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To cite this article: B Körmöndi *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **323** 012024

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The secret ingredient – the role of governance in green infrastructure development: through the examples of European cities

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Abstract. The first signs of considering green infrastructure in the process of urban planning appeared long before WWII with the developments of Chicago and Paris, for example, in the late 19th century. In order to relieve the increasingly crowded centres of fast-growing cities, the afforestation of public spaces and the creation of more liveable existing spaces became increasingly important; this includes the development and renovation of parks and water surfaces to adapt to urban needs and requirements, making the development of urban green infrastructure more important than in the past. Over time, green infrastructure developments grew more detailed and complex; since the end of the 20th century, they have become one of the most important goals of urban development, focusing on the environment and healthy living conditions. In the early stages of project development, the needs of urban residents and the active utilisation of green areas are factors of growing importance; refining design and construction has also become a more intricate process. Significant changes to the original style of plans has taken place over the past decades, evolving with the needs of the era and technological advances, requiring suitable action to maintain pace with enhanced developments.

1. Introduction

The increase in city dwellers and the expansion of urban areas has been an accelerating process since the industrial revolution. The development of urban habitation was most significant in the twentieth century. In 1900 there were 16 cities with over 1 million inhabitants (Montgomery et al. 2003), and in 2010 this number grew to 449 as a result of the continuous urbanisation process. These changes in urban development are mainly due to social and economic transitions that have occurred in the last 150 years. The dimension of urbanised areas has also grown immensely (Seto et al. 2014; UN 2018), due to the population increase in cities. New socio-economic factors have recently brought about novel urban patterns usually put under the term polycentric development (Clark 2003). As a result, the structure of suburban areas has changed (new industrial, logistic and residential areas have been erected within a very short time), and thus new forms and functions – mainly due to digitalisation and post-Fordist economic transformation – have appeared.



Suburban areas usually occupy territories with traditional green belts around cities, resulting in enormous and contiguous urban areas; this increases both the territorial dimensions of urbanised areas and the diameter of urban heat islands. In fact, the Urban Heat Island (UHI) (Unger 1999), is one of the most important challenges to address. An urban heat island is traditionally defined as closed isotherms that delineate an area warmer than its surroundings (Unger et al. 2010; Voogt and Oke 1997). UHI is a complex result of various interrelated phenomena (Unger et al. 2000). Among many, one cause of the urban heat island is global warming, which has steadily accelerated in past decades; however, disappearance and lack of surfaces with cooling effects due to expansion of built areas and new trends in urban design are among the key factors. The effects of an urban heat island become particularly unbearable in summer when heat stress occurs. Besides this, a related index contains significant by measurements of UHI with satellite imagery - this is the NDVI (Normalised Difference Vegetation Index) (Chen et al. 2006; Dezso et al. 2005; Owen, Carlson, and Gillies 1998).

There are many other concerns in urban areas. First, cities usually have a great deal of sealed surfaces which enable quick stormwater runoff, causing severe problems such as infrastructure overload, quick evaporation, and a low albedo. According to Oke (Oke 1987), cities tend to have an albedo 5-10 per cent lower than the surrounding rural areas. Second, from a social perspective, traffic is believed to be a major, if not the biggest, source of stress in our lives. (APS 2008). Third, those living in less developed neighbourhoods are particularly vulnerable, as they have limited access to good quality green areas and housing estates tend to be of poorer technical conditions. Finally, and importantly, urbanisation has a negative effect on biodiversity (McKinney 2006).

2. Aims of research

The aim of this paper is to collect and analyse the processes that lead to successful green infrastructure development in the cities of London, Copenhagen, Budapest and Graz. The hypothesis posits that success lies not only in the coherence and consistency of plans, but also in governance that ensures the implementation of community priorities. To underline this, an investigation of strategic plans, governance and participation projects was conducted. The intention is to find differences and similarities on how the four cities are reacting to the drastic changes of recent decades, such as the ongoing urbanisation process and climate issues described above.

The main driver of this study was to check the effectiveness of different approaches towards green infrastructure planning and highlight those planning and governance tools that led to success in the past.

