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SMART CITY 스마트시티 글로벌 저널 2022

TOP Agenda

Smart City Global Journal 2022

Urban Transformation and Carbon Neutrality in Smart Cities

KAIA Korea Agency for Infrastructure Technology Advancement

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Foreword

As the current pandemic continues to take a heavy toll on people's lives, we have entered into a new era of living with COVID, where we coexist with the COVID-19. Various schools of thought are beginning to shed some light on how our daily lives and the urban environment will interact differently under the name of New Normal. However, the role of a city where industry, technology, and people come together and our common response to global climate changes are the epitomai of the core values that remain true even in the face of unprecedented changes.

In addition, 2021 has been yet another year of extreme weather events. According to a recent report published by the Inter-governmental Panel of Climate Change(IPCC), the global warming rate has increased by up to 10 years than predicted three years ago, and the point at which the global average temperature reaches 1.5°C above that of the pre-industrial level could be as early as 2030.

Many experts point to carbon emission as the main culprit of global warming. Consequently, governments around the world are accelerating the development and implementation of decarbonization policies. More than 120 countries have declared carbon neutrality, and several cities have asserted their ambitious goal of achieving zero net carbon emissions by 2025.

머리말

코로나 팬데믹이 장기화되면서, 우리는 코로나와 공존하고 회복하는 '위드 코로나(With Corona)' 시대로 들어서게 됐습니다. '뉴 노멀(New Normal)'이라는 이름으로 맞이할 삶과 도시환경에 대해 여러 학자들이 다양한 생각을 제안하고 있습니다. 하지만 새로운 일상에서도 변하지 않는 가치는 존재합니다. 당대의 산업, 기술, 사람 등이 조합되는 도시의 역할과 기후 변화에 대한 공동의 대응은 변하지 않는 가치 중 하나입니다.

올해도 인류는 극단적인 기상 현상을 겪었습니다. 최근 기후 변화 정부 간 협의체 Inter-governmental Panel on Climate Change(IPCC)가 발행한 보고서에 따르면, 지구 온난화 상승 속도는 3년 전 예측보다 최대 10년 이상 빨라졌고, 지구 평균 온도는 산업화 이전 대비 평균 1.5℃ 오르는 시점이 빠르면 2030년이 될 수 있다고 예측하였습니다.

많은 전문가들은 지구 온난화의 원인으로 탄소 배출을 지목하고 있습니다. 이에 따라 각국 정부는 탈탄소 정책 마련에 속도를 내고 있습니다. 전 세계 120여 개 국가가 기후 위기 대응을 위한 탄소중립을 선언했고, 몇몇 도시는 빠르면 2025년까지 탄소의 순배출이 제로가 되는 도시를 만들겠다고 선언하였습니다.

Last December, Korea announced the 2050 Carbon Neutrality Strategy that includes expanding the use of clean power and hydrogen across all sectors, improving energy efficiency to a significant level, commercial deployment of carbon removal and other future technologies, scaling up the circular economy to improve industrial sustainability and enhancing carbon sinks.

As we progress toward becoming a carbon-neutral society, countries around the world are paying close attention to the role of smart cities that use cutting-edge technologies such as artificial intelligence, the Internet of Things, and big data. This is one of the reasons why countries participating in the 2021 P4G Seoul Summit, held in Seoul last May, declared that they would pursue a smart and resilient green city where mankind and nature coexist harmoniously.

At Presentation of Smart City Strategy Associated with Korean New Deal, President Moon, Jae-in declared that smart cities are the inevitable future and the core initiative of the Korean New Deal will be to accelerate the construction of smart cities in a way that combines the digital and the green.

Korea is also conducting the National Pilot Smart City projects in Sejong and Busan. It is expanding the Smart Challenge projects, in which local governments, citizens, private companies, and universities participate together, to 45 regions this year, making the program nationwide. It has also developed a ‘data hub model’ via National Strategic Smart City Program R&D and is demonstrating it in Daegu and Siheung. To support the successful deployment of these projects, Korea has introduced a Regulatory Special System(Sandbox) to freely test various smart city technologies and services. This sandbox system has lifted the burden of 34 regulatory hurdles and allows for rapid commercialization under certain

우리나라도 작년 12월, '경제구조의 저탄소화', '신 유망 저탄소 산업 생태계 조성', '탄소중립 사회로의 공정 전환' 등 3대 정책 방향에 '탄소중립 제도적 기반 강화'를 더한 '2050 탄소중립' 추진 전략을 발표하였습니다.

탄소중립사회로 가는 과정에서 세계 각국은 인공지능, 사물인터넷, 빅데이터 등 최첨단 기술을 활용한 스마트시티의 역할을 주목하고 있습니다. 지난 5월 서울에서 개최된 '2021 P4G 서울 녹색 미래 정상회의'에서 참가국들이 인간과 자연이 조화롭게 공존하는 스마트하고 회복력 있는 녹색 도시를 추구하겠다고 선언한 이유이기도 합니다.

'한국판 뉴딜 연계 스마트시티 추진 전략 보고 대회'에서 문재인 대통령께서는 스마트시티는 피할 수 없는 도시의 미래이며, 디지털과 그린을 결합한 한국판 뉴딜의 핵심 사업으로 스마트시티 건설에 속도를 낼 것이라고 말씀하셨습니다.

우리나라는 세종시와 부산시에서 국가시범도시 사업을 추진하고 있고 지자체 · 시민 · 민간기업 · 대학이 함께 참여하는 스마트 챌린지 사업을 올해 45개 지역으로 확대하여 우수한 솔루션을 전국으로 확산하고 있습니다. 또한, 스마트시티 혁신성장동력 R&D를 통해 '데이터 허브 모델'을 개발하여 대구시와 시흥시에서 실증하고 있고, 다양한 스마트시티 기술과 서비스를 일정한 조건하에서 자유롭게 실험하고 사업화할 수 있도록 규제 샌드박스 제도를 도입하여 34건의 규제 애로가 해소되었습니다.

스마트시티의 해외 진출도 점차 속도를 내고 있습니다. 정부 간(G2G) 스마트시티 협력 프로젝트를 발굴하고, 우리 기업의 해외 진출을 지원하는 국제 협력 사업인 'K-City Network 사업 국제공모'를 통해 올해 11개 사업을 선정하여 우리나라 스마

conditions.

The overseas expansion of smart cities is also accelerating. Through the K-City Network international competition, inter-governmental(G2G) smart city cooperation opportunities are discovered, and the international expansion of Korean companies is supported. Eleven projects were selected this year alone. Through the implementation of these projects, we are promoting and sharing our industry technology and experience abroad. Despite the pandemic, a total of 111 projects from 39 countries applied for this year's business competition, confirming the high interest in Korean smart cities.

Cities face diverse challenges. One solution cannot be applied to all cities. Therefore, smart cities that provide customized local services should play a key role, and urban problems must be resolved through a collective response, not by each city alone. This highlights the need to share the knowledge and ideas of global experts in expanding smart cities overseas.

In this journal, experts described national policies and practices that promote equality of access and optimize energy management efficiency by transforming urban structures into compact, self-sufficient communities in reducing carbon emissions. These efforts are being carried out at various levels of government, local government associations, and private sector organizations. Some experts emphasized smart city data-based decision-making and policy-making while stressing the need for essential citizen participation for the realization of a carbon-neutral society.

With the full support and cooperation of the Ministry of Land, Infrastructure, and Transport, Smart City Top Agenda 2022 was published to discover and discuss

트시티의 경험과 기업의 우수한 기술을 해외에 확산하고 있습니다. 코로나19 상황 속에서도 금년 사업공모에 39개국 총 111개 사업이 응모하는 등 한국형 스마트시티에 대한 높은 관심을 재차 확인할 수 있었습니다.

도시들이 직면하고 있는 문제는 다양합니다. 하나의 해결 방안이 모든 도시에 적용될 수는 없습니다. 그렇기 때문에 지역 맞춤형 서비스를 제공하는 스마트시티가 핵심적인 역할을 해야 합니다. 또한, 도시의 문제는 개별 도시가 아닌 공동의 대응으로 해결해 나가야 합니다. 우리가 스마트시티 해외 진출과 함께 글로벌 전문가들의 다양한 지식과 아이디어를 공유해야 하는 이유입니다.

본 저널에서 전문가들은 탄소 배출을 줄이기 위해 도시 구조를 압축적인 밀도의 자급자족 지역사회로 전환하여 접근성의 평등을 촉진하고 에너지 관리 효율을 최적화하는 각국의 정책과 사례를 설명하였습니다. 이러한 노력은 지방정부를 비롯해 지자체 연합회, 민간 전문기관 등 다양한 차원으로 전개되고 있습니다. 몇몇 전문가들은 탄소중립사회 실현을 위한 스마트시티 데이터 기반의 의사 결정과 정책 수립 그리고 그 과정에서 반드시 필요한 시민 참여를 강조하였습니다.

올해도 국토부의 전폭적인 지원과 협조를 통해 스마트시티의 미래 이슈 발굴과 담론 형성을 위한 「스마트시티 탑 어젠다 2022」를 발간하게 되었습니다. 어떤 도시는 미래를, 어떤 도시는 문제 해결의 실마리를 저널에서 찾을 수 있기를 기대합니다. 그리고 앞으로 다양한 분야 전문가들의 견해가 더해져 새로운 어젠다로 발전되기를 희망합니다.

future issues of smart cities. Some may find visions for the future of smart cities, while others may uncover clues to resolving their smart city issues through this journal. It is my sincere hope that the ideas and opinions of experts in various fields will contribute to the rebirth of of the new agendas.

Lastly, I would like to express my deepest gratitude to all those who participated in the publication of the Smart City Top Agenda 2022 and above all, to the domestic and foreign experts who delivered their insights through writing.

Thank you.

Park, Seung-ki

President of Korea Agency for Infrastructure Technology Advancement

마지막으로, 스마트시티 저널 발간 작업에 참여해 주신 모든 분들, 무엇보다 글을 통해 혜안을 전해주신 국내외 전문가 분들에게 깊은 감사의 마음을 전합니다.

감사합니다.

국토교통과학기술진흥원

박승기 원장

CONTENTS

The proximity revolution for a better life in the city*

더 나은 도시 생활을 위한 근접성 혁명

* This text is a free adaptation of "Urban life and proximity at the time of COVID-19", published in March 2020 as an e-book, by Editions de L'Observatoire, in Paris

Carlos Moreno

Professor Carlos Moreno is scientific director of the “Entrepreneurship, territory, innovation - ETI Chair” at IAE Paris, University of Paris-1 Panthéon-Sorbonne. Scientist recognized for his reflections, works and original proposals concerning urban issues, he is a pioneer of the “Smart City”, having brought a new look to this topic. Also engaged in the field to test his concepts, with a vast national and international ecosystem, he initiates or participates in multiple activities, bringing together experts from around the world to promote the transformation of lifestyles and urban spaces and meet the challenges of cities, metropolises and territories in the 21st century. He received the 2019 Prospective Medal from the Academy of Architecture and the OBEL award in October 2021.
https://www.dezeen.com/2021/10/26/15-minute-city-carlos-moreno-obel-award/

ABSTRACT

Rethinking urban life in a world of massive disruptions (climate change, air pollution, nature, water biodiversity and now the Covid-19) has become one of the greatest challenges of the 21st century. To face these crisis, we must urgently address lifestyles and mobility, move away from the omnipresent car and the petroleum era and question what kind of city we really want to live in.

The proposition of Professor Carlos Moreno is the “fifteen-minute city”, in a compact zone (or the “half-hour territory” in a semi-dense or sparse zone) where inhabitants can access all their essential needs of life: living, working, supplying, caring, educating, enjoying. The fifteen-minute city addresses the key components required for a sustainable world (ecological, social, economic) and integrates the concepts of chrono-urbanism, chronotopia, and topophilia. This reinvention of proximities utilizes the convergence of open data, digital mapping, geolocation and the massification of new services. Nevertheless, citizens and their quality of life are always at the heart of the 15-minute city. It is thus a polycentric city which combines urban intelligence, social inclusion and technological innovation and ultimately defines itself as an urban life planning.

Paris is among the world’s first cities to have implemented the 15-minute city, where it is famously quoted as the “big-bang of proximities”. It has recognized this innovative approach based on a global and systemic vision of the city in order to meet the fundamental needs of its inhabitants and to urgently address the unprecedented challenges it is facing today.

KEYWORDS

15-minute city, 30-minute territory, Covid-19, climate change, interdependencies, complexity, living cities, time and urban spaces, urban life planning, urban rhythms, carbon-free mobility, hyper-proximities, biodiversity, shared services, urban commons, chrono-urbanism, chronotopia, topophilia, urban intelligence, social inclusion, common good

초록

기후변화, 대기오염, 자연, 물, 생명 다양성, 코로나19까지 엄청난 혼란의 시기가 도래하였으며, 이러한 시기에 도시 생활 방식을 재고하는 것은 21세기 우리가 당면한 중요한 과제이다. 기존의 자동차와 석유 중심 사회에서 벗어나, 우리가 진정으로 살고 싶은 도시가 어떤 곳인지 생각해보고, 나아가 우리의 생활방식과 이동 수단에 대해 근본적인 질문을 던져야 한다. 이와 관련하여 필자는 15분 도시 혹은 30분 도시를 제안한다. 15분 도시(혹은 30분 도시)란 밀집된 도시에서 살아가는 주민들이 삶에 필수적인 주거, 노동, 공급, 돌봄, 교육 및 여가 서비스에 15분(혹은 밀도가 다소 낮은 지역의 경우 30분) 이내에 접근할 수 있는 도시 구조를 의미한다.

15분 도시는 생태적, 사회적, 경제적으로 지속가능한 세계에 필요한 핵심 구성 요소들과 크로노-어바니즘*Chrono-urbanism*(도시민들의 시간 우선주의), 크로노토피아*Chronotopia*(장소의 다목적성) 및 토포필리아*Topophilia*(장소애-場所愛) 개념을 하나로 아우르는 핵심 개념이기도 하다. 15분 도시와 같은 도시 근접성에 관한 새로운 접근 방법은 공공 데이터, 디지털 지도 작성, 지리 위치 정보 및 새로운 서비스의 대중화를 기반으로 이루어질 수 있으며, 이는 시민과 그들의 삶의 질을 높이는 것을 근본 목표로 한다. 즉, 15분 도시는 도시 지능화 기술, 사회적 포용, 기술 혁신이 하나로 융합된 다중심 도시*Polycentric city*를 뜻하며, 동시에 도시 생활 계획*Urban life planning* 그 자체인 것이다. 파리는 15분 도시를 선도적으로 시행한 도시 중 하나로 '근접성 빅뱅'*Big-bang of proximities*으로 회자되고 있다. 15분 도시는 거주자들의 근본적인 수요를 충족하고, 오늘날 직면한 예측할 수 없는 도전들에 대응하기 위한 글로벌하고 체계적인 도시 비전을 기반으로 한 혁신적인 접근으로 인식되고 있다.

키워드

15분 도시, 30분 도시, 코로나19, 기후변화, 상호의존성, 복잡성, 살아 있는 도시, 시간 및 도시 공간, 도시 생활 계획, 도시 리듬, 무탄소 이동, 초-근접성, 생물 다양성, 공유 서비스, 도시 커먼즈, 크로노-어바니즘, 크로노토피아, 토포필리아, 도시 지능화, 사회적 포용, 공유재

Rethinking urban life

Here we are, since the appearance of the coronavirus, brutally plunged into the hardest health crisis in modern history.

Paradoxically, this global threat also acts as the revealer of a major fact of this century: the strength of cities, the expression of their power, which is at the heart of the violent disruption of the system in all regards. Yes, the 21st century, that of cities, metropolises, megalopolises, as an expression of the urban reality, brings with it other expressions of dysfunctions, which become of major importance through their capacity of massively disrupting urban life. In a world where life is based on interdependencies, we have never witnessed such a demonstration for the key principles of complexity. Indeed, at the level of urban life, on the whole planet, this axiomatic, which we have been repeating constantly for so many years, proves to be perfectly illustrated: we live in living cities, at the same time imperfect, incomplete and fragile.

For the first time, we must reflect and act on the health of citizens, by not only providing them with medical care, but also by offering them a different rhythm of life, another sociability.

With climate change and its visible effects - heat waves, air pollution (which has serious consequences for urban health), the place of nature, water, biodiversity, and now the viral spread of the Covid-19, we are facing the essential urban challenges for the years to come. The challenge that this crisis reminds us of is that of a radical change in lifestyle, here and now. Living differently today is, above all, modifying our relationships with time and urban spaces, it is questioning our mobility, the reason behind our trips. Transport times have already contributed to a serious deterioration in the quality of life and are also becoming a new urban health threat.

Our world cities, everywhere on the planet, still concentrate most of the human activity, but they are still carried by the paradigm of the petroleum era and its impacts on roads and urban planning in general. The era of the

omnipresent car, associated with a lifestyle based on the ownership of a vehicle as an element of social status, is still present, but it is wavering. There is a growing awareness of our cities which have become unbreathable through the triple effect of the emissions produced by buildings, heating and cooling networks, and full-on petrol transports.

At the time of Covid-19, which is locking down urban life with physical distancing as the only way to stop its virality, we wonder: how to offer urban residents a peaceful city while satisfying its essential urban social functions?

How then can we reconcile the irreversible development of an urban world with the imperative needs linked to a real quality of life, now that, for an unknown time, we are going to live with this planetary viral threat which is shaking the planet?

The key question keeps coming up: what city do we want to live in?

It is time to move not towards city planning, but towards *urban life* planning.

My proposition: the "fifteen-minute city", in a compact zone (or the "half-hour territory" in a semi-dense or sparse zone), hyper-proximity, "accessible" to all and at any time···. The one where, in less than 15 minutes, an inhabitant can access his essential needs of life: live, work, get supplies, take care of himself, educate himself, enjoying himself. Living with the Covid-19 now requires us to have an ambitious urban policy to implement this radical transformation of our lifestyles. Preserving our quality of life requires relationships that must profoundly change between these two essential components: time and space.

In his book *Triple Zero*, Professor Muhammad Yunus, Nobel Peace Prize laureate, talks about a world with "zero carbon, poverty and exclusion". He then refers to the three inseparable strands of life that have become predominantly urban: ecological, social, economic. None of these three components should be overlooked if we are talking about a truly sustainable world. The complexity taught by the great universal intellectual Edgar Morin leads us to think of their intersections. The one between ecology

and the social is a livable world; between ecology and economics, a viable world; between the social and the economy, a fair world. Yes, a sustainable world is at the intersection of a livable, viable and just world.

The energy transition, with the paradigm shift towards carbon-free and renewable sources, is a priority, of course, but when transport has become the first CO_2 emitter, it is a question of meeting the requirements of the sustainable city in terms of energy by going far beyond, by questioning our urban rhythms.
A new chrono-urbanism must be at the heart of our roadmap for the coming years, to propose, build other rhythms of life, other ways of occupying urban space to transform its use, to access essential urban social functions. It is a question of operating a transformation of the still highly monofunctional urban space, with the city center and its various specializations towards a polycentric city, meshed, connected, reconciled with nature, refreshed, peaceful, benefiting from real public spaces for all, in order to offer this quality of life in short distances, that of the six essential urban social functions. By promoting urban planning through uses that fight against automobile dependency and avoid long journeys by public transport, we reintroduce a choice of proximity, a de-mobility reducing great tensions through active mobility, on foot or by bicycle.
This is a challenge that concerns all the players in urban life and which requires everyone to reconsider their role in this urban life in order to open up to other horizons, carrying a high quality of societal life.

It is then a question of bringing the inhabitant's demand closer to the offer, of ensuring a functional mix by developing social, economic and cultural interactions, of ensuring a reasoned densification, desaturating it by increasing public meeting and mixing spaces, transforming streets into carbon-free mobility spaces and thus be present there, to live there; it is discovering on foot or by bike, reinventing new hyper-proximities, rediscovering biodiversity in one’s place of life by encouraging short circuits. But it also means optimizing the range of services thanks to digital tech-

nology and collaborative and sharing models.

It is a question of turning digitalisation into a factor of social bonding, of inclusion and not into a factor of exclusion or a generation of "*zombie-geeks*", those who are massively connected and socially disconnected, with the corollary of bubbles and *fakes*, taken as "*a priori* truths".

It is also to link our hyper-proximities in order to live in our cities with new generation public services, close at hand, multimodal and shared services. It is also the challenge of reinventing and enhancing urban commons.

More than ever, this hyper-proximity will be a source of new economic and social models in our cities, now emerging. To rediscover the urban life of proximity, is to leave suffered mobility for chosen mobility. It is another way of living in the city, so that the social bond found with proximity becomes part of this high quality of life. It is to give back to the city that which is most precious: to be a universe of life; may it find again its metabolism, like any living organism; it is to make the city alive and for everyone.

Rethinking the living in the city

In this approach, yes, plants and biodiversity, which are part of life, are essential. This is the concept of "organic density". The mineral density has dehumanized the city. It has become soulless and has been transformed into a place of passage and even a source of promiscuity carrying social and human tensions of all kinds. Being a source of discomfort and a very strong deterioration in the quality of life, it must give way to this "reasoned", "pointillist" organic density. Immersed in plants, dotted with "green connectors" with living materials present, both in construction and throughout the life cycle, this organic density goes hand in hand with the need for social intensity, favored by quality planning that facilitate a life that breathes, that connects people. Indoor green spaces, roofs, intermediate spaces and streets, squares create conditions to promote social bonding,

essential to embody life.

This massive presence of the organic world, of biodiversity, of nature captures carbon, and also participates in the metabolism of the whole of urban life. But plants are also a factor of attractiveness and quality in human relationships in the city. Beyond capturing carbon, plants also stabilise humans. All studies show that the compact city, even a very dense one, which has been able to integrate plants in the universe of daily life, is a city whose inhabitants reduce the so-called “escape routes” to find green spaces. This therefore has a direct effect also on mobility, and goes in the direction of improving chrono-urbanism, of the “fifteen-minute city”, allowing inhabitants to benefit from a high quality of societal life, by staying within a fifteen-minute perimeter from home.

Vegetation and hydrology go hand in hand. Managing water resources is one of the concerns that must be at the heart of urban life today. One of the major needs to be addressed in the next decade is a change in attitude towards the life cycle of city water. With the “fifteen-minute city”, the local network, the reinvention of chrono-urbanism, takes on its full meaning and becomes strategic when the convergence of vegetation, nature and water projects itself into the urban transition to this high quality of societal life.
Yes, with climate change, heat waves, more and more visible water stress, air pollution which has serious consequences on urban health, the place of the urban living space, useful time and the role of digitization are essential new challenges for the years to come.
It is a new way of exploring this world of the transformation of life, which are the urban commons of social functions which are essential in order to territorialize in short-distance multi-centralities: living, working, supplying, caring, educating, enjoying. Yes, because the awareness of the growing challenges for our urban commons is at the heart of our future choices in this new period of coexistence with the Covid-19: with water, air, shade, space, time and silence, they will be at the heart of new urban battles.

Rethinking the life time

Thinking about *chrono-urbanism* means questioning in depth what the city offers residents for the use of their life time. The legacy of Fordism, a lifestyle based on a very strong specialization, with a spatially segmented urban life, has resulted in the "theft" of what is most precious to men, our useful time. The Covid-19 crisis has brought a new perspective into our relationships with our life time, which have been transformed under the constraints of the confinement. Other ways of being present in time have emerged. But what time, in fact, are we talking about?

The observation is overwhelming. The form taken by the city and the way it has taken over our lives has meant that it is the very notion of time that has been taken from us in favor of its only visible facet, that of linear time. We have become prisoners of the clock that marks the pace of urban life, with its obligations resulting in almost permanent accelerations. But is this the only time we have available as a substance of life? That of a subtle but very real bondage, which seems elastic to us but which we must in reality consume willingly or by force in order to manage above all the need?

In Greek mythology, where we draw our roots from, Chronos is a God embodying *Time* but he is also *Destiny*. He unites with the Goddess Anankè, the *Necessity*. Of their three children, Chaos represents the unmanageable, the disorder, the desolation. This triptych "Linear Time - Necessity - Chaos" thus came to obscure the other expressions of Time for among the Greeks there were two other embodiments of time, much less known. *Kaïros*, the time of opportune creation, that of the instant when action crystallizes, that of the depth of the instant, and *Aiôn*, that of the force of life, of immanence, of individuation, of unlimited lifespan.

The crisis of our predominantly urbanized societies leads us to return to the sources of this notion of life time. Faced with the climatic danger, which threatens the very survival of our civilization at the end of this century and

is already disrupting our lifestyles, faced with the 6th mass extinction of biodiversity and its consequences on our environment, violently affected by the viral pandemic, urban life is at the heart of the problem, and it can only be the source of the solution. Becoming aware of the existing dissociation between space and time is a key step in order to be able to question, in depth, our lifestyles, production and consumption, including our journeys which are big consumers of linear time and are ultimately just a corollary. The challenge is then to understand that linear time, *Chronos*, has lost a large part of its inner soul, that of our humanity, of our vital breath, the time of *Aiôn*, which regenerates us, and of another, that of the creative flame, of the moment when everything changes when creativity is at the rendezvous, of the seized opportunity, the time of *Kaïros*.

The city then becomes a place that we can look at differently if it offers us the possibility of meeting these two other dimensions of Time. This is actually the real issue that is currently unfolding before our eyes and the shock wave of the Covid-19 crisis puts us on the brink. *In which city do we want to live?* That, according to the current utilitarian way of life, based on segregation and the separation between space and life time, which leads us to remain in acceleration, to live only in an exhausting linear time, which inevitably empties its hourglass ? Or otherwise, according to another way of life, that which allows us to make *Kaïros* visible, as a moment of creation and to rediscover our humanity with the time of *Aion*, our deep inner and social breath, giving another dimension to our actions? This city, offering a wide range of possible places, is another way of offering ourselves to us. With a functional utilitarian urbanism, the urbanism based on uses thus takes on its full meaning.

Through a sublime imaginary dialogue between Marco Polo and Emperor Kublai Khan, Italo Calvino, in *The Invisible Cities*, takes us along this path: “Cities, like dreams, are made of desires and fears, even if the thread of their discourse is secret, their rules are absurd, their perspectives deceitful, and everything conceals something else. You don't enjoy a city because

of its seven or seventy-seven wonders, but because of the answer it gives to one of your questions."

Finding a new convergence between space and time actually goes beyond *chrono-urbanism*, because it is really about finding the desire for a city and fighting against the fears that it generates and that we amplify. This is why two other elements are essential, chronotopia and topophilia.
Chronotopia brings together our spaces and our lifetimes to make visible the talk of the city, to grasp the rules of common life and to socialize the places which we live in, making them flexible and multi-use. It is by this proximity that we can be freed from the grip of linear time, *Chronos*, to find the interstices that make visible the Time suitable for creativity, the *Kaïros*.

It is in this approach that we find the deep meaning of the "fifteen-minute city", of the city of proximities, of the city of short distances. It's about breaking the rhythm of linear time, *Chronos*, the chronometer that measures, quantifies and regulates the use of our life time. It is in this way that we become aware that other times exist, that of *Kaïros*, creativity, the link with the other, the discovery of resources, which were invisible and which become so many opportune moments. So many opportunities to seize in this proximity made and become accessible. And this is indeed the meaning in Latin, of *Kaïros, Opportunitas*, to grasp as its winged incarnation which takes us on a journey, that of the time of creativity.
This is also why the fifteen-minute city is the opposite of social grouping and constitutes on the contrary the opportunity to get rid of constraints, to transform each place into a multitude of possibilities, where each one leads to another, like a succession of new openings. One place, several uses, each use, new creativity.

It remains for us to give its place to the other indispensable time, that of immanence, of the Unlimited lifetime, of each one's dignity, that of growing as a human deep from within, the Time of *Aion*. It signifies us by be-

coming aware of what we are, and it magnifies the places where we live. It is therefore the love that we carry within us, which is expressed through the love of the places we frequent, which are part of us. It's the love of places, the love of the possibilities of each place, the love of life in each of these places. It is the *topophilia*, so that our experience becomes perennial and turns into a positive story; so that memory is part of our present and it guides our future. Because by thus being aware of where we come from, we then help shape where we are going. It is the essential foundation of new urbanities, the respect for places and objects. This is the guiding principle so as not to soil the ground, not to scuttle the public good, to respect the common good, not to take over a private good. Topophilia is a powerful vector for the appropriation of a living memory, of an encounter between myself, my sociability and the places around me. Paraphrasing, Augustin Berque, quoting in the *Ecoumène* Jean-Marc Besse, "between me and myself there is the city". Because the more I discover it, the more it is part of me, I embody it myself and therefore I protect it. *Topophilia* as a collective tool is an instrument which allows us to channel our affections towards places, around a common frame of life.

Chrono-urbanism, chronotopia, topophilia, three concepts that converge around the city of 15 minutes to allow us to experience an infinity of places of urban possibilities. It is not an instantaneous transformation, it is an ambition, a roadmap, a path. It is a journey to embody the places, to find humanity at the end of the street, to give a heart to the heart of the city.

It is the challenge of shifting our gaze towards what we are, to our lifetime, to get out of the inevitable linearity of the chronometer, of the watch and to give time the other components that make us a real creative humanity, with dignity, otherness and compassion.

Rethinking digital technology

From birth to death, the urban world is mainly the universe, space and time of humans. Being born in a city is already belonging to an urban culture, imbued with the rhythm and way of life of cities, metropolises, megalopolises, of these urban concentrations which have become world cities. From childhood to adolescence, the transition to adulthood and aging, several urban worlds of life coexist.

In contrast to a technocentric approach to "smart" cities, because they are the custodians of a significant silicon / algorithms per square meter ratio, for urban intelligence it is the quality of life in the city which must be at the heart of any approach to innovation. Developing urban life, rediscovering nature, biodiversity and reclaiming useful time, lifetime, means proposing new uses in this proximity to be reinvented, with the contributions of the major technological revolutions in progress, affected by digital technology.

The real challenges of urban transformation are ecological, social and economic, around citizens, humans, for a peaceful, polycentric and meshed city. Technology thus becomes a powerful lever to develop this transformation.

The twenty-first century brings to life, for the first time, four major technological revolutions simultaneously: digital, biosystem, robotics and nanotechnology. These revolutions raise new challenges in this century which are now crucial to reflect on. The digital revolution, in particular, is profoundly changing the urban phenomenon around the world. This dimension brings us to add a new element to qualify the city of the 21st century, the ubiquity or the ability to benefit from a technological connection anytime, anywhere, permanently. We have seen with the Covid-19 the major impact that digital technology plays for teleworking and to maintain sociability which is physically restricted.

Today we are witnessing the convergence of open data, digital mapping,

geolocation and the massification of new services. What is interesting at the moment is not only the fact that the data is open, but that they themselves become sources of knowledge and social objects. Immersed in a socio-territorial environment, the data mobilizes energies and thus gives rise to new services and uses. Transport on demand, car sharing, multimodal mobility, decentralized energies, heritage enhancement, urban public spaces of conviviality, personalized public health, better quality of life for the third and fourth age, online mass education, open spaces for culture, of art and leisure, participatory democracy under open governance systems, collaborative information systems···. These are some examples of services that will make life easier in the local city, in the polycentric city, which are being born today. Today, finding this lively city, dear to the philosopher of architecture and town planning Jane Jacobs, but combining urban intelligence, social inclusion and technological innovation.

"An infinite sphere, the center of which is everywhere, the circumference nowhere."

Jane Jacobs supported the living city, in the neighborhoods, with mingling in all its forms. She opposed the functionalist vision of the city, made of artificial separations. The streets had eyes, and a continuous presence was the sign of its beating heart, with the hearts of its people.

The "fifteen-minute city" is thus living spaces everywhere, a place, several uses, and for each use new possibilities for all: it is the polycentric city, in the manner of the sentence of Pascal, "An infinite sphere, the center of which is everywhere, the circumference nowhere". Infinitude is that of the proposed uses, of the polymorphic infrastructures: finding peaceful, vegetated streets, places of the common good, mobility by walking or cycling; do your shopping and access multiple services near you; make school the capital of the neighborhood; have nearby health centers; create citizen kiosks open to all, transform a nightclub into a gym in the afternoon, turn a cinema into a linguistic workshop, transform a theater into a place of train-

ing for learning French, have a sports center that hosts tutoring activities, make repair workshops for objects in a local business, bring art and culture back to the street with artistic platforms, bring to life the historical memory and heritage with digital technology and multimedia, opening music kiosks, bringing artists out and creating spaces where they can meet, express themselves, from amateurs to professionals and from actors to clamors and graphic designers. Bring the street to life as a vast place of exchange, creation, transmission, mixing, so as to no longer be an anonymous place of passage for people in a hurry, who ignore each other. It is a participative and supportive city with a constant proliferation of citizen initiatives.

The “fifteen-minute city”, the city of proximity, we want it as a vast network of places so that useful time is a lifetime. It’s another way of living, consuming, working, being in town. It also means rethinking the way to move, to cross the city, to explore it, to discover it. The existing equipment will have different functions, users, customers according to the day and the hour. It is by this life of proximity that we can take back time for ourselves, for our family, loved ones, neighbors, friends and take care of the most fragile.

Our goal is to offer these multifunctional features, either face-to-face or where appropriate, via digital technology, making it possible to reduce the trips required to access them. Beyond the square meters already built, we want to make proximity within everyone's reach by discovering its neighborhood, optimization and simplified access to local resources. We want this proximity to also be one of social mixes to promote meetings, intermingling, fight against any segregation and against any discrimination, that also of mutual aid, solidarity, sharing, caring for others, which allows the most vulnerable to benefit from the support of their neighborhood.

Rediscovering these proximities also means making oneself resilient in the face of these serious disturbances that will occur regularly in our life universes where promiscuity is often present. Yes, giving the dense city an expression of organic and social life on a human scale, to find the hu-

man with his heart at the end of the street, is above all the strength of the "fifteen-minute city". We want to reconcile our way of living in the city with the concerns of sustainable development, the fight for the climate and biodiversity, and the preservation of urban health.
The "fifteen-minute city", the "half-hour territory", are proposed approaches to build another way of living in the face of unavoidable quality of life issues. The real urban and territorial resilience will be that of polycentric life, of the real rediscovery of proximity in all its aspects, of the development of the city of short distances, of regions and territories with multipolar frames.

For us who work on chrono-urbanism, chronotopia, topophilia as powerful tools to change paradigm, to change the rhythm of life in the city, to find a new convergence of useful time and urban spaces, to love proximity and our places of life, we say yes, polycentralities are more than ever at the heart of the changes to come, to live differently.

A big-bang of proximities in Paris

Like all metropolises, Paris is constantly changing. It is complex, has its metabolism, born of the interaction of multiple systems that make it up, and faces new challenges: climate change, ecological transition, changes in lifestyles, competition and cooperation between cities and metropolises.

Paris must respond in a visionary and, at the same time, agile and pragmatic way. The 15-Minute City is above all the construction of services, uses and common goods that meet the fundamental needs of its inhabitants and their quest for well-being. It is an innovative approach based on a global and systemic vision of the City in the medium and long term to develop the quality of life of citizens, bringing together three significant levers to transform life in the City: developing social links and creating value, reinvent-

ing urban infrastructures, and relying on technological revolutions, mainly digital technology.

In Paris, we propose an urban project that responds particularly well to the health crisis's constraints. It allows us to live in the city without being exposed to the risks of the masses, a breeding ground for viral propagation, whilst developing the intensity of social ties. It is a Paris, a proximity city, favoring the integral quality of life in more shared, accessible, versatile, multi-service urban spaces to develop a city where we can access essential needs within short distances. We want to make proximity accessible to everyone by discovering one's neighborhood, optimization and simplified access to local resources.
By promoting urban planning through uses that fight against automobile dependency and avoid long journeys by public transport, we reintroduce a choice of proximity by active mobility, on foot or by bicycle. We want to reconcile our way of living in the city with sustainable development concerns, the fight for climate and biodiversity, and the preservation of urban health.

Our goal is to offer these multifunctional features, either face-to-face or, if necessary, via digital technology, making it possible to reduce the trips required to access them. We want this proximity to be one of social mix to promote meetings, intermingling, fighting against any segregation or discrimination, mutual aid, solidarity, sharing, caring for others, which allows the most vulnerable to benefit from the support of their neighborhood.

With the 15-Minute City, we want to propose in Paris extensive uses of the polymorphic infrastructures: finding peaceful, vegetated streets, places of the common good, mobility by walking or cycling; do your shopping and access multiple services near you; make school the capital of the neighborhood; have nearby health centers; create citizen kiosks open to all, transform a nightclub into a gym in the afternoon, turn a cinema into a linguistic workshop, transform a theatre into a place of training for learning French, have a sports center that hosts tutoring activities, make repair workshops

for objects in a local business, bring art and culture back to the street with artistic platforms, bring to life the historical memory and heritage with digital technology and multimedia, opening music kiosks, bringing artists out and creating spaces where they can meet, express themselves, from amateurs to professionals and from actors to clamours and graphic designers. Bring the street to life as a vast place of exchange, creation, transmission, mixing to no longer be an anonymous place of passage for people in a hurry who ignore each other. It is a participative and supportive city with a constant proliferation of citizen initiatives.

The 15-Minute City is not a magic wand. It must be adapted to the local conditions of each city. Paris is both a world city and a city that is unbalanced between east and west, north and south. There are rebalancing measures to be taken, particularly in terms of the economy, housing and work.
To respect the equality of all Parisians, the concrete realization of the idea of the city of the 15-Minute City will require, in the long term, an intervention on the whole of Parisian territory so that the inhabitants all have access to a 'common base' constituting the 15-Minute City.
The city of the quarter of an hour also involves adapting the shops. The aim will be to strengthen the local shops and services network and encourage local production and/or short circuits with the "Fabriquer à Paris" label (shops and food halls, cultural shops, recycling centres, crafts, concierge services, manufacturing spaces and urban logistics).
Of course, nothing can be done without the opinion of the inhabitants of the districts. It is their neighbourhood, so their consent is needed. Therefore, Paris will first carry out an intervention in pilot areas: the city will identify, together with the arrondissement town halls, the neighbourhoods that require rapid and extensive action. An exhaustive analysis of local public, associative or private facilities and services, existing or created, will be conducted with the borough councils in these neighbourhoods. A consultation of the inhabitants and users of the area on their needs and ideas will also be undertaken. Then, the necessary services will be created.
To create this 'common base of services', the general idea is not to system-

atically build or establish new facilities specific to each district. It is more a question, when possible, of transforming existing places so that they can be used for several activities rather than just one. This transformation of spaces could be based on three main themes: school, culture and participatory democracy.

Thus, the concept of the 15-Minute city would not only promote the well-being of inhabitants by simplifying their lives and the city but would also constitute a possible response to future health and climate challenges.

How Great Cities Happen:

Integrating People, Land Use and Transport

위대한 도시는 어떻게 출현하는가:
사람, 토지 이용, 교통의 통합

Roz Hansen

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ABSTRACT

The writing of How great cities happen – integrating people, land use and transport had its beginnings in the authors' involvement in the preparation of Plan Melbourne 2017-2050, a land use transport strategy guiding the future growth and development of metropolitan Melbourne, Australia. Our work generated a broader agenda into thinking about city futures and what makes a great 21st century city. Investigating strategies, policies and initiatives of cities such as Vancouver BC, London, Melbourne, Malmo, and Freiburg im Breisgau in Germany the book's primary focus is about land use transport planning being delivered in an integrated, interconnected and sustainable way.

To understand the concept of a good city is complex and challenging. Drawing from our book this paper highlights some of the different approaches as to how cities have sought to integrate land use and transport planning. What is evident in these cities is the importance, at the outset, to have a clear vision of the kind of city that is desired in terms of its spatial pattern, urban form and structure. Understanding the needs and aspirations of the communities living in cities and the social, economic and environmental composition and anticipated structural changes within the city all influence land use transport planning outcomes. Transport acts as an enabler and facilitator of change that supports the vision and its goals.

The paper focuses on five main areas they being economic productivity and job accessibility, social inclusion, affordable housing, urban environmental performance and governance and funding arrangements. It advocates for the city of 20-minute neighbourhood and how integrated land use transport planning can enhance social sustainability at the neighbourhood and metropolitan scales. With many cities facing issues of homelessness, lack of affordable housing, structural economic changes and adverse impacts of climate change this paper provides ways of addressing these issues.

KEYWORDS

Integrated land use transport planning, economic productivity, social inclusion, vision statement, 20-minute neighbourhood

초록

『위대한 도시는 어떻게 출현하는가』라는 책은 저자들이 멜버른 메트로폴리탄의 미래 성장과 개발에 지침이 되는 토지이용교통전략*land use transport Strategy*인 '2017~2050 멜버른 계획*Plan Melbourne*'의 수립에 참여하면서 시작되었다. 이 연구는 도시의 미래와 '무엇이 21세기의 위대한 도시를 만드는가'에 대해 생각하기 위한 광범위한 어젠다를 도출했다. 캐나다 밴쿠버, 영국 런던, 호주 멜버른, 스웨덴 말뫼, 독일 프라이부르크와 같은 도시의 전략, 정책, 이니셔티브를 조사한 이 책의 주요 초점은 통합되고 상호연결되며 지속가능한 방법에 의해 도출된 토지이용 교통계획에 있다.

좋은 도시라는 개념을 이해하는 것은 복잡하고 어려운 일이다. 앞의 책을 토대로 작성한 이 리포트는 도시들이 토지이용과 교통계획의 통합을 추구하면서 사용해 온 다양한 접근법들을 조명하고 있다. 이들 도시의 사례에서 분명히 드러나는 것은 처음부터 도시의 공간 패턴, 도시형태, 도시구조란 측면에서 목표로 하는 도시의 유형에 대한 명확한 비전을 갖는 것이 중요하다는 점이다. 도시 내 공동체들의 열망과 욕구, 사회적, 경제적 그리고 환경적 구성요소들과 도시 내에서 예견되는 구조적 변화들이 모두 토지이용 교통계획의 결과에 영향을 미친다. 교통은 도시의 비전과 목표를 지지하는 변화의 조력자이자 촉진자로서 역할을 한다.

이 글은 경제적 생산성과 직업 접근 가능성, 사회적 통합, 적정가격 주택, 도시환경 성과와 거버넌스, 자금 조달의 5가지 주요 분야에 초점을 두고 있다. 또한 20분 도시*20-minute neighbourhood*와 통합된 토지이용 교통계획이 어떻게 근린생활권과 대도시 규모에서 사회적 지속가능성을 강화할 수 있는가에 대하여 주창한다. 많은 도시들이 노숙자 문제, 적정가격 주택의 부족, 경제구조 변화, 기후 변화라는 부정적 영향에 직면한 상황에서 이러한 문제들에 대한 대응 방법을 제시하고자 한다.

키워드

통합적 토지이용 교통계획, 경제적 생산성, 사회적 통합, 비전 선언, 20분 도시

INTRODUCTION

Much has been written about what constitutes a 'good' and even 'great' city. The concept is highly value-laden. The starting point in shaping and influencing the social, economic and environmental performance of a city is having a clear vision of the kind of city that is desired and then to use transport and other measures to help deliver that vision (Cervero, 2014). Vision statements and goals invariably underpin city strategic planning.

The Metro Vancouver 2040 regional growth strategy for the Greater Vancouver Region, BC vision statement is highly aspirational by aiming for:

'the highest quality of life embracing cultural vitality, economic prosperity, social justice and compassion, all nurtured in and by a beautiful and healthy natural environment' (Metro Vancouver, 2020).

The strategy adopts five goals – create a compact urban form; support a sustainable economy; protect the environment and respond to climate change impacts; develop complete communities; and support sustainable transportation choices. The strategy's focus on developing medium and higher density mixed use development at transit nodes and along transit corridors has played a vital role in Vancouver's land use transport integration narrative.

A similar approach has been adopted in London, UK where transport plans are closely linked to social and environmental outcomes such as future job growth and public health. Of particular interest is Freiburg im Breisgau, Germany. Its vision statement - 'a city of short distances' – is similar to that of complete communities and 20-minute neighbourhoods. The emphasis in this compact, small university city is the provision of active modes of transport (walking, cycling and public transport) including high frequency

tram, train and bus services, car free zones, grouped car parking where needed and shared walking and cycle networks. For Melbourne, Australia the vision statement as outlined in *Plan Melbourne 2017-2050* is that

'Melbourne will continue to be a global city of opportunity and choice' (Victoria State Government, 2017).

Plan Melbourne identifies seven key outcomes they being delivering jobs and investment, housing choice and affordability, a more connected Melbourne, liveable communities, environment and water, a state of cities and delivering better governance. Translating these outcomes spatially Plan Melbourne supports a polycentric city structure underpinned by an integrated land use transport strategy.

Set within a triple bottom line framework cities such as these have engaged with the community throughout all stages of the vision shaping and strategic planning processes. They have linked land use planning to structural economic change; embedded affordable housing within compact, mixed use urban growth plans supported by active transport networks; integrated urban greening and biodiversity initiatives; and all of this supported by integrated governance arrangements and visionary leadership.

UNDERSTANDING A CITY'S ECONOMIC GEOGRAPHY

Considerable work has been done on how accessibility improvements can drive productivity growth. The spatial arrangement of city transport projects can strengthen or weaken urban productivity growth, as well as create social disadvantage and urban inequities. An effective integrated land use transport policy depends on understanding the city's economic

structure, how it is changing and how strategic land use transport planning can be applied to shape change in a desired way.

