

Neighbourhood 4.0: A response to urban futures

AK Cooper^{1,2}, N Sebake¹

¹ Council for Scientific and Industrial Research, Email: ACooper@csir.co.za

² Centre for Geoinformation Science, University of Pretoria, Pretoria, South Africa.

ABSTRACT

South Africa's commitment to meeting the Sustainable Development Goal (SDG) 11, “*Make cities and human settlements inclusive, safe, resilient and sustainable*”, requires the country to have an understanding of the range of possible, likely and preferred urban futures. With concepts such as digital cities, smart cities, smart infrastructure, smart places and urban resilience, it is evident that there has been some consideration of cities and infrastructure of the future. However, little is known about urban futures at a neighbourhood level. Therefore, the idea of investigating possible urban futures provides an opportunity for exploring the implications of the global forces of change and urban issues that are shaping not only cities, but neighbourhoods as well.

The “*Fourth Industrial Revolution*” and “*Industry 4.0*” are labels being applied now to the era of cyber-physical systems that go beyond mere automation, with industries and systems that are decentralized but integrated and transparent, self-optimizing, self-configuring and self-diagnosing. It encompasses concepts such as smart factories, the Internet of things, and highly-flexible mass customization. Broadly, the Third Industrial Revolution was then driven by computers, the Second by electricity and the First by steam power.

Whether hyperbole or a fad or a black swan or the natural evolution of automation or a paradigm shift or even a new opportunity for developing countries to leapfrog past the developed world, what are the implications of the Fourth Industrial Revolution for human settlements? What is needed by cities, towns, neighbourhoods and dwellings to benefit from Industry 4.0? Will Industry 4.0 benefit only human settlements that are well resourced and populated by the rich and well-educated, or can Industry 4.0 actually benefit impoverished communities?

This paper considers the neighbourhood of the future, or Neighbourhood 4.0. Our research aims at identifying and understanding the neighbourhoods of the future, because they are unlikely to face the same challenges neighbourhoods face now.

Keywords: Industry 4.0, Neighbourhood 4.0, Urban Futures, Sustainable Development Goals, Urbanization

1 INTRODUCTION

1.1 URBANISATION AND MEGACITIES

Globally, the proportion of people living in urban areas is expected to grow from 47% in 2000 to 50% in 2014, 60% by 2025 and 67% (or 6.6 billion people) by 2050. Most of this growth is expected in developing countries, as people move from rural areas (Cooper & Du Plessis, 2008; United Nations, 2017). Although urbanisation is not new, its speed, scale and scope in the past decades has been unprecedented in world history, with more people living in urban areas than in rural areas. This has an impact on the future (Karuri-Sebina *et al.*, 2016).

This phenomenon is resulting in an increase in the megacities phenomenon, including for instance, Lagos (Nigeria), Dhaka (Bangladesh), Mumbai (India) and New York (USA) (Karuri-Sebina *et al.*, 2016). Megacities house over 10 million people (Cooper & Du Plessis, 2008), and typically have extremely high population density levels, ranging from 20,000 to 30,000 people per square kilometre (Karuri-Sebina *et al.*, 2016). These higher densities are resulting in the formation of new, unique settlement patterns and urban forms.

Although, South Africa does not yet technically have megacities, the combination of the three metropolitan municipalities in Gauteng (Johannesburg, Tshwane, and Ekurhuleni) reflects all the characteristics of a megacity. Together they cover some 5,765 km², and their combined population rose from some 7,7 million in 2001 to as much as 10,5 million in 2011 (Cooper & Du Plessis, 2008; StatsSA, 2018). Given the predominance of a low-density housing model, South Africa's urban environments are among the most inefficient and wasteful

globally (Du Plessis & Landman 2002). Still primarily based on a low-density housing model, this has resulted in the formation of settlements that sprawl over large areas, making it expensive for to deliver housing and basic services to furthest (often poorest) households (Cooper & Du Plessis, 2008; National Planning Commission, 2011).

In addition to unique urban forms, this rapid urban growth makes it difficult for cities to manage their already pressurised resource base (Zimmerman, 2014; Karuri-Sebina *et al.*, 2016).

1.2 RATIONALE

Urbanisation is inevitable, and the trend of rapid urban growth is likely to continue well into the future (Chakraborty, *et al.*, 2015). To meet the needs associated with an increasing urban population, cities must be more innovative in their approaches to improve the efficiency of their operation (Guzmán Araña, 2014).

It is therefore important that this phenomenon is studied, not only to understand how megacities function, but also how their ecology may be managed (Cooper & Du Plessis, 2008). With concepts such as digital cities, smart cities, smart infrastructure, smart places and urban resilience becoming prominent in both research and implementation, there is evidence that there has been some consideration of cities and infrastructure of the future.

There is relatively little known about urban futures at a neighbourhood level. Despite this, there are a number of ways that communities are responding to urban futures and the need for housing and services at a neighbourhood level, a level at which urban dwellers are most affected. Current trends in neighbourhoods include gentrification, ethnic enclaves, redlining, formation of informal settlements, backyard shacks, gated communities, rent control, high-rise public housing, slum clearance, sprawl and shared space (no segregation between pedestrians and vehicles), all of which can be considered undesirable and have unexpected consequences, depending on the circumstances.

Gibberd (2013) argues that built environment development strategies need to be developed at a neighbourhood level to make the day-to-day living patterns of the community more sustainable over time. Glaser *et al* (2012) concur, adding that planning of “the city at eye level” (which they term street plinths) is better, particularly so that pedestrians feel safe and comfortable and are captivated by what they see, smell and hear.

