing architecture to resource-saving utilities, including "air conditioning balloons" that can follow us as we walk in our flat, to warm (or refresh) us instead of the generic space we are living in. However, most "smart city" plans are still based on the digital dimension only and on evolution of basic utilities—such as transportation conditions and energy consumption, safety surveillance, and the access to public services. They involve mostly the digital dimension (in terms of data captured and services offered) and, more importantly, address the "how could the city work better?" question more than "how the citizen could live better in the city and enjoy a greater wellbeing?". They try to optimize the way basic utilities perform, more than supporting targeted lifestyle and addressing physical and spiritual needs that could be interpreted from the analysis of people's "true" behavior—not just the one in the online world but also in the real life, as they work and enjoy life in the city.

1.4 From Smart to Cyber Cities

We all rely on digital technologies and on the ubiquitous connectivity that allows us to spend more and more time online—this trend has become stronger and stronger in the last few decades and will develop further with the advent of "smart cities," made up by smart buildings and smart flats, with smart self-driving cars and a host of other smart-wearable objects—all working as spokes of a smartphone, screen-based hub, to support our quest for working, playing, and living smartly. Alas, the physical

dimension (and the spiritual one that is more discernible by analyzing how we behave in real life as well) still matters a lot, whether related to food and entertainment, to our total wellbeing, or to the climate change risk that is impacting our overall ecosystem. Hence, "smart" may not be enough. And the way "smart cities" are currently designed and planned for development may also be just an imperfect, first step towards a more holistic, balanced, and sustainable direction. In fact, in a society where high-tech artifacts are becoming omnipresent and quasi-indispensable, the digital dimension impacts everything, including real estate and infrastructure assets, contributing to make their value more "intangible-based" and "intangibles-driven," defined by the data they can generate and that can be captured, aggregated, and analyzed to look for past correlations and future predictions—eventually, to derive serviceable, timely, relevant intelligence on built stuff, as well as on our bodies and state of mind. But this digital dimension, and the level and sophistication that could be allowed in its interaction with the human species, is hardly captured and expressed by the "smart" adjective. Smart, in the English language means chic, trim, neat and fashionable, trendy, and even snappy—adjectives which are all part of the proposition of smart things but should not stand as its core. In other languages, smart could be even translated in more outspoken (and less positive) ways—described as something that plays well on a trick and mostly to its benefit by outsmarting others ("furbo," e.g., could stand as a good Italian translation—with someone "furbo" that does neither necessarily nor naturally stand for intelligent, hard-working, and team player. It could be someone that makes up with selfish tricks for the lack of the abovementioned qualities).

A more proper adjective to describe how digital technologies are changing cities could then be "cyber"—more directly referring to the dynamic interaction between humans and the digital machines (computers, but also big data platforms—BDP and Internet of Things, IoT, devices), let alone the reference to the fashionable Tesla "cyber truck" promoted by Elon Musk. A "cyber city" would then refer to a place where virtual reality, BDP, and IoT are building parallel "twin" cities based on information and intelligence to provide something more than basic utilities. The different emphasis is not small change. On one side, data can be gathered to augment the level of information that are needed to optimize (say) the traffic conditions, or to monitor safety, or to reduce the use of energy based on occupancy and need. On the other side, they can be developed to offer a kind of easy to use interface connecting the virtual reality and our daily life in the physical realm, with the twin digital-to-physical dimensions feeding back continuously to each other. In a "cyber city," the augmented physical reality gets developed and compenetrated by the digital dimension and vice versa. Data and information are also used to mine intelligence about cause-effect correlations and potentially, based on nonlinear patterns that are discernible for artificial intelligence/machine learning (AI/ ML) applications, to create intelligence that can be used to identify and deliver solutions to hard problems. These problems may also involve what we described as "utilities" but can extend to the many and multifaceted dimensions of the working and social life. A cyber city would then, in our extended definition, cultivate the ambition to deliver solutions across the economic and personal spheres, contributing to the success or failure of

businesses, to the development of an urban tribe or social community, and to the overall civilization (or lack of it) of an entire society—hence, it would support the ambition to make the city a winner on a global scale. A recent study by ULI (Urban Land Institute) has provided an interesting framework for summarizing most of the technology trends at play that are promising to revolutionize cities, in Table 1.1.