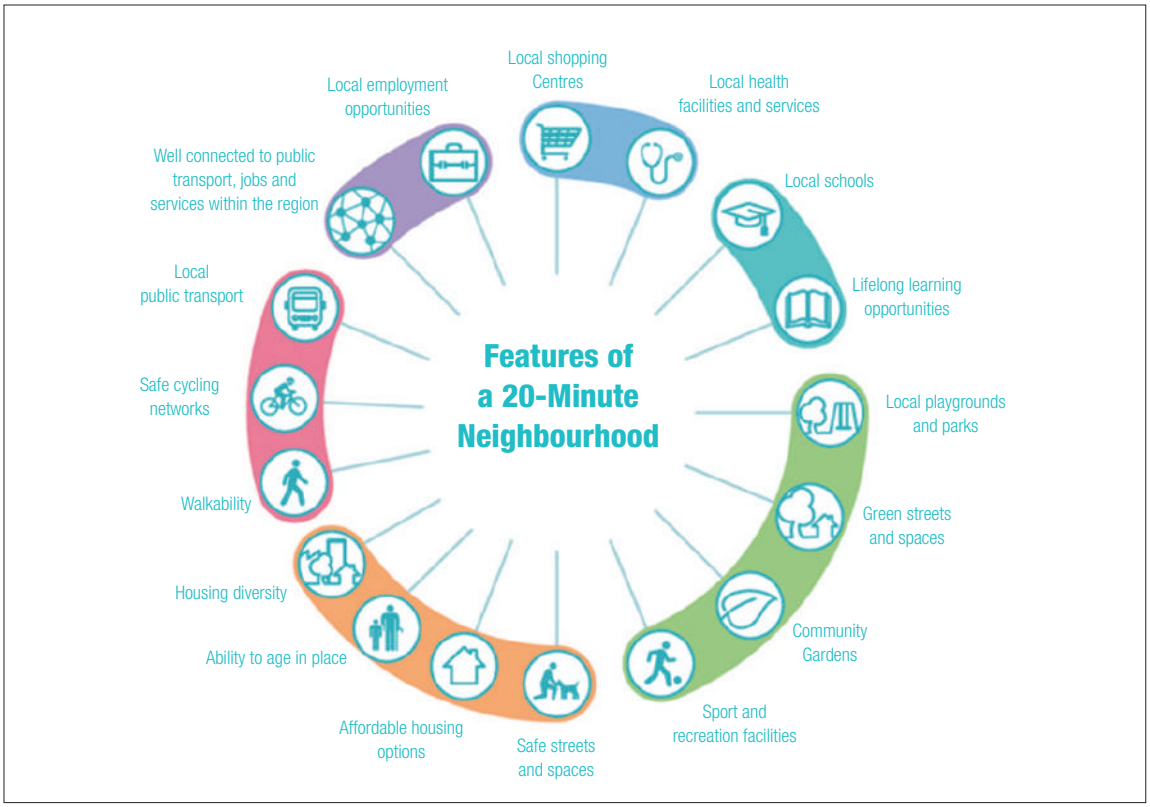
For example, a Melbourne policy goal is to promote productivity growth and enable better sharing of the benefits of growth across the entire metropolis. As mentioned Plan Melbourne supports a polycentric urban structure comprising a small number of National Employment and Innovation Clusters (NEIC) within 20km of the Melbourne CBD and several subregional mixed use high density hubs rich in jobs and services including public transport accessibility. Delivering an integrated transport network that supports agglomeration economics and employment accessibility is essential for cities such as Melbourne. Whilst the current spoke and wheel train network in Melbourne enhances access to Central Melbourne and the inner suburbs the Victorian State government is now planning a 90 km long Suburban Rail Loop (SRL). The SRL aims to complement the existing radial rail network by creating a cross town orbital rail network connecting Melbourne's rich jobs and services middle suburbs. https://youtu.be/xUDydY0FXBA

Like Melbourne, the change in the economic structure of London has had significant spatial implications and adopts a polycentric outcome. Growth in the financial and business service sectors has fueled employment growth and is heavily concentrated in Central London. Outside London's highly productive core are several employment centres serving subregional and local populations. Major transport projects such as Crossrail 1 and 2 support the linking of population growth, housing and employment development, poverty reduction and regeneration of disadvantaged urban areas. Both the Melbourne and London Plans highlight the need for an evidence based understanding of the current and future economic geography of cities to guide land use and transport policy directions.

MEETING SOCIAL NEEDS

Whereas economic and environmental goals can be easier to quantify and measure this is often not the case for social goals. Terms such as wellbeing, equality, happiness, social inclusion, resilience, and liveability are used in land use transport strategies but what facilitates the creation of strong communities and what do strong communities look like is yet to be fully understood. The structure of our cities, especially at the neighbourhood level, influences a resident's experiences and opportunities as well as their well-being and health. What is evident is the importance of mobility to wellbeing and equality of capabilities. A minimum public transport service should enable most of us to do most of the things we want to do most of the time. A high frequency public transport service that offers a wide span of accessibility, is safe and affordable to use and connects people to jobs and services not only shapes people's choices and opportunities but influences a city's economic productivity.

Land use can impact on social outcomes. For example, 'third places' or public urban spaces can foster community interaction and social inclusion especially at the neighbourhood level. Cafés, town squares, community markets, parks and sporting facilities play a vital role in creating local networks and community ties. With many cities now focusing on place making the success of a neighbourhood providing rich experiences, a sense of belonging and opportunities for human interactions depends on the interplay of social, land use and physical qualities (Mehta 2009). As Jane Jacobs acknowledged many years ago, neighbourhoods that are mixed use, pedestrian focused and street activated are key building blocks to achieving a well-functioning city. In recent years several cities including Melbourne, Paris, and Portland are focused on creating cities of 15 or 20-minute neighbourhoods – that is, neighbourhoods where most of our daily needs are met within a short walk or cycle trip. (See Figure 1) Local mobility choices, particularly safe walking and cycling paths accompanied by a frequent lo-



Source: Plan Melbourne 2017-2050

Figure 1

Plan Melbourne's 20-minute neighbourhood concept

cal public transport service, are integral to this concept of neighbourhood. They are also ingredients promoting a healthy community.

Access to the natural environment within our cities is also a factor affecting well-being and quality of life. The greening of cities through the adoption of urban forest strategies, green walls and roofs in new developments, promotion of biodiversity in our urban nature trails, parks and gardens and community gardens are initiatives gaining momentum. However, there are still inequalities in terms of access to green spaces particularly in areas of low socio-economic status. More work is needed in understanding social capital, socio-economic disadvantage, and the structural organisation of neighbourhoods if the social and physical needs of people living in cities are to be properly addressed.

The needs of two groups in particular are largely neglected in terms of land use transport planning recognising that impacts in one's early life can shape future life chances. They are children and youth (Stanley et al, 2017). It is estimated that by 2030 more than 60% of urban dwellers in the world's cities will be under 18 years of age. Every city should be designed with children and youth in mind including the quality of the environment they grow up in and the opportunities and experiences available to them. Five core challenges facing children living in urban environments have been identified they are traffic and pollution; high rise living and urban sprawl; crime, social fears, and risk aversion; inadequate and unequal access to the city; and isolation and intolerance (Arup, 2017). In terms of planning children's infrastructure the focus is primarily at the neighbourhood scale commencing with the local streets and spaces in front of people's homes and creation of walkable neighbourhoods offering a mix of destinations that include natural elements to support physical activity, social interaction, and feelings of trust.

In western cities there is a growing issue of obesity in children. The number of children undertaking active transport to school is dropping. Less than 5% of children in Australia walk to school. Children living near freeways and heavy traffic are suffering from poorer health than those living further away. Less children are playing outdoors and yet physically active children are often healthier, happier, and better socially connected than children living a sedentary lifestyle. Ensuring children and youth have safe access to stimulating and good quality, well designed and secure areas for play and informal recreation, preferably with trees and greenery, is regulated in London. Play spaces need to be well connected to pedestrian, cycling and public transport routes and be family friendly and free from access barriers such as major roads or railway lines. As stated in the Arup (2017) report:

'The benefits of a child friendly city go beyond children to add value to all

citizens' lives. The amount of time children spend playing outdoors, their ability to get around independently, and their level of contact with nature are strong indicators of how a city is performing, and not just for children but for all city dwellers.'

Youth today face many challenges. Youth unemployment and reduced levels of secondary education participation are evident in cities such as Melbourne, London, and Vancouver BC. Reduced independent mobility for youth is also linked to higher rates of obesity, declining self-confidence, growing disengagement with the local community, and reduced emotional resilience. Access to a range of places including cinemas, cafés, shops, sporting facilities and other affordable and challenging public spaces for youth to encourage self-esteem and independence as well as improve personal health are needed in a land use transport strategy. But what is just as important is ensuring that both children and youth are actively involved in the planning, design, and delivery of their needs. The City of Boston in the US operates the Youth Lead the Change: Participatory Budgeting Boston program where young people from across the city suggest ideas and vote on the priorities for capital projects that they believe will generate long term improvements to parks, streets, schools, and neighbourhoods on city owned property. This participatory budgeting process is an important way of identifying the needs and priorities of Boston youth and, while there is room for improvements, participants feel they are making a difference for youth (Augsberger et al 2016).

HAVING A PLACE TO CALL HOME

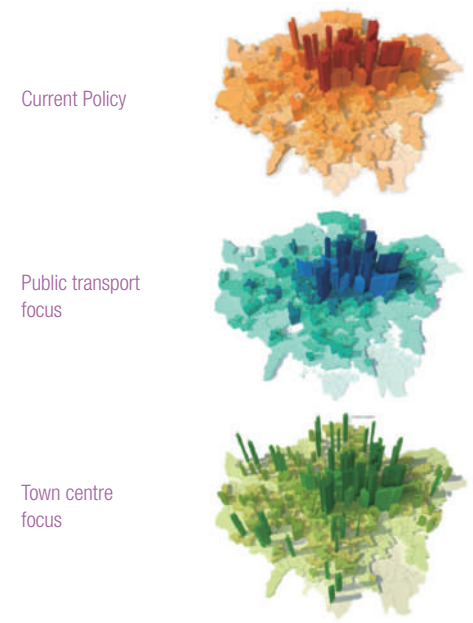
Access to secure, comfortable housing that is affordable to own or rent not only sustains, improves, and even transforms people's lives but it influences a person's wellbeing, sense of belonging and being able to participate socially and economically in society. Cities such as London,

Vancouver BC, Melbourne, and New York are facing an acute shortage of affordable housing and growth in the numbers of people homeless. The widening gap between household income and the cost of housing to buy or rent is creating patterns of spatial disadvantage and inequality, which, in turn, is having adverse impacts on the liveability, productivity and fairness of these cities. There is a need to better connect housing policies with infrastructure and economic development policies. By enabling more people to live closer to where jobs and services are located, productivity growth is enhanced, the city environmental footprint is reduced and social and economic disadvantage is alleviated as much as possible.

Just like many other commodities, house prices depend on demand and supply. Population growth is a fundamental driver of housing demand as is the formation of smaller households. However, as more people value good accessibility to jobs and services the housing in these highly accessible central and inner urban locations become gentrified pushing lower income groups further out where there are less services and fewer jobs. In Melbourne the repopulation of its CBD facilitated by a boom in high rise apartment development has spilled into the inner urban areas within 5 to 7 km from downtown. These inner urban areas typify all that is good about the 20-minute neighbourhood in terms of excellent access to job dense, service rich and high amenity environments. The median house price in Melbourne is just over AUD1million (June Quarter 2021). In Vancouver BC it has reached CAD1.175 million and in London it is £655,840 (August 2021). The median dwelling price to median gross household income ratio in Melbourne in the early 1980s was around 2.5 but was 8 in 2020. The lack of housing that is affordable in Australia is having intergenerational impacts as well as spatial socio-economic inequities.

The integration of land use and transport can address some of the issues of disadvantage that are linked to the location and cost of housing. Initiatives and incentives provided by the Greater London Authority (GLA) encourage more housing to be constructed closer to where the job agglomerations ex-

ist and are planned for in the future. Complemented by a multi-modal transport network that provides easy, convenient, and safe access to jobs and services, the GLA has ensured that more than 70% of all residential development constructed since 2000 in London has been within 800 metres of rail or tube stations and more than 80% within 1km of public transport services. The London Plan not only supports more housing in the central and inner areas where many of the Opportunity Areas are located for redevelopment but encourages more housing along public transport routes (especially rail) and within and close to selected town centres. This spatial framework has both an inner London focus and a denser Outer London focus of which integrating new housing development and public transport investment is fundamental to accommodating population growth in a more balanced and sustainable manner. (see Figure 2)



Source: De Cani 2015

Figure 2

The role of transport in growing London's housing stock

A clear strategy to co-locate medium and higher density housing with good access to public transport is evident also in Vancouver BC based on its transit oriented development (TOD) policies. Similarly in Melbourne with its polycentric city structure encouraging urban densification within and close to NEICs and metropolitan activity centres the inter-relationships between land use and public transport are being strengthened. However in these cities, as is the case in London, ensuring that housing is affordable continues to be a challenge. Increasing pressure is being placed on the available social/public housing stock where demand is outpacing supply. In cities like Melbourne the existing social housing stock is ageing. The cost of maintenance of this government owned housing is increasing and the high proportion of family style accommodation in this sector is unsuitable for the current needs of many tenants who are high-need singles, including people with disabilities and older people. Across Australia less than 5%

of all housing is social housing with an estimated tripling of this housing needed by 2036.

Although increasing housing supply is integral to responding to issues of population growth and housing affordability, building more housing does not necessarily mean cheaper housing or that housing is affordable to buy or rent. Some cities such as Greater London have imposed a green belt around the metropolis. Despite pressures to extend the urban area beyond this 1947 initiative many workers in Greater London now live outside the green belt and commute daily often by public transport. Plan Melbourne has also adopted an urban growth boundary to metropolitan Melbourne with a target that 70% of all new housing be located within the established urban areas and 30% in the greenfield urban growth areas.

The jury is out as to whether or not urban growth boundaries impact on housing affordability. What is clear is that cities need long term housing strategies linked to land use and infrastructure strategies with an emphasis on eliminating social and economic disadvantage. Various mechanisms are available to governments to increase the quantity of social and affordable housing near jobs and services. It is estimated that 34% of the cost of a new house in Melbourne is government imposed development charges and levies, stamp duty, the goods and services tax, land tax and various building fees (Urban Development Institute of Australia, 2020). Regulation and red tape can add significant cost and delays in the construction of new housing. In 2010 the UK government introduced the Community Infrastructure Levy (CIL) on all new development, not just housing. Because new development has an impact on the demand for infrastructure, services, and amenities then all such development should pay a share of the cost. In so doing the cost burden of infrastructure levies on new housing is reduced.

Cities like Portland, Oregon apply tax increment financing (TIF) funds into affordable housing projects in urban renewal districts with the most vulner-

able and disadvantaged as the target groups. TIF has also been widely used in the US to fund infrastructure including affordable housing. Social impact bonds are another tool used to finance projects that deliver improved social outcomes including social housing. Of growing interest are housing development co-operatives and community land trusts (CLTs) which operate in the UK, Europe, and the US. As non-profit community organisations they too contribute to the supply of affordable housing.

Finally the planning and development systems in cities can play a vital role in encouraging the construction of more social housing and affordable housing. Using tools such as inclusionary zoning and development bonuses to developers who include these types of housing in their projects, particularly in locations rich in jobs and services, are being applied in the US and UK. The London Plan acknowledges the potential of redeveloping government owned land for social and affordable housing. In addition, there is growing interest in pre-fabricated housing and various construction innovations to help reduce the overall cost of housing. As evidenced in London, the supply of affordable housing is integral to the economic, social, and environmental well-being of cities. To ignore this issue only tightens the hand brake on the economic productivity and prosperity of cities.

TRANSPORT AND THE ENVIRONMENT

The latest Intergovernmental Panel on Climate Change (IPCC) Report provides new estimates of the possibility of exceeding the global warming level of 1.5℃ in the coming decades. Unless there are rapid, immediate, and wide scale reductions in greenhouse gas (GHG) emissions the ability to limit warming to close to 1.5℃ and even 2℃ will be beyond reach. Cities generate about 70% of GHG emissions, depending on what

is included or excluded from this measurement. The number of people living in cities is estimated to reach almost 70% of the world's population by 2050. Unless global warming can be arrested it is now inevitable that the catastrophic impacts of climate change will wreak havoc amongst communities and nations. While action is required at the global and national levels, a co-ordinated role is required at the city and neighbourhood levels too.

Consideration of environmental issues is now critical to the design and operation of cities. The transport sector is the second largest source of GHG emissions following electricity and heat generation. The fastest emissions growth is within the road sector. Increased motor vehicles per capita plus significant growth in road freight in cities such as Melbourne is contributing to rising GHG emission levels. Melbourne's urban transport GHG emissions are estimated to be three times more than in Greater London due, in part, to Australia's low density urban settlement patterns and lower public transport service-densities (Stanley et al 2017). Some cities have become the victims of urban sprawl. Population growth pressures and most of new housing occurring in urban fringe and peri urban locations outside the city is resulting in more people having to travel longer distances to get to work. Ironically, although the housing may be relatively cheap in these outlying urban areas transport costs are usually high.

Innovations are emerging such as new fuel sources for cars and production of electric vehicles but transitioning to more sustainable transport is difficult given that the current mode of private vehicles in our cities is locked in by existing transport infrastructure, economics, and governance arrangements. Cities like London are successfully employing congestion pricing to reduce the number of cars entering Central London but this has been accompanied by improvements to the rail and bus networks. Reducing GHG emissions generated by the transport sector requires both technological and behavioural changes including:

- Fewer and shorter trip lengths using integrated land use transport planning tools such as increased mixed use higher density development, TOD, and 15/20-minute neighbourhoods;
- Modal shift from car to walking and cycling and making car use more difficult e.g. reduce parking spaces in retail and commercial centres;
- Increase public transport mode share by improvements to the coverage, frequency, quality, reliability, and service levels;
- Shift in freight movement from road to rail with intermodal hubs to facilitate movement of goods;
- Increase in car occupancy using car-pooling and dedicated lanes on roads to high occupancy vehicles;
- Pricing reform to achieve freight efficiencies; and
- Car/truck emissions intensity by encouraging cleaner fuels, tightening emissions standards, applying intelligent transport systems etc.

Stockholm now has almost 85% of its people using public transport whereas 62% of residents in Copenhagen cycle to work, school or university each day noting that bicycles outnumber cars in that city by more than 5 to 1. If alternatives to using the car to travel to work, education or shops are provided and the infrastructure is accessible, well designed, frequent, and safe then shifting behaviours in travel modes can occur. Compact cities with medium to high density development reduce urban sprawl and travel distances but they also require the active transport infrastructure for walking, cycling and public transport services. Densification also reduces the size of the urban footprint and offers more space for natural areas within cities.

Freiburg im Breisgau in Germany is a university town with a long sustainability record. Neighbourhoods have been built where everything is in close proximity – shops, schools, public institutions, open space etc. and public transport. As a 'city of short distances' a new tram system weaves its way through the urban areas. Narrow roads limit car access and park-

Source: Photographs by Roslynne Hansen

Figures 3 and 4

The suburb of Vauban in Freiburg im Breisgau and the city's tram greenways

ing is either restricted to drop off and pick up use or contained in a limited number of multi-level parking stations. Considerable progress has been made with waste management, recycling of water and use of solar energy and a communal forest covers almost 40% of the municipality. This small, compact, and charming city has achieved much in the way of sustainability, healthy living, and provision of social and affordable housing. Freiburg city buys land, installs the infrastructure, and then sells it at an affordable price to the community. Freiburg's active transport network is so effective that it has reduced the city's car ownership by 30%. Much of the city's success is due to political and technical leadership and a consistent approach to planning over many years. (See figures 3 and 4)

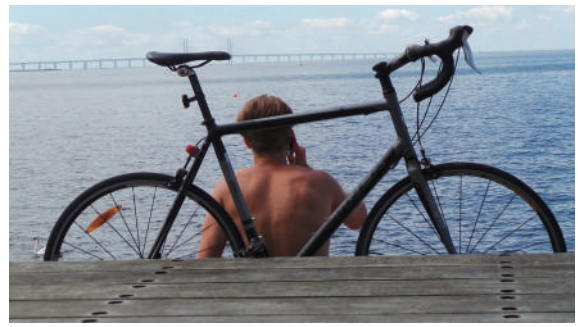
The environmental impact of cities can be managed. It requires significant changes in the way we plan and develop our cities as well as the location, design, and operation of infrastructure such as transport to support the land use pattern that we want. The move towards 20-minute and even 15-minute neighbourhoods is an important part of reducing GHG emissions. The concept not only creates health and well-being gains but environmental gains.

GOVERNANCE AND FUNDING

What do we mean by good governance? It refers to processes of making and implementing decisions. Terms such as accountability, transparency, responsive, equitable, effective, inclusive, efficient, and abiding by the rule of law are often linked to good governance. A siloed or sector based approach to urban governance is unlikely to deal with the many challenges facing our cities. A shift from a hierarchical to a more network based approach to decision making is emerging in some cities as an ingredient of integrated strategic land use transport planning.

Because urban governance operates at different scales from local/municipal to states/provincial and national/federal it is important to determine which matters warrant government policy interventions, which should be left to private markets and which are the realm of interested people and local organisations. For example, in formulating strategic land use transport policy and planning for cities the main issues include productivity/jobs, GHG emissions, affordable housing, social inclusion, health and safety and biodiversity/natural environment. Just as the governance and funding arrangements are important so too is genuine and meaningful community consultation and engagement. After all, we are planning for people.

Different governance arrangements operate in cities. In Freiburg a single local authority has responsibility for the whole city and it makes sense for it to undertake the strategic long term land use transport planning. Another is the municipality of Malmo in Sweden which has transformed the city from an industrial past to a city of knowledge and culture. Working with Copenhagen and other centres within the region on regional development and public transport networks Malmo has capitalised on the construction of the Øresund Bridge (rail and road transport) facilitating redevelopment of its central railway station area and acting as a catalyst for major urban renewal initiatives such as the Bo01 project in Malmo's Western Harbour



Source: Photographs by Roslynne Hansen

Figure 5

Bo01 urban renewal project, Malmo

Figure 6

Øresund Bridge connecting Malmo, Sweden to Copenhagen in Denmark

area. Using a single voice the Malmo city government has worked with national and regional government to value add on a major road and rail bridge transport project connecting Sweden to Denmark.

In the case of Vancouver multiple authorities within the city region act regionally through Metro Vancouver under legislated authority. In the case of London the Mayor of London working with the Greater London Authority (GLA) and Transport for London (TfL) fulfil the key integrating roles. In Melbourne the city is divided into 31 local municipal areas where the allocation of responsibility and accountability is more complex and challenging. Different State government departments are responsible for the preparation and implementation of metropolitan wide land use and transport strategies. Despite efforts to co-ordinate these departments' activities there are instances where the aim of integrating land use and transport plans is weakened. Melbourne would benefit from a single metropolitan authority approach.

Having the right governance structures in place to deliver integrated land use transport policy is fundamental. However, policy alone is unlikely to deliver the outcomes sought. Good project planning accompanied by effective project delivery is essential as is rigorous cost benefit analysis and open community engagement about the scope, benefits, and costs of such projects. Securing funding to implement long term transport plans is a challenge for most cities. Whereas the case for increasing public transport

services is well founded – lowering road congestion, enhancing urban agglomeration economics, cutting GHG emissions etc – the financial cost recovery rate in major cities in the US, Canada and Australia is typically 30-60% of operating costs.

Potential capital/operating funding for transport derives mainly from three sources – government, users, and other beneficiaries such as property owners who benefit from nearby transport improvements (that is, benefit value capture). Tax increment financing, fuel taxes, road pricing, road tolls, carbon taxes, parking levies and land/property taxes are some of the mechanisms used by governments to fund transport projects. For example, in London the GLA has introduced Enterprise Zones along some major rail extension corridors which enhance the development potential and hence value of the land along this route. By applying value capture techniques on the land that benefits from such investment enables the GLA to repay the funds borrowed to construct the rail extension. There need to be potential funding opportunities that can not only improve public transport financial cost recovery rates but support improvements to those services. Possible funding measures will vary depending on the nature of the transport project, the governance arrangements in place and the ability to recoup the costs of operating and maintaining a good quality transport system that delivers city wide social, economic, and environmental benefits.

CONCLUSION

Different models or approaches are being adopted in cities to deliver land use transport integration policies and plans. The key take-outs from this discussion include the following:

1) The need for a strong vision for the future underpinned by community values and supported by a spatial policy and planning response

whereby infrastructure, such as transport, becomes an enabler in delivering the vision.

2) Long term integrated land use transport strategies need to be linked to 10-year implementation plans that identify project initiatives within defined timelines.
3) Although a highly accessible central area of cities is important to a productive and liveable city the needs of the remaining parts of the city should not be dominated by the needs of the central area when it comes to land use transport planning.
4) A sound understanding of the structural economic changes occurring in cities now and in the future shapes the content and context of integrated land use transport strategies with triple bottom line sustainability goals.
5) A strategic approach to land use transport integration operates at different scales from local/neighbourhood to city/metropolitan and regional rather than the more traditional and less effective top-down approach.
6) Setting hard targets and taking transformative actions, especially on environmental issues within cities, are needed if cities are to be productive, liveable, and sustainable places to live, work and visit.
7) Adopting a governance arrangement that is likely to produce the best integrated land use transport planning outcomes needs leadership and authority to 'speak for the city' as well as the funding and financial mechanisms to achieve the vision.

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Superblock Barcelona

Towards the City We Want

슈퍼블록 바르셀로나 – 우리가 꿈꾸는 도시를 향하여

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ABSTRACT

Barcelona is one of the densest cities in Europe where the need for public space for citizens is even more evident in the current pandemic situation. At the same time, citizens are increasingly demanding, as shown by social movements, the need to have a city with less pollution and noise. For these reasons, the city of Barcelona has a very determined commitment to adapt public space and mobility to achieve a more liveable city.

Barcelona Superblock program aims to recover a part of the public space currently occupied by private vehicles for public use, while gaining new places to stay, increasing urban greenery and therefore putting people at the center of the transformation. The superblock projects in the Poblenou and Sant Antoni neighborhoods, both set up between 2016 and 2018, are a proof that the model can be implemented efficiently in the orthogonal, wide-streets network of the Eixample district. Today we are working to scale the program up to the entire city. Superblock Barcelona represents a vision of future for Barcelona.

In the well known Eixample - the central district of Barcelona, Superblock program provides the opportunity for updating it, according to social and environmental contemporary requirements while creating a new environmental infrastructure trough 21 new green axes and 21 new squares. With the priority of achieving, through joint work with the citizens, a healthier, greener, fairer and safer public space that promotes social relations and the local economy.

KEYWORDS

Barcelona new urban model, public space for people, Superblock

초록

바르셀로나는 유럽에서 가장 인구밀도가 높은 도시 중 하나로, 코로나 이후 시민을 위한 공공 공간의 필요성에 대한 목소리가 더욱 커지고 있다. 동시에 다양한 사회 운동에서 볼 수 있었듯이, 시민들은 도시의 공기 오염과 소음을 줄일 수 있는 대책을 요구하고 있다. 이러한 맥락에서, 바르셀로나는 공공 공간 및 이동성 확충을 통해 좀 더 살기 좋은 도시를 만들기 위한 노력을 기울이고 있다.

바르셀로나 슈퍼블록*Barcelona Superblock* 프로젝트는 현재 개인 승용차 및 오토바이가 차지하고 있는 공적 공간을 공공이 사용하도록 회복하는 것을 목표로 한다. 또한 이를 통해 사람들이 머물 수 있는 공간 및 도심의 녹지를 확보하여, 사람 중심의 도시를 향한 변화를 이끌어내고자 한다. 2016년과 2018년 사이에 출범한 포블레노우*Poblenou*와 성 안토니*Sant Antoni* 지구의 슈퍼블록 프로젝트는, 직교형*orthogonal*의 대로*wide street* 네트워크로 이루어진 에이샴플레*Eixample* 구역에도 효율적으로 적용 가능하다는 것을 보여 주는 대표적 사례이다. 최근에 바르셀로나시는 이를 시 전체에 적용할 수 있도록 프로젝트의 규모를 확장하는 데 노력을 기울이고 있다. 바르셀로나 슈퍼블록은 바르셀로나의 미래가 나아갈 방향을 제시한다.

바르셀로나의 중심에 위치한 에이샴플레 구역에 슈퍼블록 프로젝트를 실행할 경우, 최신의 사회적 · 환경적 요구를 수용하는 곳으로 새로이 업데이트될 수 있으며, 이와 동시에 21개의 녹색 축과 21개의 광장과 같은 새로운 환경 인프라를 만들어낼 수 있다. 특히 시민과의 공동 노력을 통해 더욱 건강하고, 자연 친화적이며, 공정하고 안전한 공적 공간을 만들어 사회적 관계 및 지역경제 발전을 증진시킬 것이다.

키워드

바르셀로나의 새로운 도시 모델, 사람을 위한 공공 공간, 슈퍼블록

A model of transformation for the whole city

During 2015-20, Superblock Barcelona has demonstrated that it can make public spaces in Barcelona healthier, fairer, and safer, favoring local social and economic relations. As of now, it is a consolidated program, highly appreciated in the city, and gained international recognition and prestige.

The concept of Superblocks should be comprehended as a model with a vision and transformative capacity for the whole city. In other words, it is a sequential transformation of multiple streets of all the city districts. Its application attempts to define a new map of Barcelona where the spaces and streets are greener and prioritize pedestrians. It is a map of new green streets. At the same time, it is a new way of visualizing the city, integrating and orienting all the actions of transformation of the city's public space.

Figure 1

Green Streets in Barcelona

Upgrading the Eixample Cerdà [1]

In this new stage, the proposals of Superblock mainly focus on the fabric of the Eixample Cerdà. This model of public space defined in the 19th century needs to evolve and adapt to satisfy new environmental and social challenges contemporary cities face.

The city has developed with a system of roads nestled between mountains, sea, and rivers. While the areas of historical significance are located in relatively peripheral areas (historic villages), the central areas are highly accessible (Eixample). Together with the management of the road network that has prioritized the fluidity of vehicular traffic for years, this circumstance caused the Eixample fabric to support as much traffic in its central section as the Ronda de Dalt and Ronda Litoral.

The traffic density resulting from this robust and highly porous road network for cars and motorcycles is the leading cause of air pollution in the Eixample District, especially in Antiga and Nova Eixample neighborhoods Esquerra de l'Eixample and the Dreta de l'Eixample.

The pollution rates in the Eixample exceed the WHO recommended thresholds. In 2018 the annual average concentration of nitrogen dioxide and microparticles[2] were respectively 54µg NO_2/m^3 and 26µg PM 10/m^3. The thresholds set by the WHO are 40µg NO_2/m^3 and 20µg PM 10/m^3, respectively.

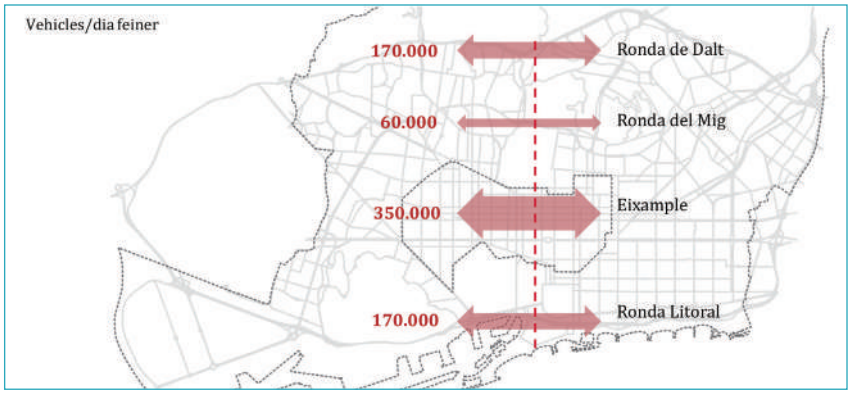
In addition, the high concentration of vehicles also means that there is a high concentration of traffic accidents. While the Eixample represents only 7% of the surface of the whole city, 29% of traffic accidents of the town occurred in the Eixample district between 2010 and 2019[3].

Traffic, however, does not only cause air pollution in the Eixample but also causes high rates of noise exposure. 55% of the population living in the Eixample are exposed to noise levels above 53dB (maximum threshold recommended by the WHO).

While the Eixample has a high level of traffic for being one of the main destinations in the metropolis and offering high permeability for vehicles,

it is also the area best served by public transport.

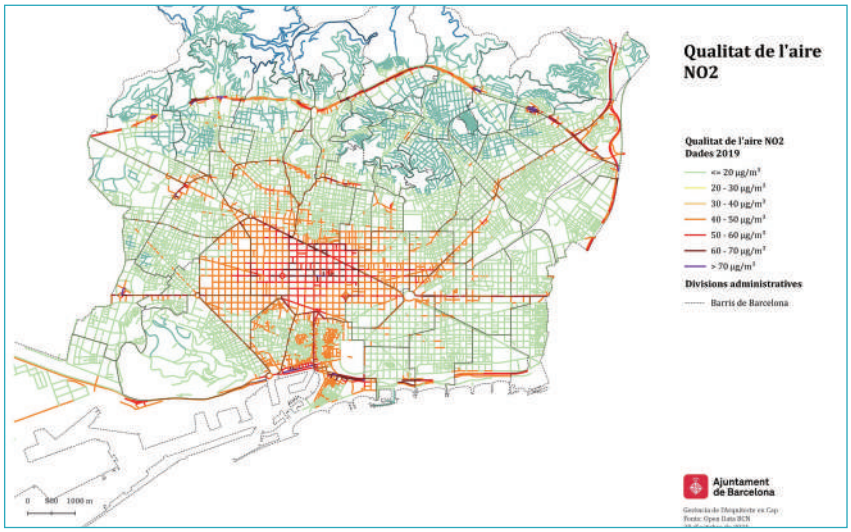
If we calculate the size of green space, Barcelona currently has 6.57m²/habitant, distributed very irregularly (not counting Collserola natural park). The Eixample is the neighborhood most deprived of urban greenery by district, with only 1.85m² available per inhabitant[4]. This lack of green space also makes the Eixample the district with the highest population density considering the total area, with about 355 inhabitants/ha, more than double the town's average, which is around 160 inhabitants/ha. By districts, Sagrada



Source: UTE Superblocks data based on traffic flows in 2018 provided by Barcelona City Council.

Figure 2

Group of the primary traffic flows in the roads of the central vertical section of Barcelona and distribution of the flows by streets in the Eixample district.



Source: Barcelona City Council. Year: 2019.

Figure 3

Concentrations of NO_2 (µg/m³) in the streets of Barcelona.

Família, Sant Antoni, and the Nova Esquerra de l'Eixample stand out above the average with 488, 476 and 431 inhabitants/ha.

If we consider the space occupied by private vehicles, which represents only 26% of trips in the city, it occupies approximately 50% of the public space dedicated to mobility in the Eixample. On the one hand, this data reveals an asymmetry existing within a transport model prioritizing sustainability, but on the other hand, an opportunity to obtain public spaces for people and greenery.

In this sense, the Eixample is a decisive area where an ambitious reform to correct current deficits and impacts based on strategies for reorganizing public space is necessary. These strategies should focus on reducing traffic by taking advantage of the modal shift towards public transport, cycling, and VMPs available here more than anywhere else in the city.

Applying the Superblock concept in Cerdà's Eixample allows us to define a new vision and project for the future through a new structural logic. The reorganization of mobility allows the generation of new green streets and new squares at its crossroads, thereby creating more urban greenery and more spaces designed for staying. In short, it will equip the Eixample with healthier public spaces and many more green spaces, guaranteeing a high-quality urban life.

A two-pronged strategy is prepared for the implementation of the project. On the one hand, the generation of new "green streets" should contribute to achieving changes in implementation scale and systemic impacts. These streets will generate novel itineraries of significant importance, connecting referential public spaces and / or connecting the Eixample with perimeter neighborhoods. On the other hand, it is necessary to create new "squares" where there are now intersections, introducing a new type of greener public space apt for public use and stay. This idea is differentiated from Cerdà's plan, where the urban structure is mainly interweaved through the streets for vehicles.

The new network of green streets is conceived as a new environmental infrastructure, which allows to increasing the presence of greenery and improving the water cycle management with permeable pavements and sub-

soil infrastructures. It is also expected to regulate the ambient temperature with the incorporation of shade and even increase the possibility of punctually incorporating energy-capturing elements. Perceived as a unit and as a system, it is expected to improve the environmental qualities of the city as a whole.

The program is approached from a transversal and integral perspective and is accompanied by two tools that go beyond the re-urbanization of spaces. On the one hand, in general, where Superblock is implemented, it is accompanied by a 'Use Plan' that regulates the use of the ground floors of buildings. It aims to ensure the plurality of use that characterizes a mixed city, protecting local commerce and services.

The other tool that comes with the program is a set of tracking indicators. These indicators aim to measure the direct effects of the implementations, such as an increase in spaces dedicated to pedestrians, green spaces, and surface drainage systems. In addition, they also attempt to estimate secondary effects such as environmental improvement. But these indicators will also allow to monitor and control other side effects such as possible price increases or changes in usage. This set of indicators is developed to conduct a continuous evaluation that serves to check the achievement of the project objectives and improve and polish aspects of implementation.

As usual, the projects promoted by Barcelona City Council must be based upon excellence in the design and optimize economic, energy, and material resources. In this case, moreover, an innovative response is required to provide a new type of public space, prioritizing people. This response should also include an infrastructural vision that integrates natural processes like water systems, greenery, and biodiversity. Furthermore, the answer must optimize energy resources to achieve a desirable degree of self-sufficiency, adaptability, and flexibility, with rational and straightforward solutions that consider the durability of materials and rationalization in maintenance.

Bearing in mind this new approach and being aware that this project is a change of model in the operation of the city, the City Council wants to promote as much as possible a reflection on the role of public space in the city, especially in the Eixample. This is an innovative project representing

a change in the current usage of streets. Therefore, we need new ideas and solutions to respond to the social and environmental challenges we face as a society.

Green streets and squares

Superblock in the Eixample can, like nowhere else in the city, recover the values that Cerdà defended. First and foremost, putting public health and hygiene at the heart of the issue, the project attempts to rehabilitate the city. Furthermore, to achieve a more egalitarian urban fabric, it intends to guarantee fair use of urban facilities and prioritizes more sustainable services and modes of transport. It also tries to incorporate nature and metabolic flows in the street infrastructures into the centralized and complex urban plan.

Therefore, it is an excellent opportunity to transform and enhance one of the city's iconic neighborhoods and recover an urban vision that was admired around the world.

The implementation of Superblock seeks to reconfigure the overall functioning of public space, streamline mobility by betting on more active and sustainable mobility, and expand the public areas for various usages, such as stay, play, meet-ups, and encounter with nature. With the reduction of private wheeled traffic, the adverse effects that these vehicles could entail can also be reduced: pollution, noise, space consumption, etc. By doing so, Superblock will improve the quality of life in the central part of the city where more than 16%[5] of the inhabitants of Barcelona live.

If we look at the physical format of the Eixample, it is apparently isotropic. However, in terms of mobility, we have already seen that it is not. Horizontal routes carry much more traffic than vertical ones, and if we look closely at the structural fabric, we will see that not all streets have the same connectivity. In addition to this, if we recognize the fact that the neighbor-

hood has its center of gravity in terms of neighborhood activities, marked by facilities such as markets, libraries, civic centers, and schools, and also the fact that it has only medium-sized green spaces irregularly distributed, we see how this isotropy is only an appearance.

The Superblock program is based on a careful analysis of reality, especially considering flows and mobility, but also takes a deep consideration of neighborhood facilities, green spaces, built environments, and the social fabric. With this comprehensive perspective, Superblocks proposes to reorder the networks of all mobility modes and apply the idea of 'hierarchization of roads', prioritizing sustainable mobility. In particular, the project attempts to free some of the streets from motorized traffic to implement a network of green streets, prioritize pedestrians and introduce more greenery into urban spaces. At the same time, it will also enhance citizens' diverse use of freed areas.

Once the idea of 'hierarchization of roads' is applied to pacify[6] the whole district globally, it is crucial to have a strategy of implementation. While the actions regarding Superblock have been taken in dispersed areas in the old town, in the Eixample it has been decided to implement them along the green streets. This is because, on the one hand, the purposes of areas in the

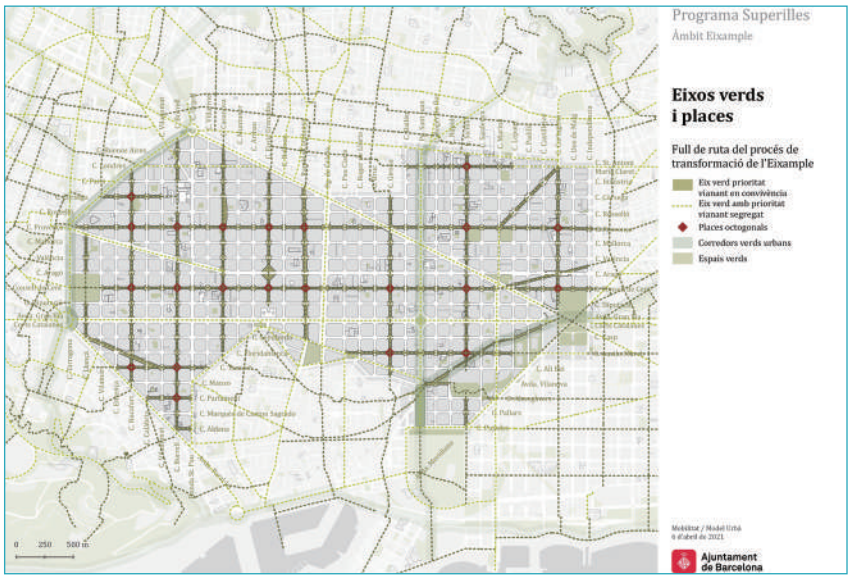


Figure 4

21 new green streets and 21 new squares in the Eixample.

Eixample are not as naturally defined as those in the old quarters. On the other hand, the effects caused by the pacification of a section of street go far beyond this. The implementation of Superblock, starting from the transformation of the green streets in the Eixample, responds better to the overall objectives of pacification of the whole district. It contributes to gaining green spaces and squares for citizens as well.

The network of green streets guarantees connectivity with the network of metropolitan roads and avenues, central green spaces of the city, and essential facilities of the various areas of the Eixample.

The green streets become a network of preferred routes for pedestrian, allowing people to travel around the city on foot more comfortably, conveniently, safely, and rapidly.

In a fabric formed essentially by streets, such as the Eixample, new squares appear at the intersections of two green streets and its street chamfers, a particular character of the district. These are spaces of approximately 2,000m^2, now dedicated almost exclusively to mobility, which can become more comfortable spaces to stay. They will have permeable pavements, more greenery, and citizens playing and using the spaces for diverse purposes.

The district's entire population can access these new squares and pacified streets within the coverage of 200m from their residence. Its scope is significantly improved, especially in the central area of the Eixample.

Out of the 61 streets (34 vertical, 21 horizontal, and 6 diagonal) in the central area of the Eixample, it is proposed to transform an area of 660,260m^2 of the total size to achieve 21 green streets (30%) and to generate 21 new squares at intersections.

These are 33.1 linear km of streets converted into new green areas, which would mean an increase of 334,750m^2 (50.52%) of public space for pedestrians. This augmentation includes spaces for greenery and other public usage.

The new structure of green streets and new squares becomes a network that prioritizes and considers the needs of everyday life, linking facilities and shops, green spaces, and schools.

New Public Space Model

Superblock is a strategy to transform public space across the city. The project aims to change the spaces currently used by private vehicles into those of citizens' use through a new model of fairer and healthier public space.

The implementation of Superblock goes beyond the rationalization of current mobility. It aims to achieve a more active and sustainable one. It also seeks to reconfigure the overall functioning of public spaces in the city by expanding the areas for usages, such as stay, play, meet-ups, and encounters with nature. These new aspects can be facilitated by the proposed reduction of motor vehicle traffic in some streets and, consequently, their adverse effects (pollution, noise, and space consumption).

Superblock program studies traffic flow and improves it. Under this program, new bike lanes are implemented, some streets are pacified and dedicated to the pedestrian network and other uses for citizens. The program tries to address the problems of loading/unloading and assesses the necessity/unnecessity of parking on the road. All the actions are part of the same integral vision that aims to reduce the number of private vehicles crossing the city center to the minimum and make the city better equipped with efficient pedestrian networks, public transport, and bicycles.

In this way, the current public space will be transformed into a new model of public space. The new model will accommodate various usage of spaces and will be more efficient and resilient from environmental perspectives.

The new model of public space is based on the revision and update of the two factors that constitute a city, suggested by Manuel de Solà-Morales: support and infrastructure. They will enhance cities' character and value as an environmental infrastructure and the idea of urbanity, reinforcing their character of proximity and diversifying the usage of public space. In this way, the model introduces a new type of streets and landscapes that will conjure a new urban identity for Barcelona.

The general criteria governing this transformation are as follows:

Proximity and the right to public space, public use of space, walk, stay, and play. Based upon a feminist vision, it is a principle prioritizing children and the elderly and favoring local services and trade.

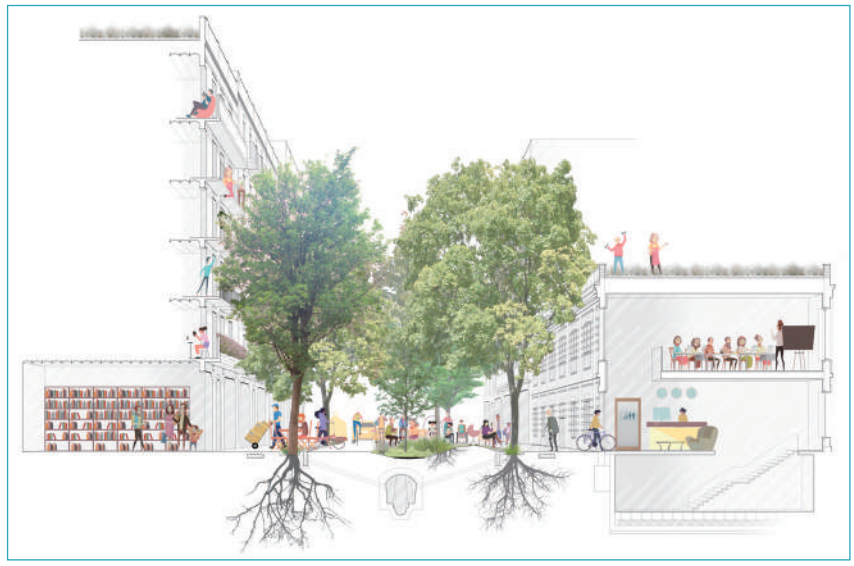
The infrastructural vision of public space, with attention to the water cycle, greenery, biodiversity, soil, and energy.

Figure 5

Streets in the 20th century.
Most of the current streets.

Figure 6

Street in the 21st century.
Areas of green streets.



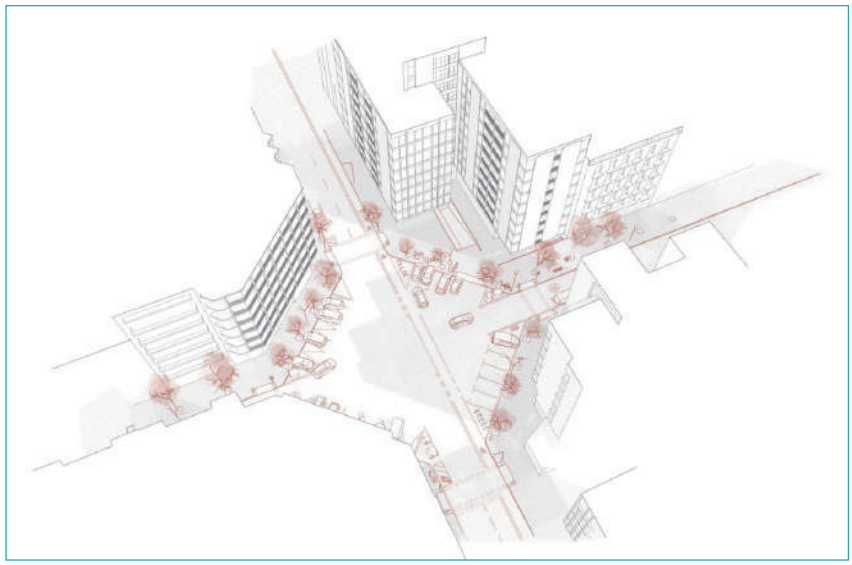


Figure 7

Typical crossroads of the Eixample in the 20th century.

