Humane by choice, smart by default: 39 building blocks for cities of the future

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Abstract: For nearly three decades, becoming smart has been claimed to be a solution to urban problems. This claim is justified, but not unconditionally. This article aims to contribute to the development of a human-centric smart city agenda, which in effect means the application of social and ecological principles, in conjunction with appropriate technology. It was concluded that the use of (digital) technology should be preceded by examining the complexity of social and ecological problems of contemporary cities. This vision resulted in a re-conceptualisation of the smart city concept into a city that aligns the use of technology with its human-centric agenda. Kate Raworth’s concept of a doughnut economy has proven useful in designing such an agenda. This concept is based on the simultaneous application of principles related to social and environmental sustainability, resulting in an agenda of 39 ‘city actions’ for cities that intent to be humane by choice and smart by default.

1 Introduction: as smart is the solution, what is the problem?
From a long time ago, people have moved to the city, looking for a better life. However, from 1950 to date urban population exploded from 750 million to 4.2 billion. The next decades another 2.5 billion will follow. Cities are engines of economic growth and the main causes of pollution and global heating too. They offer exciting opportunities for people to thrive and at the same time, a large part of their population lives in poverty and lacks housing and other elementary facilities.

For nearly three decades, becoming smart has been claimed to be a solution to urban problems. This claim is justified, but not unconditionally. This article aims to contribute to the development of a human-centric smart city agenda, which in effect means the application of social and ecological principles, in conjunction with appropriate technology. In order to achieve this goal, smart city literature has been critically assessed for its contribution to the agenda. Five narratives that represent different ways of framing the role of (digital) technologies in solving urban problems have been summarised and commented on.

It was concluded that the use of (digital) technology should be preceded by examining the complexity of social and ecological problems of contemporary cities. This vision resulted in a re-conceptualisation of the smart city concept into a city that aligns the use of technology with its human-centric agenda. Kate Raworth’s concept of a doughnut economy has proven useful in designing such an agenda. This concept is based on the simultaneous application of principles related to social and environmental sustainability, resulting in an agenda of 39 ‘city actions’ for cities that intent to be humane by choice and smart by default.
In their article *Smart Cities as Company Storytelling*, Söderström *et al.* documented how IBM and other technology companies crafted the smart city as a narrative that framed the problems of world cities in a way these companies can offer to solve [6]. Over time, the number of narratives multiplied, resulting in what the author has called the Smart city tales [7].

IBM's eagerness to dominate the smart urban technology market must be seen in connection with the company's move away from hardware design and production to concentrate on consultancy and software [8]. In that time, the projections of the so-called smart city technology market, showed growth by 20% per year from over $300 billion in 2015 to over $750 billion in 2020, which seems undue to date [9]. It is no surprise that other companies, like Cisco soon followed IBM's example by establishing its' Smart and Connected Communities Institute [10]. The Fujitsu Group started promoting Human Centric Intelligent Society, Siemens invested in a new Infrastructure and Cities division in 2011. Microsoft entered the stage in 2013 with its City Next initiative. Below, Google's (Alphabet) ventures will be explored as well.

The author will summarise five, partially overlapping narratives: the connected city, the corporate city, the data-driven city, the city as a platform and the eco-technology city. This division is compatible with the five multiple smart city development paths that result from the bibliometric analyses of Mora and Deakin [3]. The difference is that they did not mention the city as a platform for a separate path and that I kept the holistic perspective for the next section.

2.1 Connected city

In the IBM vision, smart cities are systems of systems: planning and management services, infrastructural services and human services, each to be differentiated further. All systems can be characterised by three ‘I’s, which are the hard cores of any smart city: being instrumented, interconnected and intelligent [11]. The masterpiece of IBM's endeavour was the installation of huge smart city operations centre in Rio de Janeiro.

In his article *Complex Cyber Terrain in Hyper Connected Areas*, Matson [12] describes the physical and virtual components of the cyberspace in urban areas. Billions of kilometers of fibre optic cable connect data centres and carrier hotels (or internet exchanges; places where private networks on the internet interact). Computers are outnumbered by the so-called ubiquitous sensor networks (USNs) like smart metres, CCTV, microphones and a whole array of sentient tools (sensors).

The importance of the ‘intelligent component’ is increasing fast with the maturation of machine learning and artificial intelligence, which has opened the doors to many new applications, facial recognition as one of the most promising and controversial ones.

2.1.1 PlanIT Valley: the smartest city never built:

Owing to the limited tamperability of the smartness of cities, but convinced of its unlimited opportunities, Steve Lewis, together with Malcolm Hutchinson decided to build a smart city from scratch: they founded a company and started to design a modular software-platform, the urban operating system (UOS) [13]. The UOS would gather information from billions of sensors placed throughout a city, in order to feed applications that monitor and control the city’s systems for lighting, surveillance, heating, cooling, waste disposal and air-control, to be built by other companies [14]. The idea was to raise a new city with 250,000 inhabitants, called PlanIT Valley near the Portuguese city Porto. In their book *Building the future*, Edmondson and Reynolds [15] give an account of the development of PlanIT Valley that reads like a thriller. Unfortunately, the gap between dream and reality appeared to be unsurpassable and the idea vanished.