3. Methodology

In order to analyse the current situation of green space development, a multi-method approach was used. This was mainly carried out by literature research (studying documents, webpages and other grey literature). For this, operative and valid plans of the investigated municipalities and linked organisations were analysed. Aside from plans, policy implementations in each city were examined, which gave a rough impression on the process of green space management; however, local characteristics could also be understood through examining the green and nature-based projects of linked third parties and non-governmental organisations. A society's sensitivity can be also measured through bottom-up projects not directly initiated or funded by the local authority and not linked to official processes. Civic engagement into municipal decision-making processes is an issue not only in planning activities but also in managing green spaces. Based on these understandings and through the literature review, a framework of key factors for success in green development was constructed. For a graphic organising and explaining these factors, see *Figure 1*, below.

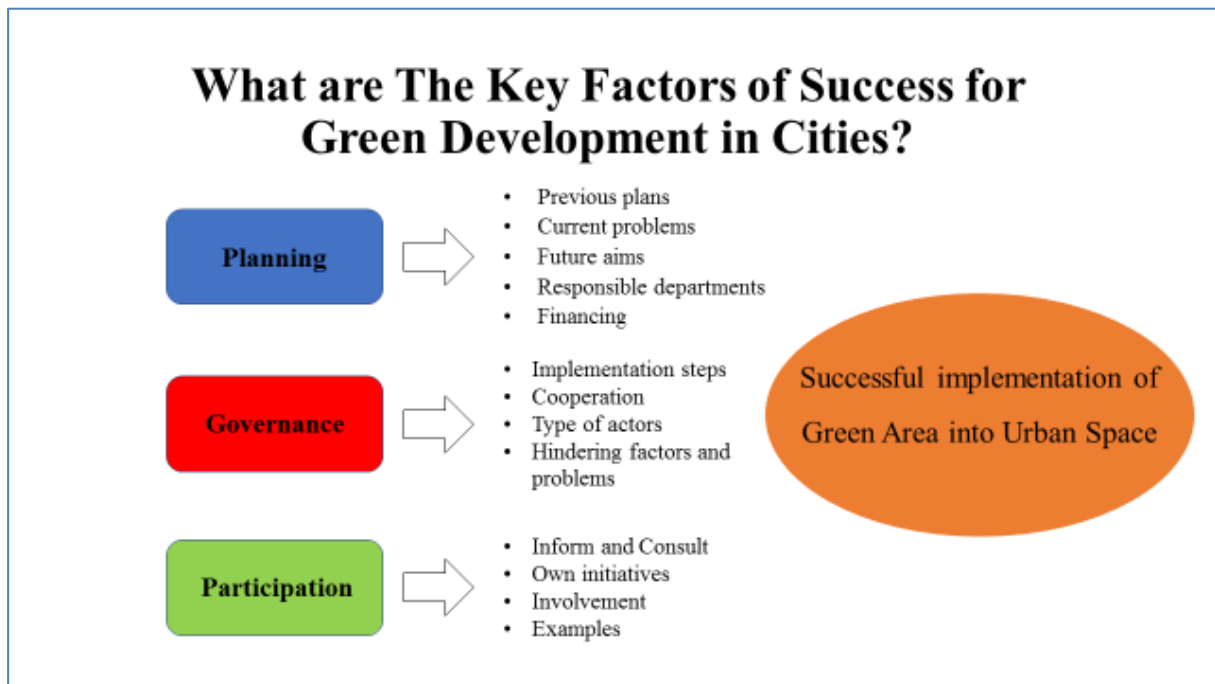


Figure 1: Key Factors of Success for Green Development in Cities; Developed by Jennifer Tempfli

Given these factors, comprehensive interviews were conducted with partners involved specifically in green infrastructure planning within municipalities. From the four selected cities, two partners answered; therefore, the Greater London Authority and the Green Office of the 12th District of Budapest were approached. During the interviews we focused on the following topics:

- What is the main political motivation towards nature-conscious or green infrastructure planning?
- What is the governmental background of green planning at the municipality?
- What is the financial background of plans?
- Which types of actors are involved and to what extent do they have a hand in the planning process?
- To what extent can residents participate in programs and how successful is this involvement?
- Are there any issues that hinder or cause problems in the participatory process?

4. Understanding the planning context

To understand the context of green infrastructure planning, differences and similarities in planning must be highlighted. Europe has a long history of urban planning that differs due to the varied history, culture, economics and social development of the countries. We can distinguish four different planning traditions according to the literature (European Commission 1997; Newman and Thornley 1996; Williams 1984). The four traditions originated from different countries; however, during the European integration of planning systems, they have become widespread and a country's planning is surely influenced by more than one approach. *Figure 2* highlights the four distinct traditions and the countries that utilise them. We will explain the various plans in the context of our focus cities in greater detail below.