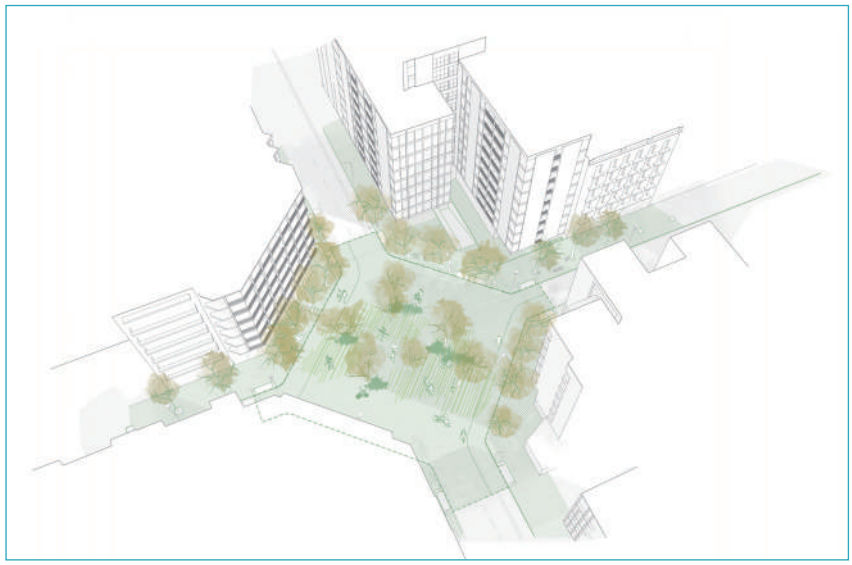


Figure 8

New squares of the Eixample in the 21st century.

The new materiality. It means providing unique solutions and environmentally less harmful, adaptable, and ergonomic materials.

The value of permanence. It is a principle respecting existing elements, landscapes, and historical heritages.

Access and services.

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6. (Translator's addition) A concept that recapitulates the core policies of Superblock. It signifies reducing private vehicles, creating environmentally friendly spaces, and decreasing air pollution and noise exposure, thereby 'pacifying' streets and making citizens feel serene.

Neighborhood Walking, Neighborhood Planning, and Smart City

스마트시티 그리고 동네걷기, 동네계획

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ABSTRACT

I think our discussions about smart cities have arrived at a very important crossroads. We are convinced of the level of our globally acknowledged smart city technology, yet, why is it that we feel hollow when it comes to the vision of a smart city? The introduction of such concepts as 15-minute and 20-minute cities into the discussion about the smart city seems to provide us with a fresh new opportunity for further discussions, but we are also faced with a reality where the total time spent commuting to and from work in the metropolitan area that accounts for 51% of the population of Korea is now pushing 140 minutes a day. Meanwhile, we are coming to terms with daily life spent within our home and neighborhood more personally than ever, since we are forced to take online classes or work from home instead of going to school or work due to the unprecedented coronavirus pandemic. What does it mean to change the findings from such experiments as the 15-minute city of Paris, the 20-minute city of Melbourne, and the superblock of Barcelona into questions about our current neighborhood life? In this paper, I have compiled rather unrefined and rough thoughts about the subject into four groups of questions about “neighborhood walking, neighborhood planning, and smart city”. It is my hope that these questions will be followed by further discussions.

KEYWORDS

smart city, 15 minute city, neighborhood walking, neighborhood planning, questions

초록

우리의 스마트시티 논의는 매우 중요한 기로에 봉착해 있다고 생각한다. 세계적으로도 인정받고 있는 우리의 스마트시티 기술에 수긍이 가면서도 그 도시 비전에 여전히 공허함을 갖게 되는 이유는 도대체 무엇일까? 15분 도시, 20분 도시와 스마트시티의 논의를 연계하는 것은 모처럼 신선한 계기를 주고 있지만, 대한민국 인구의 51%가 모여 사는 수도권에서 출퇴근에 소비하는 총 시간이 하루 140분까지 늘어나고 있는 현실이 우리 앞에 놓여 있다. 한편, 전대미문의 코로나 사태로 인해 우리는 등교와 출근이 아닌 온라인 수업과 재택근무 등을 강제적으로 경험하게 되면서, 그 어느 때보다도 집과 동네의 일상을 몸으로 느끼고 있다. 파리의 15분 도시, 멜버른의 20분 도시, 그리고 바르셀로나의 슈퍼블록 실험이 제시하는 내용을 우리의 동네 생활 질문으로 바꾼다는 것은 무엇을 의미할까? 본 글에서 정제되지 못하고 거칠기만 한 지금의 생각들을 네 꾸러미의 '동네걷기 동네계획' 질문으로 묶어본다. 미약하나마 이로부터 후속 논의가 이어지길 기대한다.

키워드

스마트시티, 15분 도시, 동네걷기, 동네계획, 질문들

Introduction

The focus of the "Smart City Top Agenda 2022" was to highlight the future living environment and compact urban spatial structures for the realization of a carbon-neutral society. To this end, a symposium was held in September 2021 under the theme of "The role of smart cities for urban structural innovation and plans for domestic application"[1]. I found it a very promising sign that the Smart City Top Agenda Symposium continues to offer an opportunity for meaningful debates every year instead of being a one-time event. In particular, this year, the symposium focused on so-called "urban spatial structure innovation" and gave participants an opportunity to learn about all case examples − such as experiments of the 15-minute city of Paris, the 20-minute city of Melbourne, and the pedestrian-friendly superblock of Barcelona − that are receiving great responses from countries around the world as well as local communities in each country. I found it especially interesting that improvement of the daily living environment was selected as a specific theme for the discussion of the smart city.

The city we usually envision when discussing the subject of smart cities is the image of a city marked by future-oriented innovative technologies, such as groundbreaking new mobility and new city management systems built with advanced technology. I was really pleased with the proposed construction of a compact urban spatial structure for daily activities where the main means of transportation was "walking" − the fundamental means of transportation since the beginning of human history −instead of some new high-tech means of transportation, and constructing it within the very real living environment around my house that contrasts to the sci-fi scene of a futuristic city. The discussion about a smart city this time sounded comparatively less hollow to me because it was directed towards the reality of specific neighborhood planning. Of course, the discussion will still

sound hollow unless we move beyond the discussion stage and intensely question and consider the so-called "smartness" that is integral in 15-minute and 20-minute cities, but nevertheless, I think it is the right direction for discussions to take.

Ultimately, I believe that, when discussing a smart city, we should ask what the most desperate problems are in our neighborhood, understand the reason why these problems occur, and seek realistically possible solutions for them. Even though discussion about spaces in a smart city may still sound unfamiliar to us who want a more convenient, safer, and more comfortable living environment, smart city services are already in operation on a far deeper level than we think. Yet, policy makers and architecture and urban researchers are missing this fact.

Several complex elements hidden in a series of recent attempts such as 15-minute and 20-minute cities, and pedestrian-first superblocks should be thoroughly broken down and analyzed, and the elements that can be applied practically to our urban structural innovation and domestically applied sites should be identified.

I think our discussions about the smart city have arrived at a very important crossroads. Personally, I felt hollow about most of what was discussed about the smart city, and I wondered why. Such concepts as 15-minute and 20-minute cities certainly provided us a new perspective in the discussions, but declarations of 15-minute and 20-minute cities sound too far-fetched in a reality where it takes more than 140 minutes for residents in the metropolitan area that accounts for 50% of the population of Korea to commute to and from work. Meanwhile, we are seriously experiencing what's happening in our home and neighborhood more than ever since we were forced to take online classes or work from home instead of going to school or work due to the unprecedented coronavirus pandemic. What does it mean to change the findings from such experiments as the 15-minute city of Paris, the 20-minute city of Melbourne, and the superblock of Barcelona into questions about our own neighborhood life? I believe those findings should lead to questions about urban structure innovation in ways that are

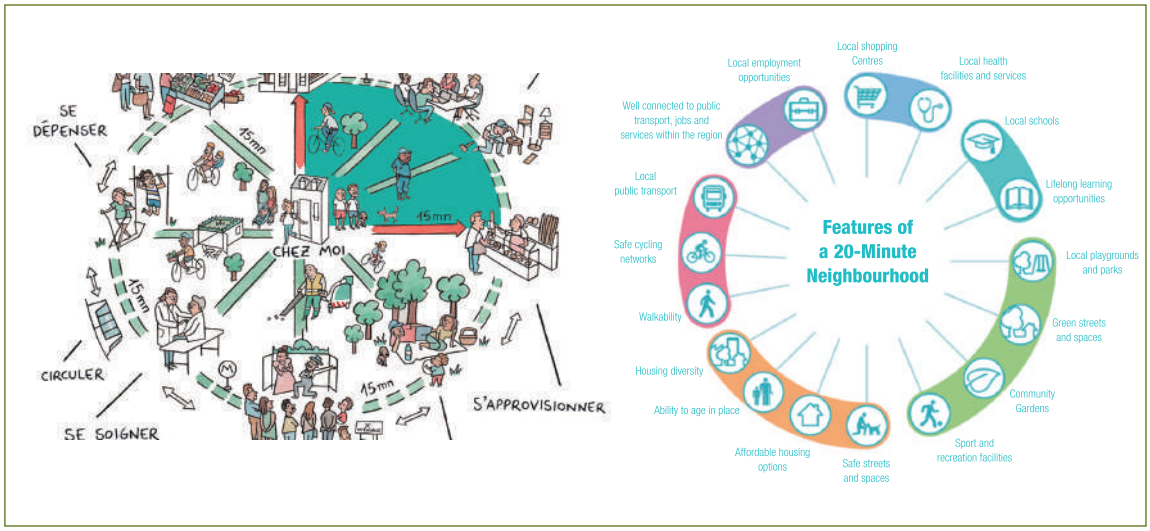
applicable within the context of our urban societies.
I asked myself a few fundamental questions, as follows, before getting into the main discussion, hoping that these questions will be followed by further studies.

[1] What do the recent urban phenomena of so-called "n-minute cities" such as the "15-minute city" and "20-minute city" signify on the scale of ordinary daily life?
[2] If these phenomena of "15-minute city" and "20-minute city" are broken down into the spatial issues relevant to the smart city discussion, what kinds of urban questions and neighborhood questions should be asked differently?
[3] What could be new research designs and practice scenarios, resulted from substantializing the smart city discussions in terms of "neighborhood walking, neighborhood planning"?
[4] What will be the fundamental conditions that must be premised for the grand discourse of smart cities that claims data and technology will solve our urban problems and improve the quality of our daily lives?

First Question

What do the recent urban phenomena of so-called "n-minute cities" such as the "15-minute city" and "20-minute city" signify on the scale of ordinary daily life?

I think it is worthwhile to explore the urban phenomenon of the so-called "n-minute cities" such as 15-minute city and 20-minute city with respect to two major axes of elements. [Figure 1] One is the axis of the facility element that is supposed to be installed in areas around our homes to give access to various urban functions and services sustaining the daily life, and



Source: : 15 minute neighborhood in Paris, Paris City Government, 20-minute neighborhood in Melbourne, Melbourne City Government

Figure 1

15-minute neighborhood in Paris, 20-minute neighborhood in Melbourn

the other is the axis of the time element, either 15 minutes or 20 minutes, that is represented by appropriate walking spheres to reach the urban functions and facilities.

Regarding the facilities for urban functions and services designed for the convenience of living, practical discussions are already in progress in the form of public policies for basic living infrastructure and social overhead capital (SOC). In particular, policies such as the national minimum standards for basic living infrastructure can be considered as an attempt to institutionalize those facilities, which was made earlier and more specifically than current proposals of Paris' 15-minute city or Melbourne's 20-minute city. This clearly shows in the standards announced by the Ministry of Land, Infrastructure and Transport in December 2018 based on the results of long-term research led by many hard-working researchers of the Architecture & Urban Research Institute (AURI)[2]. The legal basis for this is Article 4 of the Special Act on the Promotion of and Support for Urban Regeneration and its 10-year national urban regeneration policies and projects since the Act was kicked off in 2013. The key to these policies and projects is to ensure that residents have access to services meant for the

convenience of living in terms of general caretaking, health, education, and leisure[3]. It is noteworthy that the central government presented the national minimum standards for facilities by region, based upon which the efficiency, economic feasibility, and accessibility of the community-based SOC programs were considered. These standards started with AURI researchers who divided neighborhoods across the country where more than 5 people reside into about 260,000 cells of 200-meter by 200-meter walkable block units, which later were classified into 10 grades of accessibility. After the basic minimum standards for living infrastructures were created in this way through consensus discussions, various factors including population density were considered to come up with standards for a 10 to 15-minute walking distance in the case of city neighborhoods and a 30-minute riding distance in the case of rural neighborhoods with low population density and a rapid decline in population. The final results of these steps then evolved into the national standards[4]. This was significant in that the results were presented as the official standards for the first time in Korea.

However, the national standards were the bare minimum required by the government, and ultimately, they only mean the lowest national minimum standards. The contribution of providing basic living infrastructure facilities is limited in neighborhood planning. It is necessary to have national minimum standards but it is not sufficient by all means. Having the minimum standards of basic infrastructure necessary for daily life is a completely different story from the actual realization of neighborhood planning designed for improving livability. It necessitates the task of continuously improving and evolving neighborhood planning optimized for the spaces of a certain region by using these minimum standards as the basis. And it is expected that the discussion about smart cities will be linked to the search for a better solution that can fulfill the task more conveniently and efficiently.

Second Question

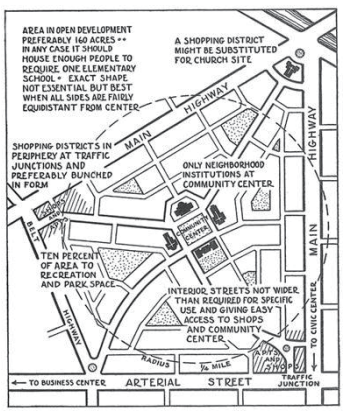
If these phenomena of "15-minute city" and "20-minute city" are broken down into the spatial issues relevant to the smart city discussion, what kinds of urban questions and neighborhood questions should be asked differently?

I think that one of the first points of contact that closely connects the urban phenomenon of 15-minute and 20-minute cities with discussions about smart cities is an axis of the time element, represented by the distance or area of either a 15-minute or 20-minute walk. Since the modern era, there have always been certain standards for areas appropriate for the provision of public facilities for education, medical care, health, and welfare in urban planning and residential planning. In Perry's neighborhood unit concept of 1929, for example, which is one of the most influential models in urban planning theory, be it positive or negative[5], we find standards for arranging facilities such as elementary schools, parks, shopping malls, and others

Figure 2

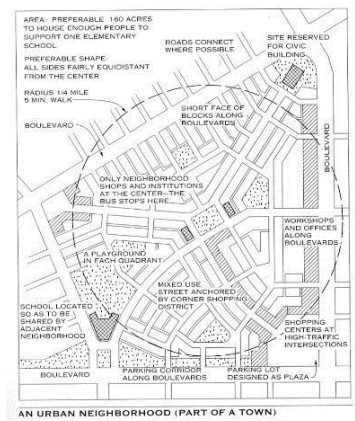
Comparing three diagrams are re-refered from Farr 2007

Clarence Perry(1929)



Source: Perry, C.(1929), The Neighborhood Unit, a Scheme for Arrangement of the Family-Life Community, Regional Plan of New York and Its Environs., New York

Duany Plater-Zyberk(1994)



Source: Congress for new urbanism. (1999). The Charter of the New Urbanism.

Douglas Farr(2007)

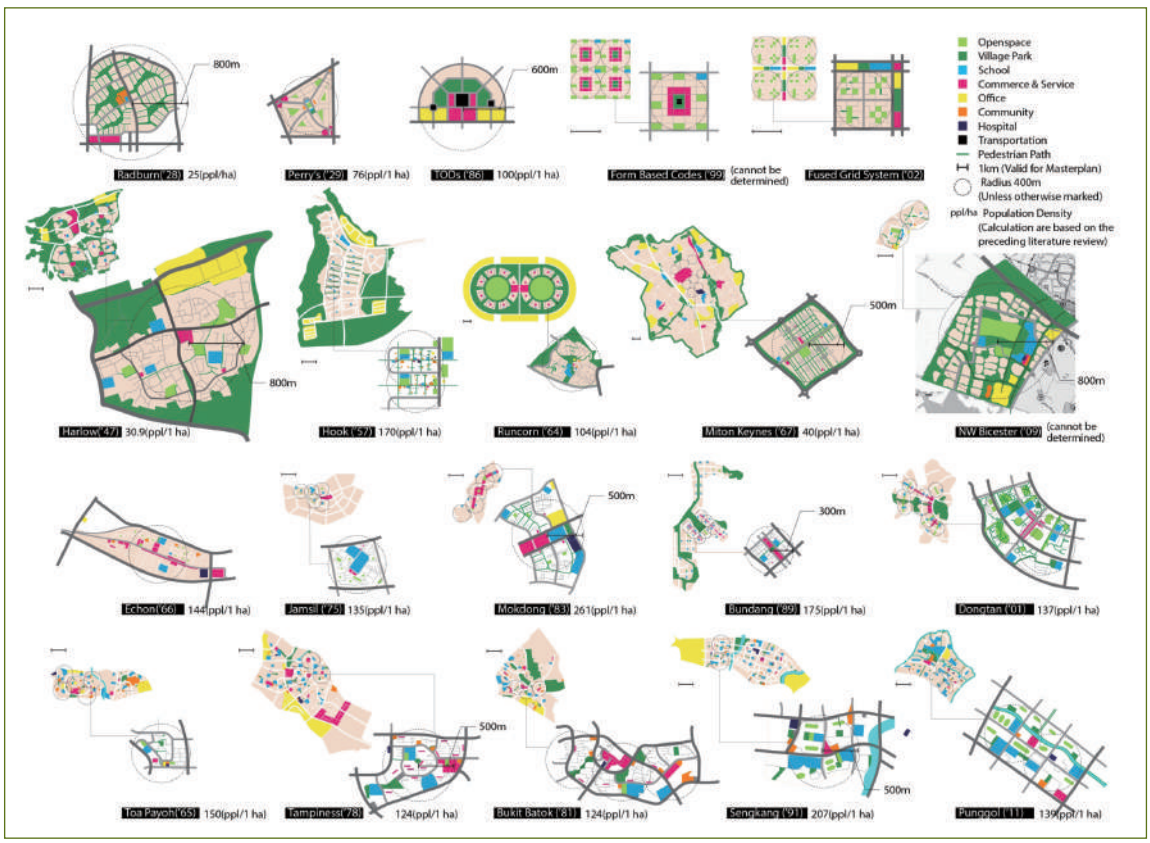
Source: Farr, D. (2008). Sustainable Urbanism: Urban Design with Nature, Wiley and Sons.

within a 400-meter radius accessible through 10-minutes of walking. We can see changes in the arrangement of services and functions of neighborhoods in the following evolved neighborhood models such as new urbanism and green sustainable urbanism[6]. Although the models have evolved from the customary placement of an elementary school in the center to the placement of a shopping mall or community center, and further, putting more emphasis on green spaces and public transportation hubs, the range of appropriate areas still remains a 10-minute walking distance and a half-mile radius.

In Europe and in the North America, the neighborhood unit model has been continuously referred, and in Korea, too, at least in apartment complexes

Figure 3
Walkability Perspective

Source: Jeeun Lee and Sohyun Park, "Exploring Neighborhood Unit's Planning Elements and Configuration Methods in Seoul and Singapore from a Walkability Perspective" Sustainability, Vol. 10, No. 4, 2018, https://doi.org/10.3390/su10040988



of the new towns, we can reference the maps that show how they are organized into walking catchment areas with the neighborhood ideas. [Figure 3] In the case of new towns and cities in Korea including Bundang and Sejong where neighborhood units with a 400m radius are continuously lined up, parks, schools, and commercial functions that are necessary for daily activities are implemented within a 10-minute walking distance[7]. It is a commonly found, time-old practice to provide all basic facilities necessary for daily activities within walking distance, and it can be witnessed again in the diagrams of the latest 15-minute and 20-minute neighborhoods. The neighborhood unit concept has been evolving for a while in the neighborhood units in new cities in Korea.

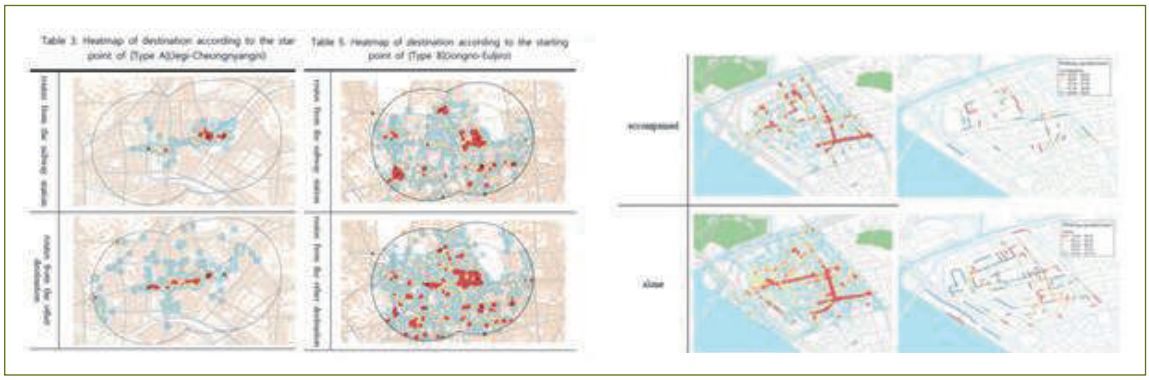
Then, specific questions about realizing smart and seamless mobility within the living environment are expected to be the key to discussions about smart cities. Preciously, one such example was the “Maul-bus”. It has been a valued means of transportation that runs into corners of a residential area and offers a ride to the final destinations, but there have been many problems with its end-point services[8]. For example, the service routes of the Maul-bus were not efficient because it had to drive around and stop at various spots, which meant it takes too long when you don't have much time, and economically, it was also recording a growing deficit as well. The ideal and appealing walkability of a neighborhood should be possible when diverse public and private transportation modes are available to supplement walking, and I am hoping that the discussions about smart mobility will provide some clues to solving problems associated with the walkability of neighborhoods. There is a rapid increase in the use of bikes, but it is not clear how efficiently this could supplement a Maul bus, and I also wonder what role the electric scooters that are easily found around the neighborhood can play in this issue. We don't have a clear idea about specific place-based public services of smart cities that should be included in neighborhood planning for the interest of the residents. There are numerous neighborhood questions that should be analyzed within the context of

discussions about smart cities. The agenda of the big frame of smart cities should be broken down into the scale of everyday life happening in the neighborhood unit and interpreted into spatial issues. We have stories to tell about the big frame of smart cities, but none about neighborhood-based small and detailed real scenarios yet.

Third Question

What could be new research designs and practice scenarios, resulted from substantializing the smart city discussions in terms of "neighborhood walking, neighborhood planning"?

The parts in the discussion about smart cities that sound less hollow and draw more of my attention are the potential of big data and new data technology, which offer fresh challenges and possibilities with regard to neighborhood walking and neighborhood planning. Ultimately, discussions about smart neighborhood walkability and smart neighborhood planning can change along with the evolvement of the basic data collected from research on walking. In the initial stage of walkability researches, data obtained from on-site observation or surveys about walking and then the data obtained from GPS tracking devices people consented to wear were checked along with their traffic logs before the results evolved into the final database. These processes proved to be a major inflection point in the research of walking. But now, a new chapter is opening in the research thanks to the accumulated data on walking collected from smartphones people carry and the public open data coming from various means of transportation that are disclosed in real-time.[9] Since the foundation of a smart city is also built on data and various Information and Communication Technologies (ICTs), a new phase in the research of neighborhood walkability has already opened, too.



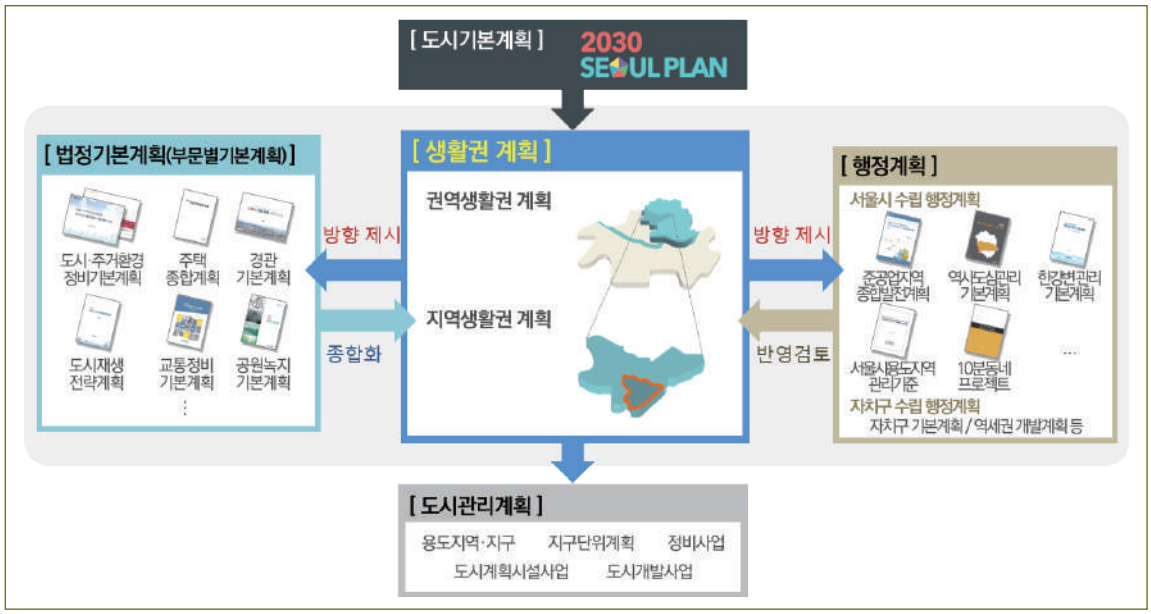
Source: Sunjae Lee and Sohyun Park, "Analysis of Elderly's Walking Patterns near Metro-stations in Seoul by Using Smartphone Pedestrian Movement Data: An Empirical Study Based on 'WalkOn' App Big Data" Journal of the Architectural Institute of Korea, Vol. 34, No. 4, 2018; Jinah Huh et al, "Exploring Residential Street Environments through Walking Companions and Walking Speeds: A Case Study of Mang-won Neighborhoods with the Elderly Focus Group" Journal of the Architectural Institute of Korea, Vol. 35, No. 1, 2019.

Figure 4

Examples of neighborhood walkability found anew through big data-based research on walking behavior

In the past, it took tremendous time and effort to draw even the most basic walking patterns such as walking time and paths of a limited number of people participating in a survey, but now, a massive volume of big data about walking can be obtained from smartphone users with their consent. This big data is offering us completely new and different aspects of neighborhood walkability such as pedestrian routes and movements, not to mention their speeds, energies, intensities, and the areas of their walking activities, in relatively easier and faster ways, if certain research goals and methods were to set up properly[10]. [Figure 4]

Big data-based research on neighborhood walkability is expected to evolve and grow indefinitely. However, how will actual neighborhood planning that reflects the results of this research evolve and grow deeper? The legal basis for neighborhood planning is very weak in Korea's current planning system. In the case of Seoul, where the community plan sits somewhere between the urban master plan and the urban management plan and three administrative blocks automatically become one living–community unit in urban planning, the city now is divided into 116 communities[11]. The fact that the community plan of Seoul has become a reality is of great significance in itself, but it is expected that the area will be gradually adjusted more to ensure better accessibility to daily life. In addition, there are sepa-



Source: Seoul Metropolitan Government, 2030 Community Plan, 2018.
https://planning.seoul.go.kr/plan/map/getPlanMap.do

Figure 5

Where will neighborhood planning stand in terms of the hierarchy in the current urban space planning and how will it evolve and develop?

rate district unit plans that require specific areas to be artificially designated under urban management plans, and there are countless newly developed plans such as SOC plans, and even smart city plans and smart green plans. [Figure 5] However, the units and content are quite different from the hierarchy of neighborhood plans such as 15-minute and 20-minute cities that we are talking about today. The scale of neighborhood planning − which aims to provide residents with services more conveniently and efficiently − also needs to be subdivided into the units of time that it takes to reach those services on foot, such as 10 minutes or 15 minutes. And this is the point stressed by cities like Paris, Melbourne, and Barcelona.

The discussion about smart cities has great power to make people form a consensus because it promises to provide convenience services for daily life, and I anticipate further in-depth discussions and consensus will follow for questions such as if, and how, these convenience services could link to the space-based neighborhood planning discussions. The actual realization of a smart city requires close communication and collaboration between related academic and business practice fields. I believe that the convergence

structure of a smart city service plan and smart city space plan needs to be newly materialized. There are currently several dilemmas with regard to collaboration and communication among related academic disciplines as well as among those in charge of research, practice, and administration.

Fourth Question

What will be the fundamental conditions that must be premised for the grand discourse of smart cities that claims data and technology will solve our urban problems and improve the quality of our daily lives?

It is not an overstatement to say that we are illiterate when it comes to life in a neighborhood. We haven't properly experienced neighborhood life. We don't know what the real lifestyle that we wish to enjoy in a 15-minute city or a 20-minute city is like, and we don't know what to do for that lifestyle. Even if we knew, we could not help but doubt how those concepts of cities could materialize in the megalopolis-type construction culture. Researchers, planners, and administrators also tend to view neighborhood residents as "others" who are the subjects of their research, planning, and administration, rather than recognizing themselves as neighborhood residents. Do they really know what my needs and our needs are? If they know, will they be able to properly fulfill the structure of the neighborhood plan that reflects them?

At a time when the quality of our living environment is emerging as an issue bigger than ever, one of the key questions that must be addressed is: who is in charge of the materialization and implementation of the so-called n-minute cities, such as 10-minute, 15-minute, and 20-minute, and what is the reality of the smart neighborhood plan that those in charge of implementing the plan want. In Korea, the agents in charge of neighborhood planning are very vague. Of course, this is not a problem that is

restricted to Korea alone. Even in most Western countries such as France, Australia, and the United States, the discourse of neighborhood planning or community design is widely shared, but they are vague and differ when it comes to implementation structures and main agents of cities and regions that implement them. It is my expectation that these points will go through more public discussion, and the potential of new data and technology made available by the smart city approach is combined with the reality of the actual living environment plan and revealed in the form of specific questions in the field, and continuously supplemented and improved.

There is a phrase that often appears in the numerous brochures and promotional videos about smart cities available in Korea: "A smart city is about turning every activity happening in a city into data and analyzing it to improve the quality of life and make the people living in a city, happy."[12] I was grateful for this statement, but at the same time I became very uncomfortable with this simplistic logic behind it because it claims that, if we simply turn activities into data and analyze it, we can automatically find solutions to "urban problems." Even though the potential of smart cities is found in areas that could be made possible by data and data technology, collecting and analyzing data themselves do not guarantee a solution, unless we could clearly comprehend what the pressing "urban problems" are, how they are defined, or how they are approached and resolved by whom. We need to define and reach a consensus on what we consider to be our urban problems. As of now, it is fortunate that they are general issues that people can relate to, such as safety from crimes and energy efficiency management, which are surely important agendas. The search for solutions to these problems is being carried out based on data. We must go one step further to reach a consensus on the more accurate identification of more complicated problems associated with improved quality of life, but I think we are not used to this yet. I think that the prerequisite conditions for the initiation of smart city solutions should be asking questions, sharing ideas, making consensus for the identification of problems. It is expected that there will be city-level questions as well as neighborhood-level questions.

At this point there seem to be more declarations of foreign solutions than identifications of our own questions in current discussions of 15-minute cities and 20-minute cities. If we kept asking sensitive and smart questions about our neighborhoods, then more solid smart city solutions for our cities would evolve further.

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Latest Movement in Smart City: Place and Relation Emerging

스마트도시의 최근 움직임: 장소와 관계의 부상

Lee, Sang-hoon

Lee Sang-hoon is a current member of the Presidential Smart City Special Committee, and recently founded and operates a project management company. Prior to establishing the company, he was a professor in the Department of Smart City at Korea University, served as managing director of the Korea Agency for Infrastructure Technology Advancement(KAIA), a government-affiliated R&D institution, and also as head of the Smart City Alliance support group. Prior to working for KAIA, he worked at the Ministry of Land, Infrastructure and Transport in charge of various fields such as urban development, urban regeneration, smart city, new town development, real estate development, metropolitan area planning, construction economy, international air transport, etc. He graduated from the Department of Sociology at the Lyon 2 University in France and the Graduate School of the same college and received his Ph.D. in Urban Regeneration from the Department of Urban Engineering at Yonsei University in Korea.

ABSTRACT

Attempts are made to develop citizens' activity spaces in the neighborhood scale and link them with smart cities, such as 15-minute city, super block, and innovation district. In other words, place-based approaches are made to organize the citizens' activities and experiences within a physical space in proximity and to support broader communications through smart cities. Meanwhile, the positive use of the solution known as the COVID-19 contact tracing system is due to the characteristics of Korean society where individuals are perceived not as fixed entities but as entities in an interdependent relationship with others, and it is expected to present an alternative possibility for modernity together with the rhizomatic relation that is found between BTS and ARMY – a horizontal relationship that produces meaning through coupling connexions.

KEYWORDS

physical space, proximity, mixed-use, 15 minute city, superblock, innovation district, place, modernity, empathetic, inter-dependent relation, rizhomatic relation

초록

시민의 활동공간을 근린주구 규모로 조직하여 스마트도시와 연계하는 시도들이 – 15분 도시, 슈퍼블록, 혁신지구 – 나타나고 있다. 시민의 활동과 경험 등을 근접한 물리적 공간에 터하여 조직하고, 스마트도시가 지원하는 장소적 접근이 이루어지고 있는 것이다. 한편, 코로나19 역학조사 지원시스템이라는 솔루션이 긍정적으로 활용된 것은, 개인을 고정된 실체가 아닌 타자와의 상호 의존적 관계 속에서 인식하고 공감하는 한국 사회의 특성에 기인하며, 이는 BTS와 아미 간에 형성된 리좀형 관계와 – 연결접속으로 의미를 생산하는 수평적인 관계 – 함께 근대성에 대한 대안적 가능성을 제시할 것으로 기대된다.

키워드

물리적 공간, 근접성, 용도 혼합, 15분 도시, 슈퍼블록, 혁신지구, 장소, 근대성, 공감, 상호의존적 관계, 리좀형 관계

Introduction

Smart cities pursue efficiency. Smart cities offer low-cost, efficient, and "smart" solutions for various problems that result from urbanization. Built upon technology – information and communication technology, in particular – smart cities are programming ways and procedures of cities' operations, and subordinating "crowded and disordered" everyday activities of citizens into a rational order. Data are being patternized to become information, further transformed into algorithms based on which solutions and services are realized. The background of smart cities is not a physical urban space: It's a digital space.

The physical urban space has been treated as a simple recipient of the smart city – a recipient in which the digital space is put. This is because smart cities have been developed in order to meet urban problems with low-cost ICT-based solutions by nature, passing over tackling physical space which requires high cost. However, many countries including Korea are building new cities according to the design for a smart city. This means it is possible to actively review physical space. Even in existing cities, there is a growing awareness about the need to consider physical space. Accordingly, there is a growing number of cases in which a smart city is being developed along with active intervention in physical space.

Interestingly, while there are people reviewing physical urban space, there are also people voicing concerns about the use of digital space and its data. Responding to the unprecedented situation caused by the COVID-19 pandemic, the Korean government developed and has been operating a COVID-19 Contact Tracing system by using the Smart City Data Hub. The feedback for the system is generally positive in Korea, but in the West, the feedback is largely negative because people believe it violates personal freedom and privacy. The case of the Contact Tracing system calls for consideration of connectivity, which is a key characteristic of smart cities.

In this paper, the issue of physical space in smart cities will be discussed through the current situation and recent trends. In addition, the issue of connectivity will be discussed with the Contact Tracing system as an example, but the discussion will expand to include socio-psychological or ethical aspects to see if it could suggest an alternative for modernity.

Physical urban space

The status of smart cities - exclusion of physical urban space

Smart cities have different goals and approaches from each other depending on the social, economic, and cultural characteristics, and degree and nature of urbanization of the city, but they all have in common that they use information and communication technology (ICT) to improve city management, quality of life, sustainability, and local economy. In other words, a smart city is an innovative network-type city that uses ICT to solve urban problems and improve the quality of life and the efficiency of city management. A smart city is composed of various elements. It is a complex ecosystem consisting of physical urban space, urban infrastructure, and platforms, as well as activities of citizens, civic groups, administrative authorities, and industry. Therefore, a smart city requires a holistic and comprehensive approach, which includes long-term strategies and planning, public-private partnerships, citizens' participation, and governance. The holistic approach also encompasses several issues, which require an active and balanced response in order for the smart city to be promoted properly and smoothly and achieve expected results. Some of those issues include the decision-making methods, the balance between physical urban space and digital space, public perception of technological innovation, and monopoly of data by platform business.

The digital space needs to be built in a way that allows it to operate at optimized balance with physical urban space. However, the actual status of

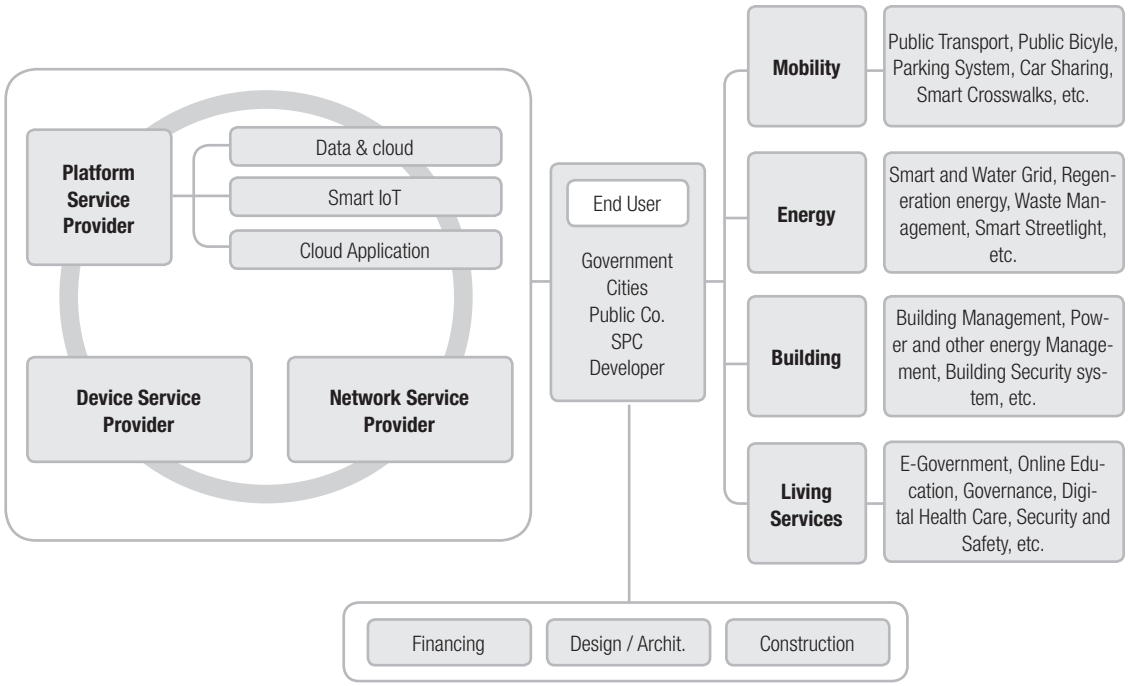
physical space in smart city policies and projects is far below the balance level, further, completely passed over.

The smart city law in Korea defines a smart city as follows:

> *"A sustainable city that provides various urban services based on urban infrastructures that are built through the convergence of construction technology and ICT to improve urban competitiveness and quality of life."*[1]

This definition indicates that the smart city law views the convergence of construction technology and ICT as the essential means for the construction of a smart city. The provisions on a smart city construction project[2] could be read in the same context. It signifies that the smart city law acknowledges the importance of physical space. These provisions are understandable, considering how smart city projects are carried out in connection with the construction of new cities as well as existing cities in Korea. However, legal regulations and the government's intentions are quite different from what's really happening in the industrial ecosystem. All the companies that are spearheading the ecosystem are in information and communication-related businesses. They are, *inter alias*, solution providers by area – mobility, energy and environment, building, etc. – platform service providers, device providers, network service providers. Smart city planning according to the law is made in most cases separately without any collaboration with urban planning which includes physical city plans. The smart city plans are established as if they are written over urban plans. It seems that experts and designers involved in smart cities lay a smart city on a physical city and regard the "circuit board" of the smart city as a morphological parallel to the physical city.

In February 2019, the Smart City Convergence Alliance was formed with the full support of the government. As of December 2021, more than 500 large corporations, small and medium companies, and venture start-ups from various fields are participating in the Alliance. A look into the Smart



Source: : Smart City Alliance(internal material)

Figure 1
Smart City Value Chain

City Value Chain prepared by the secretariat of the Alliance reveals an interesting fact: unlike the typical value chain, it includes design, civil engineering, and construction industries.[3] It means companies engaged in these physical space-related industries are participating in the Alliance, and the Alliance is moving forward by actively considering this fact. It suggests a strong interest that the government has in the physical space with respect to a smart city.

The Sejong National Pilot City Project illustrates well the government's intention related to physical space among the government projects implemented since the establishment of the Smart City Act in 2017[4]. The master planner led the establishment of smart city planning, and requested the Project Owner to implement to modify the existing physical city plan to connect it with the smart city plan so that various services, mobility services in particular, could be realized efficiently. Unfortunately, however, Sejong National Pilot City Project is an exceptional case. Most other government-led projects have been carried out without considering existing

urban planning or urban space. As for the Busan EDC National Pilot City Project, it was easy to modify the existing physical city plan because it was a new city project like the Sejong plan, but the project also did not consider urban planning or physical space. In fact, the master planner team submitted a proposal of a physical space plan which requires modifying the existing city plan, when establishing the smart city plan. But their attempt was not realized due to the opposition of the new city project owner. Among an important number of government-led smart city projects, there was a project – unique case – explicitly linking physical space and smart city. It's the urban regeneration project of smart city type which implemented physical improvements, s/w projects, and smart city projects simultaneously in the designated areas. Bit this project had been implemented in 2018 only, since then suspended for various reasons.

Smart city + Physical space

Most smart city projects in Korea – except for a few exceptional cases – were carried out with a focus on solutions and services built on ICT, because the smart city emerged as a solution that could solve urban problems by using ICT at low costs. Smart city projects have been pushed forward with as little consideration to high-cost physical space as possible. This was not only the case in Korea, but also in most countries such as the United States and Europe.

15-MINUTE CITY However, different attempts were made by some urbanists. The concept of neighborhood units was advocated by the American urban planner Clarence Perry in the 1920s, and a walkable city was proposed by the New Urbanism that emerged in the 1980s. They were followed by similar ideas that appeared in the early 2010s including the urban cell, the 30-minute neighborhood, and the 20-minute neighborhood. Kent Larson of the MIT Media Lab presented the notion of a neighborhood called "the 20-minute city" in a TED talk in June 2012. It centers on compact urban cells with a population of 15,000-20,000 where most functions that residents need for daily life are accessible within about a one-mile

radius by 20 minutes of walking, and these urban cells are connected in a network through public transportation.[5]

Research on the relationship between time and quality of life has been also carried out by a group of urban experts and sociologists under the name of chrono-urbanism[6]. While this movement was going on, Carlos Moreno, a specialist in intelligent control of complex systems and smart cities at the University of Sorbonne in France, proposed the "15-minute city" in 2016.[7]

The 15-minute city is a proposal of development of a multi-centric city where the life in proximity assures a mixed use of urban space, and allows thereby dynamic social, economic, and cultural interactions. It gives access to six essential functions – living, working, supplying, caring, learning, enjoying – within 15 minutes of walking or 20 minutes of bike riding. The 15-minute city is covered by 3 major concepts; new urban rhythm to reduce long commuting time aggravating the life quality (chrono-urbanism), use of existing places to diversify by means of introducing different usages (chronotopia), and the reinforcement of new urbanity by residents' attachment to their place (topophilia).[8] According to Moreno, the 15-minute city has 4 components – density, proximity, diversity, and digitalization. He argues that the optimal density would encourage local solutions to local problems, the proximity would reduce the space and time necessary for activity, and the diversity according to mixed-use development and multicultural neighborhoods would improve the urban experience and boost community participation in the planning process. In particular, the digitalization coming from smart cities is a key aspect of the 15-minute city, and the 4th industrial revolution technologies such as video teleconferences, online shopping, etc. have reduced the need for commuting. Consequently, these 4 components, when implemented at scale, would provide a city with easy access and high quality of life. Mayor Anne Hidalgo, who was re-elected in the Paris mayoral election in 2020, included a 15-minute city in her campaign pledge, which indicates the 15-minute city is being realized as an actual policy of the city of Paris instead of simply being a concept and theory.[9]

SUPER BLOCK Barcelona's "super block" is another idea similar to the 15-minute city in the sense that neighborhood-scaled small cities are developed in a big city with diverse functions well equipped and easy access to those functions. In fact, the beginning of the super block was a mobility policy that was triggered by environmental issues, especially a noise problem.[10] The key to this idea is to create a super block by linking small blocks and controlling the traffic inside the super block to make the inside roads part of a green and mixed-use space that can provide a pleasant communal environment to the block residents. The super block plan was officially adopted in 2015, and its main idea was to build 500 super blocks throughout the city and turn 70% of the roads into mixed-use spaces.[11] Since its pilot project in Poblenou – an extensive neighborhood located to the east of the city center – in 2016, additional super blocks have been created through the participation of citizens. The Eixample district, designed by Cerdà and developed in the second half of the 19th century, has a grid structure consisting of 100m × 100m blocks.[12] A super block is created by combining nine blocks (3×3), and an underground parking lot and green areas are created on the streets within the block. A plaza is also created in the intersection where four blocks meet. The speed of vehicles within the super block is limited to 10 km/h to improve environmental conditions such as traffic, noise, pollution, and greenhouse gases. The streets within the block are used as multi-purpose spaces for walking, outdoor markets, outdoor games, events, and all other activities that promote interaction between people and businesses. The Barcelona city government is promoting the super block project and the smart city project in complementary directions. For example, although vehicle operation in the super block is limited, mobility is increased by installing smart elevators that use real-time passenger data at subway stations. In the case of Subway Line 9, the data is used for improved mobility by effectively carrying passengers and allowing the elevator to reach the platform just before the arrival of subway vehicles. This system also alleviates traffic congestion and reduces the consumption of energy and greenhouse gas emissions.

Figure 2

Eixample District in Barcelona

INNOVATION DISTRICT Although it remains within the same framework of a small urban space + smart city, a movement different from the 15-minute city or the super block of Barcelona is taking place in Korea. While existing smart cities were aiming at solving urban problems and improving the quality of life, this attempt strives to create jobs through innovation. It is about designating an area in the city center where diverse functions are concentrated in proximity, therefore accessible within 15-20 minutes of walking or bike riding, then building an innovative ecosystem and creating jobs through physical improvements, software projects, and smart city projects.[13]

In the previous century, large-scale industrial clusters such as Silicon Valley spearheaded innovation. But these clusters are spatially isolated, away from cities so that it resulted in limited mobility, housing supply, and leisure activity problems, etc. The 21st century saw the emergence of the concept of an innovation district that made up for the spatial isolation problem.