2.2 Corporate city

Apart from the concept of PlanIT Valley, the first narrative is focused on the ‘smartification’ of existing towns. However, all over the world, emerging and developing countries, in particular, administrators were dreaming about building smart cities from scratch. These greenfield cities are not meant to solve urban problems or accommodate the growth of the urban population, but primarily to attract foreign investors [16]. Countries started to compete with one another in attracting global capital and (are) marketing themselves as world-leading cultural, creative or smart-brick cities [17].

Cisco together with Gale international, an international property development company, became the developers of New Songdo in South Korea. New Songdo was in the first place meant to become a giant business park and it is set out to enable a decent corporate lifestyle and business experience for people from abroad and cities that offer an attractive living environment for expatriates and innate higher employees, offering houses full of technical gadgets, full-featured office space, outstanding connectivity and accessibility. All streets are equipped with sensors and cameras primarily for safety reasons and to monitor traffic [18].

Once New Songdo City was finished, Gale International and Cisco planned to roll out 20 other new cities across China and India. Other greenfield cities will appear in Africa, such as Eko-Atlantic City in Lagos (Nigeria) and the newly to build mega city NEOM in Saudi Arabia [19]. Basically, smart neighbourhoods like Hudson Yards in New York have the same intention.

2.3 Data-driven city

The third narrative is connected to the collection and refined analyses of data that companies like Google, Facebook and Amazon ‘tap’ for commercial reasons from citizens’ Internet and mobile phones communications.

Sidewalk Labs, legally operating under the umbrella of Alphabet (Google), responded to an open call for a proposal for re-development of Quayside, brownfield land around Toronto’s old port [20]. Sidewalk Labs won the competition with a tempting 220-page document. The company promised to combine progressive urban design and new digital technology to create a people-centred neighbourhood that would achieve precedent-setting levels of sustainability, affordability, mobility, and economic opportunity. At October 17th 2017, the plan has been presented in the presence of the prime minister, Justin Trudeau.

From an urbanist point of view, the plans that were developed subsequently are on par. However, that was not Google's first motive, neither was the creation of smart city gadgets like adaptive lighting or underground utility channels. Instead, its interest is ubiquitous sensing of city life, to expand its already massive collection of personalised profiles with real-time geotagged knowledge of where people are, what they are whishing or doing in order to provide them with targeted advertising [21]. Sidewalk Labs wanted to construct a digital layer over Quayside and later over Toronto containing a robust set of application programming interfaces that provides a canvass for developers to build applications into the community. The larger the quantity and diversity of the data gained from residents and visitors, the better Sidewalk Labs would succeed in involving third parties to monetise these data.

However, at 7 May 2020, Sidewalk Labs CEO Daniel Doctoroff announced that its ambitious dream was over [22]. The stated reason was the devastating coronavirus pandemic’s effect on real estate prices. However, the company's ambitions had already been scaled back, and swelling criticism on the growing influence of big technology companies on people's lives might have played a decisive role.

2.4 City as a platform

The fourth narrative relates to private companies and city governments as well. Amazon, Uber and Airbnb are forerunners in the development of a platform approach that is disrupting traditional sectors like retail, taxi and hotel business. Other companies followed, for instance, the scooter-sharing companies Bird, Lime and others, a company such as We Work that dominates co-working and co-living and the fast-growing market of meal delivery services.
Nearly all of these companies started as startups and have grown thanks to VC companies. Between 2016 and 2018 these companies invested worldwide $76.8 billion, most of which in mobile tech ($46.8). Food delivery came in the second place ($14.6). In total, 46% of all investments were in the US, about 35% in China. Singapore is at the third place with 6%. San Francisco, Beijing, New York, Shanghai, Singapore are the places with most investments in urban tech [23].

However, city governments too discovered the advantages of a digital platform. From the end of the 20th century, digital cities brought together a wealth of information and services concerning employment, housing, administration, mobility, health, security and utilities. Citizens can also raise questions or make a request to repair broken street furniture. Most citizens appreciate if they can request services digitally if — in case of questions — help is available, which is often a problem.

More recently, cities also use digital technologies to increase public engagement or to give people a voice in decision making or budgeting. In this case, citizens must be enabled to react to each other's opinions and there must be relevant information. Madrid and Barcelona are very advanced in using technological devices to enhance citizens engagement. e-Estonia is currently the most ambitious project in technology-assisted politics in the world: it includes anybody involved with government and it has changed the daily lives of citizens [24, 25].

2.5 Low-carbon city

From the beginning of the 21st century, cities realised their role in the consumption of carbon-based energy and the subsequent emissions of greenhouse gases. The report Smart 2020: Enabling the low-carbon economy in the information age, published by the Climate group saw the ICT industry as a key player that can offer technological solutions to save energy and reduce emissions [26]. Cities have started to deploy digital technologies (i) to build energy-positive buildings, (ii) to adapt the electricity network to the growing production of wind and solar energy using smart grids, (iii) to modernise transport networks to accommodate a growing stream of passengers as an alternative for car use and (iv) to introduce adaptive street lighting. This narrative is in particular connected to the European commission that defined smart cities as places that create the conditions to trigger the mass-market take-up of energy efficiency technology (by transforming) their buildings, energy networks and transport systems into those of the future ... [27].