1.3 THE OUTLINE OF THE PAPER

In this paper we begin by describing the neighbourhood, we then provide some background on the Industrial and other revolutions, prior to outlining the international imperative and national policy and legislative framework on urban futures. Thereafter, we consider the impact of the Sustainable Development Goals and the apparent new paradigm of the Fourth Industrial Revolution on Neighbourhood 4.0. Lastly, we present some emerging characteristics of Neighbourhood 4.0 before concluding.

2 THE NATURE OF A NEIGHBOURHOOD

A neighbourhood is defined as “*a district or community within a town or city*” (OUP, 2018). It consists of a collection of buildings (e.g. private dwellings, commercial and government buildings), internal streets and/or paths and perhaps designated (and even controlled) entrances and exits, and public open spaces.

A neighbourhood can be delineated by a barrier (i.e. a mountain, river, railroad or highway), a change in land use (i.e. an industrial area adjacent to a residential neighbourhood), legal requirements (i.e. zoning) or by social convention. Alternatively, a neighbourhood could be determined by its core (such as the neighbourhood shops), by its homogeneity (i.e. building styles or sizes, demographics, etc.), by some arbiter of taste (e.g. delineating an historic district), by a developer (e.g. Jonathan Liebmann’s creation of the Maboneng Precinct in Johannesburg (GTA, 2018)), or some arbitrary characteristics. Consequently, a neighbourhood can straddle administrative or cadastral boundaries, i.e. across suburbs or original farms (in South Africa). Neighbourhood boundaries can be fixed or fuzzy. They can change as the environment changes, particularly due to new construction, i.e. a new highway splitting up an old neighbourhood. Neighbourhoods can be isolated by their boundaries through barriers or buffer strips, sometimes done deliberately, for instance under Apartheid in

South Africa (Landman, 2000), as peace lines in Northern Ireland (Department of Justice, 2017) and ghettos throughout history, most notoriously those of Nazi Germany (Yad Vashem, 2018).

Residents themselves can also isolate themselves intentionally in enclosed neighbourhoods with controlled access, with the aim of improving their safety and quality of life (Landman, 2000). The *Guidelines for Human Settlement Planning and Design*, commonly known as the Red Book, supports this notion stating that, “residents of South African cities should be encouraged to again assume ownership of their neighbourhoods. This is essentially a case of territoriality... [which is] a sense of ownership of one’s living or working environments” (CSIR, 2000).

The success of a neighbourhood is generally determined by, and determines, the community’s social cohesion. This is largely independent of the skills and the resources of the individual community members, because the actions required need just time and effort, e.g. keeping the streets and properties clean, looking out for one’s neighbours, looking after and socialising children, conducting patrols and supporting local events. It also needs inhabitants interested in face-to-face social interactions and a balance between the self-interests of the individuals and the interests of the community within a neighbourhood (Glaser *et al*, 2001; Wikipedia, 2018b). Typically, a neighbourhood provides some services to the community and has some sort of a core, whether obvious (such as a square or a cluster of shops) or implied. Indeed, the absence of an obvious core might imperil the potential success of the community. Successful neighbourhoods are then more liveable, more enjoyable and safer.

3 INDUSTRIAL AND OTHER REVOLUTIONS

3.1 OVERVIEW

The Fourth Industrial Revolution and Industry 4.0 are labels that are being applied now to the era of cyber-physical systems that go beyond mere automation, with industries and systems that are decentralized but integrated and transparent, self-optimizing, self-configuring and self-diagnosing. It encompasses concepts such as smart factories, the Internet of things, and highly-flexible mass customization, and was introduced by the Industry 4.0 Work Group of the Federal Ministry of Education and Research in Germany (BMBF, 2017). Broadly, the Third Industrial Revolution was then driven by computers, the Second by electricity and the First by steam power. Toynbee (1884) first popularised the term *industrial revolution* (in English, at least), though Engels (1845) wrote “*Diese Erfindungen gaben bekanntlich den Anstoß zu einer industriellen Revolution*” (but was only translated into English in 1892), and the term was used loosely in French before that (Griffin, 2013), such as by Briavoinne (1837), “*C’est dans ce moment que la révolution industrielle commence*”.

3.2 EARLY REVOLUTIONS

Before the Industrial Age though, there were a number of periods of technological innovation and development that could have been considered to be industrial revolutions (and hence the first), though they are generally considered to be agricultural rather than industrial revolutions (Britannica 2018, Wikipedia 2018a, 2018c-2018n). These include:

- The Neolithic or First Agricultural Revolution, introducing the likes of farming, towns, pottery and proto-writing;
- The Bronze Age, introducing bronze, brass, glass, writing systems, navigation and long-distance trade); the Iron Age (cast and wrought iron, and carbon steel);
- The Romans introducing the mechanical reaper, wheeled plough, screw press for pressing olives, greenhouse, foot-powered loom, glassblowing, aqueduct and weatherproof roads;
- The Medieval Renaissances, specifically the Renaissance of the 12th century, which introduced gunpowder (to Europe), vertical windmills, spectacles, mechanical clocks, Gothic architecture, three-field crop rotation and universities (the Carolingian and the Ottonian Renaissances, from about 770 to 1000, were primarily within the courts and dependent on royal patronage, but did standardise Medieval Latin, calligraphy and currency);
- The Scientific Revolution, from the Renaissance to the Enlightenment (mid 16th to late 18th centuries), introduced the scientific method, printing press, heliocentric solar system, gravity, anatomy, modern chemistry, optics, electricity, calculus, refracting and reflecting telescopes, vacuum pump, mercury barometer and microscope; and

- The British Agricultural Revolution, from the mid-17th Century to, and overlapping with, the First Industrial Revolution, introduced the four-field crop rotation; single national market free of tariffs, tolls and customs barriers; selective breeding of livestock; and canals.