A "synapsis-based" model (Digital transformation in financial services 2018) made up of what we described in another book as five fundamental pillars would then come to dominate most of the ways of working of the emerging "cyber city." Data and information would be continuously captured in real time and capitalized in central (or dispersed) BDP—and they would be made available to multiple counterparts in a transparent, safe, and economically efficient way for them to work on it, as if they were a gold mine. Traditional and more innovative applied analytical techniques would then become widespread and used by multiple counterparts to extract meaningful intelligence out of this data and to get information with a purpose. On this basis, new model of interactions and intermediation would develop and flourish, connecting multiple stakeholders together—in a more holistically extended and inclusive approach, not driven by the mere arbitrage of information advantages but the quest for solutions. In our example of the "synapsis bank," it is for the bank to evolve from its mere intermediation "buy money—sell money" game towards a more stakeholders-based, many to many one, where multiple stakeholders are brought together to working on a specific hard problem. The value chain is also reconfigured, with the direct, supporting involvement of the many stakeholders and with the final aim to provide a solution that was not in the cards and truly additive to the value of the ecosystem. Solutions, the fourth pillar of our synapsis framework, would then be delivered and sold, eventually adapted and reinterpreted, to the overall community on the basis of trust, the real scarce resource of the digital realm—threatened by cyber risk, fake news, data manipulators, thefts, and so on.

1.5 Beauty, with a Purpose

For all the talk of "smart" things—from smartphones to smart building, smart companies, smart cities, and, of course, smart individual—all coming to dominate our contemporary reality, this term could be interpreted almost as an offensive one, as its "intelligent and chic" interpretation moves towards a "fashionable and snappy one" and then to a "witty and natty" one ("furbo" in Italian—somebody playing dirty tricks to get an unfair advantage on others). We have then proposed to use cyber instead, and with specific reference to the cities of the future. Cyber, and cybernetic (as a dynamic way of humans and machines to interact and change behavior based on continuous feed backs), captures better the idea of a city that is looking to develop better and more inclusive solutions towards sustainable futures where mind and body and digital and physical dimensions are optimized as a seamless dimension

Table 1.1 A new urban technology framework is potentially transforming cities in unprecedented ways (ULI framework)

 **Digital twins** Augmented and virtual realities (and associated city systems models) create digital versions of cities that become part of the city	 **Tribalisation** Social media and mobile connectivity create small, fluid tribes defined as much by digital as physical places	 **Share and share alike** The subscription and sharing economy extends to ever more of our 'stuff': houses, cars, even clothes	 **Smart cities** Tech progress creates denser, more efficient cities, better governance, and the orderly provision of citizen services	**Builders assemble** Onsite construction becomes a final assembly process for large, complex sub-assemblies manufactured in factories	 **Smart buildings** The Internet of Things makes buildings and places better machines: more efficient, flexible and sustainable
 **Digital retail** From stores to omni-channel; from things to experiences	 **Future of work** Emphasis of work changes from the company to the individual and the project	 **Digital manufacturing** Additive manufacturing sees making things return to the city center	 **Wellbeing** The monitored and quantified self supports healthy and happy lifestyles and citizen wellbeing	 **Mobility-as-a-service** Public, private and active transport become joined-up, pay-as-you-go	 **Smart-machine** My house, my car and my robots all understand me

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(or driver) of happiness and meaningful pursuits. Cybernetics is in fact referring to an interdisciplinary, mathematical-based approach that is aiming to study the complex systems of living beings, whether of natural or artificial origin. Hence, cybernetics cities, or cyber cities (in short), can better express the complexity of the "human + machine" coexistence and its most immediate fall out, that is, the convergence and relationship between physical and digital.

Where "smart cities" refer to multiple applications, mostly related to everyday utilities which are relevant but not crucial in the way we could design and perform our new ways of living, "cyber cities" come to support more productive and enjoyable lives of its citizens: they support the pursuit of a meaningful, total (mind and body) "well-being with a purpose." Cyber cities are then supporting a more human-centric approach, where citizens as producers and consumers (and investors as well) are called to play a crucial role as co-designer and actuators of urban developments and regenerations. Cities are, according to Carlo Ratti, by definition, plural, public, and productive (The city of tomorrow 2018), and they are created (or evolved) by society itself, with design by mutation happening as a collective process. Cities' evolution happens as driven by the energy of the crowd and relying more and more on the intertwined forces of the digital and physical realms. It's a mix of bits and atoms, according to Ratti, that needs to be reconciled at city level. And, according to us, it's on this reconciliation that greater resilience and sustainability can be built and ensured, to face off crisis like the pandemic or the climate change ones. This is a huge task on which public Institutions and private sectors need to work synergically and where multiple industrial sectors and players can have a role. In fact, we have argued in other works (Finance, real estate and wealth-being, Claudio Scardovi 2020) how finance and real estate, along with technology, can become the acting forces of the redefinition, regeneration, and evolution of large metropolitan cities, as plural, public, productive, and enjoyable—hence highly attractive and sustaining the creation of a shared wealth and well-being. But it is this "well-being with a purpose" that should ultimately come to define them.

