

Application of ICT for Urban Regeneration, Environmental Protection and Social Equality in Scotland

Branka Dimitrijević¹

Department of Architecture, University of Strathclyde, 75 Montrose Street, Glasgow G1 1XJ, Scotland, United Kingdom, Branka.Dimitrijevic@strath.ac.uk

ABSTRACT

The paper first examines how the concept of 'smart cities' is applied in Scotland through the use of sensors and ICT technologies to collect data and inform decision-making for the regeneration of rural and urban settlements, environmental protection and social equality to date, and goes on to consider the challenges that lie ahead. The case studies include the 'Future City' project in Glasgow and the outcomes of researcher engagement with a community group in the town of Linlithgow.

Examples are given to demonstrate how the 'smart city' concept is applied in the regeneration of settlements by improving regional, national and international digital connectivity. These include the use of ICT and the Internet of Things (IoT) as they relate to the economy and employment, as well as projects for improving the efficiency of services and quality of life, to boost regeneration and resilience of neglected settlements.

The paper also examines the level of development of smart monitoring strategies for environmental protection in Scotland. Finally, it presents actions for improving social equality by supporting digital access skills; informing on local food production and waste reduction; using new methods to provide health services; enabling easier access to education and information about employment opportunities; increasing the safety of urban areas; and sharing resources and skills through 'collaborative commons'.

The paper highlights the areas which currently require new research and development.

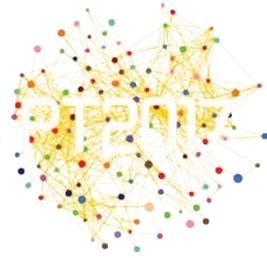
Keywords: smart cities, urban regeneration, environmental protection, social equality

INTRODUCTION

This paper examines how the relatively new concept of 'smart cities' is being developed and applied in practice in Scotland, and what challenges have to be addressed and overcome through future research. It begins by describing the context, i.e. the key philosophy for global sustainable development, and then provides examples of how the 'smart city' concept is used in urban regeneration, environmental protection and the development of a more equal society.

The United Nations Conference on Environment and Development, held in Rio de Janeiro in June 1992, outlined the principles of future global sustainable development (UN, 1992). The

¹ Corresponding author



main conference output was the *Agenda 21*, which identified priority actions and provided guidelines for their achievement. The *Agenda 21*, a guiding philosophy for global sustainable development, provided the basis for subsequent international agreements related to global environmental, social and economic problems. The key principle of sustainable development is that it can only be achieved if socio-economic development is based on the responsible use, preservation and renewal of the Earth's limited natural resources, and the use of renewable resources.

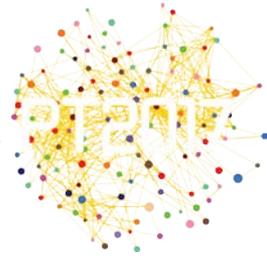
Several current socio-economic and environmental conditions remain the focus for everyone concerned with a more sustainable development. One of the major social problems, related to the rapid growth of some cities, is urban poverty due to slow provision of housing for the people in search of employment in cities. It is estimated that around 881 million people live in slums (UN-Habitat, 2015). Rapid growth of cities causes various environmental problems. If it is not accompanied by the development of low carbon transport and the planting of trees to absorb carbon, poor air quality can endanger the health of citizens even when they have adequate housing.

The depletion of fossil fuels has triggered conflicts over the remaining reserves, but also reflection on the future of energy generation from renewable and clean energy sources. Rifkin (2011) proposed a long-term economic sustainability plan to address the global economic crisis, energy security, and climate change. Rifkin's vision is that the energy produced from renewable sources should be stored and then distributed through ICT energy distribution systems directly to the energy users in buildings and transport, and to the local or national grid. Rifkin (2014) also explored the concepts of the Internet of Things and 'collaborative commons', envisaging that the availability and transfer of 'big data' in real time, via sensors to IoT platforms, will enable more efficient and effective decision-making and stimulate greater social interaction, which will result in wider public engagement in collaborative economic activities.

The IoT enabled the development of the 'smart city' concept, which can be applied to a settlement of any size. It is based on the digital communication of data, collected via sensors and other information, required to improve the performance of services. Data collected via sensors could be digitally transferred to an IoT platform and then to a decision-maker. The decision-makers cannot understand the meaning of a large quantity of data if it is not presented and analysed in a meaningful way. They also need adequate tools to make optimal decisions based on a clear understanding of the data and commonly-agreed improvement goals. When decisions are made, they have to be communicated to all stakeholders. Following the application of decisions, stakeholders should be able to provide feedback to the decision-makers about the decisions' effectiveness and impact, in order to inform future decision-making.