As summarised above, these agricultural and industrial revolutions were primarily supply driven, but some consider them to have been facilitated by surpluses (that can be spent on developing and implementing the new technologies) and the enabling political environment, and to have been preceded by increasing demand.

3.3 INDUSTRIAL REVOLUTIONS

The First Industrial Revolution was the transition from manual and animal power to steam power, from agrarian and rural societies to industrial and urban ones, and from cottage industries to the factory system; canals and railroads; textiles, iron and chemicals; the development of standard components and machine tools; capitalism, organised labour and increasing literacy, social reform and mass political participation. It began in Great Britain in the mid-1700s in textile manufacturing and spread rapidly to Europe and North America. It coincided with The Enlightenment, which emphasised the scientific method, reductionism (understanding the characteristics of the parts of a system and of the system itself) and questioning of orthodoxy, which obviously can help spur the thinking needed for a paradigm shift such as an industrial revolution.

The Second Industrial Revolution (or *Technological Revolution*) was driven by electricity, steel, oil, railways, telecommunications, industrial chemistry and metallurgy; and introduced production lines, mass production, control theory, accounting, scientific management, all-weather roads, bicycles, automobiles, aircraft, plastics, radio and universal time; allowed much greater construction works and more powerful engines; and globalization. It was first recognised by Geddes (1915), "... a new economic order a Second Industrial Revolution is once more arising, requiring corresponding changes in economic theories, corresponding expression in its turn". It began around 1870, after the American Civil War (1861-5) and the Meiji Restoration in Japan (1868), and with the unification of Germany after the Franco-Prussian War (1870-1). It started in Western Europe, North America and Japan, and is considered to have been ended by the First World War in 1914. Obviously, industrial development continued during the War and while primarily focused on military technologies and processes (e.g. tanks, tracer bullets and aircraft carriers), it did yield spin-offs for civilian use, such as modern plastic surgery, sanitary napkins, mobile X-ray machines and daylight saving time, and due to the high numbers of women working for the war effort in factories and so on, helped to accelerate the granting of voting rights for women around the world. After World War One, significant industrial developments included liquid-fuelled rockets, television, the electric razor, frozen food and purified insulin.

The Third Industrial Revolution (or *Digital Revolution*) has been driven primarily by transistors, semiconductors, computers, communication technology, software and digital data storage. It began in the 1950s, primarily in North America and Great Britain, leveraging off the technologies they developed and used during the Second World War for cryptography, ballistics, the atomic bomb and so on. Hilton (1964) referred to the scientific-social-technological-economic-cultural revolution and the cybercultural revolution. It is not clear when the terms Third Industrial Revolution and Digital Revolution were first used, but by 1982 the International Conference on Communication had as its theme, The Digital Revolution (Schoppe, 1982). We are still in this era, with personal computers, smartphones, the Internet, the World Wide Web, digital social networks, electronic commerce – and information overload, digital surveillance, spam and fake news!

At the same time, but not really connected, the Green Revolution (or Third Agricultural Revolution) took place between 1950 and 1970, delivering high-yielding varieties of cereals and increased use of chemical fertilizers, agro-chemicals, irrigation and mechanization. It is alleged that the Green Revolution saved 1 billion people from starvation by 1970.

The industrial revolutions do not have rigid boundaries, can overlap, occurred at different rates in different parts of the world and are not necessarily linear. For example, a subsistence farmer could plough with an animal-drawn plough (pre-Industrial Age) drawing a standard plough (First Industrial Revolution), and deliver their surplus food to market by truck (Second Industrial Revolution), having used an app on their smartphone to select the best market.

Neighbourhoods began with the Neolithic Revolution and the introduction of towns, as inhabitants needed to band together to survive and thrive. Figure illustrates how the various ages discussed in this section have contributed to the development of neighbourhoods.

3.4 FOURTH INDUSTRIAL REVOLUTION

Some are sceptical that there actually is a Fourth Industrial Revolution now, because innovation is continuous and non-linear and exponential growth occurs at any time, not just when any industrial revolution might start (Garbee, 2016). Hence, one could consider it to be Industry 3.1. Further, the 4th Industrial Revolution was proclaimed in 1940 for modern communications, in 1948 for atomic energy, in 1955 for electronics, in the 1970s for computers, in 1984 for information, and then for nanotechnology (Garbee, 2016).