3 Towards a human-centric approach

All aforementioned narratives assume a tight link between technology and economic growth and the wellbeing of the citizens, imagining a new kind of technology-led urban utopia. They promise the solution of problems, including crime, traffic congestion, pollution, global heating, inefficient services and economic stagnation and healthy life for all [17]. The author does not deny that many claims are genuine and might be beneficial too. However, the exclusive focus on technology comes with hitches and unwanted side effects. Moreover, its benefits are unequally spread within and between cities.

3.1 Imminent techlash

‘The smart city is a dream ... It's a magical place we long for.’ These are the opening sentences of Mike Barlow’s and Lévy-Bencheton’s [28] book Smart Cities, Smart Future in which they refer at the downsides of the techno-centric approach and at the same time showing examples of human-centric applications of technology. However, the question is not only whether technology will solve urban problems, but also which exactly are these problems, who is trusted to define them, which are their causes, who is most affected and which ones must be solved most urgently. Only after answering these questions, the discussion may be extended to the contribution of technology. Ben Green, in his must-read book The smart enough city, rightfully states that the application of technology without embracing the complications and the complexity (of urban life) has resulted in many urban problems [29].

Siemens makes the strongest and most explicit statement of the beneficial outcomes of smart-city policies: Several decades from now cities will have countless autonomous, intelligently functioning IT systems that will have perfect knowledge of users’ habits and energy consumption, and provide optimum service ... The goal of such a city is to optimally regulate and control resources by means of autonomous IT systems [18]. In the same vein, the World bank adds that technologies like 5G mobile networks, blockchain, big data, machine learning, artificial intelligence, autonomous vehicles, low-cost space exploration and micro-satellites, biometrics, digital ID, digital payments and drones offer great promise for cities facing issues such as explosive growth and a huge backlog of infrastructure and service delivery, leapfrogging generations of older models [30]. Both citations are either rather simplifications of the complexity of cities and the behaviour of citizens or a frightening estimation of the power in the hand of technological companies [31]. Adam Greenfield, one of the most critical opponents of smart city development seems to believe the latter: the overarching goals of the smart city concept is the centralised capture of data produced by all of a city's connected devices and the application of advanced analytical techniques ... to permit the optimisation of all the flows of matter, energy and information [18].

Meanwhile, many municipalities have adopted the technocratic vision. An empirical study of the plans of 21 ‘self-appointed’ smart cities, concludes that most of them consider the ICT infrastructure and data analytics as the key enablers of their strategy, regardless of the cities’ goals [9]. In the same vein, Angelidou [32] concludes after having analysed the policy plans of 15 cities that these plans fail to incorporate bottom-up approaches, are poorly adapted to accommodate the local needs, and consider issues of privacy and security inadequately.

According to The Economist, it is unmistakably that business leaders, having in mind a multi-billion smart city technologies market overstate the benefits of technology, despite scientific publications that prove otherwise. Therefore, it is not surprising that a techlash is underway [33]; scepticism of the general public is increasing and politicians are becoming more critical regarding behemoths like Google, Amazon and Facebook, because of their treatment of sensitive data, their lack of transparency of algorithm-based decision making, their profits and tax evasion and the gig economy in general. Or in the words of professor Galloway [34]: the real talent of tech companies .... is not mastery of technology, business models, or building cultures of creativity. Instead, tech's genius is fostering the unfettered belief that they are making the world a better place ... while accidentally becoming billionaires ...

As understandable as the scepticism regarding technology is, it is just as dangerous as the overestimation of its blessings. A recent study of McKinsey [35] Smart Cities: Digital solutions for a more livable future distinguished 55 urban applications in different fields that are capable to improve the quality of life of all citizens. Barlow and Lévy-Bencheton [28] are not pessimistic either; instead, their book is a plea for human-centric solutions, developed with design thinking [29]. They refer to the distinction Boy Cohen has made between smart cities 1.0, 2.0 and 3.0, which are company-driven, municipality-driven and community-driven, respectively, representing the voice of the citizens. Mora and Deakin [3] underline too that studying the fallacies of the technology-driven smart cities concept must not result in the conclusion that they are false dawn only. Instead, what is needed is a critical understanding of urbanism to offer a knowledge platform to build smart cities in real-life environments. This is where this article wants to contribute.

3.2 Reversing the concept

Let us start with a real case example: a group of people in the vicinity of the Dutch city of Eindhoven have decided after long discussions to build a village of their own. Applying design thinking, the first step was to develop a prototype image of the city.
new neighbourhood. This appeared to be an uncompromising productive environment for joint energy generation, food production, water and waste management, joint digital data management and an efficient and sustainable transport system and applying enabling technologies where they add value. After many more meetings, in collaboration with the city and the Technical University Eindhoven, Brainport Smart District is becoming the place for 1500 new homes and 12 hectares of business premises. This process is grounded in places ... with their specific populations, resources and problems, rather than start with technology ... (The) notion of smart must be rooted in the ... knowledge generated through the needs, desires and realities of ordinary lives ... [17].

In order to become human centric, the logic behind the concept of a smart city has to be reserved. As Ben Green accentuates, the first step is obtaining deep and widely supported insight into the problems of the city and the changes that will most benefit city residents before even thinking about enabling technologies [29]. Besides, deploying technology in conjunction with other non-technical innovations and with other forms of social change will have the largest impact.