It is the search for this ultimate city's purpose, along with its beauty, that drives its successful urban developments or redevelopments and the many regeneration programs of aspiring "cyber cities." The "smart city," as domain of digitally integrated urban spaces, with ubiquitous tech suffusing every dimension of the physical realm, should develop with an active participation of its citizen that are contributing to its co-designing and will end up co-living within the city, working in this and spending leisure time in it—they should then demonstrate (and be guided, by professional people) a strong interest in its aesthetic dimension. Beauty is, in fact, critical for the marketability of a place, and the first indicator of its place-location (or value proposition) strategy. Only beauty can support the full realization and sustainability of the wealth-well-being-fullness of the city's citizens. Only beauty can express (in a synthetic yet very powerful way) the finally recovered mind and body equilibrium of people that is a key component of sustainability. Purpose and beauty should therefore suffuse and influence every dimension of the cyber city, along with ubiquitous technology and its ecosystem of sensors collecting information from the urban space. Purpose and beauty should inspire the design and management of open

(big) data platforms, both centralized and decentralized, as a basis for the formal and informal collaboration between citizens and governments, where machines and crowds and companies and institutions work together to innovate. Data-driven feedback loops among these parties can in fact be used to design and actuate several test beds of innovation, across the many dimensions of the wealth and well-beingness of individuals. Purpose and beauty should then drive the actions of the network-enabled actuators that, by synapsis, can transform the urban space and allow a real, meaningful, incremental impact on the way we experience our work and we enjoy leisure time and socialize across tribal (digital and physical) communities. Purpose and beauty could provide the special passion and those ever-changing emotions that can make a large city, or even a small place, unique and in a world of its own. Purpose and beauties would therefore underpin the increased resilience and sustainability of cities that are at stake today and key goals to achieve.

1.6 Cyber Cities Are Not for Cyborgs

The design of cyber cities, the design of their architecture and of their built environment, and their technological infrastructure are driving an always-on, real-time, fully connected living, in an enmeshed, sentient, and seamless cyber-physical space. In this, bits and atoms become suffused, and multiple machine-to-crowd-to-individual communication flows can develop, across multiple interfaces. As screen-based (via PC, smartphone, watches, and so), or as touch-sight or voice activated or as directly implanted in the people's body and brain, with intertwined biology and technology to create an almost new human-machine system, with Elon Musk obviously working on a cyber-brain as well. With his Neuralink project and related company, Musk is aiming to implant flexible "threads" into the human brain to allow the transfer of big volumes of data. This is not to create cyborgs, or to allow AI to take over human brains, but to allow the two to coexist in symbiosis—again, as a fusion of the cyber and physical dimensions of an extended, augmented, and suffused reality. It may look still look as sci-fi as of today, with a few years ahead before the first, actual implant. But in truth, the relevance of screen-based digital devices is already diminishing, and they could progressively and potentially disappear in a digitalized-physicalized world. IoT of a different nature are instead already taking more relevance, with new devices doing the ubiquitous computing trough the digital cloud to which they are connected, with batteries always on, that can be easily recharged by radio waves and become almost limitless in the duration and useful life.

As IoT ubiquitous devices shrink in size and with batteries always on and charged, their cyber-physical dimension gets embedded everywhere, including inside our body and brain, with intuitive to use, not invasive to implant, almost invisible, unobtrusive new devices—such as eye lens or glasses or listening and amplifying devices that can work as a computer for us, with a navigator actioned by our sight, hence able to provide, for example, the full screening, background checking, and any other relevant information in real time on the people standing in

front of us, not to mention the real-time translation of the foreign tongue in use. Not only that. At the individual level, new human-machine integrated systems (from exoskeletons that can allow paralyzed people to walk again, and to other people to run faster) to brain implants (as foreseen and invested by Elon Musk—with first trials soon undergoing) that are connecting IoT directly with our synapsis, all of this will allow us to reconsider our human mind and body relationship and coexistence, potentially removing some of the biological and physical related constraints we thought were just unsurmountable (we also thought that men could not fly on thin air or spend time in the sea depths). As it's the case for cities, also the possibilities of evolution for people are almost limitless and more than just "smart." We can become smart-digital people if we leverage a few tricks from our smartphone, as proxy of a prothesis we can take with us when walking or doing activities for work or leisure. But a cybernetic human is something more, as he can evolve via the balanced extension of our cyber and physical capabilities, extending our many powers and augmenting our will and power almost at whim: from our computational skills to our memory and ability to translate out thought in infinite languages and from our strength and speed to our ability to see and hear at far away and microcosmic levels. We are born human, but we can become trans-human if we can leverage technology at best, in a cyber-physical way, extending our "persona" without necessarily becoming an AI-controlled cyborg.