DATA PRESENTATION, ANALYSIS, COMMUNICATION AND FEEDBACK

An example of data presentation and analysis are the charts representing climatic conditions in cities. They usually provide information on average monthly daylight, temperature, rainfall, wind speed, etc., collected over many years. Without such simple visual representation of data, it is much more difficult to come to a quick and optimal decision about a preferred month for visiting a city. As digital technologies enable the collection of



large amounts of different data, their analysis and visualisation is a challenge which has to be overcome to enable easy use of data in decision-making.

Another challenge is to develop suitable decision-making tools. Some decision-making tools are available online, e.g. a tool in Google maps to identify the shortest walking route through a city between two locations. The criterion used by Google maps to recommend a walking route is to identify the shortest route through the city streets. However, a user's criteria might be that a walking route does not have to be the shortest one, but should pass through the city's parks and quieter streets. This example illustrates the importance of integrating the criteria which meet the needs of a user or multiple users into decision-making tools. Regarding the management of cities, decision-making tools have to include criteria which will help achieve commonly-agreed goals to improve urban services while considering the interests of multiple stakeholders.

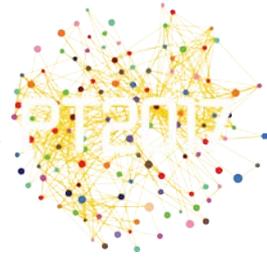
Various digital applications, or 'apps', have been developed as decision-making tools. Some of them enable feedback through the provision of additional information by the app users. The users of the Glasgow Cycling app can anonymously provide information on the cycling routes they use, to assist in refining the app (Future City Glasgow, n.d.). Another example of stakeholders' feedback to decision-makers is the website 'Fix My Street', through which citizens can report problems in their streets (Fix My Street, n.d.).

SMART CITY CONCEPT FOR URBAN REGENERATION IN SCOTLAND

The city of Glasgow is a good example of continuous urban regeneration. At the beginning of the 20th century, Glasgow was an industrial city with around 1 million inhabitants. As motor vehicles and airplanes gradually replaced ships and trains as the main means of transport after WW1, Glasgow's shipping industry and the city declined. After being one of the richest cities in the UK, second only to London, it became one of the poorest, and its population halved, now standing at around 600,000 citizens (Scotland, n.d.). Since the 1970s, urban regeneration and investment in new economic activities had helped the city's revival. Shipyards on the river Clyde have been replaced by new buildings, and the image of the city has been transformed.

Plans and actions for urban regeneration start with the collection of baseline information for decision-making, such as economic activity - employment, income per head; quality and capacity of built assets and services; social conditions and needs; environmental quality and natural resources; and regional, national and international connectivity. The last is important in the context of the application of the 'smart city' concept. The methods for acquiring baseline data and information regarding urban regeneration have been expanding. Traditional methods include surveys and reports on economic, social and environmental conditions, as well as on built assets and infrastructure systems. The 'smart city' concept entails the collection of some data via sensors, e.g. on environmental conditions - quality of air, water, soil, biodiversity; and on infrastructure use and conditions - traffic, water supply, energy consumption, infrastructure (capacity, condition, failures, etc.).

The opportunities arising from the application of the 'smart city' concept in urban regeneration include improving regional, national and international digital connectivity; developing an ICT/IoT-related economy and employment; opening up opportunities for entrepreneurs to develop innovative business services based on ICT/IoT; and improving the



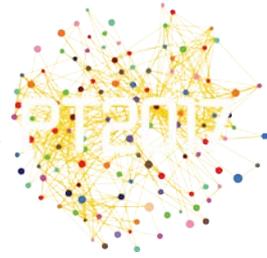
efficiency of services and quality of life to boost regeneration of neglected urban areas. The importance of providing digital access in all settlements was the basis for the development of the Scottish Government's Digital Strategy in 2011, with the ambition to make broadband available across Scotland by 2020 (Scottish Government, 2011). The strategy objectives are to simplify public services, grow a digital economy, enable digital participation, and provide digital connectivity fit for the future.