No city administrator must be overwhelmed by the huge supply on the smart city technologies market without a preceding debate with residents, (knowledge) institutions, and companies about the city's challenges and how to deal with them. Good governance comes prior to technology [36]. As Francesca Bria, former chief technology officer of Barcelona said: We are reversing the smart city paradigm. Instead of starting from technology and extracting all the data we can before thinking about how to use it, we started aligning the tech agenda with the agenda of the city [37].

From a human-centric perspective, a useful definition of a smart city is a city that aligns the use of technology with a human-centric agenda. The content of this agenda results from explicit choices with regards to the meaning of human-centricity. Making these choices is the next step below. However, if these choices are prioritised, it is legitimate to consider the use of enabling (digital) technologies as smart by default.

4 Defining the agenda for the future of cities: humane by choice and smart by default

Throughout history to this day, cities have faced many problems: war and violence, disease, disasters, housing, utilities, traffic, crime, inequality, poverty and greed. Moreover, the pace of population growth in cities is frightening: every day, urban population increases by almost 150,000 – mostly poor – people, due to migration or births. Between to date and 2050, the world's urban population is projected to rise from 4.2–6.7 billion residents [38].

4.1 Doughnut model

The litany of problems affects all cities in the world, but not in the same way. To cope with these problems in a human-centric way, each city has to make a diagnose of its own challenges, define solutions and explore which technology can improve these solutions’ efficiency.

The afore-mentioned problems are related and often at odds, think about struggling poverty and reversing global heating. Therefore, these problems cannot be solved in separated silos: framing the challenges that cities face in a coherent way is essential. The author found the concept of a doughnut economy developed by the British economist Kate Raworth a useful approach to define a human-centric urban agenda. The model is for the first time presented in an Oxfam discussion paper titled A Safe and Just Space for Humanity [39] and later published as Doughnut Economics [40]. The doughnut model takes the simultaneous application of principles regarding social and environmental sustainability as the starting point for actions of the residents in general and the administration of a city in particular. Except for cities, this tool can be applied to any other entity (the world as a whole, a country, a region, a neighbourhood and even a household).

Some might find a doughnut, not the most palatable metaphor, but its form fits pretty well. If you look at a doughnut, you see a small circle in the middle and a large circle on the outside (Fig. 1).

The small circle represents the minimal social objectives (basic-needs) of an entity. The large circle represents its long-term self-sustaining capacity. Human activities in each entity must not overshoot its ecological ceiling, thus harming the self-sustainable capacity of that entity. At the same time, these activities must not shortfall the social foundation of that entity, harming its long-term well-being. Between both circles, a safe and just space for humanity – now and in the future – is created.

Kate Raworth has defined the social foundation by 12 and the ecological ceiling by nine principles (Table 1).

In order to apply the model at the city level, Kate Raworth became engaged with the thriving cities initiative, a project to elaborate the doughnut model at the city level in Amsterdam, Philadelphia and Portland (Oregon) and afterwards in Copenhagen, Durban, Lisbon, New York City, Paris, Rio de Janeiro and Vancouver. Each of these cities formulated their own targets for the short and long term to ‘localise’ the above-mentioned principles [41].

The principles (and related targets) with respect to the social basement and the ecological ceiling are the starting point to develop a human-centric urban agenda, which consists of ‘actions’ that together create a ‘save and just space’.

4.2 Creating a safe and just space by defining city actions

The remaining part of this article is the result of my research regarding the definition of city actions for a safe and just space in relation to the aforementioned principles. The author has collected initiatives from city administrations and other stakeholders to make cities more human-centric also considering the (digital) technologies that they deployed. The author uses the term city actions because of the involvement of many stakeholders.

Many of these actions are directly aimed at remedying the consequences of exceeding the ecological ceiling or falling short of the social base, for example, to reduce greenhouse gas emissions. All actions will have implications for other principles for better or for worse. For instance, higher prices for carbon fuels might raise inequality. Therefore, in the design of actions prevention of unwanted interrelations with other principles has to be included.

During the research, the author discovered that (i) for each action a rather limited set of principles regarding social basement and the ecological ceiling has to be considered and (ii) these actions can be clustered. Table 2 shows six clusters and for each
cluster, the most involving principles regarding social basement and ecological ceiling are indicated.

Section 5 presents the human-centric urban agenda that is based on the clusters of city actions mentioned in Table 2. This agenda applies to cities in general. Its purpose is to support city administrators who intend to develop a dedicated agenda for their own city, in particular, given its specific characteristics and citizens' preferences.

The development of a dedicated agenda within a specific city involves the cooperation of many stakeholders. It is a participatory process for which deliberative polling is a useful procedure. This tool discerns several stages, each characterised by expert input, moderated group discussion, consensus building and voting [42].