Innovation district refers to a geographic realm where cutting-edge institu-

tions and companies, start-ups, incubators, and accelerators are clustered and connected with each other. The district is found in the center of a city, physically compact, and offers easy access to public transportation. It is technologically well connected and dotted with mixed-use buildings where residential units, offices, small retail shops are located. Recently, a large number of innovative companies and experts have begun moving into a small but well-equipped residential area in the center of the city where they secure common or shared workspaces. This is how small but leading companies in the knowledge-intensive industry are establishing their main facilities at locations in the vicinity of other companies, research labs, and colleges instead of green spaces as in the past so that they can share views and ideas, and practice open innovation together.[14] They prefer starting a company in a shared workspace and having easy and efficient access to everything from legal counseling to elaborate lab equipment while mingling with other entrepreneurs, instead of practicing innovation by isolating themselves in a garage or inventing something alone. The role of the enabler is of utmost importance in order for an innovation district to function properly. Public and private research institutes, universities, and private companies can play the role of enablers who establish an innovation ecosystem, build internal and external cooperation system, provide financial and legal advice, support technology testing and scaling up, etc., and further create physical innovation space.[15] Various types of business ecosystems can be created by regenerating old city centers or developing smart cities, linking them with innovation districts. As such, an environment that makes the city more dynamic and energetic and meets varying needs and demands for living can be set up, and more than anything, the competitiveness of the city can be enhanced.

All three cases discussed above – 15-minute city, super block, and innovation district – have the common feature that they prefer compact neighborhoods and share the characteristics such as diversity, sustainability, human scale, and accessibility. However, it doesn't seem that they can be applied universally in other locations, because each of them reflects the nature of the place where it appeared. Innovation districts set aside, as they are

emerging in Korea, will the 15-minute city or a super block be applicable in the Korean context?

In general, a 15-minute city has the potential to bring about gentrification or economic and cultural disparities between the center and periphery. When talking about a 15-minute city in a Korean context, it should be pointed out that Korean cities generally have very high densities and that they are subject to zoning regulations. Therefore, the possibility of a 15-minute city should be considered primarily for small and medium-sized local cities with relatively low density, instead of cities in the Seoul metropolitan area or large cities. As for the super block, it is certainly a very attractive plan. However, Barcelona, – and the Eixample district in particular – is characterized by regularly and perpendicularly laid out roads and streets that are wide and homogeneous; identically shaped and sized blocks and grid-type urban structure; and evenly distributed neighborhood functions and mixed-use. Korean cities are quite different. With respect to mixed-use, for example, commercial and residential areas are in most cases separated by the zoning system. In addition, urban planning control – zoning minimum – could cause unexpected negative effects in a different context. As far as the regulation on the number of parking slots and width of roads is concerned, it could give rise to the increase of vehicles on the roads and the construction of wide roads rather than induce car-free streets. Except in some wealthy commercial districts, the creation of a car-free, walkable city will be difficult due to the regulation with such results. Any move to alter physical urban space requires consideration of physical, economic, and social characteristics such as the topography or density of the city, the degree of urbanization, disparities within the city, and the legal system. And in order to enhance the possibility, the smart city should be given an appropriate role.

Interdependent relationship with smart city

Connecting a smart city with an innovation district can be said to be discussed more with rather forceful and aggressive interests such as innovation and economic competitiveness than with a universal interest in citizens' lives like it does with the 15-minute city or super block. Is it an approach unique to East Asia, especially Korea? The development of ICT is bringing about a major change in not only smart cities but also in industrial paradigms. The industrial revolution, which started with steam engines and spinning machines, has improved efficiency and increased productivity through separation and division of labor. The framework of industrial separation and division of labor is being dismantled by ICT, and efficiency and productivity are increasing through convergence rather than separation and division of labor. The scientific revolution, civil revolution, and industrial revolution that occurred in the West resulted in so-called modernity, and valued and substantialized corresponding ideas such as subject (vs. object), self (vs. other), reason (vs. emotion), human (vs. nature), which brought about a sense of order particular to modernity. The technology that led the industrial revolution put so much focus on efficiency and utilitarian value that meaning and uniqueness were excluded and turned all objects, even humans, into instruments. The development of ICT and the ensuing emergence of the smart city is founded upon convergence, not separation, as its fundamental standard. It means it has given rise to a significant change. Nevertheless, we are left to wonder if we are still inappropriately clinging to the "substances" and order given by modernity? Is our relationship with technology a relationship that is instrumentalized by technology like in the past? Are we beings that are subordinated to technology and instrumentalized to achieve economic innovation? In this chapter, we try to find alternatives to these questions.

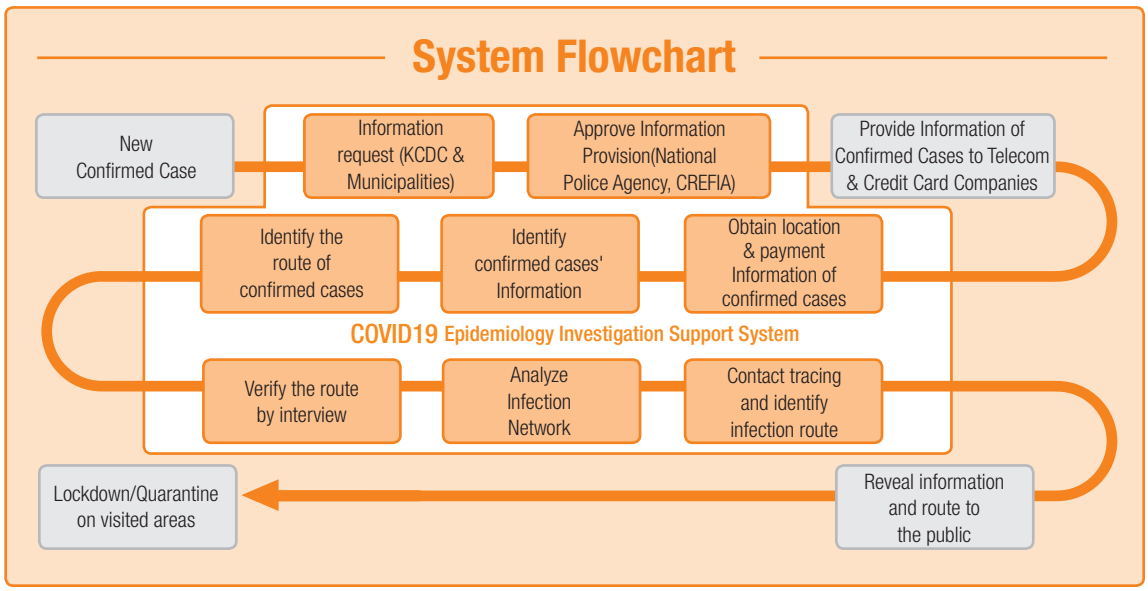
Covid-19 contact tracing system: relationship orientation

In March 2020, COVID-19 started spreading quickly across the city of Daegu. The government, experts, media, and citizens were all alarmed and hoped the spread of the virus would slow down shortly. It was under this circumstance that the Contact Tracing System was developed. This system was built upon the data hub platform that was developed through the national smart city R&D Program.[16] The system identifies the movement of confirmed patients and people they might have had contact with based on two types of information: mobile phone location information (GPS) and credit card transaction information. This system takes only 2-3 minutes to request and collect all necessary pieces of information including: request to and permission from the National Police Agency to collect location information; request and collection of information from 3 telecommunication companies; request to and permission from the Credit Finance Association related to credit card transaction information; request and collection of information from 22 credit card companies. This system is always mentioned when explaining the excellence of Korea's quarantine system to other countries, and it has also been presented and discussed in an important number of webinars held with multilateral development banks, interna-

Figure 3

COVID-19 Contact Tracing System

Source: National smart city R&D Program



tional organizations, and major countries.

After the MERS outbreak in 2015, comprehensive measures to respond to infectious diseases have been established as legal systems. A national consensus was reached on the necessity, ground, and method of proactive response to infectious diseases, and based on this, various measures, including epidemiological investigations – contact tracing, were legally reinforced or newly prepared. Strict control over the contents of the contact tracing, i.e., personal information, was also prepared as well. Although these measures were explained together when the Contact Tracing System was presented and discussed, a significant number of Westerners expressed negative opinions about it, claiming that Korea's Contact Tracing System was infringing on individuals' freedom and privacy.

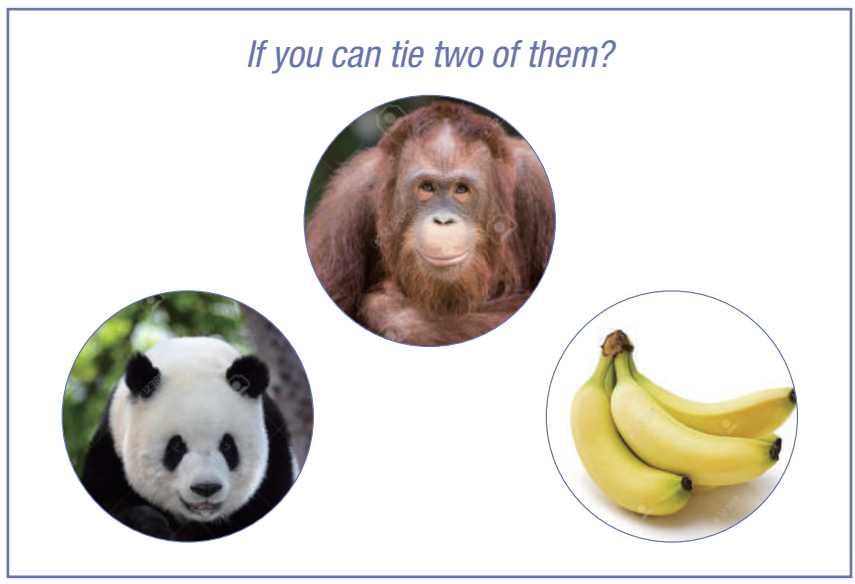
Social consensus and acceptance of contact tracing for epidemiological investigations are difficult to comprehend only in terms of the seriousness of such viruses as MERS or COVID-19 or the social atmosphere. It necessitates further discussions on how our society is structured and how it works, because contact tracing was socially acceptable in Korea due to the way society works here. Discussion on how our society works based on what principle will explain how society accepted the contact tracing, and furthermore, it will provide a glimpse into the possibility of a smart city in terms of how and in what way the smart city will work.

What made COVID-19 contact tracing possible? The answer is that Korean society operates in a relationship-oriented way, and it is an interdependent relationship. Interdependent relationships can make it easy to establish emotional solidarity that members of society can empathize with. Accepting an epidemiological investigation, and thus acknowledging that, when confirmed to be positive on a COVID-19 test, personal information could be exposed, if only on a limited basis, signifies that people are aware that they are already in an interdependent relationship with others and that members of society are not independent of others. This awareness creates an emotional sympathy that makes people identify the pain of others as

being like their own and avoid the risk of having others contact the virus through contact with them. In terms of people's relationship with others, it means that the others are not objectified and that a relationship – an inter-dependent relationship – has already been formed between themselves and others. Interactions happen based upon this foundation, and an emotional solidarity is created in the form of sympathy between themselves and others, or with all members of society.[17]

There is a famous visual test that demonstrates Korean relationship-oriented psychology well. The picture below shows a panda bear, a banana, and a monkey. When asked to look at the picture and pick two similar objects, most Westerners pick the panda bear and the monkey because these two are mammals. On the other hand, about 90% of Koreans are said to pick banana and monkey as two similar objects. This is because, in Koreans' minds, monkeys eat bananas, and this is because we naturally perceive our identities based upon our relationship with others. In the case of objectifying others, I, the subject, see others as objectified beings who have nothing to do with me, and perceive them by their nature or essence for categorizing. This is ultimately to control the others, not to mention dominate them.

Figure 4
psychology test



The size of cities is very large. In small-size settlements of the past, it was possible for everyone to know and relate to each other, but it's impossible in large cities. It is easy to control others while hiding behind the shield of anonymity and to satisfy one's desires and selfishness in the name of freedom and rights. In the face of the COVID-19 pandemic, cities are revealing signs of this trend. Small-scale neighborhood projects, such as a 15-minute city, can be a very meaningful attempt to prevent such negative signs. In our context, smart cities are also very important. Smart cities can enhance the connectivity between citizens, which has been impossible due to the large scale of cities and zoning system leading to separation. But the connectivity alone is not enough. Ultimately, on the basis of owner spirit, we do promote relations with others not in the way of power-conflict, but of interdependence. In other words, it is necessary to encourage an interdependent relationship between citizens – even between anonymous citizens – and to make citizens aware of it. Citizens will be able to empathize with others and set common civil and social goals and act upon them when they act upon the recognition that all are connected together within an interdependent relationship. This is not collectivism that identifies the self with the group, by any means.[18] For overcoming the crisis that COVID-19 forced upon us, the smart city will be effective by combining its "non-contact" nature – various online solutions in communications and activities – and its connectivity-based interdependent and empathetic relation orientation. The response model that Korean society has demonstrated during the COVID-19 pandemic can be a meaningful reference of an interdependent smart city.

BTS-Army: Rhizomatic relation

What does the boy band named BTS have to do with the smart city and the way society works as mentioned previously? In fact, what we are interested in is not BTS themselves, but the relationship between BTS and its fanbase called their ARMY and how it works. That's because the relationship between BTS and their ARMY is established and works in a way very similar to the interdependent relationship orientation of Korean society as

discussed in the case of the contact tracing system.[19]

The ARMY publishes its own academic journal and proactively hosts academic conferences and workshops. The title of the academic journal published by ARMY is Rhizomatic Revolution Review. So, what does the academic journal mean by its title, Rhizomatic Revolution?

French philosopher Gilles Deleuze criticizes the Hegelian logic of identity and advocated the logic of difference. A new creation is possible only when a difference is affirmed, he claimed. Therefore, he was against what made something fixed and permanent, such as identity, territorialization, coding, signifiance, and subjectification. The concept that explains this idea is tree and rhizome. A tree is literally what it is: a plant that has its roots below the ground and its trunk, branches, and leaves above the ground. A tree presupposes a hierarchical and vertical order, because it starts from the root, and then its trunk emerges, and leaves sprout as it grows. On the other hand, a rhizome, which refers to subterranean plant stems such as ginger and the root of the lotus, sends out roots and shoots from its nodes underground as it proliferates continuously. It spreads horizontally without a central stem as it creates new shoots from its nodes, and you cannot tell where it started or originated from. In his book, A Thousand Plateaus, Gilles Deleuze uses the botanical term, rhizome, as the concept that explains virtually all subjects such as social structures, political systems, scientific methods, and philosophy.[20]

Unlike the arborescent relation which is hierarchical and centralized of a tree, the rhizomatic relation is marked by a horizontal connection without a single-center, and it is what characterizes the relationship between BTS and ARMY. This is not a tree-type relationship where the idols are at the center and their fans are worshiping from the side. BTS' activities are shared online in real-time without being restricted by space thanks to ICT, and the band is different from what the perfect stars look like as they live in a world completely different from ordinary people. BTS fans share ev-

erything about BTS' daily life, how they practice, what they dream, what they are concerned about, and what they have on their minds, and they feel BTS is closer to them than their friends. In other words, they are connected through a horizontal friendship.

Philosopher Lee Ji-young explains this with the term “BTS phenomenon”.

> *The “BTS Phenomenon” shows a decentralized rhizomatic system. In this system, there is no single center of power, such as a large capital or the media power associated with it. ARMY and BTS are in a horizontal relationship with each other as friends and supporters, rather than one being the center. ARMY is also a connexion of countless different rhizomes that don’t share interests or similarities other than the commonality of being BTS fans.*[21]

Since this connexion has no central principle responsible for fixed meaning, there is no order or final destination. Nothing that exists in this world can have a fixed meaning, and all things in the world are creating meanings through countless connexions. Therefore, the meaning of producing and segmenting differs depending on what is connected to what. The BTS-ARMY community has changed the existing rules required by the tree-type society and has been creating new ones, and it is creating new political roles and meaning that no other idol group fans could have made. In this sense, they are carrying out a revolutionary practice. And that is the final destination of their academic journal, Rhizomatic Revolution Review, that ARMY publishes.

The interdependent relationship mentioned in the contact tracing case, the sympathetic solidarity formed through this relationship, and the horizontal and decentralized rhizomatic relationship between BTS and ARMY – where meaning and relationships are newly formed by countless connexions – are all in line with the connectivity and relationship orientation of smart cities.[22]

Conclusion

The 15-minute city, super block, and innovation district all assume that the activities of residents happen dynamically mainly in small neighborhoods. The 15-minute city and super block aim for improved quality of life, diversity, and sustainability, but the 15-minute city grants the smart city an active support function, while in a super block, it is using the smart city in a complementary form. On the other hand, the innovation district being discussed in Korea is designed to make innovation happen through smart cities based on diversity, proximity, networking, and collaboration. Although all three plans utilize smart cities in terms of data, algorithms, programs, and platforms, the offline activities of residents are mainly focused on experiences based on proximity – despite its technical and abstractive approach. That means the neighborhood that provides residents a ground for their livelihood is not an abstractive space, but a space where residents live, make experiences, and create meaning.[23] In other words, they value the place-based approach.

What will we get if we look at the place-based approach from a smart city? The digital space created by the smart city has nothing to do with place, because, in a digital space, there is no locale. The essence of a smart city is data. The data we encounter is abstractive, such as congestion degree or traffic volume. For this reason, some say it is necessary to put the data in context. American anthropologist Shanon Mattern argues that, "urban information is made, commodified, accessed, secreted, politicized, and operationalized",[24] therefore we need to put data in context. According to her, there are countless forms of data and sites of intelligence-generation, and in addition to the data that we commonly encounter, there are knowledge and information that are difficult to be processed as information but are essential in our lives nonetheless, such as place-based information, cultural memories, performative forms of knowledge, etc. She also emphasized the importance of memories and history of a city, the sensory and experiential nature of spatial information, the wisdom of local crowds and communi-

ties, and the importance of information permeating the city.[25]

Shanon Mattern's discussion can be expressed in a few keywords such as the specific context of data, the sense of place of urban information, memory and history, intangible knowledge, sense and experience, and wisdom, and all of them can be also summarized in terms of place and time of urban intelligence including data. It means a sense of place is being emphasized even for data, but can the data of smart cities accommodate a sense of place?

The interdependent and empathetic relationship of Korean society as manifested through the COVID-19 contact tracing system, and the non-centered horizontal relationship in which meaning and relationships are created by the connexion between BTS and ARMY – the rhizomatic relationship – let us foresee not only the potential of a smart city but also an alternative to modernity. What kind of offline activities do the broader online relationships and interactions require? That's the question we should ask ourselves who had to engage in online activities dynamically such as video teleconferences, digital healthcare, and online education after cities were locked down and social distancing was mandated in the wake of the COVID-19 pandemic. Because we want to meet people in person, socialize with them, and make contact with them, despite of all these online communications and activities. That is, we need a physical space for contact, communication, and sharing. Neighborhood-scaled close spaces that allow various contact and communication in person, and experiential activities can complement the smart city by providing a stable and realistic location for the broad interactions and relationships provided by smart cities. Meanwhile, it remains to be seen how the online rhizomatic relation will expand, what new order it will demand, and how it will change the organization of the city.[26]

| References |

1. Article II, Section 1 of the Act on the Smart City Development and the Promotion of related Industry
2. Article II, Section 6 of the Act states, “A smart city construction project means … installing, constructing, building, repairing, and improving, as well as supplying and operating smart city infrastructure, buildings, and structures to provide smart city services in accordance with the smart city plan.”
3. Design, civil engineering, and construction are not included in the value chain or supply chain in any materials from consulting firms, market research institutes, and tech companies.
4. Government-supported projects are divided into national pilot city projects (Sejong and Busan), which are new city projects; challenge projects for existing cities (four types including city-type, town-type, campus-type, and solution diffusion-type); and regulatory sandbox projects.
5. Kent Larson, ‘Brilliant designs to fit more people in every city’, TED×Boston, June 2012
6. François Ascher, ‘Du vivre en juste à temps au chrono-urbanisme’, Les Annales de la recherche urbaine, vol. 77, no 1, 1997, p. 112-122
7. Carlos Moreno, ‘La ville du quart d'heure : pour un nouveau chrono-urbanisme’, La Tribune, Oct.5, 2016
8. The explanation of the 15-minute city is drawn from the presentation made by Prof. Moreno at the Smart City Top Agenda Symposium(TAS) held in Goyang, Korea, on September 9, 2021
9. When asked “Can the 15-minute city be a permanent alternative?”, Prof. Moreno answered, “We don't want to force people to stay in the 15-minute neighborhood or reconstruct the settlements of the past. What we want to do is to create a better urban structure.” Natalie Whittle, ‘Welcome to the 15-minute city’, Financial Times, July 17, 2020
10. The concept of super block in Barcelona began to be discussed in the mid-80s as a solution to traffic noise, particularly the noise problem of passing traffic, at the city council led by urban ecologist Salvador Rueda (City councilor), and the first super block was built in the Born

area of the old city center in 1993. In 2003, two super blocks were built around the Gracia Street, Eixample, by removing pavements, introducing speed limits for vehicles, and eliminating one-way streets. As a result, walking and use of bikes increased by 10% and 30%, respectively, while the traffic was decreased by 26%. However, it also resulted in the gentrification problems, such as increased number of stores, real estate speculation, and inflow of tourists.

11. The center-right government, led by Xavier Trias, started the planning in 2012 and finally adopted it in 2015, and it was taken over by the Ada Colau administration of the Green-Left Coalition when it came to power after winning the elections in the same year. The Poblenou super block was the first to be build under this plan. The plan was spearheaded by Salvador Rueda, who had been an advocate of super block since the mid-80s.
12. Eixample is a new town with a total area of 7.48 km^2, constructed according to the first plan in 1860 and the revised plan in 1863 due to the industrial revolution in Barcelona in the mid-19th century and the consequential housing shortage problem, and the urban planner and civil enginner, Ildefons Cerdà, took the lead in its design.
13. Such discussions are made with smart city-related research and management institutes, as well as industries and research institutes at the center. In April 2020, the Smart City National R&D Project Group published a similar planning report titled Planning Report for the Global Smart City Innolab Construction International Joint Research Project, and the Presidential Special Committee for Smart City also proposed innovation district-related policies at the smart city policy conference in September 2021.
14. Many innovation districts are emerging around the world. In the United States, innovation districts are created in cities such as Atlanta, Boston, Detroit, Houston, Philadelphia, Pittsburgh, and San Diego, as well as in areas surrounding enabler institutions in the Midwest. In the case of Europe, innovative districts have been created and thriving in Barcelona, Berlin, London, and Stockholm, as well as in Montreal and Toronto in

North America.

15. The Cambridge Innovation Center is a good example of an innovation space. It is a real estate service company founded in Boston by two MIT graduates, and it has campuses in nine cities as of today. The Center provides shared spaces (CIC campuses) for offices, conference rooms, and labs to startups, corporate innovation departments (spin-offs), and VC funds.
16. On Feb.24, 2020, the development kicked off in response to opinions about using the smart city data hub as an epidemiological investigation support system between the research team and related ministries. The development was completed on March 16, and after 10 days of pilot operation, it was delivered to the Korea Centers for Disease Control and Prevention on March 26.
17. Korean language is predicate-centric rather than subject-centric, and by sharing the predicate field with others, such as the predicate fields indicative of alma mater and hometown, Korean speaking people form a strong emotional bond with interlocutors and build metaphorical and close relationships with them instead of a relationship between an object and a subject.

    Lee, Sanghoon, 'Community Formation and Spatio-Temporal Implications in Residential Regeneration Project', Yonsei University Ph.D. thesis, 2017, pp. 14-17
18. In a society where collectivism is strong, it does not matter if a woman enters a public bathroom for men and cleans it, for example. The reason is that the woman is perceived as a member of the "cleaning crew", or a cleaner, instead of a female. This is something that would not happen in Korean society.
19. Acclaimed to be the strongest fandom in history, ARMY is believed to be a massive fanbase, considering that BTS has 34.21 million Twitter followers and 59.5 million who are subscribing to their YouTube channel, "Bangtan TV" as of november 2021. ARMY's members are from various age groups and occupations, and their residences are also spread throughout the world. Like other singers' fandoms, ARMY mem-

bers votes for BTS for the boy band to win awards, and they stream the band's music videos and sound sources to break their sales records. They are doing all that to lay the groundwork for BTS to carry out long-term and stable music activities. What is unique is that, in addition to these activities, they are engaged in activities as a "value-oriented community" to realize the values and musical messages that BTS delivers. There are various individuals and groups within ARMY. Various social activities such as donations to the socially marginalized or the underprivileged, operation of the ARMY website, academic activities, free teaching, psychological counseling, medical and legal counseling, and others are being carried out by them.

Lee, Ji-young, 'BTS ARMY is evolving into a borderless community beyond the fandom', Hankook Ilbo, Sept.9, 2020

20. Deleuze, G. & Guattari, F. 'A Thousand Plateaus: Capitalism and Schizophrenia', translated by B. Massumi, University of Minnesota Press, 1987, pp 3~25
21. Lee Ji-young, 'BTS Art Revolution, BTS Meets Deleuze', Parrhesia, 2018, p.91
22. The interdependent relationship and rhizomatic relationship runs in parallel with the Buddhist theory of dependent origination, which claims that everything that exists is created by direct and indirect factors that are dependent on each other, and therefore, there is no absolute being (God) or fundamental principle (idea) other than the conditions or components involved in the creation of things. Let's take the vine as an example. The vine comes from the seed of the grape. In this case, the seed of the grape is the direct cause of the birth of the vine. However, this seed can grow into a vine only by relying on indirect factors such as moisture, soil, sunlight, and labor. The vine cannot exist if any one of these indirect factors is missing. Therefore, the vine is created through the interaction of the direct factor, i.e., the seed, and various indirect factors that help its germination and growth, and it does not require such things as the essence of an apple tree or the hand of God. Elements such as moisture and soil also exist because of mutual bonding of

oxygen and hydrogen, or innumerable elements relying on and bonding with each other. All things exist because their components are depending on each other.

23. A place is a key concept in human geography, and it refers to a space where people give meanings to and build relationship with humans. Originally derived from phenomenology, it meant a lived and experienced space as opposed to an abstract and mathematical space. After that, the concept becomes the main topic in human geography in the late 1970s represented by Yi-Fu Tuan and Edward Relph. For reference, political geographer John Agnew suggests location, locale, and sense of place as three components of a place. John Agnew, 'Place and Politics: the Geographical Meditation of State and Society', Allen and Unwin, 1987, pp. 26–28
24. Shanon Mattern, 'A City Is Not a Computer', Place Journal, Febryart 2017., p.6
    http://placesjournal.org/article/a-city-is-not-a-computer
25. Shanon Mattern, ibid, p.12
26. Many of the messages that BTS delivers have socially critical connotations, and ARMY has accepted them and makes changes by cutting through the existing social order and dismantling its hierarchy.

Smart Cities & Urban Transformation:

the Smart City as Public Space

스마트시티와 도시 전환: 공공 공간으로서의 스마트시티

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ABSTRACT

Datatech and cities are developing in a symbiotic relationship and are mutually influencing and transforming each other. However, we will only realize the full potential of datafication and smart cities if a number of conditions are met. In order to turn data into real value for our urban environment, we need liquid and dense data, which are to a large extent opened up and democratized, and progressively lead to more control, optimization and autonomy of the online world around us. At the same time, we also need to fulfill a number of crucial institutional conditions, which entail that cities should act as coordinators, regulators and experimentation environments in order to realize the beneficial potential of smart cities. If these conditions are fulfilled, transformative changes to our cities can be expected. The main question then becomes how to ensure a new public space in which everyone has a right to the smart city. The paper argues for novel ways of co-creative placemaking for the new hybrid virtual-physical reality, taking into account a number of important trade-offs.

KEYWORDS

datafication, smart cities, urban transformation, public space, placemaking

초록

데이터테크와 도시는 공생 관계 속에서 발전하고 있으며, 상호 영향을 주고받으면서 서로를 변화시키고 있다. 그러나 여러 조건이 충족될 때에만, 우리는 데이터화와 스마트시티의 풍부한 잠재력을 깨닫게 될 것이다. 우리의 도시 환경에 적합한 실질적 가치를 가지도록 데이터를 변환시키기 위해서는 광범위하게 공개되고, 민주적이며, 점진적으로 우리 주변의 온라인 세계를 더욱 잘 통제하거나 최적화 또는 자율화할 수 있는 유동적이고 밀도 있는 데이터가 필요하다. 동시에 스마트시티의 잠재적 혜택을 실현하기 위해서는 도시가 조정자, 규제자인 동시에 실험적 환경을 제공할 수 있어야 한다. 따라서 이를 위한 여러 가지 중요한 제도적 요건들도 충족해야 한다. 그렇게 되어야 우리의 도시를 바꿔 놓을 전환적 변화를 기대할 수 있다. 따라서 '모든 사람이 스마트시티에 대한 권리를 지닌 새로운 공공 공간을 어떻게 확보할 것인가'가 중요한 질문으로 떠오른다. 이 글은 몇 가지 중요한 균형을 고려하면서, 새로운 하이브리드 가상적–물리적 현실을 위한 공동 가치 창출의 장소 만들기라는 참신한 방법이 필요하다고 주장한다.

키워드

데이터화, 스마트시티, 도시 전환, 공공 공간, 장소 만들기

Introduction

The bullhorn acacia is a peculiar type of acacia tree found in Central America. It is known to biologists because it lives in perfect symbiosis with a specific race of ants. These ants live off small protein packages which the tree deposits on its leaves. In return, the ant armies attack all plant eaters who come near the tree. This century-long symbiosis has determined both species to a remarkable degree. The ants have physically adapted to release aggressive pheromones that scare off herbivores. And the tree gets its name from the large, hollow thorns that have formed over time to house the ant colonies.

Just like the acacia and the ant, cities and technology are symbionts: they help to produce each other, develop together and co-determine each other. It's not a coincidence that one of the first cities known in history, Uruk in Mesopotamia, is also the place where the groundbreaking technology of writing is thought to have originated. This technology formed the basis of large-scale administration and trade, which in turn underpin the rise of cities. Later key technologies such as cement, sewers and the car were also introduced within the urban context, and subsequently transformed the function, the look and the shape of the city.

In what follows, I will put forward a number of ideas about a similar type of symbiosis, and thus transformation, which is currently taking place under the header of 'smart cities', and on how we can ensure that the result is beneficial for individuals and society as a whole (based on Ballon & Smets, 2021; Ballon, 2019; Ballon et al, 2017; Ballon, 2016).

Smart cities and datatech

Today, a new key technology has developed in symbiosis with our cities, i.e. datatech. Datatech consists of all technological means to

capture, store, visualise, analyse and transmit data. In an urban context, this includes cameras and beacons, sensors and actuators, smartphones and wearables, antennas and networks, and also the associated apps, systems and platforms. These technologies have led to an enormous increase in data in and about the city, in terms of volume, speed, accuracy and variety.
This in turn enables a range of applications, from monitoring air quality and sound pollution, sharing bikes, tools or holiday homes, alerting security services, detecting traffic jams and steering traffic flows, to optimizing energy usage by buildings or street lights, or nudging citizens to spend more time exploring local retail or culture.
The idea of the 'smart city' refers to the expectation that these new technologies will fundamentally alter and shape our cities. As MIT's William Mitchell described near the turn of the century in his essay 'Smart City 2020':

"Preindustrial cities were mostly skeleton and skin—inert material arranged to provide shelter, security, and intensification of land use. In the industrial era, buildings and neighborhoods acquired more and more elaborate flow systems for water and energy supplies, sewage, ventilation, transportation, and trash removal. With their inputs, outputs, and artificial physiologies, they began to resemble living organisms. Today these organisms are developing artificial nervous systems that enable them to behave in intelligently coordinated ways. As the cities and their components become smarter, they begin to take new shapes and patterns. They become programmable. And the design of their software becomes as crucial—socially, economically, and culturally —as that of their hardware."

This rather techno-centric vision was subsequently complemented with more socio-economic ones. The 2008 financial crisis, together with fast-growing urbanization worldwide, made cities realize the need to find efficient, scalable and cost-saving means to tackle societal problems, without increasing the amount of manpower. The smart city became in this way more a means than a goal, i.e. the combination of digital technologies with our physical environment in order to impact positively on a wide range of

application domains (Townsend, 2013).

The influential typology of Giffinger et al (2007) covers the very broad categories of smart economy, smart people, smart governance, smart mobility, smart environment and smart living. Still, most 'smart'-applications focus on three crucial challenges that cities have always wrestled with: mobility, safety and liveability. Clearly, these are so-called wicked problems, which are both complex, chaotic and unpredictable, and which are in dire need of more accurate and immediately available data. Citizens themselves also rather consistently rate these three categories as the most important priorities for smart city applications (Ballon et al, 2020).

Of course, 'datafication' is not new. Every urban administration aims at processing reports from city personnel as well as notifications by citizens, combined with periodical counts and statistical analyses. But current datatech enables cities to collect and use data in both a more systematic (planned, methodical) and systemic (directly linked to core urban activities) manner. Mayer-Schönberger & Cukier (2013) describe datafication as 'making the invisible visible': ensuring that often unnoticed activities, events and trends can be monitored, analyzed and optimized.

The value of datafication

However, it is clear that collecting data about urban issues does not automatically lead to their solution. In other words, the ability to translate data into value is dependent upon a number of factors. In practice, experiences show three main conditions for datafication to actually have an impact in the city. These are:

1) There is sufficient density and liquidity of data;
2) Data is partially democratized;
3) There is an increasing autonomy in the data process.

We know how datafication has engendered far-reaching innovations in the

corporate world (Normann, 2001). The first requirement for this is dematerialization: 'freeing' information from the physical and temporal context from which it stems. Secondly, there is a process of 'liquidification': making it possible to configure and manipulate the resulting data streams with advanced processing and analysis. But value only results if in the end a high measure of 'density' is reached: the mobilization of data for a specific time/space/actor-combination. In other words, datafication only leads to value if the right information can be accessed at the right moment, in the right place and for the right person or institution.

This logic is also valid for the urban environment. When a person works from home and receives a notification of delays in train traffic, the relevance of this is rather low. When a person receives this news while standing on the train platform, the importance increases. But most direct value is created when the person receives this information just before leaving for the train station, so to be able to use the freed-up time in a different way or to seek alternative transport.

The potential of datafication is also influenced by its measure of openness and 'democratization' (Walravens et al, 2014). For instance, the influential urban game Pokémon Go was developed based on freely accessible geographical data in OpenStreetMap. Open data has the potential to create more transparency in markets, to engender more quickly innovative applications and to sidestep information monopolies. And not only usage has become more voluntary, but also the input of data, whether this relates to citizens sharing pictures and videos on social media, counting the number of birds in their gardens or measuring the air pollution in their streets, or contributing to the aforementioned 'Wikipedia for maps', OpenStreetMap.

Finally, datafication is also a continuous process which goes through several phases, each leading to a greater potential for value. Based on Porter & Heppelmann (2014), we can distinguish in an urban context four phases in the datafication of our material surroundings:

1) **Monitoring**: objects in the city collect data about their own functioning and the context around them;

2) **Control**: they can switch on and off functions based on this data, possibly combined with other data;
3) **Optimisation**: models can be constructed to predict and diagnose what is their optimal behavior;
4) **Autonomy**: they communicate with other objects and systems and take action without direct human interference.

These four phases exhibit not only an increasing potential for value creation and impact, but also increasing complexity and interdependence: every phase builds upon the previous one. In order to exert control, an object or system first needs to be able to monitor. And for autonomy, all previous phases of monitoring, control and optimization need to be combined. In this way, the development of smart mobility systems can be understood: from e.g. a smart camera able to detect oncoming traffic (monitoring), to a smart traffic light able to switch to green or red based on that monitoring (control), a smart traffic control center working with prediction models based on data for the whole area (optimization), and eventually a smart mobility system in which there is mutual coordination between smart street furniture and (semi-) autonomous cars.
The combination of liquid and dense data, which is to a certain extent opened up and democratized, and progressively leads to more control, optimization and autonomy, makes datafication into a process that can lead to innovation and value creation for our urban environment. But experience shows that more is needed to transform our cities in beneficial ways, i.e. we also need changes in institutions and institutional rules and processes.

Three institutional conditions

Transition thinking teaches us that datatech alone, even if deployed in the most optimal way, will not lead to real urban transformation. Cities are no machines that can be fully predicted and programmed, but

they have a fundamentally contingent and chaotic nature. Because of this, a number of organizational and institutional conditions are equally important as the datatech-related aspects discussed above. In this short overview, I will argue that cities need to start acting as coordinator, supervisor and experimental environment, in order to turn the potential of datafication for cities into reality.

Systemic innovation and coordination

First of all, for a transition towards a smart city, a high measure of coordination is needed. This is because a smart city requires systemic innovation at different levels. The first one is the co-functioning of a whole range of technologies. Think of telecom, IT, transport, energy and other technologies, which all need to interact, even though they are developed by different industries, at different speed and according to different requirements. Major breakthroughs are necessary, related to wireless communication protocols, distributed software systems, sensors, or battery technologies, of which we cannot know if and how they will unfold. If systemic innovation at this first level does not work, our smart world will not function properly.
At a second level, systemic innovation is needed because technology and usage need to evolve together. Smart technologies to motivate us via nudges and challenges to follow through a fitness program could never have been successful if not enough individual consumers had adopted wearable technologies and started sharing their data online. One cannot function without the other. The same goes for any smart innovation related to changing our energy consumption, mobility habits or shopping behavior.
Both these levels are well known from previous generations of digital innovation. But in the smart city environment, a third level is added to this: systemic innovation also means that innovation in the virtual, online space should necessarily go hand in hand with changes and innovation in our physical surroundings, and vice versa.

Smart parking does not only mean deploying parking sensors who may communicate wirelessly whether the parking space is occupied, and sufficient users with smartphones using the related parking app, but it also

means the physical street will change. The street can come to resemble a parking garage with green and red indicators showing which place has been reserved and paid for. It can incorporate parking guidance systems that take into account individual profiles, available rental bikes or which tram stops are nearest. In whole areas, on-street parking can be eliminated altogether and streets can be totally redesigned accordingly, while other areas may be populated with electric charging systems.

Strong organizational capacity is needed to accomplish such transitions. However, this capacity is not concentrated with one specific institution. Take again smart parking. This can mean a real breakthrough for urban mobility, as we know that a large proportion of cars in traffic jams in the city are in fact searching for a parking spot. But in order to get these cars out of traffic as soon as possible, real-time data about the availability of public as well as about privately owned parking spots, public transport and rental bikes, car sharing and charging infrastructure all need to be linked and coupled with parking access and payment systems. No city can do this on its own. Cooperation between cities and regions, but also with the financial, energy, logistical and IT sectors is an absolute necessity, not only in the deployment but also in the R&D and innovation phase of smart cities. In short, it is time that the digital efforts of cities are focused not internally anymore, but externally, i.e. towards partnerships and cooperation.

Dystopia and regulation

The second institutional turnaround is related to preventing and mending dystopian aspects of the smart city evolution.

Datafication can be a great blessing to help tackling wicked societal problems, but it may also lead to a range of unwanted outcomes. Cities operating as a panopticon in which a central operator continuously monitors and sanctions citizens' activities, are not 'smart' in any sense of the word. And while nudging, i.e. encouraging pro-social behavior, and removing hidden costs for positive actions, constitutes a very promising application of smart technologies, this can without sufficient safeguards easily turn into nannying, bullying or even forcing.

Also, the superior model of common digital platforms which underpin the

smart city evolution, can lead to a dystopian situation of private monopolies and powerlessness of communities against commercial exploitation. Datafication without limits can lead not only to loss of privacy, but also to widespread price discrimination and manipulation. We know that some commercial smart city platforms have experimented with 'surge pricing', where prices for urban services are multiplied in an untransparent way at times of great demand, as well as with price discrimination where individual citizens desperately in need of services are charged a premium.

This is where public institutions need to step in. Governments need to build up as fast as possible the necessary knowledge, expertise and authority to impose demands upon the most crucial systems. There are many instruments available, including regulation, labelling and certification, licensing and access rights, or using the purchase power of governments to ask for certain specifications in systems which are being ordered.

Especially for code developed directly for cities, it should be normal to demand standardization, certification, open APIs and privacy by design. It is crucial that a new generation of certification authorities is set up, capable to assess and sanction the correct working, safety and effectiveness of smart city applications.

But not all software systems for smart cities are being ordered and bought by public clients. Consider the drones, intelligent cars, apps and private camera and security networks which are increasingly populating our cities. They too need to be checked and certified.

Many people will argue the difficulty or even impossibility of scrutinizing private, complex and highly confidential systems. The comparison can be made with software used in gambling machines in casinos (Tufekci, 2015). This software is also proprietary and highly secret, yet it is subject to severe audits and tests by the government, not in laboratory conditions, but in real-life circumstances. Surely, there is no reason for our gambling machines to be scrutinized any better than our cars, voting computers or legal software.

This means that public institutions may not abdicate powers in a smart city context, but should act as regulator, coordinator and supervisor. Across

the world, clear data charters are being formulated that help cities and other governmental bodies to take up this role. The next step should be to develop and adopt 'software charters' for smart cities, which can then be enforced via the means listed above.

The smart city as Living Lab

But the role of the city should not stop at dialogue, coordination and regulation. It is also necessary to develop a clear Research, Development & Innovation (RDI)-mandate and framework for cities. Any organization that is dealing with fast technological change and subsequently needs to reinvent itself, invests in RDI. Yet in cities, this function is as a rule either absent, underdeveloped or not formalized.

Again, this does not mean that cities need to perform RDI alone. Inevitably, this needs to be done together with industry, knowledge institutes and citizens. Setting up a so-called smart city 'Living Lab', i.e. a real-life test and experimentation environment for novel applications and systems, can be a solution for this. In such a context, different agendas and approaches can be reconciled, not only through dialogue, but in joint innovation projects that prepare the ground for large-scale roll-out.

In a living lab, public institutions can discover, shape and work towards new objectives, without necessarily owning all necessary knowledge and expertise in-house. For large companies, it is a way to introduce new solutions and build up an innovation ecosystem around it. For start-ups and small developers, a living lab provides the context and means to get a reality check for their ideas. Knowledge institutions are able to put their research into practice. And even ideas and practices of citizens can be taken on board, by giving them the opportunity to co-create, experience and influence new applications. The advantage is not only getting citizen feedback which may lead to better services, but also insights as to the determinants of citizen acceptance for a certain set of measures.

This last aspect is not optional or a luxury. Smart cities should not be a technocratic, but a democratic choice. The smart city is about private needs and services, but at the same time about public space and public functions.

These are both physical and virtual. Their development will be partly unplanned and accidental, by doing, by producing, by using. That is the productive chaos of the city. But the smart city should also urgently become subject of conscious, public debate. What do we consider to be priorities? What do we need to avoid at all cost? How do we turn ideas into practice? Those are choices to be made together. Only then the city becomes a solution instead of a problem.

The concept of public space

So far, I have stressed on the one hand the advantages of datafication and the means to transform data into value, and on the other hand the institutional measures to be taken to make sure smart cities. But what is the final objective? What is the common principle that is able to guide all these developments? This is, in my view, the concept of public space. A city is more than a collection of buildings or a conglomeration of people. It is a collective, societal endeavor that can fail or succeed.

Foundational authors such as Habermas (1962) and Lefebvre (1968) point to the interlinked concepts of the public sphere and public space to denote this. Habermas' concept of the public sphere, where citizens together define societal challenges and solutions, historically originates from (mostly urban) public space. It is the result of meetings, discussions and information exchange at marketplaces, agoras and common grounds. Later, mediated communication largely takes over this function, and a more virtual public sphere arises.

Henri Lefebvre emphasizes the way in which public space continues to form and steer the social sphere. In this sense, the city does not only take up space, it creates space, in a literal and figurative way. This is why the 'right to the city' of all citizens is so important: it determines access to all societal matters. More recently, Shaw & Graham (2017) expanded this no-

tion to the ‘digital right to the city’. They regard a strong role of government as a necessary counterbalance to private platforms that threaten the digital rights of people to the city, e.g. the right of equal treatment, access and service levels.

All of these authors emphasize that public space and the exchange of symbolic content are strongly intertwined, and that a virtual element is added through media or digital platforms. We call space public if it is accessible and usable for all, and free of unwanted economic or political coercion. Therefore, we can also say that democracy and public space are intimately connected. An understanding of collectivity is only possible when there is space for interaction on the one hand, and a sense of responsibility for common goods on the other hand. This is why critics of modern cities have often lamented the ‘degradation’ of public space into merely transport or consumption zones. In his classic book on urbanity, The Fall of Public Man, Sennet (1977) argues that this is one of the main causes and at the same time expressions of contemporary narcissism and egocentricity.

All of this should be true for the smart city as well. If we want everyone to have access, if we want to make the smart city into a place where social interactions and even democracy blossom, then the overarching objective should be to (re-)create it as a public space. The next sections will shortly outline a few important aspects to be considered in this context.

Smart cities and the physical transformation of the city

The new smart city space that is arising, is a hybrid virtual/physical space, which takes many forms. Mobility is probably the application domain where the virtual and the physical are expected to meet first and foremost. This is not surprising, since 60 to 70% of all public space in modern cities is dedicated to car traffic. Every smart mobility solution will therefore have potentially far-reaching physical consequences. Sharing cars

and bicycles, made possible by digital transmitters, apps and platforms, is seen as one of the most promising services in this context. At the same time, so-called freefloating systems, that allow these shared vehicles to be left behind at random locations, present a huge spatial challenge for cities and may even undo the positive effects of sharing. Solutions currently explored include foreseeing specific public space and amenities, dedicating certain areas to shared vehicles only, imposing public licenses on companies in this industry or even ensuring public supply of certain shared vehicles.

In addition, perverse effects may arise that cause car and bike sharing to go at the expense of public transport rather than at the expense of private car ownership and use, and may thus even lead to increased car usage in total. The expectation that shared cars, whether self-driving or not, will automatically lead to a transport nirvana, is as naïve as the expectation, expressed in the 1990s, that personal computers on the work floor would automatically lead to a paperless office. Again, active coordination and intervention are needed to ensure that there are positive outcomes in terms of public space and the level of influence that public institutions can exert over mobility.

The same goes for smart parking systems, which allow more efficient use of parking space and promise changes in mobility behavior. If configured and applied well, these can lead to more optimal use of industrial buildings, private driveways and peripheral and off-street parking spaces. But they can just as well lead to increased parking demand pressure in popular parts of the city.

Other smart city systems can have equally profound effects on the form factor and usage of public space. Geospatial data on crime, traffic accidents or littering blackspots, energy consumption or consumer spending are used for the planning and justification of interventions in public space. They can also lead to the more efficient monitoring and maintenance of public services, green infrastructures, street furniture and so on. But at the same time, they can result in gentrification and segregation through increased surveillance, a stronger exploitation of certain urban zones, or simply

through greater participation of certain groups in smart services.