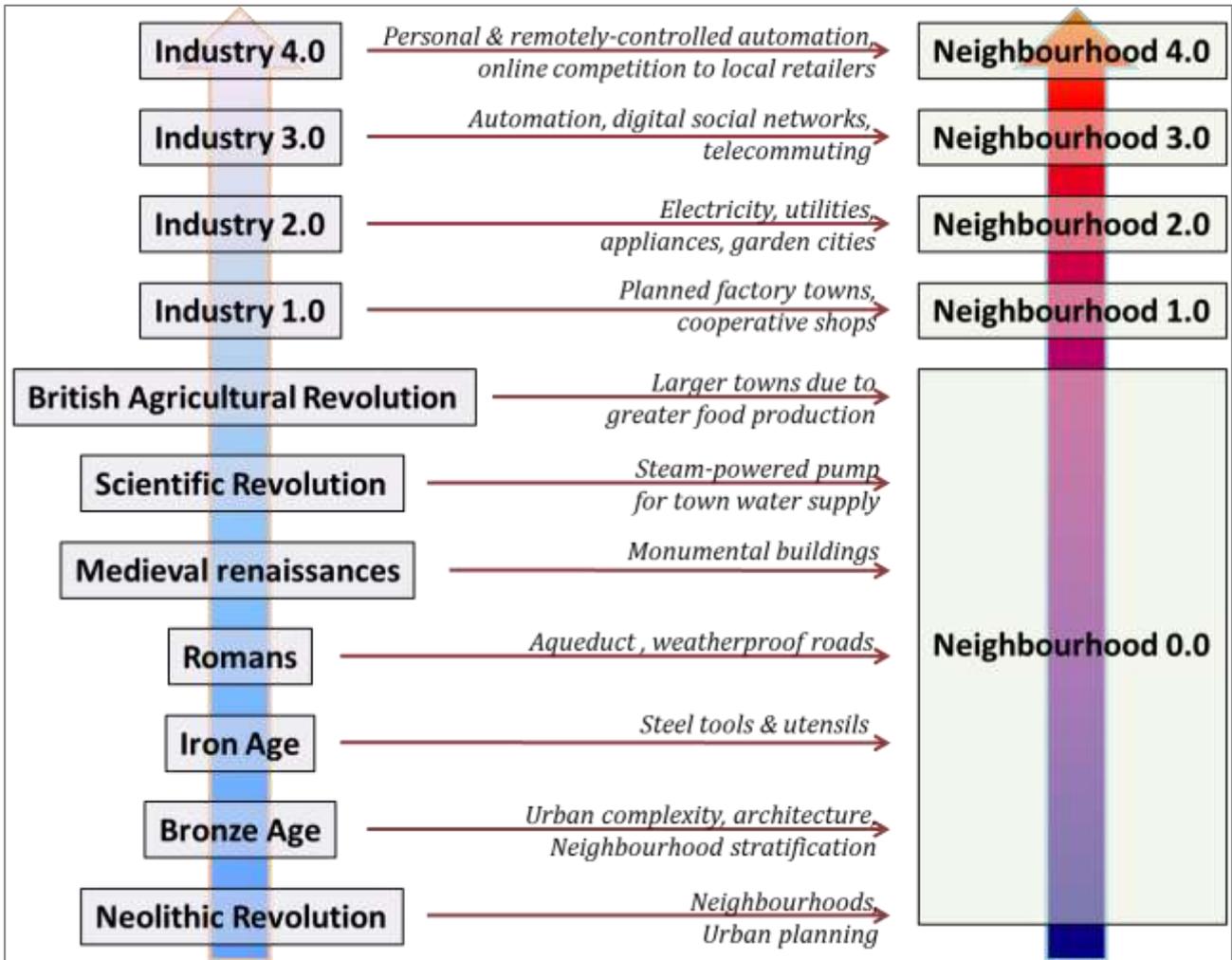


Figure 1 The industrial ages and neighbourhoods

In her speech on 17 May 2018 introducing the Budget Vote for the Department of Higher Education and Training, Minister Naledi Pandor identified three features of society that she regards as a challenge to action for higher education: protests around #feesmustfall; the need to produce skilled human resources; and the Fourth Industrial Revolution. For this third challenge, she intends “to create a multi-stakeholder task team to advise us on how we should take up opportunities of the 4th Industrial Revolution” (Pandor, 2018).

Of great concern in South Africa, though, are the high levels of poverty, the lack of skilled labour, the poor condition of the education system and de-industrialization. These really need to be addressed before South Africa can make a significant impact on Industry 4.0 – though individuals and companies might become world leaders in Industry 4.0 in their own right.

Whether hyperbole or a fad or a black swan or the natural evolution of automation or a paradigm shift or even a new opportunity for developing countries to leapfrog past the developed world, what are the implications of the Fourth Industrial Revolution for human settlements? What is needed by cities, towns, neighbourhoods and dwellings to benefit from Industry 4.0? Will Industry 4.0 benefit only human settlements that are well resourced and populated by the rich and well-educated, or can Industry 4.0 actually benefit impoverished communities?

4 INTERNATIONAL IMPERATIVE AND NATIONAL POLICY AND LEGISLATIVE FRAMEWORK ON URBAN FUTURES

4.1 INTERNATIONAL IMPERATIVE

4.1.1 Sustainable Development Goals (SDGs)

The seventeen Sustainable Development Goals (SDGs) were adopted through a resolution of the United Nations on 25 September 2015 (United Nations, 2015b). These SDGs are wide ranging, having 169 targets and 304 indicators. The SDGs succeeded the eight Millennium Development Goals (MDGs), which ran from 2000 to 2015 (United Nations, 2015a). Both the MDGs and SDGs have aimed at addressing critical existing problems, with the MDGs even being beyond the reach of some countries. It should be noted however, that the MDGs and SDGs were never intended to be visionary statements of the future with stretching targets for all countries, rather they were meant set measurable and realistic goals for improving lives and the environment globally. For example, the word 'future' is mentioned only once amongst the goals, targets and indicators, in Target 14.c, and then only in referencing the document "*The future we want*" (United Nations, 2015b). Hence, the SDGs will be easy for some countries to achieve, but difficult for others. Regardless of this, the SDGs provide a baseline for any decent neighbourhood of the future. The 17 SDGs are:

- Goal 1. End poverty in all its forms everywhere
- Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture
- Goal 3. Ensure healthy lives and promote well-being for all at all ages
- Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
- Goal 5. Achieve gender equality and empower all women and girls
- Goal 6. Ensure availability and sustainable management of water and sanitation for all
- Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all
- Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
- Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
- Goal 10. Reduce inequality within and among countries
- Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable
- Goal 12. Ensure sustainable consumption and production patterns
- Goal 13. Take urgent action to combat climate change and its impacts*
- Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development
- Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
- Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
- Goal 17. Strengthen the means of implementation and revitalize the global partnership for sustainable development (United Nations, 2015b).

None of the goals, targets and indicators explicitly mentions the words '*smart*', '*digital*', '*neighbourhood*' or '*suburb*'. The word 'automation' is mentioned only once in terms of the penetration of automated teller machines (ATMs) for Indicator 8.10.1.