### 5 City actions: building blocks for cities of the future

Below, 39 actions are listed that enable a city to thrive between the social basement and the ecological ceiling in the long run. These actions are grouped in six clusters, where each cluster is focused on a combination of most involving principles, preceded by a non-referenced introduction, based on the report of my research that can be downloaded [43]. If applicable, actions are accompanied by examples of enabling digital technology, most of which are provided with references to corresponding websites.

| Table 1 | Principles for a save and just place for humanity [39] |
| --- | --- |
| Prevention of overshooting the ecological ceiling | Complying with the social basement |
| (1) climate change | (1) energy |
| reduction of greenhouse gases by buildings, traffic and agriculture to 55% below 1990 level in 2050 and to 95% below in 2050 | availability of sufficient renewable sources of energy for anybody |
| (2) ocean acidification | (2) water |
| decrease of acidification of the oceans by absorbing too much carbon dioxide emitted by humans | public water is assessible, attractive, clean and safe |
| (3) chemical pollution | (3) food |
| shut down chemical pollution caused by the release of toxins reducing the biodiversity and fertility of all living subjects | the provision of a well-balanced and affordable diet for anybody |
| (4) nitrogen and phosphorus loading | (4) health |
| decreasing the nitrogen and phosphorus loading by inefficient and excessive use of fertiliser | equal chance of living a healthy life for all citizens |
| (5) fresh water withdrawal | (5) education |
| prevention of excessive use of fresh water that results in drying-up od sources | high-quality learning environment for children and adults |
| (6) land conversion | (6) income and work |
| reversal of land conversion by building and road construction and agricultural land use | a fair division of income and jobs |
| (7) biodiversity support | (7) peace and justice |
| retaining biodiversity and maintaining natural capital through the circulation of nutrients | police and judicial authorities ensure safety and enforce law for all citizens equally |
| (8) air pollution | (8) political voice |
| Shutting down air pollution by the emission of aerosols (dust particles) reducing the number of premature deaths | citizens are involved in political decision making and the creation of their living environment |
| (9) ozone layer depletion | (9) social equity |
| shutting down ozone layer degradation by the emission of gases | enjoyment of experience of independence, equality of opportunity and illegal exercise of power |
| (10) gender equality, inclusiveness and equality for all citizens | (10) gender equality |
| sufficient availability of affordable and decent homes | inclusiveness and equality for all citizens |
| (11) housing | (11) housing |
| availability of rich opportunities for social networking and participation through multiple channels | (12) networks |

| Table 2 | Clusters of city actions with most involving principles |
| --- | --- |
| City actions directed | Prevention of overshooting ecological ceiling |
| | Climate change | Ocean acidification | Chemical pollution | Nitrogen loading | Water withdrawal | Land conversion | Biodiversity | Air pollution | Ozon layer depletion |
| sustainable prosperity | X | X | X | X | X | X | X | X |
| social empowerment | - | - | - | - | - | - | - | - |
| health care | - | - | - | - | - | - | - | - |
| quality living environment | X | - | - | - | X | X | - | - |
| mobility | X | - | - | - | - | X | - | - |
| connected community | X | - | - | - | - | X | - | - |
definitely decreased poverty and improved health care, housing, utilities and the supply of food and consumption goods. Inequality. Economic growth as we are acquainted with has exhausting raw materials and social externalities such as growing environmental externalities, such as greenhouse gases, pollution, unhealthy food habits and new diseases. City actions to align with the bottom line and sustainable growth justifiable societal goals without taking into consideration the ecological ceiling must reckon with resistance if their burden is unsustainable.

### Table 3: Sustainable prosperity

| Topic | City action focused on social and ecological sustainability |
|-------|-------------------------------------------------------------|
| (1) income and taxation | redesigning taxation on capital and profits, to obtain a fairer allocation of income between and within countries |
| (2) decent income | abolishing poverty by warranting household incomes that allow a decent and independent life |
| (3) circular production and consumption | instigating the transition towards circular production by making available information, rewards (facilities and procurement), development of guidelines and codes and legislation (licenses and building permits) and focus on high quality products, food at first |
| (4) high-value reuse | compelling high-value reuse, repairing, recycling or composting of materials, the reduction of waste, the limitation of toxic emissions, the use of bio-based materials, the availability of replacement components, the use of industrial produced and standardised components |
| (5) organic waste | bundling and connecting all organic residual streams into a central bio-refinery hub where bulk products can be transported on a large scale, and where local small flows can come together a publicly accessible digital platform for organic waste where suppliers (sewerage and food processing industries) of organic waste meet potential producers of proteins for animal feed, biogas and building blocks for the production of bio-plastics |
| (6) production of renewable energy | deploying all available and save sources for energy (wind on land, solar parks, solar panels on roofs, geothermal heat and concentrated solar energy) to fully replace carbon energy digital innovations, such as smart grids and micro grids to reduce the physical expansion of network capacity together with storage facilities |
| (7) agricultural land use in (peri)urban area | increasing the variety of land use forms, like regenerative multi-crop farms to greenhouses, food forests, vertical farms and urban farms and gardens using digital technology to improve productivity with a minimal addition of fertilisers and pesticides |
| (8) product as a service | propagating and enabling a shift from proprietary goods to the shared use of cars, equipment, lightning, bikes, etc. resulting in higher quality, more efficient use, better maintenance and cheaper consumer prices |
| (9) jobs for all adults | compensating increasing unemployment by automatisation, sharing, and reuse by dividing job opportunities and the creation of useful new ones |
| (10) adequate housing and facilities | making available affordable housing for everybody, including facilities like electricity, water, sanitation and heating |

#### 5.1 Sustainable prosperity

The concept of sustainable prosperity reflects an extensive literature under headings such as inclusive development, triple bottom line and sustainable growth. These concepts reject economic growth, growth of the GNP or making a profit as justifiable societal goals without taking into consideration environmental externalities, such as greenhouse gases, pollution, exhausting raw materials and social externalities such as growing inequality. Economic growth as we are acquainted with has definitely decreased poverty and improved health care, housing, utilities and the supply of food and consumption goods. Unfortunately, it came with waste, acidification of the ocean, unhealthy food habits and new diseases. City actions to align with the ecological ceiling must reckon with resistance if their burden is felt by the poorest groups in the first place. In this case, they can increase inequality and prevent the development of the poorest countries. Table 3 briefly describes city actions focused on sustainable prosperity. In the short term, the actions are directed at repairing damage already done with respect to the social basement and the ecological ceiling. In the longer term, they will make cities thrive.