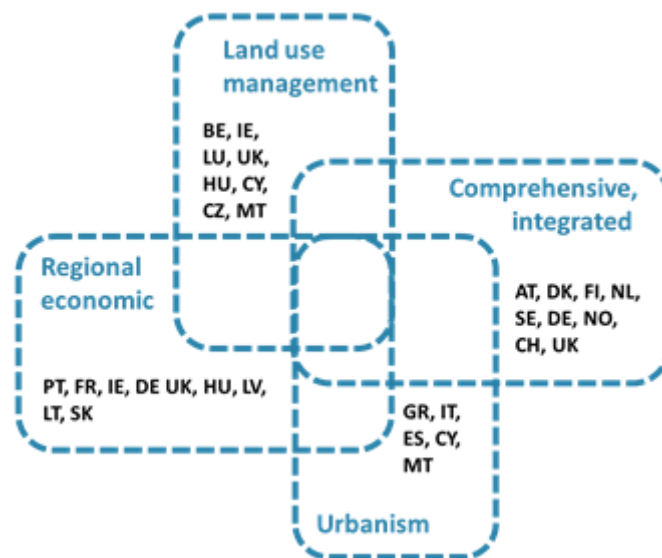


Figure 2. The four planning traditions of Europe. (Salamin 2018)

London represents the *land use management* approach, which emphasises the regulation of changing land-use by utilising strategic and local plans. This approach focuses on the management of physical space by applying urban planning tools as regulations. In this respect, green infrastructure planning is a basic and well-used tool to influence land use. Green infrastructure planning exists on multiple scales: regional (for example, Abercrombie's *Greater London Plan*, 1944), local and object scales (where the share of green space is defined when giving a planning permit). One should also not forget the importance of neighbourhood planning in the UK, in which Ebenezer Howard left an influential legacy (Howard, 1902).

Copenhagen's Fingerplan is one of the most famous urban plans in Europe and has been a success story due to its easy-to-understand metaphor: using a human hand to cover urban patterns (Vejre, Primdahl, and Brandt 2007). The Finger plan was established in 1947 and emphasises that Danish planning systems are characterised by a *comprehensive integrated* approach, a Dutch tradition that involves the various tools of space-shaping. The focus lies in the spatial effects of policies and the coordination of actors and sectors; further, vertical and horizontal coordination is highly important.

Austrian planning is also based on a *comprehensive integrated* approach. Spatial planning is the autonomous responsibility of the states, but the plans are only binding for state administration and public administration at the lower levels. Municipalities and cities have autonomy in local planning. They have enacted three plans: Local Development Programme, a strategy plan determining the needs of communities; the Zoning Plan, defining the types of use for different spaces; and the Development Plan, which defines the requirements of buildings on a plot-scale.

Hungarian planning is nearest to the *land-use management* approach. However, in Hungary, physical spatial planning is very much divided from urban development planning. This duality is well represented in the fact that physical land-use planning and building control activities are regulated, but urban development activities are not well defined. Green infrastructure planning usually is represented in conceptual planning. Deficiencies occur because overall concepts should be broken down into smaller levels and scales of decision-making. Recently, many small-scale green projects have been implemented; however, it is still difficult to integrate plans to achieve connectivity of green spaces through the city. Regarding Budapest, the capital city (also an independent municipality) is divided to 23 district local authorities. This leads to multiple problems, especially in green infrastructure management.

4.1. Historical overview

London and Copenhagen were the first pioneers in terms of urban green planning in Europe in the 19th and 20th centuries, respectively. More space for better provisions and infrastructural function were among the main concerns, as huge growth in the city's population was expected in the coming years. London's first attempts towards a green planning were made in 1829 when the "Breathing Places Plan" by John Loudon was published (Johnson, 2012). He was initiating a tenfold expansion of the city and planned on implementing infrastructure for water, gas, fresh air and removal of filth, while planning alternate rings of green space around London. This was pursued later in Abercrombie and Forshaw's County of London Plan (Forshaw & Abercrombie, 1943), which focused on the quality of green spaces, their separation from industries and the cultural relationship. These plans are considered the cornerstone of London's green space development. London's Green belt came to existence in 1955 and the whole planning of the city was aligned with the concept.