Based on these augmented capabilities and almost limitless powers, we can in fact re-imagine our identity, redesigning our extended and more functional economic and social functions—at individual and group level. We can leverage transplants and implants to reinvent ourselves with the aesthetics dimension (as in the case of cosmetic surgery) already preceding the redesign of other, more functional, and less frivolous assets of ours. As cybernetic individuals, living in cybernetic cities that can enable in full our augmented cyber-physical capabilities and almost limitless powers—cyborg-like but not as cyborgs—we can end up living a new condition and paradigm of human existence where physical and digital suffuse and biological and technological dimensions get seamlessly intertwined, powered by applications sitting over the cloud. How would such a setup have been impacted on the recent pandemics if already in place? How could our behavior be influenced to prevent climate change (as an inherent anthropological phenomenon) if digital and physical were always interconnected? How could we all work and live social and economic lives at an order of magnitude more productive and information rich, if we all had already Elon's threads implanted and well-functioning in our brain? With the new technology, not necessarily screen-based, we can project and multiply our self to a conceivably infinite degrees, internally and externally, becoming meta-human, with tech inside and prosthetics outside, cyber and physical all over the place, all inextricably enmeshed and coevolutionary, and living in cyber cities. However, cyber cities are not for cyborgs. And the IoT and machine-based developments are not suggesting a prevalence of the robot, even if the risk of a GAI (general artificial intelligence) super power that takes over the humanity do exist. For the sake of this discussion, we will just argue that "smart cities" need to naturally evolve into "cyber cities," so that cyber individuals can develop into meta-humans, with meta cities in

turn emerging to reconfirm the centricity of humankind in the context of the contemporary civilizations.

1.7 Death of the Smartphone

With the advent of mainframes, of the world wide web, of the digital cloud and with the progressive maturity reached by AI and quantum computing, it has become obvious, on one side, how the physical realm can no longer be considered prevailing, let alone absolute. On the other side, the digital one, the object of many "hyped" transformations, is also not enough to ensure the pursuit of economic and social success and the development of super competitive ecosystems. In the first days of the "lockdown" period, we may have come to believe (or just hope) that more digital connectivity and more computing power could have done the trick, to allow us to live the same life, as productive and enjoyable, just more online and less offline. We have then come to count the days towards unlocking, to take back our outside-our-homes, physical dimension—then realizing how much our digital twin has become so critical to "just get back to the old normal." We need digital tracing, for health safety; continuous monitoring, for enforcing social distancing; and so on. But also, we need our cyber twin to keep the extended mobility, communication, training, dating, etc. that we have come to learn and appreciate when locked at home. Most of this can now be offered and delivered via our smartphone—our prostatic, digital extension and everyday companion. For sure, we own globally more than 5 Bn mobile phones and counting, and we spend a good 3–4 h per day staring at a screen the size of our hand. Certainly, we also feel subjugated and sometimes frustrated by our digital and "smart" prothesis, as it becomes so encompassing to allow us to communicate or pay, consult information or manage our domotics-based home, read a book, and play music as well as drive, run and exercise, and meet and date people for work or leisure. Sometimes, we become so overloaded by applications and bombarded by information that we seek some "data diet," to recover in full some of the physical sensations that have been acting for us, since time immemorial, as our interactive interface with the outside physical environment.

But, as we described, a new generation of IoT devices, all supported by a more and more ubiquitous connectivity and by powerful applications available over the cloud, will greatly reduce the "power of the screen." It will potentially lead to what we have been dramatically dubbing "the death of the smartphone." In this IoT-enhanced, nonscreen-based environment, we can recover and augment, at the same time, part of our set of physical sensations. This is not a dream of a distant future. Take, for example, Mojo Vision, a startup from the Silicon Valley that is developing augmented reality contact lenses that will give users real-time information from the web. It may have as end game the creation of an interactive world that can be layered on top of the real one. Mojo Vision's contact lens includes a micro-LED screen, a microprocessor, wireless communication, and sensors that could be connected over the cloud. Its lenses have then a digital display that is navigated with