One of the public services which has been simplified by using digital technology is the Scottish Government's online service for completing and submitting building warrant applications, completions certificates, supporting drawings and documents, and for obtaining a location plan and paying the application fee electronically (eBuilding Standards, n.d.). The Scottish Government has also published the Place Standard Tool (Scottish Government, n.d-a) which can be used to initiate discussions about priorities in the development of communities. The issues considered are work and local economy, housing, facilities and amenities, public transport, parking and traffic, streets and spaces, natural space, play and recreation, social interaction, identity and belonging, safety, maintenance, influence and sense of control, and moving around.

The Future City Glasgow project, funded by Innovate UK in 2013, explored innovative ways of using technology and data to make life in the city safer, smarter and more sustainable (Future City Glasgow, n.d.). The project portal provides access to over 370 datasets which can be used to develop various decision-making tools. The initial focus is on visualising data (e.g. renewable energy sources), providing information and apps for active travel and social transport, and increasing safety via smart city lighting.

The importance of the availability and potential use of digital technology in the regeneration of settlements of all sizes has been highlighted through the engagement of researchers with citizens of Linlithgow, a town of around 15,000 inhabitants, located between Glasgow and Edinburgh (Dimitrijevic, 2015). Local citizens have formed a group named Transition Linlithgow (Transition Linlithgow, n.d.), inspired by the 'Transition Town' concept outlined by Hopkins (2008), who suggested various ways in which communities can become more resilient through local generation of energy from renewables; local food production; different organisation of healthcare; use of local building materials; reduction and reuse of waste; and other activities that communities might initiate according to their social, economic and environmental context. In Scotland, there are 15 Transition Town 'official groups' in cities and smaller towns (Transition Scotland, n.d.).

In collaboration with researchers, the Transition Linlithgow group proposed the development of an information, decision-making and community engagement portal. The citizens suggested that the objectives of such a portal should be to provide access to data, share and visualise data, create value, maximise opportunities and highlight challenges. They indicated that key functions of the proposed portal should be: (a) sharing and visualisation of data required for decision-making on sustainable living and development; (b) related decision-making tools; and (c) opportunities for citizens' interaction.



SMART ENVIRONMENTAL PROTECTION

Strategies and plans for environmental protection rely on baseline data on environmental conditions. The Scottish Government has initiated a range of actions aimed at reducing local and global environmental impact by tackling climate change, moving towards a zero-waste Scotland and increasing the use of renewable energy (Scottish Government, n.d-b). Information on environmental monitoring and data is published on the Scotland's Environment website (Scotland's Environment, n.d.). An example of the data available on the Scotland's Environment website relates to the monitoring of pollutants. It provides a map with the location of pollutant facilities, the sector in which they operate, and the number of such facilities in each year. More detailed data is also available, including quantity of releases, type of pollutants, release medium, etc.

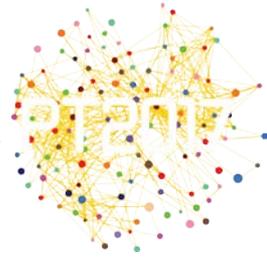
Environmental protection in cities is focused on the quality of air and water, and on the protection of biodiversity. Greenspace Scotland has been established to promote the use and maintenance of informal green spaces in cities and towns (Greenspace Scotland, n.d.). They support community projects, and provide services and advice for creating and maintaining green community spaces.

Air pollution levels across Scotland are updated hourly and the data is provided on a dedicated website (Air Quality in Scotland, n.d.). As the main source of air pollution is from the transport of goods and people by petrol-powered vehicles, the solution lies in the transition to low carbon transport such as electric vehicles, trams, trains, etc. Edinburgh has recently introduced electric trams. Glasgow provides 400 bicycles for rent, and electric charging for vehicles is gradually being introduced. Digital access enables smarter use of vehicles, with 'car pooling' websites through which drivers can invite potential passengers to join a journey for a small fee (Bla Bla Car, n.d.). The car-sharing programme Developing Car Clubs in Scotland was launched in October 2010, funded by Transport Scotland, the national transport agency for Scotland (Car Plus Bike Plus, n.d.). It provides information on and links to car-sharing clubs.

The quality of drinking water across Scotland is monitored by Scottish Water, which alerts the population if drinking water in an area has been polluted (Scottish Water, n.d). Information and advice on flood protection and management are provided through the website of the Scottish Environment Protection Agency (SEPA, n.d.).