In any case, good practices demonstrate the enormous potential ahead. As an example, in Barcelona, the city administration was, thanks to smart monitoring, able to demonstrate that cars represent only 24% of all mobility in the city, while claiming up to 70% of all public space. Based on this, plans were devised to shrink the amount of roads in the city dedicated to cars from over 900 km to less than half of that number, again aided by smart technologies. Such drastic measures have the potential to revolutionize public space in the city. And in Copenhagen and Milan, extensive data analysis and predictive modelling of the local consequences of climate change have resulted in highly ambitious, but well-substantiated plans to multiply the amount of trees in the city. Again, nothing less than a physical transformation of these cities is on the horizon.

Placemaking and the requirement of balance

How do we turn our transforming cities into public space? All of these points in the direction of a new form of co-creation. In the context of smart cities, it is often remarked that novel smart services as far as possible should be co-created with all stakeholders, including end users. This is what living labs, as mentioned earlier, attempt to achieve. Most 'living labs' envisage this as involving users in ideation sessions about new applications, gathering data about their activities within the city, and/or involving them in real-life testing of a new smart solution.

However, if we take the idea of the virtual/physical transformation of the city seriously, we should extend the co-creation efforts to include also so-called placemaking. This concept refers to the ideas of urban activists or architects such as Jane Jacobs or Jan Gehl. They saw placemaking as co-constructing an interesting, dynamic and liveable public space, tailored to pedestrians and cyclists. Placemaking is a form of urban development

that is not about constructing buildings, but about, quite literally, creating space. It involves citizens to plan, direct and redecorate public space.
Consultation about this often happens in digital form. Previously, online platforms had already made participative budgeting more easy and more accessible; now also urban design itself can be partly democratized. This may happen through dedicated web platforms, but also via a combination of smartphones and beacons in the form of interactive trajectories through the city, or even virtual reality or augmented reality environments and digital twins for involving citizens in urban planning. In this way, more direct and realistic feedback can be collected and acted upon.

This new form of placemaking reclaims the streets and open spaces of the city for its citizens. The hybrid virtual/physical environment that we are redesigning becomes again the theatre of human interaction, and thanks to its virtual presence users can also leave traces, get data, question the environment, interact with it. It becomes public space.
Placemaking can and should go quite far. However, as argued above, with all this there is a need to take into account multiple stakeholders, as well as a need to consider dangers and perverse effects, and to make sure they are mitigated. This means that smart city placemaking always should strive for balance, between stakeholders, and between objectives.
Based on the discussion above, we can identify at least six balances or trade-offs that need to be considered in next-generation placemaking for the smart city:

1) The balance between public infrastructure, private use and social interaction. This balance is what traditionally characterizes a successful public space. In a smart city context, however, what constitutes public infrastructure is not always evident. Platforms, apps, smart street furniture, bus stops, advertising boards, parking meters, streetlights, telecom and sensor networks all increasingly fall outside of public reach. As argued earlier, public-private cooperation is an essential part of smart city development. However, the risk of 'instrumentalization' of public space due to a private 'access layer' only

concerned with private service offerings, should be actively countered;

2) The balance between novelty and 'readability'. Cities are creative environments where constant building and renovating takes place, but usually within a rather permanent street plan and neighborhood logic. These ensure the 'readability' of the city in the longer run. In a smart city, there is equally continuous innovation, but we should avoid disorientation because of ever-changing interfaces and application logics;
3) The balance between visibility and privacy. A successful public space has, in the words of Jan Gehl, 'soft borders' between public and private. Private front yards and semi-public spaces opening up to public space need to be encouraged. Also, we as private individuals are visible to everyone once we go outside in the city. At the same time, the multitude of the public ensures the necessary anonymity and privacy. In the smart city, even based on anonymized data, individual identification and discrimination become easy. As argued earlier, the balance between visibility and privacy needs to be safeguarded by effective regulation;
4) The balance between design and user experience. A city does not only develop according to top-down plans, but also leaves room for more spontaneous private initiative. A typical example is to lay out paths through a park based on the actual walking routes of people crossing it. Likewise, a smart city should leave ample room for user feedback and participation;
5) The balance between 'bonding' and bridging'. A successful public or semi-public space offers chances to interact with one's peer group of family, friends and colleagues ('bonding'), but also to encounter and meet new people ('bridging'). Smart cities should inspire themselves on successful approaches by certain social media platforms to balance both;
6) The balance between control and serendipity. In a city, there are elements which give users a certain control over their environment, such as the push button at traffic lights. Things over which users

have no control, like retail offerings, are rather left to discovery and to lucky coincidences. In other words, there is a balance between control/predictability and surprise/serendipity. In a smart city context, where it becomes more easy to profile users and predict their preferences and behavior, it needs to be ensured that the experience of the city is not over-formatted and remains sufficiently serendipitous.

Conclusion

Datatech and cities are developing in a symbiotic relationship and are transforming each other. However, we will only realize the full potential of datafication and smart cities if a number of conditions are met. In order to turn data into real value for our urban environment, we need liquid and dense data, which are to a large extent opened up and democratized, and progressively lead to more control, optimization and autonomy of the online world around us. At the same time, we also need to fulfill a number of crucial institutional conditions, which entail that cities should act as coordinators, regulators and experimentation environments in order to realize the beneficial potential of smart cities.

If these conditions are fulfilled, transformative changes to our cities can be expected. The main question then becomes how to ensure a new public space in which everyone has a right to the smart city. I argued that we need novel ways of co-creative placemaking for the new hybrid virtual-physical reality, taking into account a number of important trade-offs, i.e. between public infrastructure, private use and social interaction, between novelty and 'readability', between visibility and privacy, between design and user experience, between 'bonding' and bridging', and between control and serendipity.

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Urban Transformation and Carbon Neutrality in Smart Cities

스마트시티의 도시 전환과 탄소 중립

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ABSTRACT

We have less than 10 years to achieve the systemic transformation necessary to constrain global temperatures to 1.5°C above pre-industrial levels. The COVID-19 pandemic has accelerated some of the changes necessary to achieve this, and this paper outlines how cities can harness these shifts to improve quality of life for residents and reduce emissions in cities. Existing models of city governance are not designed to achieve large-scale, mission-driven change, and this paper explores two innovative approaches that are currently being implemented in cities. It also shows how the changes imposed by pandemic has created an opening for multiple, mixed-use neighbourhoods, and how these can be planned and designed to minimise emissions throughout the development lifecycle.

The paper includes a number of best practice examples to show how cities can make the shift from car-centred to people-centred planning, and how emissions can be reduced with the electrification of transport and the transition to a clean energy system in cities. In addition, it demonstrates that the built environment can be decarbonised by adhering to a hierarchy of principles that includes retrofitting existing buildings and the adoption of clean construction methods. Finally, it shows that cities can build resilience to climate impacts by mainstreaming adaptation into the day to day work of cities.

KEYWORDS

Climate change, cities, Doughnut Economics, carbon budget, net zero, 15-minute city, urban planning, mass transit, electric vehicles, clean energy

초록

전 세계 기온의 상승 폭을 산업화 시대 이전인 1.5℃ 수준으로 제한하는 데 필요한 시스템 전반의 전환을 이루기 위해, 우리에게 주어진 시간은 채 10년도 되지 않는다. 코로나19 팬데믹 상황에서 이를 달성하기 위해 필요한 몇 가지 변화는 가속되고 있다. 이 글에서는 도시가 어떻게 이러한 변화를 활용하여 주민의 삶의 질을 높이면서도 도시의 배출량을 줄일 수 있을지를 검토한다. 기존의 도시 거버넌스 모델은 애당초 대규모의 미션 지향적*mission-driven* 변화를 달성하도록 설계되지 않았기에, 이 글은 현재 여러 도시에서 시행 중인 두 가지 혁신적 접근 방법을 탐색한다. 또한 팬데믹에 의해 시작된 변화가 어떻게 다목적 · 복합용도 근린 생활권을 위한 기회가 되었는지, 그리고 어떻게 이러한 근린 생활권을 계획하고 설계해야 개발의 전 과정에 걸쳐 배출량을 최소화할 수 있을지 보여준다.

이 글은 도시가 어떻게 자동차 중심에서 사람 중심의 계획으로 전환될 수 있는지, 또 도시 내에서 전기 운송 수단과 클린 에너지 시스템으로의 전환이 어떻게 배출량을 줄일 수 있는지를 보여 주는 몇 가지 모범 사례를 담고 있다. 나아가 이 글은 기존 건물을 개보수하고 클린 공법을 포함한 원칙 체계를 준수함으로써, 건조 환경*built environment*(자연 환경이 아닌 인위적 조성을 가해 만들어낸 도시의 물리적 환경–감수자주)에서도 탈탄소화를 달성할 수 있음을 입증한다. 마지막으로 도시의 일상적인 일에 적응하는 것을 주류화함으로써, 도시가 기후 영향에 대한 리질리언스(회복력)를 지닐 수 있다는 것을 보여준다.

키워드

기후 변화, 도시, 도넛 경제학, 탄소 예산, 넷–제로, 15분 도시, 도시계획, 대중교통, 전기자동차, 클린 에너지

Introduction

We have a very short time frame in which to prevent runaway climate breakdown. As this summer's report[1] from the Intergovernmental Panel on Climate Change made clear, we have less than 10 years left in which to constrain global temperatures to 1.5°C above pre-industrial levels. This means that remaining within a safe carbon budget requires complete systemic transformation in less than a decade.

The COVID-19 pandemic has demonstrated how quickly governments, business and civil society can act in a crisis. It has also accelerated many of the trends towards more sustainable ways of living and working in cities, such as greater digitalisation, localisation and the shift towards mixed-use developments, as well as highlighting the value of clean air and greenspace in urban areas. The challenge for cities is to harness these changes to cut emissions, improve quality of life and build resilience within the time available.

Innovative models of governance

Existing city governance is not designed to achieve large-scale mission driven change. The scale and pace of change required to avoid passing any ecological tipping points, and to do so while ensuring that the majority of people enjoy improvement in their standards of living, is so huge that current models of government have to be radically changed. We need mission-driven governments that are ready and able, as active and interventionist participants, to create and shape markets for the benefit of society and the clean transition. Firstly, this means defining a city's overall mission, and second, it means redesigning the mechanisms of government so that they are fit for purpose. Two standout examples of new approaches that have emerged in recent years are the 'Doughnut' Economic model,

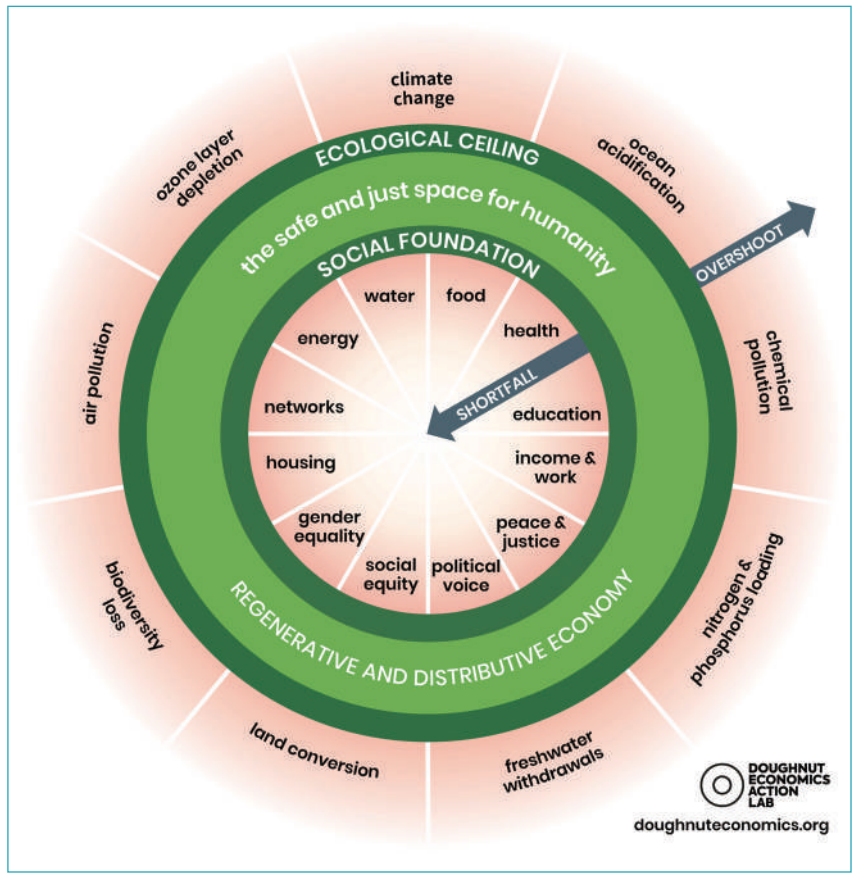
as pioneered in Amsterdam, and climate budgeting, which was first introduced in Oslo.

Defining an overall mission: Doughnut Economics

Developed by the British economist Kate Raworth, the 'Doughnut Economics' concept[2] envisions an economy which allows all people, everywhere to thrive within sustainable levels of resource consumption. Recognising the physical limits to the exploitation of natural resources, the model utilises the 'Planetary Boundaries' Framework, as developed by Johan Rockstrom et al[3], which proposes a 'safe operating space' for humanity within quantified limits for nine key processes such as climate breakdown, freshwater consumption, and agricultural land use, among others.

The concept dispenses with GDP as the primary indicator of political and economic success, remaining agnostic about economic growth. Instead,

Figure 1
Doughnut Economics



the goal is for humanity to thrive within the doughnut-shaped space, or the "safe and just space for humanity." It is a holistic approach to governance, derived from the principles of the UN Sustainable Development Goals, and can be distilled to a single core question for a city: 'How can our city be a home to thriving people, in a thriving place, whilst respecting the wellbeing of all people, and the health of the whole planet?'[4]

To date the model has been successfully downscaled to city level and piloted in Amsterdam, Philadelphia and Portland. A key first step for implementation is the development of the 'City Portrait,' which provides a snapshot of the city and its impact through four lenses: social, ecological, local and global. The city is presented with an opportunity to build resilient, ecologically safe and socially just communities.

In April 2020, Amsterdam became the first municipality[5] in the world to publish a City Doughnut.[6] A city portrait was developed via a series of workshops in diverse neighbourhoods to understand citizens' priorities for a thriving city. This informed Amsterdam's strategy for transitioning to a circular city and adopting a smarter approach to managing raw materials, production, and consumption. The city doughnut is necessarily a collaborative effort between the municipality, businesses and residents.

In its first iteration, the methodology for downscaling the doughnut was developed with a focus on global north cities with high levels of resource consumption and large ecological footprints. Future iterations, however, will develop approaches that will better reflect the needs, interests and perspectives of global south cities.

Redesigning mechanisms of government: climate budgeting

Designed as a whole-of-government approach for implementing emissions reductions, climate budgeting integrates climate considerations into decision-making across all city departments. Most importantly, before the annual financial budget can be passed - usually the most important decision city government takes each year - it needs to be demonstrated that it will deliver the annual targets of the climate budget. This shifts the notion of what is the 'city budget'.

The model was first developed in Oslo in order to achieve a Paris Agreement-aligned target of reducing city GHG emissions by 95% (from 2009 levels) by 2030. The city's annual 'climate budget' outlines emission reduction measures for the year, including the costs, targets and lines of responsibility for them. ('Climate budgeting' as a key governance tool in cities which enforces decisions that ensure the city can stay within its 'carbon budget' - the maximum level of greenhouse gas emissions permitted over a time period, usually up to 2030 or 2050. The climate budget approach breaks down long term targets into short-term, annual carbon budgets).

Under this approach, climate action is not the sole responsibility of the environment department, as is often the case at present, but rather is distributed across all city departments, with each department required to report regularly on progress as part of financial reporting. This means, for example, that the agency responsible for waste management is also responsible for climate action in the waste sector. A climate budget will incorporate all aspects of city governance, from procurement and contracts to training and job descriptions. It is mission-driven government in practice.

Oslo's climate budget forms an integral part of the municipal budget and is overseen by the Department of Finance, which accounts for climate measures as it accounts for financial spending. The city council only approves spending plans that are in line with its climate strategy and emissions reduction goals. The climate budget for 2021 is designed to reduce emissions from the construction industry and road traffic with improved charging infrastructure and more sustainable transport of bulk materials. Proposals for 2022 include investments in public transit capacity and transitioning to zero emission public transit by the end of 2023.

The model has been in place in Oslo since 2016 and finds high levels of public support. A number of Norwegian municipalities are also now implementing the tool, and Oslo is leading a two-year pilot project for 11 global cities to explore how climate budgeting can be adapted for cities of various sizes. Barcelona, Berlin, Los Angeles, Milan, Montreal, Mumbai, Stockholm, Paris, Rio de Janeiro and Tshwane are all participants.

Taking action at the neighbourhood level: the city as a system

The COVID-19 pandemic has transformed the way we live and work in cities. Despite predictions made early on in the crisis, there is no evidence to date of a mass exodus of people away from urban centres. Recent studies of residents[7] in London and Paris found little appetite for leaving the city, with most believing their cities will rebound. Spending in city centre businesses is returning.[8] What is less clear at this stage, however, is how the pandemic might re-shape the city over the long term. The future of the central business district remains an open question as a shift to hybrid patterns of working means fewer people making daily commutes and more people working from home, or, at least, in their local neighbourhoods. It is in this space that cities can take the opportunity, in collaboration with city residents, business, and other stakeholders, to redesign urban living with quality of life and sustainability as the focus.

City action on high emitting sectors such as transport and buildings has long been key to achieving the emission reductions necessary to limit global temperature rise to 1.5°C, but the disruption of the past 18 months has accelerated the trend towards the idea of the city as a system which enables citizens to live more sustainably. The post-pandemic 'new normal' creates an opening for multiple, thriving, mixed use neighbourhoods, which cut emissions and improve quality of life in an integrated way by reducing the need for travel. The past 18 months has witnessed a surge of interest in the '15-minute city' concept, as developed by Carlos Moreno, in which urban life is organised so that people can access all the services they need to live, learn and thrive within their immediate vicinity. Originally designed with compact European cities in mind, the model is being adapted to local contexts in diverse global cities. Melbourne's city plan for 2017-2050[9] is guided by the principle of '20 minute neighbourhoods,' while Shanghai and Guangzhou have included '15 Minute community Life Circles' in their masterplans. Bogota's Barrios Vitales (Vital Neighbourhoods) integrate a network of green corridors with pedestrian and cycle priority roads to create people-centred mobility and thriving streets.

This development is timely, as research[10] by C40 in collaboration with built

environment firm ARUP indicates that action at a neighbourhood level has a significant role to play in accelerating progress towards net-zero; a 'green and thriving' neighbourhood can be planned, designed and operated to minimise emissions throughout the development lifecycle. Moreover, by integrating emissions reduction with promoting quality of life, the neighbourhood becomes an attractive place to be for residents, workers and visitors. Achieving net zero emissions requires neighbourhoods to set targets for three categories of emissions:

Operational

The emissions that occur continually throughout the lifetime of the neighbourhood, such as emissions from energy used in buildings, public spaces and transport, and emissions from processing waste. All new buildings should have net zero operational emissions.

Embodied

The emissions from the materials and construction processes of buildings and infrastructure. All embodied emissions should be assessed, including those due to material extraction, manufacturing, assembly, maintenance, repairs, deconstruction, demolition, waste and end of life impacts. The neighbourhood should establish a process for requiring lifecycle emissions assessments from all construction.

Consumption

The emissions from goods and services, such as from food, clothes, and technology purchased by people in the neighbourhood. Consumption-based emissions assessments involve more complex data and for this reason a neighbourhood should focus on tangible, ambitious actions to reduce emissions from consumption, such as 'sharing economy' initiatives. Glasgow has a vision[11] for an alternative economy based on fixing and sharing as a gateway to stimulate civic participation. Among the city's initiatives are plans to expand community food growing and stimulate the 'share and repair' economy by fostering small businesses that promote the reuse of items like clothing and electronics.

Climate Positive District, Shougang

The Shougang Climate Positive Development Project is situated in the New Shougang Comprehensive High-end Industry Services Park and will be home to 5,000 residents and 25,000 jobs. The new district will act as a pilot for a new approach to low carbon, sustainable urban development within the city of Beijing. To achieve a climate positive impact, the emissions within the boundary of the project have been minimised through savings in energy consumption and use of clean energy. The project adopts a series of on-site low-carbon strategies for the design, construction and management of the district such as building energy saving and Green Building Certification, renewable energy usage, transit oriented design and low carbon mobility, water resources management, domestic waste management to reduce the need for landfill as well as urban tree planting to enhance carbon sink capacity in green areas.

Complete Neighbourhoods

A neighbourhood that fosters greater quality of life is resilient and people centred. It is human scale and encourages healthy and sustainable lifestyles by making it attractive to work and play locally. By giving street space back to people and providing equitable access to greenspace, cultural life, and integrated public transport connections, cities have the power to shape the individual choices that lead to low-carbon lifestyles.

The 'complete neighbourhood' is compact and mixed-use. Local services such as grocers, public services, parks, cafes, and flexible working spaces are integrated within new and existing areas of housing, while large, isolated and discrete 'zones,' such as retail, residential, and commerce within the neighbourhood should be avoided. Key services should be provided at the neighbourhood level, rather than requiring travel to another area of the city.

People Centred Streets and Mobility

A city designed around the needs of cars is neither human-friendly or environmentally sustainable. According to the World Health Organization, approximately 1.3 million people[12] die each year as a result of road traffic crashes, and more than half of these are among vulnerable road users such as pedestrians, cyclists, and motorcyclists. Internal combustion vehicles are also a major contributor to deaths from air pollution; one study[13] found that ambient PM2.5 and ozone specifically caused by vehicle emissions was linked to 361,000 premature deaths worldwide. Pollutants from cars such as nitrogen dioxide and PM2.5 means that the average health cost of a car in inner London is £8,000 ($10,830) over the course of the vehicle's lifetime; for diesel vehicles, that figure is doubled.[14] Moreover, passenger vehicles account for 45% global CO_2 emissions from transport.[15]

Car-centric urban planning has significant social and economic impacts; in the car-captured city, the young, the elderly, and those who cannot afford to own vehicles face reduced access to employment, education, and social and leisure activities. Congestion also constrains a city's economic development; in Beijing,[16] congestion reduces the city's GDP by 15% per while traffic jams in Nairobi[17] cost the national economy approximately $1 billion per year. Moreover, on average, private cars are stationary for 96%[18] of the time, and public space that is used to store personal vehicles represents an enormous opportunity cost; land occupied by car parking could be used for green infrastructure, leisure, housing, active transport, small businesses, or any number of more socially, economically and environmentally beneficial uses. In addition, not only do cars demand city space, they also require carbon intensive materials for the construction of roads and other infrastructure, as well as contributing to urban sprawl.

Achieving net-zero emissions, improving public health and making neighbourhoods desirable places to be requires reducing the space allocated to motorised vehicles and re-assigning it for active travel or community

space. Walking, cycling, or other non-motorised modes should be the default choice for mobility, with active transport encouraged through the provision of well-designed spaces and supporting infrastructure. It means, for many cities, a shift of focus from the throughput of vehicles to creating places where people want to stop and linger. Key components of people-centred streets and mobility include:

Re-prioritising street space

The use of private vehicles should be discouraged. Motorised transport can be made less desirable by reducing the availability of car parking and fuel stations, and fewer or narrower car lanes. A comprehensive car parking strategy can locate car parking in certain areas, leaving main streets car-free. Surface parking can be transformed into green spaces.

Good street design

Streets should be planned and designed to create a safe and enjoyable environment for active travel, making walking and cycling the modes of choice for people from all age, gender, ethnic, ability and income groups. Well-designed streets will reduce emissions from motorised vehicles (and associated carbon-intensive infrastructure) by providing viable active travel options while also creating an active public realm that supports health and wellbeing, community cohesion and the local economy. Achieving good street design may include wider footways, increased street crossings, suitable street lighting and furniture, secure bike-parking and affordable bike-sharing schemes. Pedestrian and cycle routes must be well-connected

Barcelona Superblocks

In Barcelona, the city is rolling out 'Superblocks' designed to encourage social cohesion and collaboration by minimising traffic and opening up urban space to multiple uses such as walking, cycling, and socialising. Under its 10year plan, one in 3 streets in the central Eixample district will become green zones which give priority to pedestrians and cyclists.

across the neighbourhood and beyond, so that longer every day trips can be undertaken actively.

Connected places

Individual neighbourhoods operate as part of wider social and economic networks, and the carbon neutral, liveable city depends on the clean and efficient mobility of people and goods between the neighbourhood and the wider city. An accessible, affordable and reliable mass transit system is essential for achieving carbon neutrality; a study in Montréal found that for every tonne of CO_2 emitted by the city's mass transit network, 20 tonnes were saved. It is also vital to a socially equitable, thriving city economy, as it serves many essential and low-income workers who rely on it to travel to work and other activities.

To achieve net zero emissions, mass transit will need to be electric or hydrogen powered. To date, Chinese cities are leading the electrification of buses; Shenzhen has had a 10,000-strong, fully electric bus fleet since 2017. Outside China, Latin American cities are progressing rapidly: Santiago has 776 electric buses in operation, with a further 991 expected, Bogota has 484 in use and 1000 on order. Paris has this year introduced a batch of 100% electric, bi-articulated e-buses, capable of carrying 140 passengers, on two BRT lines. They will be charged via a ground wireless system.

Transit Oriented Development

Cities can reduce emissions and improve people's quality of life by setting targets for new developments to be built around public transport hubs. New York City has a target for 95% of new housing to be built within half a mile of mass transit stations, while Jakarta has a target for 95% of the city's residents to be within 500 metres of public transport. The city's Bus Rapid Transit system, Transjakarta, is integrated with other local transport operators to serve a large region.

Physical interchanges need to be carefully planned to ensure the easy movement of people and goods. An integrated approach to transport planning will facilitate multi-modal low carbon journeys between neighbourhoods for both passengers and freight, ensuring easy and affordable payment systems, live and reliable travel updates, access to bike and vehicle sharing schemes, and access to local logistics hubs and freight consolidation centres for 'last mile' deliveries.

According to research by the World Economic Forum,[19] the growth of e-commerce is expected to lead to a 36% increase in the number of delivery vehicles in the top 100 cities globally until 2030. Emissions from delivery traffic will increase by 32% while congestion will rise by over 21%. Cities can, and are, working to improve the efficiency of goods delivery as well as electrifying freight vehicles. Montreal has converted a former bus station as a local logistics hub where heavy vehicles unload goods to be distributed via electric delivery vehicles and e-cargo bikes. In Oslo, goods are delivered via electric trucks and e-bikes from a low-carbon distribution hub in the city centre, while Rotterdam will introduce a zero emissions zone for freight by 2025.

Electric Mobility

In a carbon neutral, people centred city, walking, cycling, and shared transport will comprise the majority of journeys, while any remaining motorised transport will be electric. Electric cars and vans will be cheaper to produce than conventional vehicles by 2027,[20] and cities are in a key position to drive the transition to cleaner transport modes.

A priority target for electrification are ride-hailing vehicles, due to the high number of kilometres they travel. Replacing a combustion engine ride-hailing vehicle with a battery electric vehicle can save 85 tonnes of CO_2 over the lifetime of the vehicle compared with 30 tonnes when replacing a private passenger car. The cities of Guangzhou and New York City will al-

low only electric vehicles to be registered on ride-hailing platforms, while Hangzhou, Beijing, Oslo, and Amsterdam have targets for all taxis to be emission-free within the next four years. London has required all new taxis to be zero-emission capable since 2018, and Shenzhen has had a fully electric taxi fleet since 2017.

Globally, cities are employing a range of strategies to accelerate the uptake of electric cars. Delhi is installing up to 500 charging points to achieve its target for 25% of new vehicles to be electric, and offering incentives for the purchase of electric two and three wheelers. Seattle is rolling out 20 fast charging stations, supplying 100% renewable electricity, that can fully charge most passenger EVs in 30 minutes. Cities can also send signals to business by setting targets for the phase out of internal combustion engines or implementing zero-emission areas.

Reducing emissions from the built environment

The UN estimates that we will be building the equivalent of a new city of more than 1.5 million each week by 2050.[21] However, buildings generate nearly 40% greenhouse gas emissions globally, and more than 50% in cities. A 2019 study[22] by C40, ARUP and the University of Leeds found that, if the most ambitious targets are reached, cities can achieve a 44% reduction in buildings and infrastructure related emissions between 2017 and 2050. Cutting carbon from buildings can be achieved by retrofitting existing buildings to make them more energy efficient and by adopting clean construction principles for building new. Cities can approach buildings with the following hierarchy:

1. Focus on the existing stock by retrofitting existing buildings and by re-using them as much as possible before demolishing.
2. Reuse existing materials and administer used materials for the future.

Reversible by Design, Paris

The Collective for Climate project will be the first net zero neighbourhood in Paris. It aims to reduce both operational and embodied emissions by 85% then go beyond net zero by creating a Carbon Fund. The reduction in embodied carbon is facilitated by the use of low-carbon and local materials, such as timber and stone. All buildings will be reversible or adaptable, allowing the uses of the buildings to change over time, extending the life of the buildings.

The buildings of today can be considered the resources of tomorrow.

3. Where new building is required, build for the future. That is: build to last, build flexibility and build with efficient use of resources and energy.
4. Design to foster a sustainable future lifestyle, such as including bicycle parking spaces or designing to enable the future user to live zero waste.

Cities are increasingly beginning to mandate policies to reduce emissions from construction at all stages of the building lifecycle. London requires whole life cycle carbon assessments for all its strategic planning applications, including emissions from energy use during the lifetime of the building; applicants must demonstrate that emissions will be reduced. Quezon City encourages material reuse and waste reduction in building projects via a rating system and corresponding tax incentives, while Los Angeles has issued a directive to reduce embodied carbon in building materials.

Buildings represent one of the largest energy consumers in cities. Achieving carbon neutrality will mean reducing energy demand by retrofitting

Qingdao Retrofit Incentive Scheme

The city government has retrofitted at least 22 million m2 of its residential building stock in order to reduce the city's reliance on coal and improve air quality. As heat for buildings is mainly supplied through a coal-based district heating network, the local government has focussed on improving the thermal integrity of city buildings. The retrofit is expected to save 200,000 tonnes of CO_2.

and adopting passive design principles in new buildings, such as prioritising well-insulated fabric, natural ventilation and the size and orientation of glazing. Smart neighbourhoods can also be designed for low-carbon heat; the L'Innesto Zero Carbon "Housing Sociale" project in Italy includes the development of a 4th generation neighbourhood heating system, powered by renewable sources combined with an urban wastewater heat recovery system.

The city as a key actor in building a smart, resilient, zero carbon energy system

Burning fossil fuels for energy is the biggest global source of greenhouse gas emissions. Meanwhile, as the climate crisis brings further heatwaves, flooding and storms, cities worldwide can expect to face an increase in power outages. As centres of innovation as well as being consumers of two thirds of the world's energy, cities are ideally positioned to play a role in driving the shift to a more resilient, zero carbon energy system. By setting ambitious targets and scaling up investment to accelerate the full decarbonisation of the energy system, the entrepreneurial, mission-driven city government can play a leading role in the clean energy revolution.

Solar City Seoul

The transition to clean energy has significant public health benefits from improved air quality. Seoul's plan to install 1GW of solar energy capacity by 2022 is expected to reduce emissions of PM2.5 by 135 tonnes per year; equivalent to the emissions of 220,000 diesel cars. The city is providing subsidies for solar panel installations on balconies and rooftops of apartment buildings, making the installation of solar PV systems mandatory for public buildings and renting unused municipal land to private power generators and cooperatives for larger-scale solar PV generation.

We cannot limit global heating to 1.5°C without a massive expansion of renewable power generation. In particular, a rapid global phase out of coal power is needed to achieve immediate cuts in emissions. The options for cities to transition away from fossil fuel based energy are as diverse and innovative as cities themselves; Los Angeles has developed the largest solar and battery energy storage system in the United States as part of its drive to achieve 100% renewable power by 2035, while Yokohoma is powering its city hall using energy from solar power generation installed in the city's homes. Quezon City has installed 5MW of solar PV rooftop systems on 50 public schools, while Barcelona has established Spain's first public electricity distributor supplying customers with 100% renewable power.

In addition, a decentralised, renewables-based energy system is key to building a city that is resilient to shocks such as extreme weather, supply chain disruptions, or fossil fuel price shocks. A power outage coinciding with extreme weather could be dangerous. Cape Town is a city that has historically experienced frequent outages, but has improved resilience and helped drive the shift away from coal-powered generation by promoting rooftop solar and small wind turbines for businesses and residents.

Building resilience

Cities are already feeling the impacts of rising global temperatures, such as flooding and sea level rise, heat waves, and storms. The number of cities exposed to these risks is expected to triple. Climate-proofing cities means mainstreaming adaptation in the day to day work of cities, such as factoring in resilience for all new infrastructure.

Cities were built on top of a natural environment, and integrating nature with urban spaces recovers the resilience services that nature can provide, such as clean air, flood-proof areas and cool spaces that can help to make cities more liveable. Street trees, river catchment management, coastal nature based barriers and blue and green urban drainage systems are all solu-

Waterfront Toronto, Toronto

The new Waterfront Toronto district aims to develop low-carbon, liveable and resilient waterfront neighbourhoods in Toronto, based on Green Building requirements, such as:

- New buildings will be designed for zero-carbon operations through passive design and clean electricity, certified either LEED Gold or Platinum
- All new buildings will disclose their embodied carbon using the Canada Green Building Council's lifecycle analysis process. They will be required to use more sustainable building materials, including 50% recycled steel and low-carbon concrete or timber products certified by the Forest Stewardship Council
- The landscape around new buildings will feature green spaces with biodiverse plantings, native species and generous tree canopies, as well as rooftop garden plots
- In addition to transit-oriented development, the precinct will provide infrastructure for and services for electric vehicles and bicycles

tions that are critical for building resilience as well as making cities more pleasant places to live.

Conclusion

The transitions taking place in cities today are triggered by both a science-based approach to stopping climate breakdown and increased demands from citizens to overcome the inequalities generated by forty years of the dominance of neo-liberal economics. In order to limit global temperature rise to 1.5°C, emissions in many cities have to be reduced by 10% or more every year for a decade - just to make it possible for even tougher reductions by mid-century, along with carbon removal and repair to damaged ecosystems.

The changes imposed by the pandemic have left an opening to rethink urban living, and cities have a significant role to play in accelerating the

shift to more localised lifestyles, reducing emissions and achieving a better quality of life for citizens in the process. Innovative models of governance that can drive the transformation have emerged and been successfully implemented in cities. These new models can merge with traditional, sectoral approaches to reduce emissions from transport, energy and buildings. In addition, urban transformation must allow for the locked-in climate impacts that are to be expected; cities can integrate nature into urban planning to build resilience and make urban areas more liveable. In order to achieve full carbon neutrality, however, these changes must happen in parallel with broader systemic change and national government action.

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Prioritising citizen engagement to achieve net zero

넷–제로*Net-Zero* 달성을 위한 최우선 순위로서의 시민 참여

Nicola Yates

As CEO of Connected Places Catapult, Nicola Yates helps scale the adoption of innovative and smart technologies which improve how places function. Nicola led the creation of Connected Places Catapult, merging the Future Cities Catapult and Transport Systems Catapult in 2019.
With experience leading two major British cities (Bristol and Hull) and a rural district, Nicola is an expert in building partnerships which are key to cultivating successful places, and understands the power of technology to transform local economies.
Nicola also works to enable net zero. Whilst CEO at Hull, she helped catalyse the Humber clean energy cluster, and under her leadership Bristol was named European Green Capital, delivering one of the most technologically-enabled programmes to date. In 2010, Nicola received an OBE for services to local government.

ABSTRACT

In order to reduce emissions, we need to change our behaviours – to reduce, re-use and recycle. Smart technology can play a role in making this change easier and rewarding but attempting to impose it won't work. Instead, citizens need to be part of the process of solution creation. This paper explores how this can work using a range of case studies to explore the topic – including last mile delivery, reducing household energy consumption through demand side response and a multi-solution trial project in Bristol involving 50,000 residents.

KEYWORDS

Citizens, engagement, technology, user-centred design, climate change, net zero,

초록

온실가스 배출량을 감축하기 위해서는 우리의 행동이 달라져야 한다. 즉 감축하고, 재사용하고, 재활용해야 한다. 스마트 기술은 이런 변화가 더 쉽게 일어나고, 우리 스스로 달라진 행동에 더 많은 보람을 느끼도록 지원할 수 있다. 하지만 이런 기술을 강요해서는 안 된다. 대신에 시민들이 문제의 해결책을 찾는 과정에 참여해야 한다. 이 글에서는 여러 사례 연구를 통해 이런 일이 어떻게 가능한지 알아볼 것이다. 여기에는 라스트 마일 배송, 수요 반응을 활용한 각 가정의 에너지 소비량 감축, 브리스톨 주민 5만 명을 대상으로 진행한 멀티 솔루션 시범 프로젝트 등이 포함된다.

키워드

시민, 참여, 기술, 사용자 중심의 디자인, 기후 변화, 탄소 중립, 스마트시티

Introduction

Achieving UK and global targets for net zero will be the defining challenge of the next three decades and a central driver of innovation and change across all sectors. The way to achieve these targets is through community involvement.

A transition to net-zero is not just about greenhouse gas emissions. There are other benefits that flow from restructuring the economy. These co-benefits include health and well-being, water quality and security, job creation and equity.

To accelerate the transition to net zero places, Connected Places Catapult is working with innovators, industry, regulators, academics and place leaders to speed the development and deployment of carbon eliminating innovations in all the ways we travel, and the places we live and work. Innovation and technologies will be important, but they will be deployed in support of a complete rethink of urban life.

We cannot fully know what lies ahead post Covid, but we're getting glimpses of what a changed world looks like. Net zero was a little more than an abstract concept for many in the world until recently. Now we've all experienced what a reduction in emissions looks and feels like, and we need to seize this moment to accelerate the transition zero emissions.

Citizens before tech

The scale of change needed over the next 10 to 30 years is dramatic in terms of the need to transform our mobility and energy systems and retrofit millions of buildings.

"You can't just drop tech on citizens and assume that they will buy into it and run with it," explains Andy Kerr, Director, UK and Ireland at Climate-KIC, Europe's largest public-private innovation partnership for climate ac-

tion. “We actually need them to want it and we need them to be part of the journey.”

Climate-KIC has been working on how to achieve that type of engagement so that citizens can shape their future.

“You have to put citizens in that space where they’re making decisions and essentially co-designing their future within cities,” says Kerr. “When you engage with communities over what sort of place that they want, they absolutely want jobs, they want investment in green spaces, they want warm affordable homes and they want clean air. And if you reshape it around their aims, then you can actually deliver net zero much more rapidly than if you just tried to drop it in on them.”

Kerr is now focusing on a new four-year project, NetZeroCities, that will support European cities in drastically cutting down greenhouse gas emissions to achieve climate neutrality.

Europe has pledged to lead on climate action and cut its emissions by 55% by 2030, with the objective of reaching climate neutrality by 2050.

To achieve this, NetZeroCities is bringing together 33 partners from 13 countries to help cities overcome the current structural, institutional and cultural barriers they face in order to achieve climate neutrality by 2030.

A central component of the project will be capacity building on systemic change, citizen engagement and democratic governance, capital and financial structuring (an important area also highlighted in Connected Places Catapult’s recent work with the *UK Cities Climate Investment Commission*[1]), and social innovation. Up to 30 pilot cities will help drive the learning about how to achieve climate neutrality at the city scale.

“This is a massive infrastructure challenge and what also is needed is that investment mindset,” says Kerr. “We need to try to get away from year-to-year thinking and focus on what sort of city we want to have.”

Apart from investment, there needs to be less emphasis on climate and carbon, and instead to look more at place in the wider context. Similarly, it must have not only citizen engagement but citizen legitimacy. Previously, this has often been an afterthought.

"We need a supply of brilliant ideas to come through to the table but the challenge we saw was that it was a very linear approach to innovation," says Kerr. "What is happening now is more of an attempt to better match that supply of good ideas with the real problems people are facing now, which is where Catapults play a role in creating these ecosystems."

Procurement is key to this: using challenge-based procurement to identify solutions is much more effective when those challenges are rooted in genuine community needs. This avoids 'technology push' and instead enables the deployment of smart technologies to solve real problems.

"Often cities have all the right ingredients; good universities, start-ups and so on–but they are not joined up or aligned with the challenges the city or region is facing in terms of net zero," adds Kerr.

Start-up in Residence, Amsterdam

Two cities which have made efforts to achieve such joined-up action are Amsterdam and London. To better tap into the local ecosystem and align procurement and innovation, Amsterdam rolled out its first list of challenges to start-ups in 2015, the first European city to adopt such a model based on one first developed in San Francisco. Effectively an open call asking how the local ecosystem could help them, the city was providing an opportunity for start-ups to work with government to come up with solutions for the identified challenges.

During a six-month programme, selected companies get the chance to pilot their products and services in the city and at the end, the municipality may become a launch customer or collaborate with the businesses in other ways.

"The Start-up in Residence [programme aims to] bridge the gap between small innovative parties and the government," says Minouche Cramer, Start-up Officer, City of Amsterdam. "It is both an innovative procurement tool and an incubation programme where start-ups and government work

together towards good solutions for societal issues."

The start-ups receive training for one day every two weeks and each is partnered up with an expert mentor. This year's edition, for the first time, focuses on sustainability and circularity.

Challenges listed include creating an on demand and flexible collection of waste and materials in the centre of Amsterdam. Public space in Amsterdam is used intensively and is vulnerable. The current state of some bridges and streets alongside canals means that they are closed to all traffic, or are not accessible to heavy vehicles – precisely the type of vehicles currently used to collect waste.

The city wants a start-up to create a zero-emission solution with a low impact on the public space where the waste is collected. The municipality is already implementing various alternative collection forms in the city centre, from door-to-door collection by cargo bike, to on-demand textile collection by van and residual waste transport on barges via the canals.

All will give residents more much needed public space and the most important tick box during the evaluation phase for the city is to have 'happy customers' (residents).

Getting the "plumbing" right

London's first Chief Digital Officer Theo Blackwell, who was appointed in 2017, has focused on fixing the digital 'plumbing' following feedback from residents during the largest-ever listening exercise by the mayor's office. This has paid off during the pandemic and paves the way to more joined-up, inclusive digital services for the future, including those that relate to net zero.

Blackwell says this plumbing means three fundamental areas: designing digital services consistently and around residents' needs; joining up data across the boroughs, public services and partners; and expanding digital infrastructure.

“We’ve adopted common digital principles, created new teams and developed new approaches to engage with the ecosystem,” says Blackwell.

One borough of London, Hounslow, is using the recovery from Covid to rethink and rebuild by focusing on becoming the UK’s first 15-minute net-zero city or neighbourhood.

The most fundamental aspect is for a citizen to be able to meet all their needs within a short walk or bike ride within 15 minutes from their home. This reduces all unnecessary travel but can also inject life into the local high street, promote health and well-being, and improve liveability and sustainability.

Athanasios Grammatikopoulos, Climate Action Solution Architect, at Connected Places Catapult, has been involved from the start. Initially Hounslow was only looking for a recovery plan - but the borough was also aiming to become net zero by 2030.

“Our proposal was, why don’t we marry the recovery plan with a decarbonised net-zero 15-minute neighbourhood?” he says. “It is based on four principles: proximity, diversity, density and ubiquity. The impact for residents would be improved living conditions and environment by offering them more people-friendly, complete, connected neighbourhoods.”

During the pandemic people became a lot more aware of the 15-minute neighbourhood. With many people only permitted to venture just a few kilometres from their homes for food shopping and exercise, people appreciated what they had on their doorstep. Those able to work from home enjoyed a lie in and explored streets free of traffic on foot and bike. They liked what they saw.

Grammatikopoulos says the 15-minute neighbourhood vision and roadmap for Hounslow is more like a business plan based on evidence with community and key stakeholder insights. Connected Places Catapult’s Human Connected Design Team firstly mapped out the key stakeholders and big drivers from the community to ensure inclusivity.

The team ensures the human element is brought to projects through things like user research and service design methodologies to make sure they are

not technology-led and that projects are informed by real challenges and opportunities from real people.

Through workshops and interviews with residents, the responses were then fed back into the vision.

“Firstly, we asked what net zero means to them, and all its facets, how it would affect their life, how it made them feel,” he says. “They were all very keen on the 15-minute concept and saw and wanted to be invested in it. They wanted to know how much involvement and how much of a voice they would have over it and what level of engagement.”

The next steps will involve GIS analysis to scope out neighbourhoods with the most potential for impact, calculate carbon baselines, and to then develop pilots and full implementation plan.

“We can then share all of this, as this is the idea of the Catapult,” he explains. “To prove a concept and then share with other boroughs and cities.”

The importance of communications and design

Getting communications right is fundamental in building community support for net-zero initiatives.

As a means of mitigating demand on the electricity grid during peak times, a number of residents in the London borough of Greenwich, as part of an EU Horizon 2020 Sharing Cities trial, were asked to reduce their electricity use for one to three hours, for example by turning off some non-essential electrical appliances for a while. When they did this, they accrued points which could later be converted into vouchers or donations to a local charity.

Liam Dargan, Service Designer at Connected Places Catapult says user research, services design and communications played a crucial role.

“Demand side response wasn’t the easiest thing for residents to under-

stand," he says. "This meant we had to put a lot of effort into carefully designing accessible communication materials to support with both the recruitment and retention of participants throughout the service."

To inform the ongoing communication strategy and to predict challenge points across the service journey, the team conducted continuous user research, through in-app surveys, workshops and interviews in user's homes. This played a key role in building a relationship and trust with with the community.

"Quite often things like citizen engagement are seen as a bit of a fluffy tick box activity," Dargan adds. "Yet it's really important to ensure meaningful outcomes and the longevity of these sort of projects."

Other traditional methods were involved to aid recruitment of residents including a website, social media channels, talks at various events, and encouraging people to sign up friends or become champions to recruit others.

By the end of the trial, the group of residents had responded to 77 demand side response alerts, saving a collective total of 757 kWh of energy – that's the equivalent of charging a smartphone over 68,000 times.

Since then, the results and learnings have been shared with other local authorities and discussions have taken place with national bodies that have the power to influence the required regulatory change to make initiatives like residential demand side response a reality in the future.

The project was also awarded the Innovation in Citizen Engagement Award by the Technology and Entrepreneurship Center at Harvard.

New tools for cities to connect to residents

As the experience of Greenwich shows, just reaching out to residents to gauge their feedback and involvement is often a challenge in

itself. Competing for their time is difficult but new software tools are becoming available to assist.

Commonplace[2] is a platform specifically designed to help local governments reach community on climate change issues, and engage them in conversation, analyse their feedback and collaborate on future ideas.

"Our approach is based on the concept that global change starts locally, so engaging communities to ensure their buy-in for change is essential," says Mike Saunders, CEO. "We are constantly looking for ways to contribute to net zero even if at a very local level. Last year, as we went into lockdown, we offered our platform for free to local authorities across the UK to help them organise their active travel planning to ensure people could walk, cycle and socially distance safely in their local areas."