#### 5.2 Social empowerment

Social empowerment is about independence, influence, active engagement and collaboration between individuals and groups. From a perspective of city authorities, it is about informing, sharing or – sometimes – renouncing power, co-operation and giving support. The need for social empowerment results from a
Table 4  Social empowerment

| Topic | City action focused on social and ecological sustainability | Supporting tools and enabling technology, in particular |
|-------|-------------------------------------------------------------|-------------------------------------------------------|
| (11) collaboration within the quadruple helix | consulting and bringing together parties of the quadruple helix to develop common goals and activities regarding ecological and social sustainability | — |
| (12) intrapreneurship | realising labour relations based on (psychological) ownership, challenging assignments, autonomy, engagement and distributed leadership in the municipal organisation and beyond | — |
| (13) direct participation of citizens in government heard and count, by more direct forms of democracy, which enable not only voting but also opportunity for deliberation | creating space for citizens and other stakeholders to make their voices heard and count, by more direct forms of democracy, which enable not only voting but also opportunity for deliberation | Barcelona [48] and Madrid [49] have already made significant progress in using technology to increase citizen's impact. The system developed by Madrid is available for any city or company [50] |
| (14) participative budgeting | enabling citizens to directly allocate parts of the municipal budget or distribute the money within a specific neighbourhood | there are already 1500 instances of participatory budgeting worldwide which often combine physical meetings with use digital voting tools [51] |
| (15) citizen engagement | deploying activities to increase citizen engagement, resulting in enhanced transparency, learning, shared ownership, cost- and time-saving(s), and greater long-term success | this website offers a checklist to map citizen engagement and a detailed description of useful engagement techniques [52] |
| (16) community development and participation | promoting and enabling of self-reliance and self-responsibility for certain communal activities by decentralisation of policy making and implementation, for example, energy cooperatives at neighbourhood level | apps to ease the accessibility of disabled persons [54–56] |
| supporting disabled persons | making provisions for disabled persons to find their way independently in urban areas, town centres, in particular | use of available technological, non-discriminatory and approved digital tools [57] |
| (17) safety | reforming the police from a military to a modern public organisation that prioritises the need for personal moral agency, is visibility in a non-aggressive way, with a trained view of emergent deviant behaviour | — |
| (18) learning city/innovative region | becoming a learning city/innovative region by share knowledge and expertise between government, citizens, knowledge institutions and companies, by participation in campuses, incubators, fab labs and by supporting starters | an overview of digital related tools to precautionary measuring, coping strategies and risk prevention or mitigation [58] |
| (19) resilience | building capacity within individuals, communities, institutions, businesses and systems to survive, adapt and grow no matter what kinds of chronic stresses and acute shocks they experience | — |

chronic shortfall in principles regarding social sustainability, such as lack of educational opportunity and democracy, inequality and discrimination. If lasting, this shortfall will disrupt social capital and cause persistent conflicts. For all those reasons, city administrators must initiate and facilitate city actions that require collaboration or co-operation between all stakeholders involved. Table 4 briefly describes the city actions focused on social empowerment. These actions take place already varying from participative budgeting to neighbourhood groups that maintain green spaces. There is a large potential for these actions, as their social and ecological effects are mostly beneficial. At the same time, digital communication can substantially improve the exchange of information between all parties involved.

5.3 Health care

Health is the first thing that people wish each other's. Health care is considered here in a rather broad meaning, for which wellbeing would be a better term, if not that its current use encompasses nearly all city actions. Thanks to health care, child mortality has decreased significantly. However, these improvements were not paralleled with societal changes, education included. As a result, the population grew unprecedentedly, making the lack of food, water and shelter even more dramatic. Elsewhere, growing wealth undermined health by pollution, toxic components food, water and materials and created new diseases. The expenses for health care are soaring, but one can wonder whether people today are healthier in comparison with the prehistoric gatherers.

Health care must be reinstitutionalised to include improving physical and mental health. Table 5 briefly describes actions which are focused on this aim. At this time, many people are obsessed with symptoms of potential diseases that threaten them. Unobtrusive monitoring at distance with the help of wearables might play a significant role in changing citizens' attention from illness to staying healthy. Health is income and class related, because of a healthier lifestyle and often better medical facilities.

5.4 Quality of the living environment

For many people, the living environment is as important as adequate housing. The creation of an attractive living environment for the rich has been accompanied by the excessive use of carbon for heating, lighting and of land to provide spacious houses and gardens. Considering the necessity to use the land for anyone's benefit, for local agriculture and green space in and near cities, and the creation of billions of new dwelling units, redesign of its use is mandatory. This includes compaction together with improving the quality of the living environment for the majority of citizens, as in many places on earth it falls short dramatically. This is in the first place because of the spatial concentration of poor and lower social classes, which not only fuels criminality but is also one of the main barriers for social mobility. Many poor people also lack amenities such as schools, shops, medical centres, playgrounds and parks at walkable distance. Table 6 briefly describes the city actions focused on improving the quality of the living environment.