SMART CITY FOR SOCIAL EQUALITY

The 'smart city' concept is also used to improve social equality in Scotland. Social equality comprises a range of social issues, but the focus here is on equal access to goods and services through digital connectivity. Digital connectivity provides various opportunities and advantages, such as increasing social inclusion via digital access skills; informing on local food production and waste reduction; new methods of providing health services; easier access to education; easy access to information about employment opportunities; increased safety of urban areas; and sharing of resources and skills through 'collaborative commons'. The Digital Glasgow Roadmap, a strategy for providing digital access across the city, was published in 2014 (GCC, 2014). The aim of the digital access strategy is to provide digital infrastructure and training to enable citizens to use and produce online goods and services.



As digital access is not always affordable to people on low income, local hubs are set up in social housing areas to provide training for the use of digital technology. The Glasgow Housing Association has set up 36 local digital hubs (GHA, 2016).

Digital connectivity enables the flow of information regarding opportunities for local food production and urban agriculture. Scotland has a strong tradition of urban agriculture on allotments - the land within cities provided for this purpose. The Community Empowerment (Scotland) Act 2015 includes a statement that 'any person may make a request to the local authority in whose area the person resides (a) to lease an allotment from the authority, or (b) to sublease an allotment from a tenant of the authority' (Scottish Government, 2015). The website of the Scottish Allotments and Gardens Society provides gardening advice, support, and relevant information to urban gardeners (SAGS, n.d.). Information and advice related to the reduction of food waste and the collection of unused or left-over food is provided through a dedicated website (Love Food Hate Waste, n.d.).

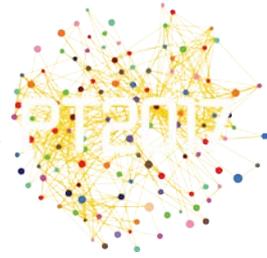
The development of digital technologies which can be used in health care is rapidly expanding. The Digital Health Care Institute brings together 'people and organisations in the health and social care, charity, technology, design and academic sectors to develop new ideas for digital technology that will improve the delivery of health and care services for the people of Scotland' (DHCI, n.d.). Digital technology enables a delivery of health service at a patient's home, which is both convenient for the patient and cost-effective.

Regarding the use of digital technologies to improve education, the Scottish Government published its strategy for Enhancing Learning and Teaching Through the Use of Digital Technology in September 2016 (Scottish Government, 2016). The strategy aims are: to develop the skills and confidence of teachers; to improve access to digital technology for all learners; to ensure that digital technology is a central consideration in all areas of curriculum and assessment delivery; and to empower leaders of change to drive innovation and investment in digital technology for learning and teaching. The University of Strathclyde in Glasgow launched the Flexible Learning Centre in November 2016 to support the development of online undergraduate, postgraduate and continuing development courses (FLC, n.d.). This new capability will enable access to higher education for future students both nationally and internationally, and reduce the cost of education.

Digital connectivity enables people to find information about jobs available in Scotland through the website s1jobs.com. Information is provided according to region and job categories. Information about locally-available resources and skills in Glasgow can now be easily found on a local website (Gumtree, n.d.). This is an example of the traditional social, collaborative, sharing economy, being boosted by digital technology.

CONCLUSIONS

The opportunities arising from the application of the 'smart city' concept in urban regeneration include: improving regional, national and international digital connectivity of urban areas in need of regeneration; developing an ICT/IoT-related economy and employment; opening up opportunities for entrepreneurs to develop innovative business services based on ICT/IoT; and improving the efficiency of services and quality of life to boost the regeneration of neglected urban areas.



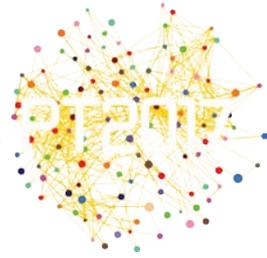
Smart environmental protection begins with the development of smart monitoring strategies. Smart monitoring and online availability of data are the next step, followed by data analysis and development of related decision-making tools. Following the application of decisions, further improvements can be made to decision-making tools, once feedback has been obtained on their effectiveness and impacts.

Digital connectivity provides various opportunities for improving social equality. This paper provided some examples of the use of digital technologies to increase social inclusion; inform on local food production and waste reduction; develop new methods of providing health services; provide easier access to education and information about employment opportunities; increase the safety of urban areas; and share resources and skills in Scotland.

While it is relatively easy to manufacture sensors and transfer data to decision-makers, the development of data representation, analysis, decision-making tools, decision communication to the stakeholders, monitoring of the effectiveness of decisions and their impacts, and providing feedback to the decision-makers are areas which currently require new research and development.