The company worked with 64 local authorities, collecting over 4.5 million contributions from people all over the UK. In Leeds, this led to the successful implementation of major active travel projects where after engagement from the platform, the city was able to commission 100km of new cycle lanes across the city.

Last mile delivery

Ellie Wooldridge, Human Insights Team Lead at Connected Places Catapult, also emphasises the need for clarity in communications. When she began looking into how last mile logistics could achieve net zero, it was clear that people on the whole still weren't sure how to define net zero. Information around the subject area is also too complex for many to relate back to their day-to-day life.

"In our interviews and focus groups citizens would more likely discuss terms such as environmental impacts, health and greener living," she explains. "When thinking about net zero and deliveries to date, citizens associate recycling a positive action but raise concerns around the number of diesel vans."

“People consider a magnitude of factors and decisions when ordering and receiving goods and shifting behaviours to support net zero is not always a key priority, and it really also depends on the context.”

She found that for those both interested and keen, the options available to consumers to opt for greener deliveries were limited and that they demanded greater flexibility and service options.

There is a high-level of distrust and cynicism in whether retailers and delivery companies are providing net zero services. The study revealed that some consumers are and would pay more for greener deliveries, however, they need to see the tangible impact to know they are paying in towards making a positive change.

“New net zero focused technologies and service models can also provide a range of unique selling points which appeal to citizen values,” she says. “Consumers and bystanders discussed experiences of e-cargo bikes services, delivering natural yoghurt and flowers, and the feelings of nostalgia and a local, community feel that these services convey”. Net zero provides organisations with a real opportunity to re-consider the user experience and their brand as a whole.

While the last mile delivery market is competitive which brings innovation and strengthens the economy, the jury is still out on the best approach to eliminating emissions in this space. Anchoring solutions in ways which resonate locally could help drive uptake.

Not top-down, not bottom-up

Wholly top-down technology driven initiatives are unlikely to deliver the social impacts cities seek but equally, bottom-up, grass roots innovation can struggle to effectively scale into city-wide solutions. In the West of England, Bristol’s first smart city strategy released two years ago incorporates both views on the challenge by building a city innovation toolbox and establishing a Bristol citizen panel.

“It’s very much co-design and co-creation of technology so we aren’t imposing it on communities when it’s not wanted,” says Sarah Lee, Smart City and Innovation Manager at Bristol City Council. “We need to make sure that as we do things better and evolve, we’re still creating the city that people want to live in.”

Bristol has built its own methodology framework used to co-design, called The Bristol Approach, and an Asset Based Community Development framework.

A five-year project has also just ended which trialed new technologies to help residents save energy and money, and explore new ways of travelling, as part of the EU-funded research project REPLICATE.

It involved 50,600 residents specifically chosen in three areas of the city where 51 percent of all accommodation are flats, 44 percent of residents are black or minority ethnic citizens and where 46 percent of households have no car. Solutions included a new district heating system, the installation of smart home devices, and retrofits, among others.

Project outcomes and findings are still to be finalised but the learnings - whether from the actual interventions or from the engagement process - will be taken to the city’s next projects.

Lee says cities must also learn to pivot and change aspects of the project along the way.

To showcase some of the technologies to residents, such as smart washing machines, and dryers – and to garner their interest – it was initially planned to drive these machines around neighbourhoods in a trailer.

“Residents’ feedback was, ‘No, we don’t want more congestion blocking our streets’,” she explains.

As a result, the city instead worked with local arts groups through the Knowle West Media Centre to create a Wendy House – a play house for children – demonstrating the technologies that was pulled around by an electric bike.

“It’s not what we envisaged or planned but it has actually been far more valuable,” she says. “This has now been gifted to community centres so

that they can continue to use that post-project and help with education on energy efficiency."

Looking forward

For cities to achieve net zero it can't only be about 5G, digital twins, sensors, and the Internet of Things. They certainly have a part to play, but must be deployed in a way to support a complete rethink of urban life post-Covid.

A 'triangle of trust' between government, business, and citizens will be critical and is where Connected Places Catapult is and will play a role. For cities to achieve net zero the whole ecosystem must work in conjunction with residents' needs, ethics, transparency and accessibility by design.

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When Technology Meets Holistic:

How ICLEI* Aligns ICT Solutions with Sustainable Development

기술과 전체론의 접목:
이클레이(ICLEI)는 어떻게 ICT 솔루션을 지속가능한 개발과 연계하는가?

* Local Governments for Sustainabilaty

Gino Van Begin
Tim Lazaroff

Gino Van Begin is the distinguished Secretary General of ICLEI since 2013. Previously, he served as ICLEI's Deputy Secretary General and Regional Director for Europe. He has ensured ICLEI performs as a responsible, forward-looking, not-for-profit local and regional government organization serving its Members worldwide. Gino Van Begin graduated with a law degree from the University of Brussels and speaks Dutch, French, English, German and Russian.

Tim Lazaroff serves as a Global Projects staff member at the ICLEI World Secretariat and recently concluded the Master of Urban Management program at TU Berlin. He has worked across multiple vantage points of U.S. politics, focusing on communications, governance, and outreach. His previous research considers crisis governance of essential services under uncertain conditions, first in public transport in his native New York, then in schools during COVID-19. Tim received a B.A. in Urban Studies and a B.S. in Management from the University of Pennsylvania.

ABSTRACT

This article examines the smart city movement from the perspective of sustainable development, furthering the case for holistic interventions that align with and adapt to cities' preexisting systems and sustainability plans. At ICLEI – Local Governments for Sustainability, we advocate for an enhanced local sustainability policy and drive local action for low emission, nature-based, equitable, resilient, and circular development in 2,500+ cities. In the 30 years of ICLEI's existence, there has been a proliferation of ICT specifically designed for use in and by cities, often referred to as "smart city" solutions. These undeniably offer innovative potential, but ICLEI does not view 'smart' as equal in status to sustainability. Although sustainability benefits are often presented as self-evident in the smart cities narrative, linkages between digitalization and sustainable development are not so straightforward and can be paradoxical. Cities must harmonize co-benefits and tradeoffs in tailoring ICT to their unique needs and sustainable development pathways. We present four cases of holistic ICT interventions from a range of development, urban, and ICLEI project contexts. Real-time monitoring at a wastewater treatment plant in Turku, Finland offers a systematic circular economy solution to efficiently manage water, nutrients, and energy at the local level. An innovative participatory approach to natural asset mapping in Kochi, India, featured local and traditional knowledge to produce outputs that are not just visually stimulating, but also enhance citizens' local environmental accountability. Bogotá, Colombia, has begun exploring ecological last mile solutions with BiciCarga, a pilot project of e-cargo bikes to promote and establish sustainable alternatives for freight distribution. In Jakarta, Indonesia, Black Soldier Fly maggots proved to be the most appropriate community waste management solution. These case interventions and our sustainable development pathways offer replicable lessons for prospective holistic ICT interventions globally.

KEYWORDS

holistic, sustainable urban development, smart city, justice, integrated solutions

초록

이 글은 도시의 기존 시스템과 지속가능한 계획에 부합하는 전체론적 조정 사례를 통해 지속가능한 발전 관점에서 스마트시티 동향을 살펴보고 있다. 이클레이*ICLEI: Local Governments for Sustainability*는 지역의 지속가능한 정책을 표방하고 2,500개 이상의 도시에서 저공해, 자연 기반, 공정하고 회복 탄력성이 있으며 순환적인 개발을 위한 지역 정책을 추진하고 있다. 이클레이가 활동해 온 지난 30년 동안, 도시 안팎에서 활용되도록 특별히 고안된 ICT*Information and Communications Technology*가 확산되었고, 이를 일반적으로 "스마트시티" 솔루션이라고 한다. 이들이 혁신적 잠재력을 제공한다는 사실을 부인하기는 어렵지만, 이클레이는 '스마트*smart*'가 지속가능성과 동등한 위상을 갖는다고 보지는 않는다. 스마트시티를 언급할 때 종종 지속가능성의 편익을 자명한 것으로 간주하지만, 디지털화와 지속가능한 개발의 연계는 그렇게 간단치가 않을 뿐더러 역설적일 수도 있다. 도시는 도시 자체의 고유한 니즈와 지속가능한 개발 계획에 ICT를 적용해 가는 과정에서 나타나는 공동의 이익과 절충 방안들을 잘 조화시켜야 한다. 우리는 다양한 개발, 도시 그리고 이클레이 프로젝트의 맥락에서 전체론적 ICT 조정이 이루어진 4가지 사례를 제시할 것이다. 핀란드 투르쿠*Turku*시의 하수처리장에 대한 실시간 모니터링은 물, 물의 오염원인 영양염류 및 에너지를 지방정부 수준에서 효율적으로 관리하는 체계적인 순환경제 솔루션을 제안한다. 인도 코치*Kochi*시의 자연 자산*natural asset*을 매핑*mapping*하는 혁신적인 참여적 접근법은, 결과물 산출을 위해 지역 및 전통 지식을 특징으로 하는데, 이는 단지 시각적인 자극을 주었을 뿐만 아니라 시민들의 지역 환경에 대한 책임감을 고취할 수 있었다. 콜롬비아 보고타*Bogotá*시는 화물 배송의 지속가능한 대안을 확립하고 증진하기 위해 화물용 전기 자전거*e-cargo bikes* 시범사업인 비시카르가*BiciCarga*를 통해 생태적 라스트 마일*last mile* 솔루션을 탐색하기 시작했다. 인도네시아 자카르타*Jakarta*시에서는 아메리카동애등에*Black Soldier Fly* 유충이 지역사회 폐기물 관리에 가장 적합한 솔루션이라는 점이 증명되었다. 이러한 조정 사례와 우리의 지속가능한 발전 경로는 전 세계적으로 유망한 전체론적인 ICT 해결책에 대한 반복 가능한 교훈을 제공한다.

키워드

전체론, 지속가능한 도시 개발, 스마트시티, 정의, 통합 솔루션

Introduction

ICLEI recognizes there is no one-size-fits all solution to sustainable urban development, aiming instead to promote holistic, context-specific solutions aligned to a given city's systems. In improving access to resources and information, digital infrastructure and technology should both improve residents' lives and contribute to a city's sustainability goals.

Information and communication technologies (ICT) undeniably offer innovative potential, but ICLEI does not necessarily view 'smart' as a precondition for sustainable development. ICLEI supports deployment of ICT in urban development if the proposed technological intervention is aligned with our member cities' values and those of our five development pathways: low emission development; nature-based development; equitable and people-centered development; resilient development, and circular development. Although sustainability benefits are often presented as self-evident in the smart cities narrative, linkages between digitalization and sustainable development are not so straightforward. Consider that digital technologies are responsible for 10% of global energy consumption and 4% of global emissions[1], surging internet usage demands new data centers[2], or that the sector's annual consumption of water, energy and materials is three times greater than those of the United Kingdom (Ferreboeuf 2019). Digital solutions *can* stray from sustainable development pathways, particularly if environmental and social tradeoffs are not addressed.

The subsequent sections discuss the smart city movement, ICLEI's five pathways towards sustainable urban development, and our organization's support to case interventions from ICLEI members Turku, Kochi, Bogotá, and Jakarta. We hope this article helps contextualize the path we wish to pave with ICLEI's 2,500+ local and regional governments: one that empowers our Members and runs squarely through communities.

What is ICLEI?

ICLEI – Local Governments for Sustainability is a global network working with more than 2,500 local and regional governments committed to sustainable urban development. Active in 125+ countries, we influence sustainability policy and drive local action for low emission, nature-based, equitable, resilient, and circular development. ICLEI brings a strong urban component to national and global sustainability policies and translates these policies into action. We make sustainability an integral part of urban development and create systemic change in urban areas through practical, integrated solutions. We help cities, towns and regions anticipate and respond to complex challenges, from rapid urbanization and climate change to ecosystem degradation and inequity. Our Members and team of experts work together through peer exchange, partnerships, and capacity building to create systemic change for urban sustainability. ICLEI creates connections among the local, regional, national, and global governmental levels. We advocate for robust national and global sustainability policies that reflect the interests of local and regional governments and their communities. Through our collective efforts to build a sustainable urban world, ICLEI is shifting the trajectory of global development.

The Smart City Movement and Sustainable Development

In the three decades of ICLEI's existence, there has been a proliferation of ICT specifically designed for use in and by cities. This asks much of cities governmentally and technologically, particularly when the smart city concept is presented as a goal in and of itself. A total pursuit of smart labels can blind governments from meaningful progress towards sustainable development in their jurisdictions, tailored to their unique needs. At ICLEI, we encourage participatory and integrated planning that considers justice

and sustainability (Agyeman 2003) and socio-planetary boundaries (Raworth 2017), while cautioning against ignoring the human and social aspects of 'smart' (Watson 2014). At the core of the smart cities narrative is the premise of 'city-as-computer' (Mattern 2021) and a need to both quantify and economize the urban. 'Smart' also furthers the illusion that human ingenuity can out-innovate climate change or any issue plaguing cities (Haraway 2016). We must ask: **who (or what) does 'smart' serve?**

We encourage healthy collaborations with the private sector. Yet private, tech-led incarnations of the smart city can neglect co-creation with cities and residents. This approach can exacerbate urban challenges, even those that ICT solutions intend to remedy. The unintended consequences of tech-first innovation are a "double-edged sword" (Surico 2021). Consider the smart city paradoxes ICLEI identified in 2016 (Horn 2016 1, 2016 2, 2016 3): 1) Efficiency increase vs. absolute consumption[3]: Per the Jevons Paradox, the drive to make cities more efficient can inadvertently increase overall energy and resource consumption. Ride-hailing services are meant to make trips faster and more efficient, but they incentivize more car journeys (plus create idling times and congestion) that increase total emissions.

2) Integrated urban systems vs. resilience[4]: The integration of systems for efficiency gains may compromise the resilience of an urban system. When system integration becomes systemic interdependence, the autonomy of single urban systems to function when others fail is eroded. Cities risk compounding natural disasters or malware attacks and must design back-up systems in tandem with digital solutions.

3) Open data vs. data management[5]: While open data enables solutions of profound scale and creates transparency, it may further digital and power inequalities, plus data security stressors. Cities must be deliberate and strategic in crafting data policy. Many city governments do not have this capacity, and those that do still must reckon with competing public-private incentives.

When company-driven, tech-focused smart city endeavors are cancelled[6], they pose a number of questions. For one, what happens to public assets if they are managed by a private entity whose main constituency is its shareholders and not the urban residents that are to use them? While tech tends to move fast, urban democratic processes (both bureaucratic governing and substantive community engagement) take more time. Patience is necessary to realize the benefits of democracy. In Global South contexts, top-down smart interventions often dedicate precious resources to making cities less equitable (Watson 2014). This implies that smart and justice must be inherently linked and contextually defined. Smart cities are as much a question of right to the city as of 5G.

ICLEI's Holistic Approach

ICLEI was early to adopt a critical posture towards smart cities in a tech and private-led environment. Clearly, there is tremendous value in integrating ICT into urban development, but we saw that some principles embedded in the smart city movement's earliest incarnations were misaligned with our values. Notably, caps on resource consumption and planetary boundaries are not typically embedded in the smart cities narrative. Inclusivity, particularly in private-led projects, has been consistently problematic and, in some cases, tokenized.

In the early 2010s, ICLEI worked with eight urban agendas defined across the spectrum of sustainable interventions. At the ICLEI World Congress 2015, these were expanded to ten, and the Smart Urban Infrastructure agenda was renamed to Smart City agenda. This focus area served as ICLEI's main assembly of smart city-related experts, albeit ones critical of emerging trends. ICLEI made the organizational decision to shift from a somewhat sectoral view on cities to a more integrated, holistic approach. To realize our vision for holistic sustainable development, the entirety of ICLEI created new narratives to communicate our organizational principles

and harmonize project efforts.

Although not entirely in response to smart cities, ICLEI's five development pathways address many pitfalls of the smart city movement. Considering ICLEI's role, defining and encouraging our Members to abide by any constrained smart city definition does less service than enabling response to proposed smart city concepts. We have found it most appropriate to position interventions within systems thinking, with principles to guide context-based implementation of five sustainable development pathways. Cities must look beyond single technologies and at the variety of urban infrastructures, designing solutions that foresee and address potential negative side-effects while fostering synergies. The pathways are a lens through which to plan holistic interventions, including for digital tools.

These pathways provide a framework for designing integrated solutions that balance the patterns of human life and the built and natural environments. They encourage holistic thinking to ensure that ICLEI, as a network of local and regional governments and global experts, optimizes our impact. For instance, we consider how nature-based development contributes to resilience, or how equity[7] informs circular development. When these pathways guide local and regional development, urban systems become more sustainable. These pathways, outlined here[8], are part of the ICLEI Malmö Commitment and Strategic Vision 2021-2027[9], which guides the work of the ICLEI network. The pathways were originally released as part of the ICLEI Montréal Commitment and Strategic Vision 2018-2024[10].

Figure 1

ICLEI's Five Sustainable Development Pathways

ICLEI's Emerging Legacy: Case Interventions

Here, we present a range of holistic case interventions from four different regional, project and development contexts. They demonstrate the ability of cities to harness digital technologies in a deliberate manner for achieving change along the five sustainable development pathways. Ultimately, individual efforts from ICLEI Members to co-create solutions will determine our organization's success in implementing and reimagining our pathways.

Turku, Finland: Rethinking Sustainable Governance

Finland's third-largest city is a frontrunner on climate action and an advocate for circular development. Supported by the Finnish Innovation Fund Sitra, the Circular Turku[11] project aims to collaboratively design a regional roadmap that will operationalize circularity in the Turku region. The project involves all relevant stakeholders – from municipal companies to regional bodies, businesses, universities, and community groups – in the design of an inclusive and systemic circular economy action plan. Through this partnership, Turku facilitates the replication of successful initiatives and methodologies initiated in the Turku region around the world through the ICLEI Network.

Although Turku is set to be climate neutral by 2029, individual Finns' carbon footprints remain quite high because of high consumption levels. From extraction to manufacturing, transport, distribution and disposal, materials and products produce substantial emissions all along their lifecycle. Turku Mayor Minna Arve is determined to reduce her citizens' 'hidden emissions', closing loops of a circular economy even beyond her city's jurisdictional boundaries. Turku is leveraging digital tools to address hidden emissions within both lifestyle and infrastructure. Turku led the 1.5-Degree Life Video Campaign[12], engaging youth groups from Turku, Yokohama,

and Nagano, Japan, to raise awareness on necessary lifestyle shifts. Then, in collaboration with twenty local and regional partners, Turku released the city-wide 1.5-Degree Life Campaign[13] on August 19, 2021. The campaign emphasizes the positive climate impacts of lifestyles shifts in key consumption categories, such as mobility, housing, and food.

Regarding infrastructure, real-time resource monitoring is enabling the Kakolanmäki Waste Water Treatment Plant[14] to be energy positive and create sector-based solutions otherwise impossible without ICT. Led by Turku's City Council, municipalities in the Turku region collaborated to design a systemic solution to water management in the area. Thermal energy extracted from wastewater is used to heat 15,000 households, while the remaining cool water is used for cooling purposes, which is nearly enough to meet almost all the city's needs. 50,000 tons of sludge are processed into biogas through anaerobic digestion, producing 30 GWh annually allocated for various regional public transport energy needs. The nutrients from the digestate become fertilizers in agriculture and landscaping. From groundwater protection to energy positive treatment and nutrients recovery, Turku's water concept offers a systematic circular economy solution to efficiently manage water, nutrients, and energy at the local level.

Kochi, India: Mainstreaming Biodiversity with Illustrated Natural Asset Maps

Kochi is one of eleven cities globally that has worked with ICLEI to map its natural assets[15] through the International Climate Initiative (IKI[16])-funded INTERACT-Bio Project[17]. It aims to mainstream biodiversity in fast-growing Global South cities and regions. Kochi's innovative participatory approach to natural asset mapping featured local and traditional knowledge to produce outputs that are not just visually stimulating, but also enhance citizens' local environmental accountability.

Illustrated Natural Asset Maps are uniquely powerful visual tools that simplify, represent, and communicate information about complex ecosystem structures, functions, and services in a geographic area. The use of illustrat-

ed natural asset maps as innovative tools to generate awareness of a city's biodiversity is novel. The maps support local governments to integrate biodiversity conservation and ecosystem management into urban planning and community involvement for sustainable development and improved quality of life. The five-step mapping process combines spatial information represented in the natural asset map, with local information on the natural, biodiversity and cultural assets of that area in an artistic illustration. These maps are visual reminders of the diversity of lifeforms and ecosystems in and around a city that tie in with local culture and history, as well as citizens' well-being. They bring out the natural assets a city must coexist with, preserve, and enhance to align with sustainable development.

In Kochi, the map has been publicly displayed in front of the Mayor's office and at pollinator and herbal gardens that form part of the city's Nature Interpretation Zone at Subhash Park[18]. The zone strives to display various biodiversity elements to serve as a live interpretation for residents, breaking down barriers in connecting to *urban* biodiversity. The map has proved useful for officials who seek a more accessible way to interpret and communicate data. When city leaders refer to the maps, they further city planning and project objectives simultaneously. Kochi intends to go beyond the current map with an interactive element that continues to process new data and create avenues for further stakeholder engagement. The project's legacy – especially as four additional Indian cities are enlisting ICLEI's support to create their own maps – will preserve biodiversity and nature-based development's place in the planning conversation.

Figure 2

Natural Asset Map in Kochi

Bogotá, Colombia: Piloting Sustainable Urban Freight Alternatives

Smart cannot always be glamorous. ICLEI's EcoLogistics Initiative[19] – one of our newly-established smart action and priority areas – addresses urban freight, an often overlooked (but growing) sector in city planning. ICLEI aims to transform the urban logistics scene in cities through effective regulatory, planning, and administrative instruments at all levels of government. By highlighting urban freight as a priority, ICLEI strengthens institutional capacity through multi-stakeholder participation and encourages a multilevel governance approach. Committing to low emission pathways means reconsidering planning priorities and behavioral change. ICLEI's EcoLogistics Community[20] helps offset these challenges when cities learn from each other[21], whether it be fellow carbo bike micro-hub pioneers in Berlin and Barcelona[22], or e-bike sharing frontrunners in Latin America[23].

Through our flagship initiative, ICLEI is implementing the IKI-funded EcoLogistics Project[24] in Argentina, Colombia and India, focused on capacitating governmental and non-governmental actors to build strategies and policies to promote low-carbon and more sustainable urban freight through local action and national support. The project follows the strategy to 1) avoid (and reduce) the freight volume and haul distance, 2) shift (and maintain) to more sustainable modes of freight transportation, and 3) improve the logistics operations by use of technologies and better operation. One of the project's key outputs has been a self-monitoring tool[25] for cities to estimate GHG emissions from urban freight and helping to make more informed decisions and goals in decarbonizing urban freight.

Economic activity in Colombia's sprawling, mountainous capital of Bogotá creates considerable traffic of all kinds, necessitating innovative solutions and strategies. Bogotá's world-renowned passenger transportation, Transmileneo, and an extensive bike lane network are the city's response to passenger transport demands. Bogotá has shown considerable willingness to consider freight transport solutions, but reconfiguring freight is extraordinarily complex, given the sheer scale (140,000+ nano stores) and informal,

fragmented nature of deliveries. Bogotá has begun exploring ecological last mile solutions with BiciCarga[26], a pilot project of e-cargo bikes to promote and establish sustainable alternatives for freight distribution. Its wider goal is to identify key stakeholders and create a valuable cycle freight network to share good practices of sustainable urban freight and inform policy making. The pilot has two models[27]: the "in-house last-mile distribution" and the "collaborative cross-docking platform". In the first, companies use cargo bikes to deliver goods from their private distribution centers to delivery points within a 5 km radius. Over a three-month span, BiciCarga made 580 deliveries and saved 270 kg of CO_2. The second model uses a shared distribution center where companies could deliver their products to and use cargo bikes for the last mile deliveries, with 2,300 deliveries and 250 kg CO_2 saved over a one-month pilot.

The lack of adequate infrastructure for cargo bikes, difficulty to access all areas of the city, inadequate street infrastructure, and unavailability of quality freight data[28] make generating innovative solutions challenging in Bogotá. Being mindful of smart city paradoxes – data sharing can be complex[29], and better deliveries may perpetuate overall higher consumption – allows cities like Bogotá to guide their futures.

Jakarta, Indonesia: Co-Creating Low-Tech Community Waste Management

Jakarta's waste management crisis can feel daunting, but the provincial government and ICLEI prefer proactivity to cynicism. The IKI-funded Ambitious City Promises Project[30](ACP), which officially ended in June 2021, sought to co-create sector-based stakeholder climate actions to pinpoint concrete, cross-cutting interventions for Southeast Asian megacities. In waste management, ACP strove to generate a localized approach to DKI Jakarta's 3R (reduce, reuse, recycle) policies at the generation source level. Pilot interventions would later inform the Ikhtiar Jakarta[31], the Indonesian capital's decade-long City Promise commitment of climate actions co-created with its citizens.

As of 2017, according to our research, 95 percent of DKI Jakarta's waste is transported to the Bantar Gebang Landfill in Bekasi, which is soon expected to reach full capacity. Only 10 percent of the remaining wastes in the province were managed through composting and recycling. Therefore, DKI Jakarta hopes to prolong the life of the landfill and source sustainable waste management solutions. Organic wastes – which constitute half of Jakarta's overall daily waste generation of 7,165 tons – are top priority. ICLEI led a study to determine the most appropriate community-based solid waste management solution for the Indonesian context.

Black Soldier Fly (BSF) processing is an emerging low-tech solution in organic waste treatment. The benefits of using maggots to recycle organic waste are numerous, given these insects' ability to recycle carbon into edible insect proteins and oils, versus methane and other harmful pollutants. Overall, BSF processing has simple operation and maintenance that do not require technical expertise, with low operation and maintenance costs and economically viable end products, all while having low GHG emissions. There are easily available machinery providers/vendors in Jakarta, which bodes well for harvesting Black Soldier Fly insects independently with simple nurseries. Holistically, this low-tech solution has much to offer. From ICLEI's study, experts determined BSF was the most appropriate community-based solid waste management solution in Indonesia. Through the ACP Project, DKI Jakarta was able to scale up the BSF processing that is locally adapted to the city's context. Cooperation with the DKI Jakarta Environment Agency yielded a site in TSP (temporary waste dump site) Rawasari. The hope for this pilot was to determine BSF's potential as a complementary solution to existing composting programs in the province. The

Figure 3

Black Soldier Fly pilot in Jakarta

facility is expected to treat at least one ton of organic waste per day and can contribute to GHG emissions reduction of 400t CO_2 annually. ICLEI sees hyperlocal solutions geared towards engagement and empowerment as best community waste management practices and believes this pilot will inspire future BSF efforts across Indonesia.

Reimagining Holistic Futures

Each city needs to lead the conversation and ultimately own its transition. ICLEI, through projects like the examples outlined above, or the GEF-7-funded UrbanShift[32], is committed to helping cities reorient their priorities along our five sustainable development pathways. We recognize both our Members' need for urgent action and diminished capacity during a pandemic and a year of acute climate disasters. The question of using smart technologies in recovery and complex emergencies[33] will inevitably emerge. There are some key considerations we wish to reinforce:

'Smart' must meet cities where they are: Being smart should be rooted in local contexts. Bogotá's freight transport is decentralized and informal; rather than create a new freight system, BiciCarga showcases alternatives within a preexisting structure. Many Global South sectors are informal; holistic ICT interventions must accommodate informality without compromising on accountability. The NGO Transport for Cairo[34] maps informal, decentralized transit networks across Africa using digital tools, empowering people to travel with routes that are already there.

Collaborative horizontal governance can drive regional action: Regions are collections of shared infrastructures divided by municipal boundaries. For any city, co-creating goal-oriented engagement with nearby governments is part of integrated sustainable development. The City of Turku's recognition of water as a shared resource unlocked new value at the wastewater treatment plant. Across the Nordics, partnership network Gate21[35]

has built a platform of municipalities, regions, companies, and knowledge institutions in advancing Greater Copenhagen's green transition.

Neutral spaces promote healthy engagements with the private sector: Cities' timelines, incentives and proposed interventions can differ considerably from those of private companies. ICLEI leads City-Business Collaboration Accelerator[36](CiBiX) workshops in projects to bridge public-private gaps. We hope to spark conversations in neutral spaces early in prospective collaborations. The European AI4Cities[37] consortium guides AI solution generation with pre-commercial procurement, enabling the public sector to steer solution development directly towards its needs.

A seemingly low-tech solution might be best: High-tech can appear as an urban antidote, yet the wisest option (in waste management[38], for example) may lie elsewhere. Jakarta and nearby Bogor[39] recognized the holistic potential of maggots for processing organic waste in Indonesia. Solutions that last also foster resilience. Quito has coordinated with community health watchers[40] using WhatsApp to serve as confidential conduits for residents reluctant to report COVID-19 symptoms. This data-driven ICT solution fosters the inclusivity and trust crucial to smart urbanism[41].

Mainstreaming nature is smart: Nature contains many untapped low-tech solutions. Recognizing how intricately our well-being depends on nature's contributions can enable cities to develop smart, cost-effective, and sustainable solutions. Integrating indigenous knowledge and healthy preexisting connections to nature facilitates this process, particularly in urban settings where nature is easily overlooked. ICT can help mainstream the biodiversity conversation into all policy and practice with tools like illustrated asset maps. Ultimately, a healthy planet is the solution.

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Smart City Explorers

Danish cities efforts towards Net-zero

스마트시티의 탐험가들 – 넷–제로를 향한 덴마크 도시들의 노력

In the paper there are several asterisk within the body text. The marked words correspond to the links and they are provided at the end of the article.

Peter Vangsbo

Mr. Peter Vangsbo is the Executive Director of the Innovation Centre Denmark in Seoul located at the Danish Embassy in Korea. Mr. Vangsbo is responsible for connects Danish innovation to Korean R&D, SMEs and private Business partners. The objective of Innovation Center Denmark is given insights into research, science, technology, new business models and commercial innovation. Innovation Centre Denmark in Seoul gives Danish companies, researchers and students access to the Asian powerhouse of research and innovation in South Korea and helps Danish innovators explore the most recent developments in emerging markets and business strategies in Korea and Asia Pacific. Innovation Centre Denmark unites government bodies, academia and business environments through the triple helix model and is a partnership between the Ministry of Higher Education and Science and the Ministry of Foreign Affairs of Denmark. Come visit us in Seoul or learn more at bit.ly/3hnKOv5.

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ABSTRACT

Cities account for 70% of global CO_2 emissions today. As the pace of urbanisation only quickens, cities face immense challenges related to sustainable waste management, mobility, climate adaptation and energy. However, as their political, economic and technological power grows, cities can harness this trend to act as leaders in the green transition and drivers of the green economy – contributing to solving the UN Sustainable Development Goals. Cities need smart solutions to ensure that they are optimised for sustainable economic activity, energy consumption and positive environmental impacts.

Digital technology, both ICT and IT, is crucial to create smart cities that fuel sustainable development. For many years, cities have applied digital technology to solve major metropolitan challenges, however the rate at which this adoption takes place is rapidly increasing. Creating smart cities is not an aim in itself. Being smart is only the means with which to achieve a city's goals of sustainable growth and liveability. To do so, a solid foundation of basic digital structures have to be in place.

Rather than addressing challenges of sustainable waste management, mobility, water, buildings, heating and cooling, and energy systems independently, substantial economic and environmental gains can be made from adopting a more integrated and holistic approach. This article address specific, examples of urban green solutions related to each sector and demonstrate the potential of taking a cross-sectoral approach to these.

The inherent complexity of building smart cities and societies implies a strong focus on both the development of new organisational structures and the establishment of horizontal technical specifications across the public and private spheres. This article features lessons learned from Danish smart cities applying sustainable solutions and showcase how cities can taking a smart approach to urban development creates liveable, sustainable and prosperous societies globally. The cases are meant to serve as a tool for inspiration for reaping the benefits of implementing sustainable, smart city solutions in your city.

KEYWORDS

Carbon Neutrality, net-zero strategies, climate resilience in urban master planning, sustainability, urban transformation, ICT and AI based sustainable transportation, Danish Embassy and Innovation Center Denmark

초록

오늘날 전 세계 이산화탄소 배출량의 70%는 도시에 기인한다. 도시화가 가속되면서, 도시는 지속가능한 폐기물 관리, 이동성, 기후 적응, 에너지와 관련된 엄청난 도전에 직면해 있다. 그러나 도시는 정치적, 경제적, 기술적 힘의 성장 추세를 이용해 녹색 전환의 리더이자 녹색 경제의 원동력으로 활동하면서 유엔 지속가능 개발목표*UN Sustainable Development Goals*의 달성에 기여할 수 있다. 도시는 지속가능한 경제 활동, 에너지 소비, 긍정적인 환경 영향에 최적화되기 위한 스마트 솔루션이 필요하다.

디지털 기술, ICT와 IT는 지속가능한 개발을 촉진하는 스마트시티를 구현하는 데 필수적이다. 도시들은 수년에 걸쳐 대도시의 문제들을 해결하기 위해 디지털 기술을 적용해 왔고, 이런 채택의 속도는 급격히 증가하고 있다. 스마트시티를 만드는 것 자체가 목적이 아니다. 스마트해진다는 것은 지속가능한 성장과 거주 적합성이라는 도시의 목표를 이루기 위한 수단일 뿐이다. 이를 위해서는 기본적인 디지털 구조의 견고한 기반이 자리를 잡아야 한다.

지속가능한 폐기물 관리, 이동성, 물, 건물, 냉 · 난방, 에너지 시스템의 문제는 독립적 해결보다는 보다 통합적이고 전체론적 접근 방식을 채택할 때 상당한 경제적, 환경적 이득을 얻을 수 있다. 이 글은 도시의 각 부문과 관련된 녹색 솔루션의 구체적인 사례를 다루며, 이러한 부문에 대한 교차적 접근의 가능성을 실증한다.

스마트시티와 스마트 사회 구축의 본질적인 복잡성은 공공과 민간 영역에 걸친 새로운 조직 구조의 개발과 수평적 기술 구현이라는 두 가지 측면에 모두 집중해야 함을 시사한다. 이 글은 지속가능한 솔루션을 적용한 덴마크 스마트시티에서 얻은 교훈을 담고 있으며, 도시개발에 스마트한 접근법을 채용함으로써 어떻게 세계적으로 살기 적합하고 지속가능하며 번영하는 사회를 만들 수 있는지 보여준다. 이 사례들은 지속가능한 스마트시티 솔루션의 적용으로 얻을 수 있을 것이라 기대되는 장점들에 대한 영감을 줄 것이다.

키워드

탄소중립성, 넷-제로(순 배출량 제로) 전략, 도시 마스터플랜에서의 기후 리질리언스, 지속가능한 도시전환, 정보통신과 인공지능기술 기반의 지속가능한 교통, 덴마크 대사관 및 덴마크 이노베이션 센터

The Danish national efforts toward net-zero

Denmark aspires to become one of the most climate-friendly countries in the world. In June 2020, the Danish Parliament overwhelmingly passed a new climate law that aims to reduce greenhouse gas emissions by 70 percent below 1990 levels by 2030, with net zero emissions targeted for 2050 (1).

In what the government claims to be the first national climate legislature, the new Danish climate law also has a commitment to climate engagement internationally. This includes an ongoing obligation to deliver on international agreements, including climate financial support to developing countries.

It has been crucial for the government that the climate law cannot just be annulled by a less ambitious government in the future – it is 100% binding. The Danish Climate Action Plan will include specific sector strategies and indicators for central sectors such as agriculture, transport, energy, construction and industry. Moreover, Denmark has already taken the first steps towards establishing a professional and efficient energy sector as the basis for the transition to a sustainable green society (2).

The Danish government has in 2021 proposed to increase spending for green research, development and demonstration by $150million USD. It is expected that a large part of this funding will go to climate-related research and innovation, including research and innovation partnership in clean energy. Furthermore, Denmark wants to intensify export promotion activities in the energy sector – both in scale and volume – to a total of $174 million USD from 2019 to the end of 2024 (3).

The Danish national efforts toward net-zero have been influenced and motivated by many progressive, innovative and forward-looking cities in Denmark.

As an example, the Danish capital Copenhagen, aims to be the world's first

Figure 1

National day celebration in Denmark ©Mr. Changhee Choi, Architectural Photographer

carbon-neutral capital city by 2025 (4) – just 4 years from now! They will meet the target even under the condition that the population of Copenhagen is expected to grow by 20 % in the next decade. This opens an opportunity to combine infrastructural changes with green growth toward carbon neutrality in 2025.

The *CPH 2025 Climate Plan** is holistic and includes specific targets and initiatives in the four key areas – energy consumption, energy production, mobility and city administration initiatives. The Climate Plan is developed in three implementation phases; 2013-2016, 2017-2020 and 2021-2025 with evaluation in between each of the phases (5).

Copenhagen have addressed carbon neutrality challenges with both adaptation and mitigation initiatives, in recognition of the added benefits such as less air pollution, better health and optimized recycling on the way to our vision: A zero waste city. But reducing carbon emissions is just a small part of being a sustainable city. It is also about growing our economy and, ultimately, improving the quality of life for our residents (4).

Investing in sustainability also has financial benefits. Cleaning the water in Copenhagen harbour improved the marine environment, and it has also benefited business, tourism, and real estate prices. An integrated public transportation system fueled with alternative environmentally friendly fu-

Figure 2

Green mobility in Copenhagen – parking of bikes in the city center ©Changhee Choi

els, not only reduces traffic congestion, it also saves us billions of money and keeps the city efficient and competitive.

Denmark's efforts toward Net-Zero is leading to both green export and new green partnership. This was highlighted in Seoul during the P4G in May 2021 where Denmark and Korea forged a comprehensive green strategic partnership between our countries signed by president Moon Jae-In and Prime Minister Mette Frederiksen that aim to further deepen cooperation on climate and environment. I am very pleased to share this, as it was South Korea's first bilateral green partnership with a foreign country.

Net-Zero commitment is the right way to green our society, our cities and our industry and to form more innovative, resilient and commercial driven green partnerships.

Intro to Urban Transformation Case*:* Copenhagen – Carbon Neutral by *2025*

Copenhagen accepts its share of the responsibility for leading the way in addressing any climate change within Copenhagen Municipalities' 2025 Climate Plan. The 2025 Climate plan want to show that it is possible

to combine growth, development and increase quality of life with the reduction of CO_2 emissions. It is all about finding solutions that are smarter, greener, healthier and more profitable. And by 2025 citizens of Copenhagen will be able to call themselves the world's first carbon neutral capital-citizens.
The roadmap describes 60 initiatives, which correspond with the main priorities for the four pillars:

Energy production: Initiatives include installing land wind turbines within the city and other municipalities, as well as offshore, biomass power generation, treatment of organic waste and separation of plastics from domestic and commercial waste, and ensuring district heating is carbon neutral. According to the plan, 80% of greenhouse gas reductions will come from changes to energy production. Flagship projects include BIO4, a new biomass-fired combined power and heat unit, which will replace a coal fired power plant, and wind farms at sea and on land (6).

Energy consumption: Initiatives to reduce heat and electricity consumption (by 20% for commercial and 10% for residential buildings) including improvements for the construction sector, energy efficient buildings, and increasing solar cell coverage to supply 1% of consumption. Flagship initiatives include the 'Energy Leap' project, which encourages large building owners to make big energy savings and lead the way for others, and building energy efficiency improvements targeted to E, F and G energy label buildings (6).

Green mobility: Improving public transport and cycle infrastructure through partnerships and promotion, transitioning the transport sector to new fuels like hydrogen and biofuels, establishing intelligent traffic management, and influencing behaviour change through mobility programs and 'attitude training'. By 2025, 75% of all trips in Copenhagen should be on foot, by bike or public transport – up from 66% today. Flagship initiatives include replacing diesel buses with carbon neutral buses, and Mobility as a Service (MaaS) which will provide residents and visitors with easier access

to all forms of public transport (4).

City administration initiatives: Reducing energy consumption from street lighting and municipal buildings by 40%, as well as installing solar panels on municipal buildings, shifting to non-polluting municipal fleets and sustainable procurement. Flagship initiatives include new requirements for non-road mobile machinery in construction projects the City of Copenhagen is involved in (4).

Figure 3

Nyhavn(New Habour) of Copenhagen, Nyhavn is a 17th-century waterfront, canal and entertainment district in Copenhagen. ©Changhee Choi

Smart Denmark: Overview of Smart City Programs in Denmark

Over the last decade, the 'smart city' concept has emerged to represent technology-driven urban benefits and the products and services that deliver them. For national governments, the smart city is attractive because it represents an opportunity to improve its towns and cities and to access a

large global market, estimated to be in the order of $1.3 trillion and growing by 17% each year. National governments are ramping up their efforts to remove barriers that are preventing regional and municipal governments from applying smart city solutions and local businesses from developing and exporting related products and services. There is a recognition that government action is required to give the country a head-start in the race to attract international companies, talent, and investment (7).

For us and our focus on smart digital cities at the Innovation Centre Denmark in Korea, Smart Cities is a way to work in a public private partnership specifically around different types of digital technologies with the aim to accelerate integrated urban improvement and Danish national prosperity and branding.

In Denmark, smart city projects have been carried out in many towns and cities, usually by the municipal government in collaboration with business and academia. Looking at four very different Danish cities (Copenhagen, Aarhus, Vejle, Albertslund) shows the widespread pursuit of smart city benefits by all of these players. For example, in the Capital Region of Denmark, employment in companies that operate in the smart cities market has risen by 60% between 2003 and 2013, which amounts to 19,500 jobs. Smart city activities in Denmark are, however, mainly small in scale and solutions are not applied widely. Businesses are frustrated by "pilot sickness" where projects are carried out without any subsequent investment or scaling up. This is not unique to Denmark. The failure to scale up smart cities pilots in Denmark reflects the wider situation in many countries around the world (8). But what does Smart Cities look like from a Danish perspective, allow me to share four different cities take on smart cities:

Smart Cities initiatives in Copenhagen

Copenhagen is the largest city in Denmark with about 600,000 inhabitants in its city area and almost 2 million in its greater metropolitan

area. The capital is generally considered to be highly advanced in regards to technology as well as quality of life and in 2014 Copenhagen won the prestigious World Smart Cities Award in Barcelona for the concept, "Copenhagen Connecting" (9).

Use data to create integrated and intelligent solutions

Copenhagen Connecting is a concept for a digital infrastructure across the entire city. The assumption behind the concept is that digital infrastructure will be the future platform for smart city innovation and will cover the city in a similar way to physical infrastructure today. A business case states a socio-economic potential in the order of USD71milion, if the concept is implemented (9).

Through a truly integrated approach linking visions (*e.g. for Copenhagen to become the first CO_2-neutral capital by 2025*)*, action plans and technologies together, the City launched 'Copenhagen Connecting' (CC) to deliver better and faster on goals through intelligent use of data. The concept is scalable and replicable, and designed to avoid vendor lock-in. Key benefits include: Better use of resources, reliable and cost-efficient services that meet the needs of citizens, involve businesses and open new business opportunities.

Using known technology in new ways, Copenhagen Connecting offers a first-of-kind digital infrastructure. It will allow for, e.g. water, energy and CO_2 savings, optimized fleets and traffic flows, crowd control, and low-cost tracking of bikes to reduce theft-rates. Copenhagen Connecting promotes an integrated use of technologies and services that promises user-friendly solutions, e.g., presents citizens with one single interface for resource management across utilities, from water to electricity and heat and with consumption on demand. Copenhagen Connecting pools data from a range of systems and sources to allow for new, cross-cutting analyses and services that target end-user needs better or more timely – e.g. to contain risks from storms and cloudbursts, or to reap energy efficiency gains at scale and speed through bundled efforts and business investments.

Copenhagen Municipality continuously exhibits data, because it aims to create transparency in areas of municipal management and foster innova-

tion and growth in the city. Internally, data production and exhibition are tools for raising the quality and generally using data to support projects and activities in the city. In addition, the use of data is largely focused on solving specific tasks better or more efficiently (4).

Combining both public and qualified private data, a key feature is that Copenhagen Solution lab will allow new business opportunities, enabling entire value-chains in an eco-system of data to the benefit of citizens and city life in conjunction with the hub initiation of Copenhagen Solutions Lab and the Copenhagen Open Data platforms.

Copenhagen Open Data is the city's portal for data about Copenhagen. *Open Data DK** is an association that consists of a number of Danish municipalities and regions, which aims to make government data open and available for use by all citizens and businesses. The goal is to improve transparency in public administration and support data-driven growth. Copenhagen's portal to data about the city contains information on infrastructure, traffic, cultural events and much more (10).

City Data Exchange is a collaboration to examine the possibilities of private/public data exchange. The City Data Exchange (CDE) was a private/public collaboration established in 2013 between the Municipality of Copenhagen, The Capital Region of Denmark, and Hitachi to examine the possibilities of private/public data exchange. This was an innovative approach to test the readiness of the market to deliver new data-sharing solutions. The project examined purchasing, selling, and sharing a broad range of data types between all kinds of users in a city – citizens, public institutions, and private companies.

In 2013, the City of Copenhagen, and the Copenhagen Region decided to invest in the creation of a marketplace for the exchange of public, and private sector data. This was an innovative approach to test the readiness of the market to deliver new data-sharing solutions.

Since May 2015, the CDE team has gathered a lot of knowledge. Establishing and operating the CDE has been a co-creation process and the CDE team has been in contact with a large group of citizens, companies, and organizations to understand the market mechanisms and build up a wider

data ecosystem around the CDE (10).

The City Data Exchange was a pilot project that ended in 2018, but a lot of urban climate change insights and knowledge have been gathered from the project. The City and the Region of Copenhagen are utilizing the insights from the CDE project to improve their internal activities and to shape new policies. The lessons from the CDE also provide insights into a wider national infrastructure for effective data sharing (12). Based on the insights from approximately 1000 people that the CDE has been in contact with, the recommendations are:

1) Start with the use case, as it is key to engage the data community that will use the data
2) Create a data competence hub, where the data community can meet and get support
3) Create simple standards and guidelines for data publishing

Select For Cities

Select for Cities was a program that aimed to create a new and innovative IoT platform for cities. The program was launched by Copenhagen, Antwerp and Helsinki municipalities who in 2015 agreed on an innovative tender through Pre-Commercial Procurement (PCP) on the development of an Internet of Everything (IoE) platform. The open innovation challenge for the European companies was "How can the cities reinvent themselves as linked and large-scale 'Internet of Everything' labs, with an easy access to developers and innovators to pilot, test and validate their solutions?" (11)

Select for Cities is an EU Horizon 2020 project, with a budget of $6.6 million, that offers companies funding for developing prototypes and testing them in real-world conditions. The aim is for the prototypes to lead to the future purchase of IoT platforms in European cities.

The companies that have participated in the process says that they are currently running a better project due to the specific feedback they have received from the cities and have sold their platforms to several different countries in southern Europe (11).

Figure 4

Street view of the Black Diamond, Permanent exhibition of treasures in the Royal Danish Library ©Changhee Choi

Open Data Copenhagen

Copenhagen has not only a 'smart plan for utilizing digital data' but is already well ahead with the investments to implement it. The City of Copenhagen has invested $41 million in new streetlights and more than $16 million in new traffic lights and intelligent traffic management. This means that the City of Copenhagen can now promise cyclists and bus passengers that by 2020 they will have their travel time reduced by 10 percent while the travel time for motorists will stay the same.