Of particular relevance for any consideration of neighbourhoods is obviously Goal 11, Make cities and human settlements inclusive, safe, resilient and sustainable, as discussed below. However, even though the targets and indicators are generally at a high level for the country as a whole (e.g. Indicator 1.1.1, *Proportion of population below the international poverty line*), there are specific targets and indicators from the other Goals that are relevant for neighbourhoods, as discussed below in Table 1.

Table 1 SDG 11 targets and indicators (United Nations, 2015b & 2018)

Target	Indicator	Neighbourhood relevance
11.1 By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums	11.1.1 Proportion of urban population living in slums, informal settlements or inadequate housing	This addresses the character of neighbourhoods directly.
11.2 By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons	11.2.1 Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities	While primarily about transport, this reflects on the accessibility of public transport from within neighbourhoods, though it is not clear how 'convenient' is to be measured.
11.3 By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries	11.3.1 Ratio of land consumption rate to population growth rate	This is measured nationally, but the neighbourhoods of the future will determine if their consumption of land is appropriate.
	11.3.2 Proportion of cities with a direct participation structure of civil society in urban planning and management that operate regularly and democratically	Not about neighbourhoods specifically.
11.4 Strengthen efforts to protect and safeguard the world's cultural and natural heritage	11.4.1 Total expenditure (public and private) per capita spent on the preservation, protection and conservation of all cultural and natural heritage, by type of heritage (cultural, natural, mixed and World Heritage Centre designation), level of government (national, regional and local/municipal), type of expenditure (operating expenditure/investment) and type of private funding (donations in kind, private non-profit sector and sponsorship)	This is relevant for each and every neighbourhood, where their cultural and natural heritage needs to be identified first, and then neighbourhood value determined, before being preserved, protected and conserved appropriately. Unfortunately, expenditure is a poor measure alone.
11.5 By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations	11.5.1 Number of deaths, missing persons and persons affected by disaster per 100,000 people	Resilience to disasters applies also at the neighbourhood level. The actual indicators will be determined by the <i>Sendai Framework for Disaster Risk Reduction 2015 – 2030</i> (United Nations 2015c).
	11.5.2 Direct disaster economic loss in relation to global GDP, including disaster damage to critical infrastructure and disruption of basic services	As above.
11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management	11.6.1 Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities	Relevant to neighbourhoods, particularly as zero waste, or as local production and consumption.
	11.6.2 Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted)	Relevant to neighbourhoods, particularly those dependent on burning fuel in the home for heating and cooking.
11.7 By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities	11.7.1 Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities	Open spaces need to be at the neighbourhood level, otherwise they are not accessible to many. Further, the community will then take ownership of their open spaces.
	11.7.2 Proportion of persons victim of physical or sexual harassment, by sex, age, disability status and place of occurrence, in the previous 12 months	Interventions need to be at the neighbourhood level, but accessing the statistics is currently a problem in South Africa.
11.a Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning	11.a.1 Proportion of population living in cities that implement urban and regional development plans integrating population projections and resource needs, by size of city	Hopefully, such planning will consider neighbourhoods explicitly.
11.b By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels	11.b.1 Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030	Risk reduction strategies apply also at the neighbourhood level. The actual indicators will be determined by the <i>Sendai Framework for Disaster Risk Reduction 2015 – 2030</i> (United Nations 2015c).
	11.b.2 Number of countries with national and local disaster risk reduction strategies	A national measure.
11.c Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials	11.c.1 Proportion of financial support to the least developed countries that is allocated to the construction and retrofitting of sustainable, resilient and resource-efficient buildings utilizing local materials	While a national measure, it is about localization and sustainable, resilient and resource-efficient buildings at the neighbourhood level.

South Africa's commitment to meeting the Sustainable Development Goal (SDG) 11 requires the country to have an understanding of the range of possible, likely and preferred urban futures. With concepts such as digital cities, smart cities, smart infrastructure, smart places and urban resilience, it is evident that there has been some consideration of cities and infrastructure of the future. However, little is known about urban futures at a neighbourhood level. Further, the 10 Targets and 15 Indicators for SDG 11 do not mention 'future', 'innovation', 'smart', 'digital', 'automation', 'neighbourhood' or 'suburb' explicitly. Therefore, the idea of investigating possible urban futures provides an opportunity for exploring the implications of the global forces of change and urban issues that are shaping not only cities, but neighbourhoods as well.

The relevance for neighbourhoods of the targets and indicators for SDG 11 are explored in Table . Table 2 discusses relevant targets and indicators from the other SDGs. The first two columns present the targets and indicators verbatim, with the third column providing an assessment of the relevance of the targets and indicators to neighbourhoods. It becomes clear that there are more indicators that need to be developed for some targets and even those indicators measured at a national level can be relevant to neighbourhoods directly. It may be argued, therefore, that a country needs successful and resilient neighbourhoods to achieve all the SDGs.

4.2 RELEVANT TARGETS AND INDICATORS IN THE OTHER SDGS

Examples of targets and indicators from the other 16 SDGs that are relevant for neighbourhoods are discussed Table .