REFERENCES

- Air Quality in Scotland. nd. Accessed April 5, 2017. <http://www.scottishairquality.co.uk/>.
- Bla Bla Car. nd. Accessed April 5, 2017. <https://www.blablacar.co.uk/>.
- eBuilding Standards. nd. Accessed April 5, 2017. <https://www.ebuildingstandards.scot/eBuildingStandardsClient/default.aspx>.
- Car Plus Bike Plus. nd. *Car Clubs in Scotland*. Accessed April 5, 2017. <https://www.carplus.org.uk/projects/car-clubs-in-scotland/>.
- Digital Health Care Institute. nd. Accessed April 5, 2017. <https://dhi-scotland.com/>.
- Dimitrijevic, Branka. 2015. From transition towns to smart cities: opportunities and challenges, *Computers and Law*. 26, 2, p. 26-28.
- Fix My Street. nd. Accessed April 5, 2017. <https://www.fixmystreet.com/>.
- Flexible Learning Centre. nd. Accessed April 5, 2017. <http://www.strath.ac.uk/engineering/flexiblelearningcentre/>.
- Future City Glasgow. nd. Accessed April 5, 2017. <http://futurecity.glasgow.gov.uk/>.
- Future City Glasgow. nd. *The Cycling App*. Accessed April 5, 2017. <http://futurecity.glasgow.gov.uk/active-travel/>.
- Glasgow City Council. 2014. *Digital Glasgow Roadmap 2014*. Accessed April 5, 2017. <https://www.glasgow.gov.uk/CHttpHandler.ashx?id=18230&p=0>.
- Glasgow Housing Association. 2016. *35th free digital centre opens in Toryglen*. Accessed April 5, 2017. <https://www.gha.org.uk/about-us/media/latest-news/35th-free-digital-centre-opens-in-toryglen>.



- Greenspace Scotland. nd. Accessed April 5, 2017. <http://greenspacescotland.org.uk/>.
- Hopkins, Rob. 2008. *The Transition Handbook: from oil dependency to local resilience*. Cambridge: Green Books.
- Love Food Hate Waste. nd. Accessed April 5, 2017. <https://scotland.lovefoodhatewaste.com/>.
- Rifkin, Jeremy. 2011. *The Third Industrial Revolution: How Lateral Power is Transforming Energy, the Economy, and the World*. New York: Palgrave MacMillan.
- Rifkin, Jeremy. 2014. *The Zero Marginal Cost Society: The Internet of Things, The Collaborative Commons, and The Eclipse of Capitalism*. New York: Palgrave MacMillan.
- Scotland. nd. Accessed April 5, 2017. <http://www.scotland.org/about-scotland/facts-about-scotland/population-of-scotland>.
- Scotland's Environment. nd. Accessed April 5, 2017. <http://www.environment.scotland.gov.uk/>.
- Scottish Allotments and Gardens Society. nd. Accessed April 5, 2017. <http://www.sags.org.uk/>.
- Scottish Environment Protection Agency. nd. Accessed April 5, 2017. <http://www.sepa.org.uk/>.
- Scottish Government. 2011. *Scotland's Digital Future: A Strategy for Scotland*. Accessed April 5, 2017. <http://www.gov.scot/Resource/Doc/343733/0114331.pdf>.
- Scottish Government. 2015. *Community Empowerment (Scotland) Act 2015*. Accessed April 5, 2017. <http://www.legislation.gov.uk/asp/2015/6/contents/enacted>.
- Scottish Government. 2016. *Enhancing Learning and Teaching Through the Use of Digital Technology*. Accessed April 5, 2017. <http://www.gov.scot/Publications/2016/09/9494>.
- Scottish Government. nd-a. *Place Standard Tool*. Accessed April 5, 2017. <http://www.placestandard.scot/#/home>.
- Scottish Government. nd-b. *Environment*. Accessed April 5, 2017. <http://www.gov.scot/Topics/Environment>.
- Scottish Water. nd. Accessed April 5, 2017. <http://www.scottishwater.co.uk/>.
- Transition Linlithgow. nd. Accessed April 5, 2017. <http://transitionlinlithgow.org.uk/>.
- Transition Scotland. nd. Accessed April 5, 2017. <http://transitionscotland.weebly.com/about.html>.
- UN-Habitat. 2015. *Global Housing Strategy: Repositioning Housing at the Centre of the New Urban Agenda*, UN-Habitat, Nairobi.
- United Nations. 1992. *Agenda 21*. United Nations Conference on Environment & Development Rio de Janeiro, Brazil, 3 to 14 June 1992. Accessed April 5, 2017. <https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf>.