Another priority for Copenhagen with regard to their smart city strategy is the publishing of accessible and open data. Through its open data portal, www.data.kk.dk, the municipality has published more than hundred data sets, including maps of parking spots, public toilets, and simulations of traffic flow, for example. A vast amount of future publications of data are planned, such as energy statistics for the city's buildings and demographic data. In addition, the potential of 'big data' is being explored as the Japanese technology company Hitachi established a big data platform (City Data Exchange) in the spring of 2019 in cooperation with the City of Copenhagen, the Capital Region of Denmark and the Danish CLEAN Cluster. The platform aims to bring together private data and open public sector data to create better public solutions and new business opportunities for companies.

Smart Cities initiatives in Aarhus

With around 260,000 inhabitants in the inner urban area and almost 850,000 in its greater urban zone, Aarhus is the second largest city in Denmark and the largest on the peninsula of Jutland. Acting as a regional centre for research and education, as well as home to Scandinavia's largest university, Aarhus is a fast-growing and evolving city in terms of its population and economy.

Aarhus opened a new innovation centre at Dokk1 in 2015. The centre for innovation supports and strengthens innovative projects that will create specific everyday improvements for citizens in Aarhus. The work of the centre relies on combining strong partnerships with innovative ideas (13). The centre is also a physical space – a neutral zone for inspiring creativity, innovation and collaboration. The City of Aarhus runs the centre with the purpose of facilitating innovation processes that bring together different public institutions, citizens, and other private actors. Employees at the centre will take on the role as partners and facilitators in the different projects

Figure 5

Aarhus Docklands(Danish: Aarhus Ø) is a new neighbourhood and construction site in Aarhus, Denmark. ©Shutterstock

bringing in their practical experience to assist at any point in the innovation process.

The smart city efforts in Aarhus, *Smart Aarhus**, are organized around the principles of citizen involvement and co-production, where cross-sector collaboration between public, private, and academic entities is the norm and an important part of Aarhus strategy to promote business and growth potentials. In short, anyone who is interested can join in the so-called four-strand helix of smart city innovation in Aarhus – public sector, industry, research and education, and civil society (8). Due to this, Aarhus University has been capable of establishing a viable smart city research centre, which is not only an influential local player, but also has clout on a national and international level. Smart Aarhus represents a new way of raising political awareness and organization with the aim of finding effective and sustainable solutions to the challenges faced by many cities today. An ongoing example is the Centre for Telemedicine in Aarhus that focuses on developing smart solutions for the health care sector. The Centre is driven by the Central Denmark Region, a key player in and co-founder of Smart Aarhus and since its inception in 2012, has connected the leading experts in the field of telemedicine from hospitals, municipalities, and private clinics. The goal is to further the use of telemedicine to the benefit of ordinary citizens.

Open Data Aarhus

In accordance with good smart city practice, the Municipality of Aarhus is also continuously sharing a wide variety of accessible and open data via its data portal, *www.odaa.dk**. Two examples of such published data are real-time traffic information, and a map of running routes. The BlipTrack sensors collecting real-time traffic data, for instance, are an open invitation for smart city innovation within traffic and mobility. Based on readily accessible and open garbage data, Aarhus itself has already made a visual map of the available space at its recycling stations, which can be accessed through the Internet (8).

Smart Resilient Cities initiatives in Vejle

The old city of Vejle is located inside a beautiful fjord in southern Jutland. Due to its dominance in the textile industry decades ago, Vejle was once nicknamed "the Manchester of Denmark", and to this day the city has retained its cultural and economic dominance in the region. That being said, Vejle is not a very large city in terms of population – just about 55.000 people inhabit its urban area. When it comes to digital innovation and smart city initiatives, then, Vejle is very much a first mover.

Resilient Vejle

Due to its geographical position, Vejle is particularly vulnerable to environmental hazards like climate change – slight rises in sea levels could cause half of the city to be flooded.

In 2013 the city became a member of the worldwide network "100 Resilient Cities" funded by the Rockefeller Foundation. The city is using the momentum from the membership of the network to become an innovation lab for resilience, building the robustness of Vejle to both sudden and long-term threats, and inspiring others as they go along. Vejle is one of the smallest cities in the partnership – far from the size of Rio de Janeiro or Los Angeles – but aspires to show that smaller provincial cities can be agile frontrunners of innovation and development. The City of Vejle works with resilience in four focus areas – climate & flooding, social resilience, resilient smart city and co-creation (8) (14).

Vejle seeks to turn its current challenges into opportunities. Vejle's ambition is to become an innovative lighthouse that demonstrates how small cities can solve big problems and show great responsibility. With Vejle's resilience strategy the municipality, invite all partners to take action and cooperate in the development of tomorrow's resilient Vejle - a cohesive, robust and sustainable city (14).

Figure 6

the Wave in Vejle, new apartments reflect the region's hilly landscape and seafaring heritage designed by Henning Larsen. ©Henning Larsen

Smart Citizens

To achieve the aim of becoming a Resilient Smart City, the City of Vejle is focusing on improving the digital literacy of all its citizens, and has launched a Digital Inclusion programme. Vejle aims to develop efforts beyond the usual groups of elderly, immigrants and socially excluded groups. For instance, young people may be digital natives, but some still have a hard time reporting their income on the taxing agency's online self-service platform. Likewise, businesses are expected to have high levels of digital competencies, but that is not necessarily the case for a farmer, a hairdresser, or a kebab shop owner. In all of those cases, Vejle engages in dialogue to develop better and more easily understood digital solutions, co-creating solutions with civil society on how to empower all societal groups in the digital society.

Pioneering City of Albertslund

The City of Albertslund is an ex-industrial suburb situated west of Copenhagen. The city has 28,000 inhabitants from 106 nationalities, an active local community, and a tradition for cross-cutting dialogue between authorities, citizens and businesses.

Innovative city renewal

Faced with a large renewal plan, including the renovation of 6,000 social housing units, renewal of technical facilities, including outdoor lighting, and the renovation of public buildings, the Albertslund Municipality established two new innovation committees in 2014. One committee is focused on "Urban Innovation" and the other on "Innovation & Welfare". Each include members from businesses, local organizations, and five elected council members. For both committees, smart cities are high on the agenda and is being approached from different angles.

The Urban Innovation Committee carries out activities to promote and identify opportunities for businesses and economic growth. This includes initiatives to help communities to modernize and adapt to the use of digital technology and green resources. During the first years, the work included the projects "indoor and outdoor lighting solutions", "Wi-Fi in the town centre" and "smart grid". As part of the move towards a smarter city, Albertslund is in the process of replacing its entire street light system, creating a digital infrastructure backbone with integrated fibre communication and sensor capabilities that will cover the entire city (8) (15).

The Innovation & Welfare Committee handles the identification and development of healthcare solutions. Here, as well, the aim is to focus on smart city solutions, for example health-promoting intelligent lighting for the elderly and smart solutions to support the municipality's new care and health centres. In 2016, a new health and rehabilitation centre in Albertslund opened as a living and learning lab for innovative healthcare solutions. The focus areas include remote health monitoring and simulation training envi-

ronments for healthcare workers and students.

DOLL – Danish Outdoor Lighting Lab

The Danish Outdoor Lighting Lab (DOLL) is a European platform for developing future LED-lighting solutions. DOLL is a consortium consisting of The Technical University of Denmark (DTU), the municipality of Albertslund and Gate 21. DOLL consists of three laboratories:

1) Quality Lab located at DTU's Photonics department in Roskilde, which offers manufacturers and buyers tests and documentation of all aspects of artificial lighting,
2) Virtual Lab located at DTU Photonics which can test, develop, and validate light solutions virtually generated in 3D, and
3) Living Lab located in Hersted Industrial Park, Albertslund that offers a 1:1 experience of the outdoor lighting. DOLL has created a large ecosystem of lighting and smart city vendors to pilot new solutions in the city.

This has made Albertslund the largest European showroom for the future of lighting technology, receiving regular international delegations who visit the city to experience the technology first hand. DOLL is expanding their platform to test, demonstrate and develop smart city solutions in Albertslund, through its Smart Urban Services project. Beyond the city, the partners behind DOLL are working to make Greater Copenhagen a 'Lighting Metropolis'. This is a new large-scale initiative that brings together the nine major municipalities in the region to develop smart lighting solutions with universities and companies. DOLL has allocated 54 million DKK of funding to the initiative and 20 pilot projects are planned so far (15).

Closing remarks

Denmark has decided to lead the transition to a green growth economy and become entirely independent of fossil fuels by 2050.

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Our cities are growing and so are the challenges to make them livable. Creating a livable city means taking a holistic approach through public-private partnerships and cross-sector collaboration, enabling smart, urban solutions that not only make cities prosperous, but also healthy, safe, and attractive places to live in. Danish cities hold a long tradition for implementing urban

Figure 7 & 8

statue in Orsted Parken and Relaxing moment behind Queens Margret II palace in Copenhagen. ©Changhee Choi

Figure 9 & 10

Royal Copenhagen main flagship store and Han Statue of the Little Seaman by Elmgreen and Dragset. ©Changhee Choi

Figure 11 & 12

Charlottenlund Palace, former royal summer residence in Charlottenlund, and bike cyclist on dedicated bike lanes in front of Danish Ministry of Foreign Affairs. ©Changhee Choi

development projects through holistic planning where the concern for the environment, people and businesses go hand in hand.

This paper highlights sustainable approaches by four different cities in Denmark across urban mobility, water, climate adaptation and intelligent energy, demonstrating how long-term planning across sectors are key elements in creating liveable cities built on holistic, sustainable solutions.

Smart city activities are taking place across Denmark in small, medium and large cities; from small towns like Vejle to mid-sized cities like Aarhus, larger cities like Copenhagen, and innovative new greenfield sites like Vinge (close to my hometown). Smart city include projects utilizing cutting-edge technology in Copenhagen and Aarhus, cities which enjoy a strong position in the global smart city community, to projects in the more rural areas of Denmark that use technology in innovative ways to improve public service delivery and business growth.

This activity is having an economic impact: it is estimated that employment in smart city companies in Denmark has risen by 60% from 2003 to 2013. In the capital region of Denmark this amounts to 19,500 jobs.

Yet, Denmark could realize greater benefits if projects are scaled beyond pilots and across city departments and regions. There is still progress to be made in meeting the requirements for smart city growth. We do this by create international partnerships! I hope this contribution will inspire and lead to international collaboration on how we jointly reinventing our cities and aim for an urban transformation toward carbon neutrality.

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Smart City Diplomacy:

Fostering the Digital Transition through International Cooperation

스마트시티 외교: 국제 협력을 통한 디지털 전환 촉진

Marta Galceran

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ABSTRACT

Digital technologies present an opportunity to change traditional paradigms of urban governance. This has led to more and more cities boosting the knowledge economy and running smart city programmes. However, no city can fully implement the digital transition alone, and therefore new partnerships and collaboration schemes are required as a critical tool supporting such processes. In the last decade, the number of smart city international cooperation initiatives has grown significantly.

Several reasons make cooperation in this field particularly appealing. First, the attractiveness of the smart city concept. Second, navigating the digital transition could prove challenging for many local governments who do not always have the desired technology or technical capabilities to embark on the smart city journey. This situation leads to some degree of dependency between one city to another in exchange for knowledge, making international municipal cooperation all the more necessary. Third, the interest in fostering smart cities networking and international cooperation goes far beyond local governments and includes global and regional intergovernmental organizations. Finally, the private sector has also been actively promoting the adoption of smart technologies.

In fact, the emergence of most international collaborative networks in the smart cities field has involved extensive engagement with the private sector, who in many cases has even played the role of initiator or facilitator of such city networking efforts. Today, international cooperation in the smart cities field is mainly articulated through international conferences, smart city committees or commissions within traditional city networks, ad-hoc networks and partnerships, smart city alliances promoted by development agencies and philanthropic foundations, and programmes developed by global and regional intergovernmental organizations.

KEYWORDS

Smart city diplomacy, City-to-city cooperation, City networks, Public-private partnerships, Alliances

초록

디지털 기술은 도시 거버넌스의 전통적 패러다임을 변화시킬 기회를 제공한다. 디지털 기술 덕분에 점차 더 많은 도시가 지식 경제*knowledge economy*를 활성화하게 되었고, 스마트시티 프로그램을 운영할 수 있게 되었다. 하지만 그 어떤 도시도 혼자서는 온전한 디지털 변혁을 이룰 수 없기에 이를 지원하는 파트너십과 협력 계획이 필요하다. 지난 10년 동안 스마트시티 국제협력 이니셔티브는 크게 증가했는데, 이 협력 이니셔티브가 매력적으로 다가오는 이유가 몇 가지 있다.

첫째, 스마트시티라는 개념 자체가 매력적이다. 둘째, 지방정부가 스마트시티를 구축하는 데 필요한 기술을 보유하지 않았거나 관련 기술을 사용할 수 없는 경우, 혼자서는 스마트시티를 구성하는 디지털 전환을 이루기 어려울 수 있다. 상황이 이렇다 보니 도시들이 지식을 공유하면서 서로 의지하게 되고, 지방자치단체 간의 협력이 더 중요해진다. 셋째, 스마트시티 네트워킹과 국제협력에 대한 관심은 지방정부를 넘어 국제적, 지역적 정부 간 조직까지도 포함한다. 마지막으로, 민간 부문 역시 스마트 기술의 도입을 적극적으로 추진하고 있다. 사실, 스마트시티 분야의 국제 협력 네트워크 대부분은 민간 부문의 폭넓은 참여 덕분에 탄생했다. 민간 부문은 소극적인 참여에 그치지 않고 이러한 도시 네트워킹을 위한 노력을 시작하거나 촉진하는 역할도 해냈다. 오늘날 스마트시티 분야의 국제 협력은 주로 국제회의, 전통적 도시 네트워크 내의 스마트시티 위원회나 위원단, 특별 네트워크와 파트너십, 개발 기관과 자선단체에 의해 추진되는 스마트시티 연합, 국제적 · 지역적 정부 간 조직이 개발한 프로그램에 의해 이루어진다.

키워드

스마트시티 외교, 도시 간 협력, 도시 네트워크, 민관 파트너십, 연합

Introduction

Digital technologies present an opportunity to change traditional paradigms of urban governance. If correctly managed, the digital transition can enable vibrant and sustainable urban economies, help fight climate change, enhance public services delivery in many sectors (i.e., public transportation, energy, health, education, waste management, etc.) and improve people's quality of life. In this sense, a discourse representing the contemporary city has long been consolidated, where information and communication technologies (ICT) are part of the city's daily life experience and help solve local challenges. This has led to more and more cities boosting the knowledge economy and running smart city programmes. However, no city can fully implement the digital transition alone, and therefore new partnerships and collaboration schemes are required as a critical tool supporting such processes.

The adoption of ICT to manage urban issues is now a pervasive global trend, for the wide use of technologies such as the internet, mobile phones, ground sensors, and satellites is no longer limited to the global north. Indeed, many cities in low-and-middle-income countries are engaged in path-breaking programs of digital innovation. As Kihlgren Grandi notes (2020, p. 103), the intent of cities "to use innovation to enhance their international competitiveness has not prevented them from engaging in cooperative efforts with their peers, mainly for knowledge transfer and co-creation of pilot projects". In this sense, collaboration in the smart cities field is now a well-established global dynamic, with new initiatives constantly burgeoning.

This essay aims to explain international cooperation in the smart cities field and outline some of the most relevant organizations that are articulating such collaborative dynamics. It is structured in three parts. The first section discusses the emergence of city diplomacy as a global dynamic that facilitates collaboration on urban issues. The second explores some of the

reasons that may explain the steady rise of smart city cooperation initiatives. The third section outlines the most common forms of international cooperation and networks, while providing examples of specific initiatives. The essay concludes with some reflections as to future trends in the smart city international cooperation field.

City Diplomacy: a Global Practice on the Rise

The involvement of cities in international relations is not a new phenomenon, nor one that has escaped the attention of scholars and practitioners alike. Today there is a well-established body of literature on paradiplomacy* and city diplomacy (see, among others, Aldecoa and Keating, 1999; Acuto and Curtis, 2019), which has grown in parallel to the increasing recognition of cities as a key international actor (Curtis, 2014). Over the last decades, cities have perfectioned the practice of addressing transnational issues that are perceived as relevant to their local context: from climate change to financial and environmental regulations, migration, urban security, income distribution, gender equality, or the digital transition. They have done so through an extensive and varied set of diplomacy tools.

Broadly speaking, city diplomacy involves interactions with a wide variety of actors: mainly other local governments, but also city networks, international organizations, research institutions, or the private sector. This cooperation can take the form of bilateral agreements, such as the establishment of twinning partnerships (probably the most ancient diplomatic practice), the signature of Memorandum of Understanding (MoU) in a particular field, or the development of technical assistance programmes. These practices

* As for paradiplomacy, it is a concept that refers to international relations conducted by subnational or regional governments on their own, such as cities. The origin of the "paradiplomacy" concept comes from merging the term "parallel" and "diplomacy", because it refers to all those international relations activities by subnational governments that could be parallel, coordinated, or complementary to the central government's (sometimes they can even conflict with the country's international policies and politics).

usually involve reciprocal institutional and training visits, provision of technical assistance, and cultural exchanges. Another relevant tool is the establishment of transnational municipal networks, which represent today the most visible expression of city diplomacy. They can be defined as formalized multilateral spaces of cooperation between three or more cities coming together to cooperate on one specific sector (e.g., thematic networks like C40 or ICLEI for climate change) or on all of them (e.g., multi-purpose networks like UCLG or Eurocities) (Kihlgren Grandi, 2020).

The relevance of city networks stems from the functions they perform and the services they offer to their members. Although their goals and governance arrangements may vary ostensibly from one network to another, in general terms they all perform three main types of functions: advocacy (i.e., they represent the collective interest of their members and lobby on their behalf); knowledge dissemination (i.e., they facilitate cooperation and knowledge exchange between members); and policy implementation (i.e., they assist in building the capacity of their members to respond to a variety of urban challenges or to implement particular policies) (Galceran-Vercher et al., 2021). As can be expected, learning and exchange of experiences can reduce the gaps in the level of development of the cities that make up these networked coalitions. City diplomacy should therefore be seen as a political force that these city networks project outward and inwards. This is particularly relevant for advancing cooperation in the smart cities field, as will be discussed in the next section.

International Cooperation in the Smart Cities Field

In the last decade, the number of smart city international cooperation initiatives has grown significantly. Several reasons make cooperation in this field particularly appealing.

First, the attractiveness of the smart city concept. This is linked to an alluring normative vision of the future where digital technologies promise to solve some of the most pressing urban challenges of the century. As March and Ribear-Rumaz (2016, p. 816) put it: "nowadays every city wants to be a smart city". At the same time, the high degree of ambiguity and versatility of the concept makes it particularly suitable for each city to try to put forth its own smart city model. Hence, in the same way that some decades ago local governments were creating spaces for collaboration around environmental sustainability policies, today part of this attention has shifted to digital transformation policies. At the end of the day, embracing an ICT-driven approach to urban management is seen as a necessary condition for producing efficient, liveable and sustainable societies.

Second, navigating the digital transition could prove challenging for many local governments who do not always have the desired technology or technical capabilities to embark on the smart city journey. This situation leads to some degree of dependency between one city to another in exchange for knowledge, making international municipal cooperation all the more necessary (Mursitama, 2018). Indeed, city networks and alliances become strategic places that facilitate the transfer of knowledge and technology between cities with the private sector, as well as the creation of pilot projects.

Third, the interest in fostering smart cities networking and international cooperation goes far beyond local governments. Indeed, many global and regional intergovernmental organizations are developing specific smart city programmes devoted to providing strategic and technical support on digital transformation to local governments. Are examples thereof UN-Habitat's flagship programme "People-Centered Smart Cities" (launched in 2020), OECD's Programme on Smart Cities and Inclusive Growth, or the Global Smart City Partnership Program (GSCP), launched in 2018 through an alliance between the Korea Ministry of Land, Infrastructure and Transport (MOLIT) and the Global Practice for Urban, Disaster Risk Management, Resilience and Land of the World Bank.

And last but not least, the private sector has also been actively promoting the adoption of digital technologies and the smart city vision. One should consider that at its inception, the concept of smart cities was often criticized for being overly supply-driven, with the private sector playing a significant role in defining both the problems to address and the solutions (Voorwinden, 2021). While this tendency has been softened with the public administration now playing a more active role, one cannot deny that local governments cannot build smart cities alone, hence the need to partner with the private sector to access smart solutions technologies or funding.

In fact, the emergence of most international collaborative networks in the smart cities field has involved extensive engagement with the private sector, who in many cases has even played the role of initiator or facilitator of such city networking efforts. Some authors point to a growing trend in which transnational forms of networked urban governance are increasingly reflecting the blending of public and private (Davidson et al., 2019). Or in other words, the rise in prominence of the smart city agenda may be leading to some degree of privatization of city diplomatic activities, which seem to be taking on an entrepreneurial character and accelerating the institutionalization of public/private relations. Some examples of this tendency are the G20 Global Smart Cities Alliance on Technology Governance, built upon the principles of public-private partnerships, or the City Possible initiative by Mastercard, announced as a "new model for urban innovation in which a global network of cities, business, academics and communities work together to make the world's cities more inclusive and sustainable" (City Possible, 2021).

Where is Smart City International Cooperation Taking Place?

Smart city diplomacy at the local level is conducted through many formats and organizational arrangements, ranging from city-to-city bilat-

Table 1

Overview of smart city international cooperation initiatives

Type	Examples
International conferences	Smart City Expo World Congress (Barcelona); Smart City Event (Amsterdam); World Smart City Expo (Korea); African Smart Cities Summit
Smart city committees/commissions within traditional city networks	UCLG's committee of digital and knowledge-based cities; Eurocities'focus area on smart cities and digital transformation
Ad-hoc networks and partnerships	World Smart Sustainable Cities Organization (WeGO); G20 Global Smart Cities Alliance on Technology Governance, Cities Coalition for Digital Rights
Smart city development projects	ASToN (African Smart Towns Network) project; International Smart Cities Network (ISCN)
Smart city programmes by intergovernmental organizations	Smart Africa Alliance; European Innovation Partnerships on Smart Cities and Communities; URBACT Programmes; ASEAN Smart Cities Network

Source: : Author's own elaboration

eral initiatives to the establishment of multilateral networking spaces (either within existing city networks or by creating new ad-hoc spaces). The following table provides an overview of the most common multilateral initiatives through which smart city international cooperation is articulated today, explored in greater depth throughout the following pages.

International Conferences

Hosting international events is one of the most widely-used diplomacy tools to raise the international profile of a city while boosting the local economy. In this sense, the smart city landscape has advanced in parallel to the proliferation of a full slate of conferences and trade shows where the latest technological innovations applied to urban development are showcased and discussed. Some well-established events in this field include *CES* (Las Vegas), *Meeting of the Minds Annual Summit* (Phoenix), the *Smart City Event* (Amsterdam), the *World Smart City Expo* (Korea), the *African Smart Cities Summit* (South Africa), the *Connected Cities & Towns Summit* (Dublin) or the *Smart City Expo World Congress* (Barcelona). Traditionally, international conferences are valuable meeting points connecting solution-

seekers and solution-providers, where companies do business and the most relevant stakeholders in a sector pool their knowledge. But they are also strategic places connecting people working in and with cities worldwide who are tackling similar challenges; hence exceptional platforms to share best practices and forge strategic partnerships.

The *Smart City Expo World Congress* (SCEWC) is a case in point, celebrated annually in mid-November since 2011. Organized by Fira Barcelona and hosted by the City of Barcelona, this event is considered the world's leading annual gathering of public and private sector industry. In its 2019 edition (the last one before the pandemic), the event brought together nearly 25.000 visitors, representatives from more than 700 cities and 146 countries, 1,010 exhibitors, 400 speakers and 90 side events (SCEWC, 2019). The conference is structured around eight focus areas, namely: enabling technologies, energy and environment, governance, economy, mobility, living & inclusion, infrastructures & buildings, safety & security. As previously argued, the SCEWC is not only a place to present and discuss the state-of-the-art in the smart cities field, but also a unique networking space that year after year nurtures a global community concerned by urban innovation. The growing number of side events organized in parallel to the main programme is a testimonial to this function. For instance, an annual meeting of Chief Information Officers and City Managers is celebrated annually under the auspices of the SCEWC. Similarly, the event is seen as an exceptional platform to announce or consolidate partnerships and catalyse international collaboration. In this regard, well-established initiatives such as the G20 Global Smart Cities Alliance, the Cities Coalition for Digital Rights, or the Sharing Cities Alliance see the SCEWC as a strategic site to organize their annual meetings.

Beyond being a strategic place boosting global smart city cooperation, events such as the SCEWC have also played a pivotal role in positioning Barcelona as a global hub for urban innovation (Cerqueira et al., 2019). It should be noted that the origins of Barcelona's smart city strategy are to be found in 2010, when the city council decided to reinvent itself and embark

on a modernization process by promoting a new economy based on knowledge industries, quality infrastructures and the adoption of technologies to improve the quality of life for its residents. As Mila Gascó-Hernandez (2018) recalls, the Smart City Expo World Congress (established precisely in 2011) was instrumental in launching this policy and promoting Barcelona's smart city brand linked to the new economy of urban services. The success of Barcelona (today recognized as a global smart city) inspired other cities to follow the same steps. This explains the growing interest in organizing SCEWC offshoots in other cities, such as Smart City Expo Latam Congress 2021 or the Smart City Expo Curitiba 2022.

Traditional City Networks Embrace the Smart City Agenda

Transnational Municipal Networks (also referred to as city networks or local governments organizations) are institutionalized structures facilitating city-to-city and city-to-city-to-another actors' cooperation. They are not a new phenomenon: the first city network (i.e., the International Union of Local Authorities) dates as far back as 1913. However, in recent years these organizations have proliferated to an extend hardly imagined some decades ago. Recent studies establish the total number of city networks in more than 200 entities and counting (Acuto & Leffel, 2021). Undoubtedly, they have become a permanent fixture of the landscape of global urban governance and one of the main channels through which urban cooperation takes place. As previously discussed, city networks perform a wide range of functions that range from training programmes, to facilitating technology transfers and investments and triggering policy exchange. They also play an instrumental role in the horizontal replication of smart cities initiatives.

While the environmental agenda and the green transition has traditionally figured high in most of these networking spaces, in recent years most of them have developed initiatives aimed at fostering cooperation surrounding digitalization processes, digital rights and other smart-city related topics. For instance, Mercociudades (Latin America) partnered up with the Interamerican Development Bank to conduct a survey on the degree of development of digital government in some of their member cities. The results

of the project served to identify best practices, which were disseminated through their website. The smart city agenda in Mercociudades is advanced through their thematic unit on Science, Technology and Capacity Building, which oversees initiatives such as the organization of their Annual Meeting of Smart Cities (now in its sixth edition). This event aims at debating common challenges such as how to use ICT to manage the Covid-19 pandemic, the implications of teleworking, how to manage the relation between private data and the public interest, or how to bridge the digital divide. In the Asia-Pacific region, CityNet has also been running specific programmes devoted to assisting its members in navigating the smart city opportunity and tapping into the potential that digital technologies offer.

The European context is particularly interesting in this regard, and the European Union has provided much support to city networks working to advance the digital transition in urban areas. A case in point is Eurocities. Founded in 1986, this multi-purpose network gathers more than 200 of the larger European cities from 38 countries, representing 130 million people. For over a decade, many European cities have played a very active role in testing and implementing innovative technological solutions to become greener, more sustainable and efficient, and better places to live in. However, the application of digital technologies has also posed several important challenges, hence the need to develop a *Smart cities & digital transformation* agenda within the organization. Under this thematic area, Eurocities is playing an instrumental role in influencing the European Union legislation concerning digital transformation policies that may impact urban areas. Are examples thereof the policy papers that this network has recently published on the Digital Services Act, or the statements it has issued concerning the deployment of fifth-generation telecommunications systems (5G) or Artificial Intelligence applications in cities (Eurocities, 2021).

At the global level, the case of *UCLG's Committee of Digital and Knowledge-based Cities* is worth mentioning. United Cities and Local Governments (UCLG) is the largest global network of cities and local, regional, and metropolitan governments and their associations. It was created in

2004 to unite the voices of local and regional authorities before the international community. Today, it includes more than 240.000 towns, cities, regions and metropolises worldwide and more than 175 local and regional government associations (including the Governors Association of Korea). In 2005, UCLG created the Committee of Digital and Knowledge-based Cities, with the "aim of reducing the digital divide and boost the implementation of local digital agendas", as well as to promote the "development of a common vision and dynamics among local governments in favour of an inclusive Information Society" (UCLG, 2021). In 2016 this committee was reformulated into the Community of Practice Digital Cities, and it is currently chaired by the City of Bilbao (Spain). Some of the outcomes of this networking space are the organization of learning meetings and the publication of a smart cities' studio every two years. Another successful example is the Uraía Platform project, which was created as a space for exchange between local governments and their partners about the possibilities offered by the introduction of smart technologies to local public management, particularly in three fields: municipal finances, management of public services and infrastructure, transparency and accountability. Uraía facilitates peer-to-peer learning, foster the transfer and adaption of smart solutions and encourages experimentation (Uraía, 2021). This platform has been established in collaboration with the Local government and decentralization Unit of UN-Habitat and FMDV.

Ad-hoc Networks and Partnerships

Beyond the more formalized local and regional governments organisations, cities have also established meaningful cooperation initiatives through global partnerships or alliances explicitly created to tackle the challenges associated with the digital transition. One of the first initiatives in this regard was the *World Smart Sustainable Cities Organization* (WeGO), created in 2010 as an alliance of local governments, smart tech solution providers, and national and regional institutions committed to the transformation of cities into smart sustainable cities. Today this partnership has more than 200 members worldwide, and is managed by a secretariat based in Seoul and four regional offices located in Chengdu (China), Ulyanovsk (Russia),

Beyoğlu (Turkey) and Mexico City (WeGov, 2021).

Methodologically, WeGo facilitates cooperation among its members by organising capacity-building programmes that aim to advance the digital capacity of their member cities, promoting the use of ICT in public administration and bridging the digital divide. These learning programmes are composed of lectures, interactive sessions and site visits. Further, the organization promotes matchmaking activities where WeGo connects smart city project partners with solution providers. It also recognizes governments in the fields of open cities, e-government services, digital inclusion, innovative smart cities, smart cities and partner cities through the WeGO awards. Another key initiative is the *G20 Smart Cities Alliance on Technology Governance,* which is considered the most extensive global partnership in the field, gathering more than 200,000 municipal, regional and national governments, companies, start-ups, research institutions, and non-profit organizations. It was officially launched in October 2019, following the initiative of Japan's presidency of the G20 and in collaboration with the World Economic Forum, which currently acts as the alliance's secretariat. Moreover, since the outset, it counted with the support of the G20 Trade and Digital Economic Ministers and two core G20-related groups: Business 20 (B20) and Urban 20 (U20).

The G20 Smart Cities Alliance is seen as a remarkable effort of global cooperation, as for the first time the smart cities and global technology governance themes entered the agenda of the G20. Specifically, the alliance aims to fill a global void, as there is no internationally-agreed framework or set of rules for how some smart city technologies are deployed (i.e., how sensor data collected in public space is used). In this sense, its primary mission is to establish a set of shared principles and global policy norms for the responsible and ethical use of smart city technologies. Some of these core principles promoted are transparency, privacy and security. To do so, the *G20 Smart Cities Alliance* has selected a cohort of 36 cities that have committed to adopting policies for privacy protection accountability for cybersecurity, improved broadband coverage, increased openness of city data, and

improved accessibility for elderly/disabled people to digital city services. These 36 cities include Belfast, Leeds and London in the UK; Barcelona and Bilbao in Spain; Toronto in Canada; Moscow, Russia; Melbourne and Newcastle in Australia; Milan, Italy; Apeldoorn in the Netherlands; and Bengaluru, Faridabad and Hyderabad in India (G20 Global Smart Cities Alliance, 2021).

Smart City Alliances Promoted by Development Agencies

National development agencies and organizations supported by philanthropic foundations have long established themselves as key actors in the global urban ecosystem. They have a long record of supporting programs aimed at advancing the social and economic development of urban areas in low-and-middle-income countries, and many of them are essential donors of the leading global city networks. Acknowledging the transformative potential of digital technologies to advance development policies, these agencies have also entered the business of supporting projects to ensure that the digital transition in cities is conducted in a socially, economically, ecologically sustainable and responsible manner. Among these projects, two initiatives stand out, supported respectively by the French Development Agency (AFD) and the German Development Agency (GIZ).

In the African context, one of the most successful and recently established initiatives is the ASToN (African Smart Towns Network) project, launched in 2019. This initiative is supported by the French Development Agency (AFD), managed by the French National Urban Renovation Agency (ANRU) and inspired by the URBACT methodology. ASToN network brings together 11 African Cities (Matola, Kigali, Kampala, Lagos, Sèmè Podji, Niamey, Kumasi, Bamako, Nouakchott, Benguerir and Bizerte) to develop digital practices and enhance the use of digital technologies. The aim of ASToN network is to "support the member cities in their digital transformation and improve their abilities to become digital players in the ecosystem" (ASTON project, 2021). To do so, each of the 11 cities focuses on a different thematic area relevant to their particular context, and works on the fields of regulations, strategies, plans and services related to each of these themes, such

as citizen participation, digital divide, city cleanliness, waste management, mobility, transportation and road safety, online taxes (e-tax), ownership & land registration or geolocation (city addressing).

As for the GIZ, it is worth mentioning the International Smart Cities Network (ISCN), commissioned by the Division Smart Cities of the Federal Ministry of the Interior, Building and Community and implemented by GIZ. The ISCN aims to promote the exchange of best practices and lessons learned between cities, ministries of urban development, and the scientific community to enable a common understanding of how the integration of digital solutions can improve citizen-centred development processes. This is pursued through several exchange formats that include an online forum (which collects the members' existing knowledge); peer-to-peer consultation among partners aimed at supporting their strategic planning processes; and regular network meetings to promote bilateral and multilateral knowledge transfer. As happens with many other networks, the covid-19 global situation has also affected the agenda of these spaces for networking and bilateral exchange. Hence, some of the topics that currently figure high in the schedule of these meetings is the digital participation for resilient cities, how can digitalization support local economic recovery, or the smart public transport in the (Post-)Pandemic City. This initiative mainly directed to the Latin American context although India is also included, being the current members of this network Brazil (Campina Grande, Fortaleza, Hortolândia), Germany, India (Bhubaneswar, Coimbatore, Kochi), Mexico (Guadalajara, Zapopan), Peru (Chiclayo, Miraflores, Trujillo) and Chile (Providencia) (GIZ, 2021).

The Smart City Diplomacy of Intergovernmental Organizations

Today, most global and regional intergovernmental organizations promote specific smart city programmes to accelerate sustainable socio-economic urban development through ICT's in their regions. This entails supporting cooperation between member states and their cities to improve access to ICT and encourage public-private partnerships. The African Union-endorsed Smart Africa Alliance is a case in point, established in 2014 to develop a single digital market on the African continent by 2030. This

initiative encourages collaboration with the private sector, such as the agreement between Smart Africa and Afriwave Telecom to advance connectivity and data capacity in the continent (Smart Africa Alliance, 2021). The European Union has also developed a good number of programmes to foster cooperation among cities and other key actors of the smart cities ecosystem. Some noteworthy examples are the European Innovation Partnerships on Smart Cities and Communities, which bring together cities, industry, SMEs, banks, research and other smart city actors; or the URBACT Programmes, aimed at fostering sharing of knowledge and good practices between European cities and other actors (Urbact, 2021).

The ongoing projects in the Southeast Asia region also offer relevant elements of analysis and reflection. Two megatrends will determine the regions' future: the rapid path of urbanisation and the deep penetration of digital technologies within society. To exemplify the scale of digital disruption, it is worth noting that the level of mobile connectivity in Southeast Asia (141%) is the highest in the world, outstripping that of Western Europe (119%), North America and East Asia (both 130%) (Centre for Livable Cities, 2018). These trends undoubtedly make the region a fertile ground for foreign direct investment in the digital economy. In this context, in 2018 an ASEAN Smart Cities Network (ASCN) was established during Singapore's ASEAN chairmanship. It was devised as a collaborative platform for the ASEAN Member States and their local governments to develop and implement "smart solutions" around six main focus areas aligned with the Master Plan on ASEAN Connectivity 2025, namely: civic and social, health and well-being, safety and security, quality environment, infrastructures, industry and innovation (Bimo Utomo, 2019).

Today ASCN encompasses 26 pilot cities across the ten ASEAN member states, ranging from provincial cities (e.g., Makassar in Indonesia and Chonburi in Thailand) to global and regional hubs (e.g., Singapore, Bangkok and Kuala Lumpur). Each city is represented by a Chief Smart City Officer (CSCO) appointed by their respective national governments. Beyond facilitating collaboration between ASEAN cities, ASCN catalyses bankable projects with

the private sector and channels funding support from ASEAN's dialogue partners (ASEAN, 2020). This ability to bring both private and public-sector investment in the region is what makes ASCN particularly meaningful. From one side, ASCN has proved to be an attractive network for external ASEAN partners such as the US, Japan, Australia and China, as well as for other multilateral lenders that have already put significant funding behind the initiative. To name but one example, the US is supporting ASCN through the US-ASEAN Smart Cities Partnership, which seeks to improve American investment in the region's digital infrastructure and digital economy (Martinus, 2020, p. 2). From the other side, ASCN is also creating inter-collaboration between regional solution partners and pilot cities. An example thereof is the ongoing collaboration between the International Enterprise Singapore (IE) and the City Government of Makassar to build Makassar's digital platform. This partnership facilitates Singapore companies' involvement in the provision of technology solutions for enhancing urban development in the city of Makassar (IE Singapore Media Release, 2016). Some have depicted ASCN as a "first-of-its-kind political strategy to promote a technocratic form of regional integration and consolidation" (Kong and Woods, 2021, p. 1).

Conclusions

As shown in this article, the initiatives aimed at fostering international cooperation in the smart cities field have proliferated in all the regions worldwide over the last decade. They have emerged in different forms and formats: from fostering international events as platforms for networking to establishing formalized alliances. Interestingly, most of these smart city networks and projects go far beyond what is often referred to as "ceremonial paradiplomacy". That is, a diplomatic activity that goes no deeper than trivial programs without real benefits and impact.

Undoubtedly, the increasingly networked and interlinked nature of urban

development is favouring cooperation among urban stakeholders. It should be recalled, that cities are not isolated islands that exist in a vacuum. Quite the opposite, cities have co-existed, collaborated, competed, and evolved together with other cities for centuries. At no other time has this been truer than when cities have perceived the existence of shared challenges. Making the most of the opportunities that the digital transition brings to urban areas is one of these moments, and we should expect more of these initiatives to flourish and consolidate in the years to come. As the old African proverb goes: "if you want to go fast, go alone. If you want to go far, go together".

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Sustainable Digital Transformation of Urban Ecosystems

도시 생태계의 지속가능한 디지털 전환

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ABSTRACT

Cities worldwide are facing an in-depth transformation, partially enabled by technology, in response to the forthcoming needs and challenges highlighted in well-known predictions. This chapter provides an overview of the different aspects which will have to be dealt with when implementing this technological transformation. Technology's role is not as an aim in itself, but as a means to improve citizens' quality of life. The relevance of introducing new services from early stages is discussed and exemplified with two applications in which citizens play different roles. Co-creation is introduced as an approach for increasing citizen participation whilst fostering innovation in urban ecosystems. Indeed, data spaces have been shown to be one of the key assets in such an innovation process, which also fosters the solidification of sustainability models and the conception of new business ones.

KEYWORDS

Co-creation, data marketplace, data spaces, Internet of Things, services, urban ecosystem

초록

전 세계 도시들은 이미 잘 알려진 예측들이 강조하는 도전과 새로운 요구에 대응하기 위해 기술을 통해 부분적으로 이루어지는 심층적 변화에 직면해 있다. 이 글은 이와 관련하여, 기술적 전환*technological transformation*을 할 때 반드시 다루어야 할 다양한 관점들에 대해 논의하고 있다. 기술은 그 자체가 목적이 되어서는 안 되며, 시민의 삶의 질을 개선하는 수단이 되어야 한다. 따라서 새로운 기술을 도입하는 단계에서는 시민의 두 가지 역할이 중요하게 논의되어야 한다. 우선, 공동 창조*Co-creation*는 시민 참여를 높이고, 도시 생태계의 혁신을 이끌어내는 중요한 접근방법이다. 또한, 데이터 공간*data spaces*은 지속가능성과 새로운 비즈니스 모델을 공고히 할 수 있는 필수 요소라는 점을 인식해야 한다.

키워드

공동 창조(co-creation), 데이터 시장(data marketplace), 데이터 공간, 사물인터넷, 서비스, 도시 생태계

Introduction

Current predictions establish that by 2050 around 70% of the world's population will dwell in a city or in a densely populated area [1]. Considerations such as this oblige us to plan and conceive solutions satisfying the necessities deriving from the elevated concentration of people in relatively small geographical nuclei. The aim should be to guarantee efficient management of the different resources while at the same time ensuring high standards of quality of life for citizens. However, in order to plan properly, it is necessary to know qualitative and quantitative attributes that directly or indirectly influence the processes under analysis, as well as the surrounding conditions. For the former, the technical staff of city councils and service providers and the citizens themselves are sources of very valuable knowledge; for the latter, it is necessary to have available capacity for monitoring the parameters that best characterise the provision of services in question. Until quite recently this knowledge was accrued by the operators on the streets who along with those responsible for services were able to predict specific anomalies that had a high probability of occurrence for meteorological, seasonal or any other type of reason. Thanks to the miniaturization and reduction in consumption of measurement devices, as well as the easy integration of diverse communication interfaces, it has become possible to monitor and collect information ubiquitously in time and space in a totally automated way. In fact, it is in the context of cities where the hype Internet of Things (IoT) became most relevant due to the plethora of applications and services that from the beginning was most evident there. However, what is more impressive is that within a decade we have seen a dizzying evolution in which the components for monitoring and instructing have become pillars for the formation of a new socio-economic paradigm [2].

In this context, this contribution describes the different waves that in one way or another make up the digital transformation of cities into efficient

and sustainable metropolises in which the different stakeholders take on an extremely proactive role. To do so, and after this introduction, the presentation has been structured based on five sections considering deployment of IoT devices, conception of new services, co-creation, data spaces and new business models. Finally, some conclusions and possible future actions are proposed.

THE FIRST WAVE: IoT DEPLOYMENT

As happens with any system that has to be optimized, it is necessary to observe its behaviour through measurement of a set of parameters that characterise the performance based on specific metrics, as well as considering a set of Key Performance Indicators (KPIs). Without doubt, the city, understood to be a system composed of numerous subsystems interacting among themselves more or less intensely, illustrates like few others this necessity to measure in a distributed way the different processes executed within it. The traffic of vehicles through the distinct streets and avenues should be characterized in the different time slots of each day of the week to provide drivers with the best routes to get to their destinations, while also minimising the environmental impact in gas emissions and noise that in the medium and long terms have important effects on health. Like-

Figure 1
Temporal and spatial noise monitoring

wise, it is necessary to measure COx or noise levels in a ubiquitous way on the different arteries and not only based on environmental stations habitually emplaced in areas remote from the zones of interest, which therefore do not provide data that are significant in suitable decision making.

In this context it is interesting to note that vehicles are one of the most relevant sources in terms of previous emissions. Hence, any action helping to reduce the density of vehicles may have a relevant impact. The deployment of wireless parking sensors for providing information about outdoor parking place availability in downtown areas is one interesting solution which helps by reducing the time taken to find available places. Indeed, this is the core of a collaborative project between the Korean Agency for Infrastructure Technology Advancement (KAIA) and the University of Cantabria (Spain) in the framework of the 2021 K-City Network Overseas smart solution demonstration action financed by the Ministry of Land, Infrastructure and Transport (MOLIT). In particular, the use of Long Range Wide Area Network (LoRaWAN) based solutions will be tested, analysed and characterized, aiming at facilitating future massive deployment in cities worldwide.

Another very illustrative example, tightly correlated with the one above, is found in the urban refuse collection service. The fullness levels of the non-organic refuse containers are strongly influenced by the season of the year, meteorological conditions, organization of specific events and by many other factors. It therefore seems logical that instead of a previously programmed collection based on specific static routes, the content levels and the corresponding previsions are made available through simple machine-learning algorithms, with the aim of adapting the routes to the real needs. It should be highlighted that it will be of great value that the traffic management and urban refuse collection services share information, in order to constantly inform each other about where the refuse trucks are and so avoid, or at least alleviate, congestion produced by the partial blocking of the streets due to the refuse collection process.

Complementarily to this, the street and beach cleaning service not only provides knowledge at all times about where each vehicle in the fleet is located, but also measures specific parameters such as the level of content of the waste containers in order to verify that the service quality indicators established in the tender are being fulfilled. In this sense, it should be noted that this capacity endowed by the deployment of IoT devices enables very dynamic management of the agreements that the city has established with the utilities, which can be penalised if the performance of the service is not as is established by the quality parameters.

And what should we say about services related to parks and gardens. As water is a tremendously scarce resource, it would seem that the most suitable way of managing its use in this setting is to measure the humidity conditions of the land before watering. An actuation of this type enables unnecessary wastage to be avoided such as is produced when just after rain we see active irrigation systems because they were programmed to do so at a particular time. Once again, in situ measurement of humidity along with the aggregation of other resources, such as meteorological prediction, facilitate sustainable and responsible decision making.

In the same way as happens with water, the reduction in consumption of electrical energy, for example, related to street lighting or even in public buildings is of great importance. Of course, the advent of Light-Emitting Diode (LED) technologies has partially palliated the problem. However, there is still room for improvement, such as when maintaining the public street lighting voltage at the maximum nominal level on an extremely rainy night with no pedestrians present. It would seem reasonable to locate presence detectors and use simple correlation algorithms to increase the nominal voltage when the presence of a pedestrian is detected and reduce it when nobody is present, for example, by 20% and 30%.

It can be observed that up to now most of the IoT devices for monitoring have been deployed at specific points in a static way. Nevertheless, a very

interesting option is to locate these on vehicles, for instance, belonging to the fleets of the utilities which provide the city with services. This approach enables extra benefit to be derived from the cost while facilitating more ubiquitous measurement throughout the city. A practical application case is related to the characterization of the heat-island effect for which temperature measurements were obtained from both static sensors deployed in the central zones as well as those coming from devices located on the fleet of buses of the public transport service. The differences between the predictions of the traditional theoretical models and those provided by the measurements in the field are shown in [3].

These are some of the examples that demonstrate the relevance of ubiquitously measuring in time and space firstly for characterizing the different processes carried out in the city and secondly for then optimizing their operating point. While the comments herein do not make it obligatory in any case to carry them out in all cities that wish to be efficient and sustainable, they do constitute an example of the possibilities that miniaturization of the electronics and reduction in consumption and cost can provide for the different aspects that the digital transformation of the urban ecosystems entails.