5.5 Mobility

Traffic is a primary source of overshooting the ecological ceiling and of falling short the social basement as well. Any human activity that causes 1.35 million deaths globally, year after year, ~20 million injuries and total damage of $1600 billion and is a major cause of global warming would be prohibited at once. Not (car) traffic, as it is tightly connected with our way of life and commercial interests.
The main challenge for city actions in this respect is how mobility can be improved and the number of cars can be reduced at the same time. More in general, how mobility fits in improving the quality of life in cities. Table 7 briefly describes the city actions focused on social and ecological sustainability. Supporting tools and enabling technology, in particular.

Table 5 Health care

| Topic | City action focused on social and ecological sustainability | Supporting tools and enabling technology, in particular |
|-------|-------------------------------------------------------------|------------------------------------------------------|
| (20) being healthy as primary objective | re-institutionalising the primary focus of local health centres on staying healthy | unobtrusive checking of physical and mental condition by wearable devices that are monitored by the local health centre accompanied by checks on the spot if necessary to ease people's concerns for illness |
| (21) decentralised and online health services | ensuring the availability of high-quality health care facilities, first-line medical care and cure, self-care included | use of technology for example telemedicine, computerisation, robotisation in surgery and artificial intelligence [59] |
| (22) information, self-diagnoses and self-treatment | making available comprehensive information about staying healthy and preventing disease, options for diagnosis and self-treatments, as an addition to support from local healthcare workers | personalised game-based motor and cognitive rehabilitation support, for instance, reliability for neurological patients [60] |
| (23) integrated medical information | making available a centralised registration of patient data to prevent unnecessary repetition of diagnostic measurements and faster treatment | the integrated medical information and analytical system that runs in Moscow for eight million patients have reduced waiting times to see a specialist to a half and saved up to two million working hours a year (over 30%) thanks to electronic forms [61] |
| (24) monitoring at distance | using surveillance technology prudently to monitor people at risk enabling them to live in their familiar environment as long as possible | wearables that include a fall/collapse detection or check the hydration level. For example, smart service power [62] |

Table 6 Quality of the living environment

| Topic | City action focused on social and ecological sustainability | Supporting tools and enabling technology, in particular |
|-------|-------------------------------------------------------------|------------------------------------------------------|
| (25) a holistic approach to urban growth | accommodating urban growth while protecting and restoring the natural environment and offering space for a wide range of regional agricultural activities, thus preserving ecological systems and allow the production of sustainable food (biophilic principles) | the new smart city Xiongan in China will be developed based on biophilic principles, after urban designer SOM had been selected to design the urban core [63, 64] |
| (26) smart concentration | making available a rich variety of housing modalities, shopping, educational, medical, communal and social facilities, playgrounds, green spaces at walking distance as a contribution to liveability, social interaction and upward mobility | — |
| (27) zoning | reducing the impediment from land use regulations (zoning) on urban concentration, which is beneficial for the environment, the walkability of neighbourhoods, and will decrease housing prices | — |
| (28) attractive public spaces | creating attractive public spaces (place making) to promote people's health, happiness, and well-being by adding functional or/and aesthetic elements, such as green (parks), playgrounds, opportunity for socialising, art, preserving landmarks, eye-catching architecture | the use of colour, light and abstract projections to make public space more vivid or to calm it down [65] |
| (29) efficient and safe streets | redesigning streets by differentiating them according to their dominant type of transportation, diminishing the use of private cars | through an extensive system of sensors and ICT infrastructure and various methods of data collection, mobility and travel behaviour can be observed and modelled [66] |
| (30) visibility | improving visibility, safety and amenity of streets, particularly in rainy weather. Many options are available for adaptive lighting and reduction of energy use | by considering ‘lighting’ as service, resulted from a coherent set of different elements, its delivery and maintenance can be outsourced to specialised industries [67] |

The main challenge for city actions in this respect is how mobility can be improved and the number of cars can be reduced at the same time. More in general, how mobility fits in improving the quality of life in cities. Table 7 briefly describes the city actions focused on social and ecological sustainability. Supporting tools and enabling technology, in particular.

5.6 Connected community

Connectivity is the virtual pendant of mobility and if used well, will contribute to the decrease the negative external effects of mobility. The associated city actions described in Table 8 are separated from those related to physical mobility (Section 5.5) due to the involvement of different principles in the doughnut model. In fact, the huge consumption of electricity related to data storage and blockchain is the only serious overshooting of the ecological ceiling. Risks related to the shortfall of the social basement are connected with the inadequateness of the protection against cyber criminality and the concentration of ownership of data, data processing and networks by oligopolistic companies and the unethical use of related technologies such as artificial intelligence. This is a large and partially unexplored field for (self)regulation and public oversight.