Table 2 Selected SDG targets and indicators (United Nations, 2015 & 2018)

SDG	Target	Indicator	Neighbourhood relevance
1	1.4, By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance	1.4.1 Proportion of population living in households with access to basic services	<i>While a national measure, it concerns service delivery to each and every neighbourhood. There should also be indicators for property ownership and the other aspects of Target 1.4.</i>
6	6.b Support and strengthen the participation of local communities in improving water and sanitation management	6.b.1 Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management	<i>This is explicitly about neighbourhoods and direct community participation.</i>

4.3 (URBAN) FUTURES LEGISLATIVE AND POLICY FRAMEWORK

There are a number of ways policy currently responds to possible urban futures, though much of this and of urban future studies focus on the higher, regional or city level, or on dwelling units and other buildings. Recent South African legislation and policy emphasise the importance of the future. The National Development Plan 2030 (NDP) contains a lengthy vision statement, which calls for "a national discussion on the future of towns, cities and rural settlements" (National Planning Commission, 2013). The Overview of the NDP also hopes that: "Our homes, neighbourhoods, villages, towns, and cities are safe and filled with laughter". Declarations about the future are made in both the Local Government: Municipal Systems Act (MSA) and the Spatial Planning and Land Use Management Act (SPLUMA) (South Africa, 2000 & 2013). To this end, both these Acts require municipalities to formulate vision statements concerning development.

Section 12(1) of SPLUMA determines that "the national and provincial spheres of government and each municipality must prepare spatial development frameworks that-(b) are informed by a long-term spatial development vision statement and plan" and section 21 says that "a municipal spatial development framework must – (c) include a longer term spatial development vision statement for the municipal area which indicate desired spatial growth and development patterns for the next 10 to 20 years". Section 26 (5) further instructs that "a municipality may, after public consultation, amend its land use scheme if the amendment is – (c) in order to further the vision and development goals of the municipality."

Section 26 of the MSA lists the core components of an Integrated Development Plan (IDP) including "(a) The municipal council's vision for the long term development of the municipality with special emphasis on the municipality's most critical development and internal transformation needs" (South Africa, 2000).

Nominally, planning is about the future, though there are concerns that planning is actually reactive (i.e. responding to legislation and policy) and that planners neglect the future. In South Africa, the key problems inhibiting long-term planning include the lack of funds in many municipalities, the limitations of the five-year cycle of the Integrated Development Plans (IDPs), the need to address backlogs and the focus on short-term projects for immediate political gains (Petzer, 2016).

5 EMERGING CHARACTERISTICS OF NEIGHBOURHOOD 4.0

Based on the above discussion, a number of characteristics emerge about the neighbourhood of the future, ones that meet the Sustainable Development Goals, whilst exploiting any offerings from Industry 4.0. For instance, a neighbourhood of the future could:

- Be walkable, with a radius of 400m generally being considered to be walkable (CSIR, 2000, Phaphana *et al.*, 2014). For example, using 400m buffers around stops and ranks in Johannesburg, Mokgukulushi *et al.* (2018) found that the Metrobus service covers 18.2% of the City's area and 28.8% of its population, while the minibus taxis cover 10.1% of the City's area and 48.4% of its population.
- Have good penetration by public transport, cycle paths, green spaces and viable neighbourhood shops and other services, which will probably require densification.
- Have a healthy food environment; it would not be a food desert. This would be achieved by ensuring that residents have ready access to nutritious food (Phaphana *et al.*, 2014; Cooper *et al.*, 2017). A neighbourhood should also provide a healthy environment with low levels of pollution, noise and offensive smells.

Further research is needed to build on this list. In doing so, we must consider the neighbourhood itself:

- How does the neighbourhood of the future affect the dwelling, dwelling density and erven (plot size) of the future given increasing security measures being installed, and dwellings becoming smaller?
- Should a neighbourhood of the future be intentional or organic? For example, should this be determined by public transport routes (e.g. as planned by Johannesburg's corridors), by job opportunities, by topography, by socio-cultural differences, by the natural environment, etc.?
- Should a neighbourhood of the future be focused on a particular demographic (e.g. a nappy valley or a retirement home), or should it encourage mixed demographics (e.g. aged parents living close to their grandchildren)?
- Should a neighbourhood of the future have an obvious neighbourhood centre?
- Is the neighbourhood level good, bad or indifferent?

At the same time, we must consider the impact of Industry 4.0 on Neighbourhood 4.0. In so doing, we need to consider whether or not:

- Industry 4.0 will balkanize households and neighbourhoods and increase social isolation, possibly due to the greater dependence on an online life, rather than in the physical world
- Industry 4.0 can make Neighbourhood 4.0 more democratic. This could be done by increasing access to decision makers, information and alternative viewpoints. It could also be achieved by allowing residents to present their own narratives, as well as, challenging the status quo with regard to urban planning.

6 CONCLUSION

This paper has identified possible characteristics of the neighbourhood of the future, or Neighbourhood 4.0. The research in this paper has been prospective or speculative; this still needs to be tested through field work and case studies. The challenges neighbourhoods face now and emerging characteristics of the neighbourhood of the future will be instrumental in helping us understand how to improve the development of neighbourhoods in the future.

ACKNOWLEDGEMENTS

This research was funded by the CSIR project, B1JP400, Understanding urban futures: Shaping a neighbourhood level response (2018/19). We would like to acknowledge and thank our colleagues for their inputs into preparing this paper, specifically Tinus Kruger, Engela Petzer, Mark Napier, Thuli Ndlovu and Beth Crankshaw. We would also like to thank the anonymous referees for their insightful comments.