THE SECOND WAVE: CONCEIVING AND DEPLOYING NEW URBAN SERVICES

In the previous section, we have shown how technology, and specifically the presence of devices capable of monitoring and/or commanding, enables the improvement of the performance of urban services. Obviously, although it has a direct impact on the citizens themselves, it would clearly be insufficient to justify certain investments if they do not have a more relevant role in the digital transformation of the urban ecosystem. When we

refer to a more relevant role, we are basically saying that a sustainable city must place the citizen at the centre of any action or service, given that the end goal must be to improve the citizen's quality of life.

Based on this premise, it is important that the different stakeholders with responsibility for management of the city provide the citizens with a clear message indicating which services will more or less imminently be made available, taking advantage of the process of transformation the city is undergoing. If not, the phenomenon will be experienced as if it were something unrelated to the citizen, or even interpreted as an investment with a doubtful return. Next, some examples are provided that will help citizens see, right from the initial stages, the benefits that the transformation will bring.

i. Augmented reality. Penetration of mobile telephones in the distinct population bands reaches levels of greater than 100% in some cases. Moreover, taking into account that the immense majority have diverse multimedia capacity, one of the first options is to make the city available to the citizen through mobile platforms. How often, as we go around our city or another one, do we suddenly wish to find out where a specific business or public building is in order to carry out a particular transaction? With support from an augmented reality application and geo-localization provided by the mobile terminal itself, citizens can visualize, on a screen, the different icons related to the information they need. Likewise, the user experience, while visiting specific points of touristic interest, can be greatly enriched through the inclusion of multimedia content, thus providing additional information as people go round the different points. In this context, the inclusion of smart tags with Near Field Communication (NFC-type) interfaces or even Quick Response (QR) codes enables, on the one hand, improvement of the interaction with the surroundings and, on the other, management of traceability of the visits to take advantage of information of great value to the municipal services with the aim

of identifying preferences and possible improvements. Obviously, the inclusion of features related to urban transport or cultural events provides options that help citizens to enjoy a user-friendly, personal experience of the city.

ii. Citizens reporting events. In contrast to the previous application in which the citizen acts as a consumer of information, other types of applications must be contemplated in which citizens act as creators of information (other considerations will be commented on in the next section). In fact, there may be nothing better for the urban ecosystem than providing the citizens with an application that will at any time enable them to report specific repetitive incidents (accidents, traffic congestion …), damage of any type (urban furniture …), possible water or gas leaks, which when managed by the application itself can reach the corresponding people responsible for finding solutions. Once the report is received, a record to that effect is produced showing at any time the progress up to finalization. All users subscribed to the aforementioned application can see, at any time and in a geo-located way, the different incidences reported and their state. Likewise, the municipal services will know about them and will activate all their mechanisms to reduce the time to find a solution given the impact that it will have on the citizens' perception.

Starting from experiences like these, the urban service providers themselves have facilitated similar applications to this one, but for the service they manage, whether it is cleaning urban streets, public illumination or parks and gardens maintenance. Based on this author's experience, having a single application agglutinating all the services facilitates the users' experience while enabling them to have a holistic view at the city level.

THE THIRD WAVE: CO-CREATION AND CITIZEN SCIENCE

As has been reiterated in the previous sections, the technological transformation of a city becomes truly significant when citizens become the key stakeholders. In this sense, applications in which citizens actively report events enable them to have a more participative role in the ecosystem. However, is that sufficient? Should we favour a more active role or a more creative one? Obviously, thinking of the citizen as a mere provider of information through an application is far from the final objective. Instead, the starting aspiration should be to promote a radical transformation that is not limited to using more or fewer IoT devices but to providing capacities and abilities to make accessing and using technology a common characteristic to promote the conception of new solutions responding to the specific needs cropping up day to day in the city. Thus, the concept of co-creation arises, understood as the capacity to conceive spontaneously specific necessities to improve the city experience at the same time as contemplating the corresponding solutions. Obviously, the materialization of this idea necessitates a suitable stimulus through the organization of workshops, with diverse profiles, either of a social character, a technical one or any other type that responds to concerns that are detected. Starting with the information collected in these activities, a set of action priorities can be identified that can eventually be covered through specific challenges and competitions in which the winners are rewarded or incentivised with packages destined, for example, to help in the creation of business activity related to the provided solution.

However, for proposals like the ones described to have a perceptible effect it is necessary to make technology available to the citizens, providing them with a set of basic tools with which to develop solutions for the problems they themselves identify, whether in the context of hardware, software or

any other type. To do so, a good example would be the project OrganiCity [4] in which an Experimentation as a Service (EaaS) platform is developed destined to providing a framework on which to design, implement, test and validate distinct solutions. The platform, for instance, enables configuration of IoT devices, through a user-friendly interface over which a set of basic instructions is sent permitting the modification of thresholds based on which the device can generate an event such as an alarm tone; data annotation upon the information collected from the citizens using a crowd sensing application; but also enabling storage of data with the aim of carrying out varied analyses using other modules that can be integrated, destined to provide support to artificial intelligence algorithms for predicting any strange behaviour or suggesting improvements in the operating points. A practical example is the use of such algorithms for predicting outdoor parking place availability based on both contextual and historical data related to parking place occupancy as well as vehicle traffic intensity in areas nearby the corresponding places. Indeed, this is the core of an application that is also being implemented in the collaborative project between KAIA and UC.

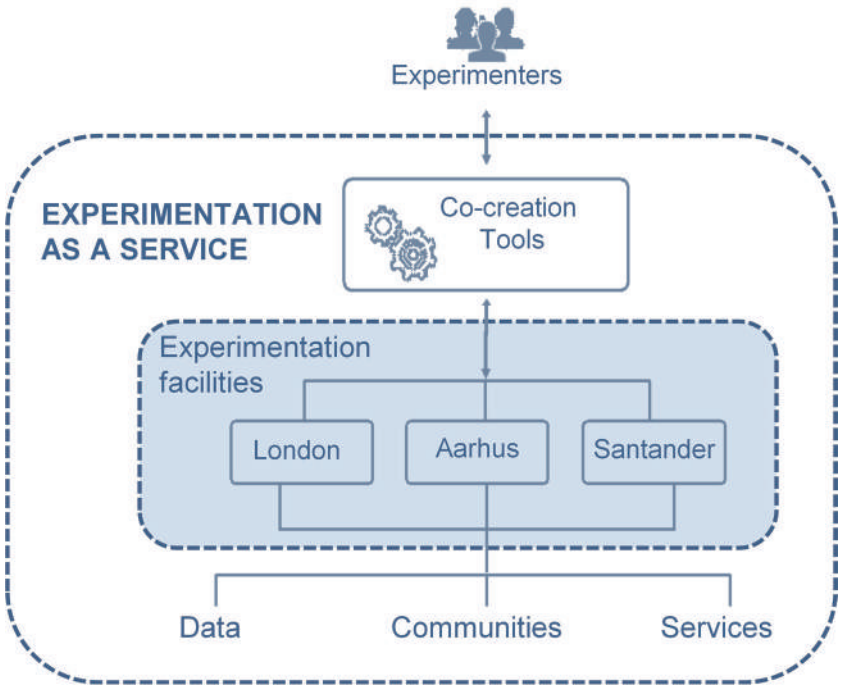

Figure 2

OrganiCity pioneers with the cities of Aarhus, London and Santander

It should be highlighted that it must be a truly living environment, enriched by new components daily, and in which the concept of federation is key with the aim of favouring the continuous expansion of the experimenter community. To do so, it is necessary to define and agree on a set of standardized interfaces providing support to interoperability among different cities to make the use of resources, specifically data from the federated sites, transparent for the experimenter community.

Finally, we should highlight that the natural extension of co-creation is the concept of citizen science, understood to be a strategy through which the necessary bridges can be established between the scientific community and citizens while favouring interaction with wider sectors of society. Likewise, awareness is promoted through timely topics such as energy saving or environmental monitoring, encouraging the citizens themselves to take part in the life cycle of investigation related to these.

THE FOURTH WAVE: DATA SPACES AND RELATED ISSUES

Another key topic in relation to digital transformation of cities is data. As has been mentioned, having information available is fundamental for making the most suitable decision at all times. Traditionally, the different urban services have had enormous amounts of data available, which have been compiled during daily operations in each service. Thus, no-one is better placed than the operator in the street to know, for example, which outdoor parking places are the most congested and which undergo the greatest rotation. Likewise, for the solid urban waste collection service, the service managers have greatest knowledge about which containers for non-organic solid refuse get filled up or which collection routes are the most suitable. This situation, which was a reality until less than a decade

ago in most cities, has several disadvantages. One is that the data in many cases had no electronic record so knowledge of that data was possessed by a limited number of specific people. Second, due to this individualized knowledge base, real-time interaction among diverse city services just did not exist, giving rise to the concept of silos or verticals, which meant that although a specific service might have been operating optimally, it may have been doing so to the detriment of another service given the interactions that inevitably and, in fact, desirably take place in a system composed of numerous subsystems such as a city.

Under these surrounding conditions, it seems quite obvious that digitalization implies a drastic change in relation to the previous scenario. Having devices that collect information brings with it the generation of a group of assets based on the data from each service which places knowledge beyond the realm of a person or technician alone. Likewise, it favours the breaking of the aforementioned silos as long as standard formats and interfaces are adopted which facilitate interaction among all urban services. For example, if the street cleaning service has access to the schedule of outdoor events to be held on a specific day, it can plan to reinforce the service in specific city areas to cope with the agglomeration of citizens there. For this reason, one of the first actions of the City Hall's manager of the systems, infrastructures and communications services is to adopt standard data models in order to guarantee internal and eventually external interoperability. Some examples of initiatives [5, 6] are already operating in many cities and have provided large quantities of data that have enabled the characterization of different services in an agile and transparent way, while providing interfaces for the different silos to exchange information. This has in turn made it feasible to achieve optimal operation points for the set of services, taking into account the restrictions applied to each one of them.

In reference to data, another implicit key aspect is data treatment with, for example, the aim of minimizing human intervention in decision making. Cities provide machine learning algorithms with a unique scenario in

which to demonstrate their full capacity, making them behave as autonomous systems. An example of this is in the prediction of finding a free parking place in a specific zone, starting from historical records of data in the area of interest, along with context data and traffic information nearby. Aggregating all this information, the algorithm provides the probabilities corresponding to the range of times. In current implementations, the execution is developed centrally in the sense that data are sent and processed remotely from the collection site. As an alternative, the possibility of data processing as close to the collection point as possible could be considered with the aim of reducing the delay, bandwidth usage and energy consumption. Obviously, in some cases the dimension of the information available will not be sufficient to make decisions and it will be necessary to have a higher concentration of information, but in many others, and depending on the type of service, this will not be needed with the corresponding advantages.

Another topic that is attracting great interest in relation to data is in their use by third parties. An illustrative example could be a citizen who has a weather station which collects information related to temperature, atmospheric pressure and humidity who decides to publish in a contextual repository or even in a data marketplace enabled for this purpose. This citizen, as the owner of the data published, must have the right to know at all times who is making use of the data, while wishing to guarantee they are unchanged. To do so, utilization of Distributed Ledger Technologies (DLT) is one of the solutions being tested in projects such as TOKEN [7]. In fact, the use of DLT permits paradigms such as dynamic management of data quality or of data monetization. In the former case, a set of attributes and associated nominal thresholds must be defined, which, if not satisfied, automatically generate the corresponding penalizations charged to the "producer", safeguarding the rights of the "consumer". It should be noted that this is an illustrative example and highlights the value of the smart contract concept.

Data monetization is another topic of growing interest given that data can be seen, in the medium term, as a fundamental asset in an intensely digitalized society. Although currently it is not very common for citizens to consider data related to, for example, weather stations as an asset, in the not too distant future it will not be unusual for a public entity or a private citizen to pay a quantity to obtain data, with a given quality of service, with the aim of providing a third party service. In this way a new economy will be created around data, which should promote the appearance of new economic activities synergetic with other currently vibrant ones such as crypto currencies. In any case, the possibility should be noted that it is fundamental for cities to have a data marketplace to leverage the promotion and establishment of the digital economy. Obviously, the next step will be data marketplace federation facilitating the access of entities and individuals to a plethora of information enabling the conception of different types of applications and services.

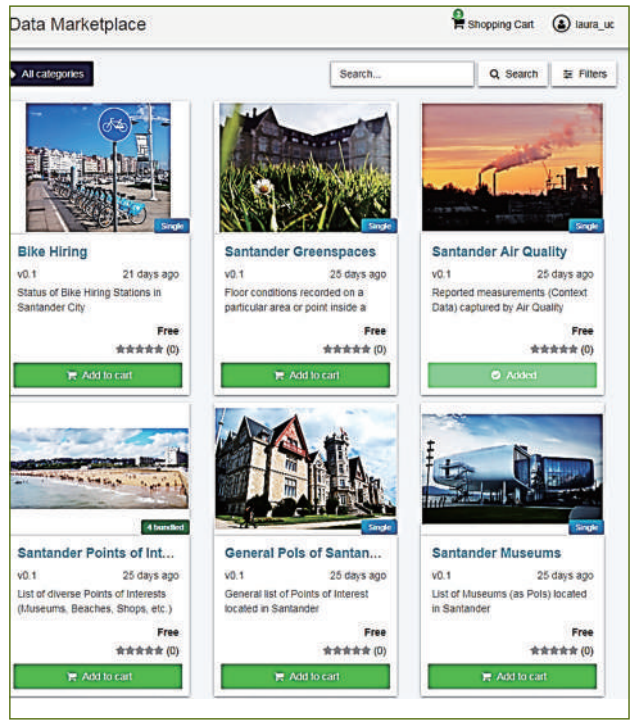

Figure 3

Santander marketplace designed and launched in the SYNCHRONICITY project [8, 9]

To finalize this section, it should be remarked that data are strongly linked to the sustainability of digital urban ecosystems [10]. This has been a recurrent topic of discussion since the first initiatives, diverse approaches having been proposed. A widely used one emanates from private-public collaboration, differentiating among implementation methods. A possible materialization consists in the conception of tenders for provision of urban services in which investment in digital assets is required to improve services. Clearly, this obliges an initial investment compensated for by the saving derived during the provision of service, so enabling the amortization of the aforementioned investment. Thus, the renewal of the public il-

lumination service with LED-type infrastructure in substitution of sodium lighting is becoming a constant in the nightscape of our cities, in which the important initial investment is repaid by the reduction in consumption and maintenance. Undoubtedly, the consideration of other agents in the sustainability equation will favour the appearance of new models in which the so-called circular economy will also play an important role.

CONCLUSIONS

This contribution has provided an analysis of the meaning and implications of digital transformation of the city in the different facets, namely, technological, social and economic. As has been said, more than just technology, it is fundamental that any action to be carried out in the urban ecosystem includes analysis of the consequences from the citizens' perspective focusing on the possible role of the citizens in coming up with solutions. The objective is to make them active stakeholders, promoting their participation in the transformation and so overcoming the digital gap. Paradigms such as co-creation or citizen science thus become useful tools that in turn enable other communities, such as the scientific one, to reach many more sectors of the population.

From the technological viewpoint, we are in a period of strong activity around tools such as machine learning which are going to shape our new model of quasi-autonomous cities. This brings with it the conception of distributed computational architectures that enable decision making as near as possible to the information collection points. Some advantages include reduction of delay, minimization of resources or energy savings. Looking towards the future, aspects such as 5G and Beyond 5G infrastructures are going to play a relevant role, facilitating the natural extension of this phenomenon from the cities to less populated environments or rural ones with the consequent advantages. Finally, it is worth highlighting federation ini-

tiatives such as the one based on the KAIA and UC collaboration, through the 2021 K-City Network Overseas smart solutions demonstration action, which enables the design, testing and validation of urban transcontinental interoperability initiatives.

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Accelerating Decarbonization with Connected Communities

커넥티드 커뮤니티를 위한 탈탄소화 촉진

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ABSTRACT

A Connected Community is a group of grid-interactive efficient buildings with diverse, flexible end use equipment and other distributed energy resources (DERs) that collectively work to maximize building, community, and grid efficiency. This paper provides an introduction into the U.S. Connected Communities program that has launched in 2021. The program promises to provide a comprehensive review of new technologies and deployment models to accelerate update of energy efficiency, grid integration, and affordable, reliable and clean energy systems.

The objective of this program is to demonstrate how groups of buildings combined with various distributed energy resources, such as electric vehicle (EV) charging and photovoltaic generation, can reliably and cost-effectively serve as grid assets by strategically deploying efficiency and demand flexibility. By demonstrating the ability of groups of buildings and DERs to modify load, the program will enable increased energy efficiency, reduced energy demand, and reduced environmental impact. The program provides an unprecedented opportunity to develop and evaluate integrated energy systems to support rapid decarbonization. There has been a rapid progression of research to understand how to design and retrofit buildings to ensure energy efficiency while enabling controllable, and flexible loads to support renewable energy systems. This urgent need is broad and deep considering the challenges to deploy Connected Communities with speed and scale and enable multi-building, aggregated, efficient, flexible, integrated energy systems.

KEYWORDS

Load flexibility, Energy efficiency, community energy systems, distributed energy resources, grid interactive

초록

Connected Community는 서로 다른 유형의 분산 에너지원과 결합하여 건물 및 전력망의 효율성을 최대화하기 위해 집합적으로 작동하는 다양하고 유연한 설비를 갖춘 전력망 상호 작용을 가지는 효과적인 건물 그룹*Grid-interactive efficient buildings, GEB*이다. 여기서는 2021년에 시작된 미국의 Connected Community 프로그램을 소개한다. 이 프로그램은 경제성과 신뢰성 있는 청정 에너지와의 전력망 통합 및 에너지 효율성을 발전시킬 수 있는 새로운 기술들에 대한 종합적인 검토 결과를 제공하는 것이다. 이 프로그램은 EV 충전 및 태양광 발전과 같은 다양한 분산형 에너지원과 결합된 건물에서 효율성과 수요 유연성을 전략적으로 배치하여 전력망 자산을 보호하는 것이 목표이다. 분산형 에너지원이 결합된 건물들은 부하 변동에 반응하여 관리하는 능력을 가짐으로써 에너지의 효율성을 높이고, 에너지 수요 및 환경에 미치는 영향을 감소시킬 수 있다. 이 프로그램은 탈탄소화를 지원하는 통합된 에너지 시스템을 개발하고 평가할 수 있는 기회를 제공한다. 재생에너지 시스템이 부하 변동에 대한 유연성과 제어가 가능하도록 함과 동시에 효율성을 보장하기 위한 건물 설계 및 개조 방안에 대한 연구가 빠르게 진행 중이다. Connected Community에서 다중건물화*multi-building* 및 효율적이며 유연하고 통합된 에너지 시스템이 요구됨으로써 매우 광범위하고 고려해야 할 사항들이 많이 있을 것이다.

키워드

에너지 부하 유연성, 에너지 효율성, 커뮤니티 에너지 시스템, 분산형 에너지원, 그리드 인터액티브

Introduction

A Connected Community (CC) is a group of grid-interactive efficient buildings (GEBs*) with diverse, flexible end use equipment and other distributed energy resources (DERs) that collectively work to maximize building, community and grid efficiency. The objective of this program is to demonstrate how groups of buildings combined with other types of DERs**, such as electric vehicle (EV) charging and photovoltaic (PV) generation, can reliably and cost-effectively serve as grid assets by strategically deploying efficiency and demand flexibility. By demonstrating the ability of groups of buildings and DERs to modify load, the program will enable increased energy efficiency, reduced energy demand, and reduced environmental impact.

The United States Department of Energy has selected 10 Connected Communities that vary in climate, geography, building type, building vintage, DERs utility/grid/regulatory structure and resource bases. This research is intended to find and share technical and market solutions that will increase demand flexibility*** and energy efficiency. In this work, a DER is defined as a resource (community-scale or building-scale) that can provide all or some immediate electric and/or power needs and can also be used by the com-

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* Connected communities build on BTO's ongoing Grid-interactive Efficient Buildings (GEB) research: www.energy.gov/eere/buildings/GEB and Zero Energy Ready strategies
www.energy.gov/eere/buildings/grid-interactive-efficient-buildings

** A resource sited close to customers that can provide all or some of their immediate electric and power needs and can also be used by the system to either reduce demand (such as energy efficiency) or provide supply to satisfy the energy, capacity, or ancillary service needs of the distribution grid. The resources, if providing electricity or thermal energy, are small in scale, connected to the distribution system, and close to load. Examples of different types of DERs include solar photovoltaic (PV), wind, combined heat and power (CHP), energy storage, demand response (DR), electric vehicles (EVs), microgrids, and energy efficiency (EE) - N. A. of R. U. C. (NARUC), "Distributed Energy Resources Rate Design and Compensation," 2016

*** Capability of DERs to adjust a building's load profile across different timescales; energy flexibility and load flexibility are often used interchangeably with demand flexibility. Unlike EE and DR, however, demand flexibility is not a resource in the traditional sense (e.g., eligible to be bid into wholesale markets), but a potential that the utility or system operator can utilize to provide reliable electricity service.

munity to either reduce demand (such as energy efficiency) or supply power to satisfy the energy, capacity, or ancillary service needs of the distribution grid generation resources for these communities should be connected to the distribution system, close to load and the majority of produced energy should be consumed within the community. Examples of different types of DERs include photovoltaics (PV), energy storage, wind, combined heat and power (CHP), demand response (DR), energy efficiency (EE), microgrids, and electric vehicle charging infrastructure (NARUC 2016).

Starting from a foundation of demand flexibility and energy efficiency, this diverse portfolio of projects was selected to provide insights from the whole portfolio for scalable solutions that can be applied throughout the country. Individual projects can include new construction, retrofits of existing building, residential, commercial, mixed use, campuses, and appropriate DERs. It is anticipated, but not required, that proposals will come from multidisciplinary partnerships between energy utilities/providers, building/home developers/owners/operators, manufacturers, researchers and other key players.

This paper begins with the background for the development of the Connected Communities program followed by a discussion of the type of technologies in the program and the overall goals. The next section provides an introduction to the ten sites selected for the program. The final section describes the plans for the program evaluation.

Background

Domestic renewable energy production has been increasing, influencing utility electricity supply operations and creating technical challenges to efficient, cost effective, and reliable grid performance. This, and

other reasons including deferred infrastructure investment, have led to a number of federal, regional, and local efforts to modernize the electric grid. At the same time, advanced building technologies utilizing smart controls are becoming more sophisticated and widely available, allowing buildings to become more responsive to occupant and grid needs. Similarly, advances in electric vehicles (EVs) and energy storage technologies are offering pathways to interact with the electric grid in more dynamic ways. EVs are forecasted to be the largest net increase in load to the utility system in the next twenty years. Charging of these vehicles will mostly be attached to buildings. By coordinating the loads of buildings with the loads of EVs, and managing those loads with the grid, it both increases the opportunity to provide grid services and decreases the risk of high costs for building/vehicle owners and for the grid.

At the same time an increasing number of truck fleets are planning to electrify their vehicles to address emissions but also to lower operating costs. The Connected Communities program recognizes the challenges and opportunities that relate to this changing energy landscape and addresses the role that demand side strategies, including buildings, electric vehicles with smart charge management and other DERs as well as supply side strategies, can offer.

DOE's Building Technologies Office (BTO) has a mission to develop and accelerate the adoption of cost-effective technologies, techniques, tools, and services that enable high-performing, energy-efficient, and demand-flexible residential and commercial buildings in both the new and existing buildings markets. The Office's overall goal is to improve the energy efficiency and productivity of buildings without sacrificing occupant comfort or product performance. Progress towards achieving this goal will make building energy costs more affordable and reduce the environmental impact of energy-related activities to the benefit of American households and businesses.

In support of this goal, BTO has developed a Grid-interactive Efficient

Buildings (GEB) strategy which aims to advance the role buildings can play in energy system design, operations and planning. This is achieved by optimizing energy consumption with an integrated approach to energy efficiency and flexibility. The GEB strategy recognizes that:

- Building end uses can be dynamically managed to reduce energy cost, consumption, help meet grid needs, and minimize electricity system costs, while meeting occupants' comfort and productivity requirements;
- Technologies such as PV, storage, CHP, EVs and their charging infrastructure, other DERs, and microgrids can be co-optimized with buildings to provide greater value and resiliency to both utility customers and the electricity system; and
- The value of energy efficiency, demand response, and other services provided by behind-the-meter DERs varies by building type, location, hour, season, and year.

A key part of this strategy includes utilizing efficient building design, op-

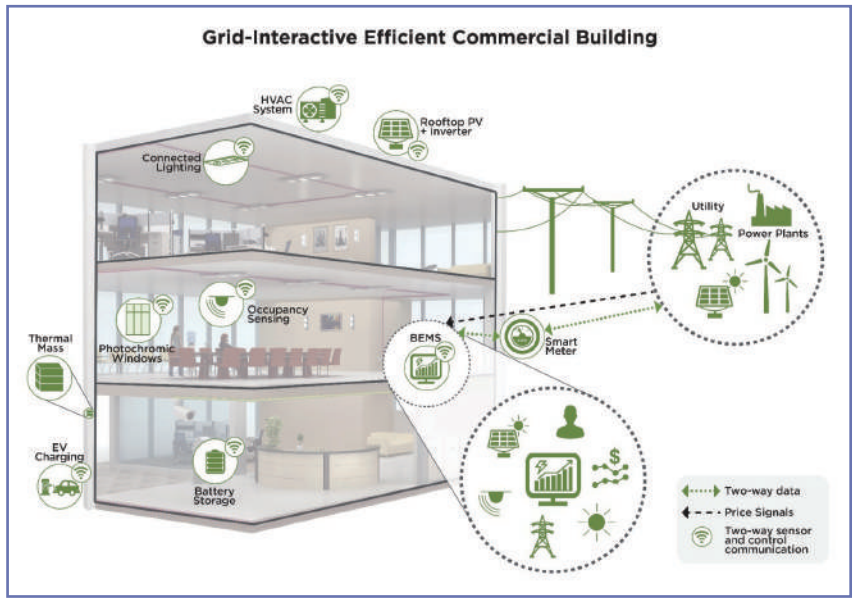


Figure 1

A Grid-interactive Efficient Building: An energy-efficient building that uses smart technologies and on-site DERs to provide demand flexibility while co-optimizing for energy cost, grid services, and occupant needs and preferences, in a continuous and integrated way.

erational strategies, and highly efficient, innovative building equipment coupled with smart technologies for building energy management. These are areas of core technological investment for BTO. The vision of GEB is the integration and continual optimization of DERs for the benefit of the buildings' owners, occupants, and the electric grid, as shown in Figure 1. Improving the energy efficiency and demand flexibility of buildings alleviates pressure on the electric grid.

Collaborating DOE Offices

The Vehicle Technology Office (VTO) supports a sustainable transportation system through research and technology development to enable a broad range of affordable, efficient and clean transportation choices. Both light and medium/heavy duty vehicle electrification are a significant change not only to the transportation of people and goods, but also to the electric grid and to the consumer experience. Plug-in electric vehicle (EV) charging represents both a potentially large new load but also one that has some level of flexibility. Flexible loads may be key to managing a future grid that is more dynamic and based on more intermittent generation. Almost all EV charging currently happens in, or connected to, a building complex and is supported by the building's overall electrical delivery system and infrastructure. A key part of any EV smart charging management must therefore be tied to the overall building's energy management strategy. VTO has awarded multiple large-scale "EV Community Partner Projects" in recent years. These projects aim to demonstrate the technology needed for successful EV deployment and charging at a community level, including personally owned vehicles, commercial delivery vehicles and buses. They also bring together a broad group of community members to enable increased vehicle electrification. They have shown that managed charging is a key to delivering low operating cost as well as innovative charging deployment. This Connected Communities program will expand these EV Community Partner Projects to recognize the critical role of building load management along with EV load management.

The Solar Energy Technology Office (SETO) supports research and development to improve the affordability, performance, and value of solar technologies on the grid. A number of SETO programs, including ongoing collaborations with OE, BTO and VTO, explore opportunities to integrate solar generation with other energy technologies to improve total system value and flexibility while maintaining or improving system affordability, reliability and security. Past research includes integrated solar generation and energy storage with technologies such as dynamic load management, advanced forecasting techniques, utility communication and control systems, and smart buildings and smart appliances to meet both consumer needs and the demands of the electricity grid. SETO also supports innovation through a number of networking, technical assistance, and analytical efforts. Programs on community solar, most notably the National Community Solar Partnership, explore new models for ownership in cases where individual, roof-mounted installations may not be feasible or competitive. The Connected Communities program is an opportunity to further extend these efforts in system design, operations optimization, and innovation.

DOE's Office of Electricity (OE), collaborating with BTO on this program, recognizes a secure and resilient power grid is vital to national security, economic security, and the services Americans rely upon. Among other priorities, OE works closely with the private and public sectors on risk management for critical energy infrastructure interdependencies; the protection and enhancement of defense critical electric infrastructure; and grid reliability, resilience and long-term recovery of damaged energy infrastructure. OE has an interest in the ability of Connected Communities to demonstrate how next-generation technologies, policy tools and technical assistance partnerships with the private sector and at all levels of government can improve the security, reliability, resilience and blackstart capabilities of the grid and in particular the nation's critical energy infrastructure. OE has a mission to support R&D for a secure, resilient and adaptive power grid. OE is actively collaborating with BTO on Connected Communities, recognizing that building optimization is improved by extending into the grid, and grid

optimization is improved by extending into buildings. The GEB strategy reflects those shared priorities across OE and EERE and will benefit from this partnership.

Connected Community Technology and Strategic Goals

Desired Outcomes

The overall desired outcome from this program is to demonstrate, through a portfolio of diverse projects, the ability of groups of buildings and DERs to provide cost effective grid services through demand flexibility and efficiency that maximize use of renewable resources and reduce emissions, while maintaining (if not enhancing) occupant satisfaction and productivity. Specific outcomes within that are:

1. Data showing if, and how much, diverse groups of buildings can reliably and cost-effectively serve as grid assets by strategically deploying efficiency and demand flexibility in conjunction with DERs, without sacrificing occupant comfort or productivity;
2. Analysis on the interaction between energy efficiency and demand flexibility measures and how GEBs improve energy affordability and grid reliability while offering environmental and community benefits;
3. Demonstration of how DERs, such as managed charging of electric vehicles, can contribute to overall building load management, grid services and reduced cost of DER ownership and operation;
4. Demonstration of proven pathways to install the hardware, software and communications necessary to make buildings grid interactive that decrease cost, set up time for installers and potential disruption to occupants;
5. Insights on occupant impact, including benefits, resulting from equip-

ment with advanced sensing, controls and capabilities to modify and optimize operational sequencing to balance comfort and grid needs;

6. Perspective into the willingness and ability of the occupants to change the timing and/or duration of their energy use, and any necessary level of compensation to meet grid needs;
7. Demonstrate the value of how demand flexibility and DER integration across buildings will attract customers, utilities, and other key stakeholders; and
8. Public dissemination of case studies of each project, including technical requirements and specifications, synthesized best practices, businesses models, partnership approaches, lessons learned, required analyses (including the results of those analyses) and analytical tools used to conduct the design, operation and evaluation of successful connected communities.

DOE will be taking a coordinated research approach in which selected projects will serve as a cohort to share challenges and best practices between each other and publicly. This will allow DOE to synthesize information across many projects that include multiple building types, applications, vintages and sectors, climates, DERs, electricity regulatory and market environments, occupancy/programmatic approaches, business models and occupant impact in an effort to scale innovation.

Examples of the Connected Communities Projects

Current connected community projects, sometimes referred to as pilots, take advantage of highly efficient homes and commercial buildings and multidisciplinary partnerships between utilities (or other energy service providers), building developers, owners, operators, manufacturers and researchers. These communities leverage high performance building design, operation and technology (e.g. dynamic windows, heat pump water heaters, and smart thermostats). A growing number of smart devices and advanced data-analytics can provide the ability to optimize energy-related operations at the building zone, by system, for the whole building and possibly between buildings in a

community.

A few early pilots of connected communities illustrate some of these concepts. For example, through work funded by the Building Technologies Office and OE, Oak Ridge National Laboratory researchers have found that, after one year of occupancy, the actual energy consumption of the homes in the Reynolds Landing Smart Neighborhood™ consumed 44% less energy (kWh) as compared to similar homes built to minimum code requirements in Alabama and reduced their peak winter heating demand (kW) by ~34% from what a traditional, all-electric community would have otherwise needed because of the highly efficient envelope and the capability to shift heating and cooling loads (ORNL 2020).

In another example, the AI-driven Smart Community in Basalt, Colorado is an affordable housing development providing very energy efficient homes with rooftop solar and backup battery storage (NREL 2019). The energy system is managed to minimize utility bills for the residents, maximize local solar consumption, support the needs of the local utility grid, and provide resilience in case of power outage. The control system was developed by the National Renewable Energy Laboratory with funding from DOE's ARPA-E agency and tested under funding from the Solar Energy Technologies Office. The goal of the demonstration is to reduce the adverse impact of solar variability on distribution grid voltage by at least 20% and support critical loads for up to 5 days with DERs in the community.

VTO also has example community projects such as the Smart Charging pilots that include Southern California Edison, which as part of their Charge Ready pilot program, deployed nearly 400 networked stations in multi-unit dwellings, workplace, and public locations. One goal of the pilot was to demonstrate demand response (DR) capabilities by reducing the rate of charge by 50%. This was successfully demonstrated using two methods: 1) stations with throttling capabilities were reduced to half charging rates and 2) stations without adjustable charging speeds used a duty-cycling technique, which stopped charging in 15-minute increments for half of the locations'

chargers. In a second example Avista Utilities ran a managed charging pilot program to own, maintain, and install EVSE on a residential or commercial customer premise. To participate in the project, the customers allowed Avista to collect charging data and perform DR experiments. The customers had the option to be notified about upcoming DR events the day before and to opt-out of that event. The project was able to curtail load up to 75% with about a 10% opt-out rate overall for the program for residential sessions.

In addition, the recently announced WestSmart EV@Scale project, an Electric Vehicle Community Partner Project award is a comprehensive and ambitious community partnership that includes more than 25 strategic partners, with PacifiCorp divisions Pacific Power, Rocky Mountain Power and sister company NV Energy all playing major roles. The project spans seven states and will address regional challenges in critical EV application focus areas, including destination highways, underserved regions, urban mobility, freight and port electrification, along with community and workplace charging. These projects are going to develop smart charging at intermodal transit hubs for buses, rail, public charging and other EV users so they can prioritize and stack charging in such a way that increases efficiencies and spreads the demand charges among different users (rail, transit bus and public charging). Other projects will be exploring smart charging solutions at local business with workplace charging. The intent is to align charging times so they coincide with times that maximize solar energy using a staggered charging system.

Connected communities can include new construction or existing building retrofits, or a mix. In addition to residential neighborhoods, other examples of building combinations that could make up a connected community include:

- A university, medical or corporate campus (PNNL, 2021)
- A downtown district of commercial and/or mixed-use buildings
- A mixed-use development or neighborhood (Centerpoint Energy 2018)

- A non-geographically contiguous collection of buildings within a utility or energy service territory (PNNL 2019)
- A U.S. national defense or security campus/installation such as a military base, and/or its surrounding community
- Commercial Industrial Parks including Shipping/Parcel Distribution Facilities, Freight Logistics Centers
- A mix of any of the above

In addition to coordination of diverse, flexible building loads, connected communities can potentially share infrastructure and energy assets to achieve economies of scale, improve system efficiency, reduce operations, maintenance and capital costs, and to island as part of a microgrid that manages loads to safely provide reliable power during grid outages. Shared resources may include (but are not limited to) community solar, EV charging infrastructure, battery storage, or thermal storage, or individual building level resources that are pooled to provide a summed performance that is greater than the parts.

By leveraging load diversity, storage and/or generation across a group of buildings, connected communities can offer more cost-effective solutions to energy goals (Victor et al. 2020). For example, if a group of buildings each use large amounts of electricity, paying associated high peak load charges at different times, they could co-invest in battery or other storage devices to share management of peaking loads for both buildings and shave non-coincident peak load at the respective times. This investment may not be financially possible for one building owner, but sharing the cost across multiple buildings reduces the cost per owner, a benefit that could multiply with additional willing building representatives. Another example is a multi-building complex with a shared central thermal plant that may be able to serve the non-coincident heating loads of multiple buildings with a lower plant capacity than the sum of the capacities if each building were to install its own thermal plant.

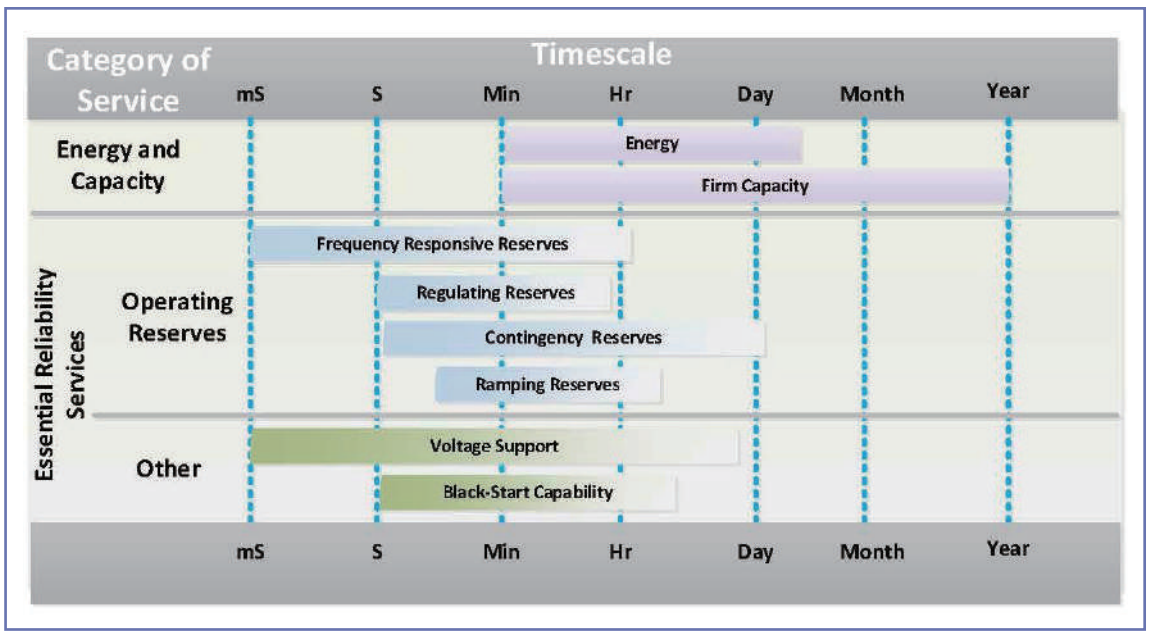
Grid Issues Addressed by the Connected Communities Program

As stated earlier, a key goal of this program is to demonstrate how groups of buildings can reliably and cost-effectively serve as grid assets by strategically deploying efficiency and demand flexibility in conjunction with DERs. There are numerous *grid issues* addressed by Connected Communities program. One of most critical is aiding variable renewable energy integration. Other include:

- Providing resource adequacy;
- Improve resilience, allowing systems to withstand or recover rapidly from disturbances;
- Deferring or avoiding major capital investments in generation, transmission, or distribution grid infrastructure;
- Maintaining voltage limits on the transmission and distribution system; and
- Extending the reliability and resilience of the surrounding electric system through coordinated islanding or the provision of black start or other recovery related services.

Figure 2

Bulk Power System Services (Denholm et al. 2019)



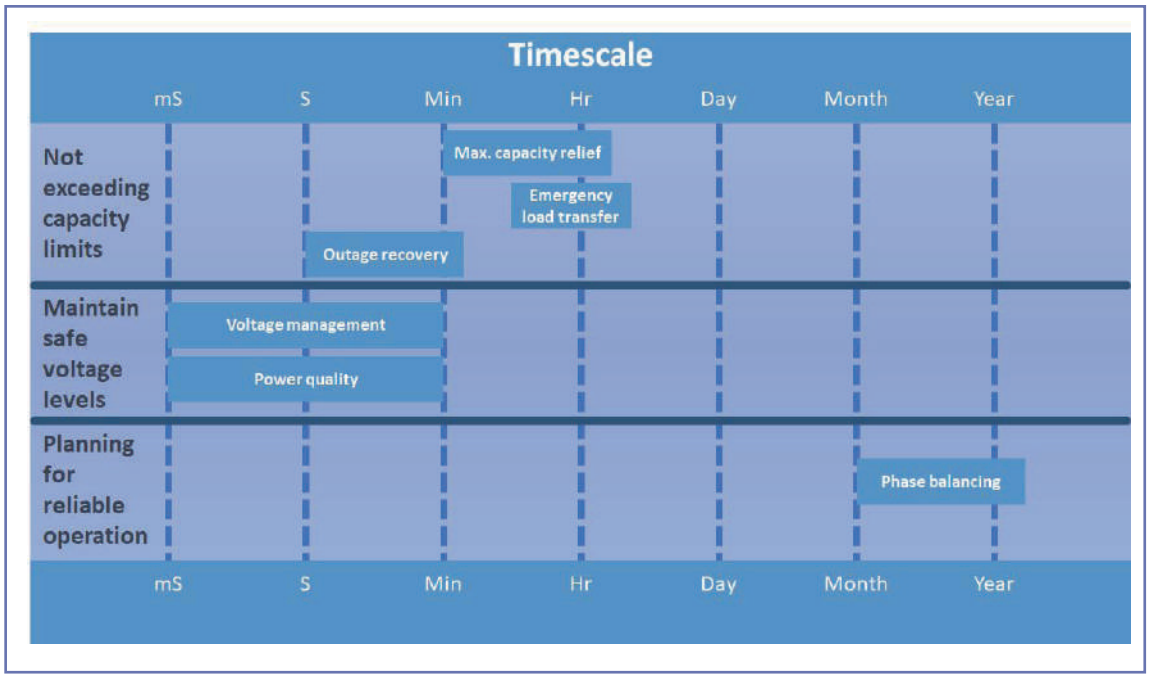


Figure 3

Distribution System Services (Capper et al. 2016)

The issues can be addressed at either the bulk power system or distribution system. Numerous grid services are required to support reliable grid operations and respond to the inherent variability and uncertainty of electricity supply and demand. Figure 2 identifies key grid services for the bulk power system. While not a requirement of CC proposed projects, we note that in most organized wholesale markets, 100kW of load flexibility is the typical minimum threshold for participation of individual or aggregations of demand-side resources in Demand Response (DR) programs (IRC 2018).

At the distribution system, connected communities can provide additional grid services (see Figure 3), some of which have been represented as non-wire alternatives (Homer et al. 2017).

Overview of the Ten Connected Community Sites

The ten sites selected for the Connected Community program were announced in October, 2021. Table 1 provides a summary of the key characteristics of the awardees. The sites cover a diverse set of building types, geographic locations, business models, and utility engagement. Both new and existing residential and commercial buildings are included. Both single and multi-family buildings are included, and the commercial building activities include novel new technologies for integrated university campus energy systems. Further details and the performance of the demonstrations will be published in the years to come. Several of the sites include a specific emphasis on serving the needs of low and moderate income communities, and seek to enable affordable energy system and reduce the energy burden associated with the high cost of energy. These sites will also consider the comfort and health of occupants.

Table 1

Connected Communities Projects

Project Title	Lead Organization	Location	Building Types	New or Retrofit
Evaluating Transactive Energy for Rural America	Post Road Foundation	1 rural New Hampshire city, 2 in Maine - likely Holton and Madison	New Hampshire: 250 Single family homes, 5-10 Commercial Maine: each with 100 single family homes, 50 Commercial, 5 Industrial	Retrofit
Advanced Clean Communities Collaborative (AC3)	IBACOS, Inc	Raleigh, North Carolina	Residential: 500 new and 500 existing, mix of single family and multi-family, and mix of owner occupied and rental, variety of vintages and efficiency levels	New and retrofit
Connected Residential Communities with Enhanced Resiliency and both Customer and Utility Attributes	SunPower Corporation	Menifee, California	2 Residential communities with ~120 single family homes each	New

Project Title	Lead Organization	Location	Building Types	New or Retrofit
OSU-ENGIE Connected Community: Automated Building Control with Knowledge of distributed Energy Resources and Electrical Systems for Grid Offerings	Ohio State University	Columbus, Ohio	20 university buildings	Retrofit
Gateway Cities Unplugged: (em) Powering Affordable Housing	Open Market ESCO LLC (OME)	Massachusetts	Up to 20 apartment communities representing >2,000 homes.	Retrofit
SmartGrid Advanced Load Management & Optimized Neighborhood (SALMON)	Portland General Electric	Portland, Oregon	500 single family homes, 40 multi-family residential buildings, 40 small commercial, and 1 large business	Retrofit
Connecting Communities for Sustainable Solutions	Slipstream Group, Inc.	Madison, Wisconsin	15 existing city facilities. Primarily office buildings, public assembly, or maintenance facilities	Retrofit
Spokane Connected Communities Project	Edo Energy	Spokane, Washington	Residential and commercial	Retrofit
Utility Managed Distributed Energy Resources Intelligent Community	Pacificorp	Salt Lake City, Utah	Residential and commercial	New and retrofit
DESIRED – Deep Efficiency and Smart Grid-Integrated Retrofits in Disadvantaged Communities	Electric Power Research Institute	Willowbrook, CA; Fresno, CA; Seattle, WA; San Diego, CA; New York, NY	Residential multifamily housing	New and retrofit

Summary and Future Directions

This paper has provided an introduction into the U.S. Connected Communities program that has launched in 2021. The program promises to provide a comprehensive review of new technologies and deployment models to accelerate update of energy efficiency, grid integration, and affordable, reliable and clean energy systems. Each site will be evaluated to consider a broad set of quantitative and qualitative topics. A foundational

element of the evaluation is the assessment of metered energy use of the buildings to consider the performance or energy efficiency retrofits, or comparison of new buildings with the regional building code. These data will include a variety of energy metrics as well as greenhouse gas savings.

The evaluation will also examine the ability of the Connected Community to provide grid services, plus a detailed review of customer bill impacts. To ensure that the technologies are viable in future projects the evaluation will also consider the building tenants and occupant experience, as well as evaluation of the indoor environmental considerations, such as building temperatures, humidity, an illuminance. Additional factors that will be evaluated include a review of the business models and methods for delivering the technologies, resilience benefits, and cybersecurity implications of the technologies deployed at the sites. Finally, the evaluation will consider regulatory policy issues, along with techno-economic assessments such as customer, utility, and other stakeholder value propositions, as well as overall cost effectiveness.

The Connected Communities program provides an outstanding and unprecedented opportunity to develop and evaluate integrated energy systems to support rapid decarbonization. There has been a rapid progression of research, development, demonstration and deployment needs to understand how to design and retrofit buildings to ensure energy efficiency while enabling controllable, and flexible loads to support renewable energy systems. This urgent need is broad and deep considering the challenges to deploy Connected Communities with speed and scale and enable multi-building, aggregated, efficient, flexible, integrated energy systems. This program will provide foundational knowledge for a broad set of stakeholders to enable a new generation of technology, business models, regulatory frameworks, and other innovations to support accelerating affordable, equitable, and healthy decarbonized buildings.

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