6 Conclusion

This paper is a contribution to the development of ecologically and socially sustainable cities. For this reason, it includes a comprehensive inventory of city actions as building blocks of a human-centric agenda. Besides, the author made explicit how these actions can be technologically enabled and can be called smart – by default – too. In their article Smart Cities as Company Story telling Söderström et al. [6] document how technology companies crafted the smart city as a fictional story that framed the problems of world
Approach, the author applied Kate Raworth’s doughnut economy model [39, 40]. The inner circle of the doughnut represents the social foundation of the city. The outer circle represents the self-sustaining capacity of its natural environment (ecological ceiling). For each circle, Raworth has formulated generic principles, which must be adapted to the local circumstances to become dedicated targets. City actions between these circles should neither overshoot the ecological ceiling, nor shortfall the social foundation of the city. In the words of Kate Raworth, a just and save space for humanity is created if long-term goals have been set, and a strategy has been developed. Until a thorough analysis of its challenges has been undertaken, the city should be tempted to deploy technology until a thorough analysis of its challenges has been undertaken, the city should be tempted to deploy technology.

Table 7

| Topic | City action focused on social and ecological sustainability | Supporting tools and enabling technology, in particular |
|-------|-------------------------------------------------------------|-------------------------------------------------------|
| (31) limiting car ownership, and use | shifting from the primacy of car traffic (electric cars included) into a variety of mobility modes, such as walking, bicycles, scooters, public transport and other forms of shared transport, taking into consideration the length, purpose and costs of the trip | apps that visualise all available transport options between two points using a real-time information system, including departure times and duration of the journey and options for reserving and paying. This whole package, mobility as a service (MaaS) is piloted in many places [58] |
| (32) autonomous cars (AV) | focusing on using AVs for (collectively) shared transport, macro-transit options in peri-urban areas and incidental family use by sequentially sharing of cars | replacing private cars with autonomous cars will not change the pressure on the land, cannibalise public transport and make traffic jams even more frequent [69] |
| (33) last mile: freight necessitating deliveries within inner-city areas to retailers or consumers by shared electric delivery vans that operate from city hubs where these goods are delivered, stored and combined | |

Table 8

| Topic | City action focused on social and ecological sustainability | Supporting tools and enabling technology, in particular |
|-------|-------------------------------------------------------------|-------------------------------------------------------|
| (34) digital rights | taking care for a coherent package that is maximising citizens’ benefits of digitalisation and internet. Affordable fast and save connectivity, improving digital self-reliance, maintaining net neutrality and open data standards, combat cybercrime | |
| (35) ethical use of AI and machine learning | ensuring the benefits of artificial intelligence and machine learning in the analysis and supervision of processes by aligning its development and operation with ethical principles. This in order to prevent breaches of privacy, discrimination, loss of human skills and possible negative long-term effects on societal well-being | the algorithms toolkit for local government leaders ensures ensure that automated decisions are fair and unintentional harm is minimised [70] |
| (36) data ownership and privacy | securing that citizens are the owners of all personal data, unless they are obliged to be surrendered to the municipality by law | decode is an EU project that creates tools that give people ownership of their data [71]. These tools combine blockchain technology with attribute-based cryptography to enable the owner of the data to manage these [72, 73] |
| (37) open data | securing that all non-personal data collected in the public realm is ‘open’, which means they it is available in a public data portal, unless there are legal objections | Opendatasoft is a platform for sharing IoT data for better city management by making real-time data easily accessible and enables merging different data sources [74] |
| (38) internet security | obliging that equipment connected to the internet has a certificate for cyber quality and holding providers of public Wi-Fi responsible for the safety of its use | a protection tools against cyber criminality is, for example, Blacksands, that was crowned the 2019 AccelCITY Champion out of >500 applicants [75] |
| (39) digital services | offering a wide range of community services, varying form the supply of identity papers, birth declaration, to the provision of public transport, energy and housing | apps to enable citizens to arrange services online, to listen to their opinion, to provide information and to facilitate all other contacts with citizens in an easy and flexible way. For instance: the CitizenApp [76], Maptionnaire [77] |

cities in a way, these companies can offer to solve. Others narratives followed, each focusing on a collection of digital technologies pretending to solve urban problems. Following Mora and Deakin [3], the author distinguished the connected city, the corporate city, the data-driven city, the city as a platform and the eco-technology city.

The techno-centric dominance of smart city narratives has met growing criticism. (Digital) technology is a powerful but certainly not neutral tool. No city should be tempted to deploy technology until a thorough analysis of its challenges has been undertaken, the long-term goals have been set, and a strategy has been developed. This strategy directs the incorporation of technology with non-technical innovations and social change. This results in a human-centric approach of smart cities, contrary to a techno-centric one. As the former chief technology officer from Barcelona, Francisca Bria said: We are reversing the smart city paradigm ... We started aligning the tech agenda with the agenda of the city [37].

In order to contribute to the development of a human-centric approach, the author applied Kate Raworth’s doughnut economy model [39, 40]. The inner circle of the doughnut represents the material and social needs of the inhabitants of the city (social basement). The outer circle represents the self-sustaining capacity of its natural environment (ecological ceiling). For each circle, Raworth has formulated generic principles, which must be adapted to the local circumstances to become dedicated targets. City actions between these circles should neither overshoot the ecological ceiling, nor shortfall the social foundation of the city. In the words of Kate Raworth, a just and save space for humanity is created if both conditions are met at the same time. The result is an agenda for city actions that are humane by choice and smart by default.

7 References

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