REFERENCES

- BMBF. 2017. *Industrie 4.0: Innovationen für die Produktion von morgen*. Bundesministerium für Bildung und Forschung, Germany, accessed 5 October 2018 <https://www.bmbf.de/pub/Industrie_4.0.pdf>
- Briavoinne, N. 1837. *Sur les inventions et perfectionnements dans l'industrie depuis la fin du XVIII^e siècle jusqu'à nos jours*. Mémoire couronné, Brussels, accessed 13 November 2018 <<http://books.google.com>>
- Britannica. 2018. *Industrial Revolution*. Encyclopaedia Britannica Inc, Chicago, IL, USA, accessed 13 November 2018 <<https://www.britannica.com/event/Industrial-Revolution>>
- Chakraborty A., Wilson B., Sarraf S & Jana, A. 2015. *Open data for informal settlements: Toward a user's guide for urban managers and planners*. Journal of Urban Management. 4(2), pp.74–91.
- Cooper A. K., and Du Plessis C. 2008. *Megacities*. Quest 4, pp.34–35.
- Cooper A, K, Schmitz P. M. U., Tshabalala N., and Whittle T. 2017. *Investigating food environments in selected areas of Tshwane*. Poster at the 37th International Symposium on Remote Sensing of Environment (ISRSE-37), Tshwane, South Africa, accessed 21 September 2018 <<http://researchspace.csir.co.za/dspace/handle/10204/9606>>
- CSIR. 2000. *Guidelines for Human Settlement Planning and Design*, (2 volumes). Report No. BOU/E2001, CSIR Building and Construction Technology, Pretoria. ISBN: 0-7988-5498-7, accessed 13 November 2018 <<http://researchspace.csir.co.za/dspace/handle/10204/3750>>
- Department of Justice. 2017. *Department of Justice Interface Programme*, Government of Northern Ireland, accessed 27 September 2018 <<https://www.justice-ni.gov.uk/articles/department-justice-interface-programme>>
- Du Plessis C., & Landman K. 2002. *Sustainability analysis of human settlements in South Africa*. Report prepared for the Department of Housing. CSIR Report BOU/C368, CSIR, Pretoria, South Africa accessed 28 September 2018 <<http://hdl.handle.net/10204/3522>>
- Engels, F. 1845. *Die Lage der arbeitenden Klasse in England*. Verlag Otto Wigand, Leipzig 1845, accessed 14 November 2018 <<http://books.google.com>>
- Engels, F. 1892. *The Condition of the Working-Class in England in 1844. With a Preface Written in 1892*. Translated by Kelley Wischnewetzky F. George Allen & Unwin Ltd, London. Reprinted 1943, accessed 13 November 2018 <<http://www.gutenberg.org/ebooks/17306>>
- Garbee, E. 2016, *The World Economic Forum is wrong. This isn't the fourth Industrial Revolution*. Slate, accessed 27 September 2018, <http://www.slate.com/articles/technology/future_tense/2016/01/the_world_economic_forum_is_wrong_this_isn_t_the_fourth_industrial_revolution.html>
- Geddes, P., 1915. *Cities in evolution: An introduction to the town planning movement and to the study of civics*. Williams & Norgate, London, accessed 13 November 2018 <<https://archive.org/details/citiesinevolutio00gedduoft/>>
- Gibberd J.T. 2013. *Neighbourhood facilities for sustainability*. WIT Transactions on Ecology and the Environment, 179, 225-234, accessed 28 September 2018, <<http://hdl.handle.net/10204/7316>>

- Glaser, M.A., Parker L.E., and Payton S. 2001. *The paradox between community and self-interest: Local government, neighborhoods, and media*. Journal of Urban Affairs, 23(1), pp.87-102.
- Glaser, M., van't Hoff M., Karssenbergh H., Laven J. and van Teeffelen J. 2012. *The city at eye level: Lessons for street plinths*. Eburon Academic Publishers, Delft. ISBN 978-90-5972-714-4.
- Griffin, E. 2013. *The 'industrial revolution': interpretations from 1830 to the present*. Draft chapter. School of History, University of East Anglia, Norwich. 19pp, accessed 13 November 2018 <<http://www.academia.edu/download/28147797/griffinindustrialrevolution.pdf>>
- GTA. 2018. *Maboneng Precinct*. Gauteng Tourism Authority, accessed 14 November 2018 <https://www.gauteng.net/attractions/maboneng_precinct/>
- Guzmán Araña S.G. 2014. *Smart sustainable cities – a road map*. ITU News No 4, International Telecommunications Union, accessed 22 February 2018 <<http://itunews.itu.int/en/5217-smart-sustainable-cities-a-road-map.note.aspx>>
- A.M. 1964. *An Ethos for the Age of Cyberculture*, Proceedings of the April 21-23, 1964, Spring Joint Computer Conference, Washington, DC, USA, pp 139-153, accessed 13 November 2018 <<http://doi.acm.org/10.1145/1464122.1464136>>
- Karuri-Sebina, G., Haegeman K.H., and Ratanawaraha A. 2016. *Urban futures: anticipating a world of cities*. Foresight, 18(5), pp.449-453.
- Landman, K. 2000. *The urban future: enclosed neighbourhoods*. Urban Futures Conference, Johannesburg, South Africa, accessed 28 September 2018 <<http://hdl.handle.net/10204/284>>
- Mokgukulushi A.M., Hattingh, M. and Cooper A.K. 2018, *Using Accessibility to Investigate the Level of Integration of the Various Public Transport Systems within the City of Johannesburg*. In: Proceedings of the AfricaGEO 2018 Conference, Kempton Park, South Africa.
- Napier, M. 2013. *Land and markets in African cities: Time for a new lens?* In: Trading Places: Accessing Land in African Cities. African Minds Publishing, Somerset West, South Africa, pp. 1-20.
- National Planning Commission. 2012. *National Development Plan 2030: Our future – make it work*. The Presidency, Pretoria.
- OUP. 2018. *Oxford dictionaries: The world's most trusted dictionaries*. Oxford University Press, accessed 27 September 2018, <<http://oxforddictionaries.com/>>
- Pandor, N. 2018. *Higher Education and Training Dept Budget Vote 2018/19*. <<https://www.gov.za/speeches/higher-education-and-training%E2%80%99s-2018-budget-vote-17-may-2018-0000>>
- Petzer, E. 2016. *Is Planning Paying Attention to "the future?"* Experiences in Eight South African Municipalities. Planning Africa Conference 2016, Sandton, p. 207-217, accessed 27 September 2018 <<http://researchspace.csir.co.za/dspace/handle/10204/9135>>
- Phaphana, H.M., Cooper A.K. and Wenhold F.A.M. 2014. *Determining the availability of, and access to, fresh fruit and vegetables in Arcadia and Eastwood, Pretoria*. In: Proceedings of the 10th International Conference of African Association of Remote Sensing of the Environment (AARSE 2014), Johannesburg, South Africa.
- Schoppe, W. 1982. *ICC Highlights from Philadelphia*. IEEE Communications Magazine, 20(6):38-39, accessed 13 November 2018 <<https://doi.org/10.1109/MCOM.1982.1091066>>
- South Africa. 2000, *Local Government: Municipal Systems Act (Act No 32 of 2000)*. G 21776, Government Printer, <<http://www.info.gov.za/>>

- South Africa. 2003. *Spatial Data Infrastructure Act (Act No 54 of 2003)*. G 25973, 4 February 2004, Government Printer, <<http://www.info.gov.za/>>
- South Africa. 2013. *Spatial Planning and Land Use Management Act (Act No 16 of 2013)*. G 36730, Government Printer, <<http://www.info.gov.za/>>
- Toynbee, A. 1884. *Lectures on the Industrial Revolution in England: Popular addresses, notes and other fragments*. Rivingtons, London, accessed 13 November 2018 <<https://archive.org/details/lecturesonindus01jowegoog/page/n4>>
- United Nations. 2015a. *We can end poverty: Millennium Development Goals and Beyond 2015*, accessed 20 September 2018 <<http://www.un.org/millenniumgoals/>>
- United Nations. 2015b. *Transforming our world: the 2030 Agenda for Sustainable Development*. Accessed 20 September 2018 <<https://sustainabledevelopment.un.org/post2015/transformingourworld>>
- United Nations. 2015c. *Sendai Framework for Disaster Risk Reduction 2015 – 2030*, accessed 30 September 2018 <<https://www.unisdr.org/we/coordinate/sendai-framework>>
- United Nations. 2017. *Sustainable Development Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable*, accessed 21 September 2018 <<https://sustainabledevelopment.un.org/sdg11>>
- United Nations. 2018. *About the Sustainable Development Goals*, accessed 20 September 2018 <<https://www.un.org/sustainabledevelopment/sustainable-development-goals/>>
- Van Niekerk, W., Petzer E, Ndaba, D., Pieterse, A., Raja, A., and Kruger, D.M. 2015. *Revising the South African guidelines for human settlement planning and design (the red book)*. In: Proceedings of the Smart and Sustainable Built Environment (SASBE) Conference 2015, 9-11 December, University of Pretoria, Pretoria, South Africa, pp.135-141.
- Wikipedia. 2018a. *Wikipedia. Home page*. Wikimedia Foundation, accessed 5 October 2018 <<http://en.wikipedia.org/>>
- Wikipedia. 2018b. *Neighbourhood*. Wikimedia Foundation, accessed 5 October 2018 <<https://en.wikipedia.org/wiki/Neighbourhood>>
- Wikipedia. 2018c. *Neolithic Revolution*. Wikimedia Foundation, accessed 5 October 2018 <https://en.wikipedia.org/wiki/Neolithic_Revolution>
- Wikipedia. 2018d. *Bronze Age*. Wikimedia Foundation, accessed 5 October 2018 <https://en.wikipedia.org/wiki/Bronze_Age>
- Wikipedia. 2018e. *Iron Age*. Wikimedia Foundation, accessed 5 October 2018 <https://en.wikipedia.org/wiki/Iron_Age>
- Wikipedia. 2018f. *Roman technology*. Wikimedia Foundation, accessed 5 October 2018 <https://en.wikipedia.org/wiki/Roman_technology>
- Wikipedia. 2018g. *Medieval renaissances*. Wikimedia Foundation, accessed 5 October 2018 <https://en.wikipedia.org/wiki/Medieval_renaissances>
- Wikipedia. 2018h. *Scientific Revolution*. Wikimedia Foundation, accessed 5 October 2018 <https://en.wikipedia.org/wiki/Scientific_Revolution>
- Wikipedia. 2018i. *British Agricultural Revolution*. Wikimedia Foundation, accessed 5 October 2018 <https://en.wikipedia.org/wiki/British_Agricultural_Revolution>
- Wikipedia. 2018j. *Industrial Revolution*. Wikimedia Foundation, accessed 5 October 2018 <https://en.wikipedia.org/wiki/Industrial_Revolution>

- Wikipedia. 2018k. *Second Industrial Revolution*. Wikimedia Foundation, accessed 5 October 2018 <https://en.wikipedia.org/wiki/Second_Industrial_Revolution>
- Wikipedia. 2018l. *Digital Revolution*. Wikimedia Foundation, accessed 5 October 2018 <https://en.wikipedia.org/wiki/Digital_Revolution>
- Wikipedia. 2018m. *Fourth Industrial Revolution*. Wikimedia Foundation, accessed 5 October 2018 <https://en.wikipedia.org/wiki/Fourth_Industrial_Revolution>
- Wikipedia. 2018n. *Industry 4.0*. Wikimedia Foundation, accessed 5 October 2018 <https://en.wikipedia.org/wiki/Industry_4.0>
- Yad Vashem. 2018. *The Ghettos*. Yad Vashem – World Holocaust Remembrance Center, accessed 27 September 2018 <<https://www.yadvashem.org/holocaust/about/ghettos.html>>