A similar approach is represented in Copenhagen's Finger plan. The Finger plan was established in 1947 (Cervero 1998), and aimed mainly to manage a mass of commuters in the area and provide suitable places for industrial and commercial activities. Today, the master plan affects over 30 municipalities in the metropolitan area of Copenhagen. The importance of the Finger plan in green space network development is that the plan designated the areas between the "fingers" as green spaces, preserving them from urban sprawl, creating well-defined green corridors around the city. The finger plan concept was later adapted by Helsinki and Stockholm. Looking at the development of the last years, we can see a clear focus of the city's policies. The aim is to enable people to stay in public places and use them for a multitude of activities. But also, the green spaces should be liveable and accessible for tourists and residents. Future needs of modern businesses must also be considered. Copenhagen puts a big emphasis on the disassembling of open spaces and its accessibility for people. Copenhagen even received the Green City award in 2014. The city's overall aim is to combine natural and urban development to impact people's well-being on a long-term basis.

In 1989 a regime change took place in Hungary, and this shift from the previous socialist regime led to big changes in the country. Urban areas were in want of green space and Budapest itself was densely built without equally distributed open spaces. The city offers great potential in restructuring brownfield areas that are located throughout the city, especially in a ring around its eastern parts (Kocsis, 2015). The utilisation of these places promises to transform regions partly used for green spaces and would, at the very least, integrate green infrastructure. Research has been done on this topic, and first attempts at implementation are already occurring. Other potentials can be found in widening river fronts or improving parks. Further, existing parks located in the city centre can be rearranged or provided with other functions that contribute to the greening of the city. Similar measures were part of local plans in several districts of Budapest, in an effort by local authorities to address the greening of the city. But also, several policies were set up by the capital municipality to make Budapest more adaptable to address the issues of urban heat island, climate change and lowering greenhouse emissions. Since one solution for these problems is to integrate green spaces, there is a large focus in this area.

Looking at Graz, we see parallels in the development of cities and green areas over time, but these areas were not planned in the same extent as in the other cities. The central green are of historical significance and are still the most important and frequently used nowadays (Hlawka, 1990). The city of Graz also has developed several campaigns for greening the city, while supporting other campaigns with similar aims. The city relies on already existing resources and green areas, with attempts to improve or reclaim them. The aim is to bring green areas closer to the citizens and develop an average area of 3 -10 square metres per person.

4.2. Governance

Although development policies initiated by city councils are usually based on green development, other actors should not be discounted, as they can have a large influence. Recent changes in development policy have raised. Especially the last years made a change in rising the awareness on environmental

problems like air pollution, and the involvement of other actors besides city councils can better address these concerns.

Governance is successful if the different levels of decision-making, planning and implementation are harmonised. While the governance of green infrastructure developments can be coordinated at city level, so individual projects can be harmonized to multiply the effectiveness of this process. All cities seek the best solutions and good practices, but conscious development requires a lot of time.

For example, in London, the Greater London Authority (GLA) is mostly responsible for the key planning. In order to increase their impact, the Authority frequently exchanges and collaborates with London's boroughs and other non-profit organisations. Since subsidies for green infrastructure projects have increased in recent years, it is important to find applicable solutions to problems related to green infrastructure and flood management. Also, we see that economic players have a larger role in green infrastructure development; these are players willing to invest in green development based on individual aims of companies and the results of cost-benefit analyses. Additionally, housing association owners that invest money into measures like green roofs in order to profit from rising rent prices, fall into this category.

Emanating from London's example, we see that all four cities use extensive concepts and policies. Since it is not always possible to reach project aims with city plans alone, due to city size and growth, other actors need to be involved. These actors deepen involvement and help accomplish district-based initiatives and smaller project-focused plans through increased cooperation.

4.3. Participation

In recent years, several public engagement projects are partly cooperating with or financed by municipalities or other non-profit organisations. It is possible to see similar developments, in terms of public engagement, that are independent from countries or cities. These developments focus on initiatives like urban gardening, addressing environmental issues, but also contribute to the well-being of residents, as we can see in the 'Guardianship Programme' ('gondnokság program'), established by the Municipality of the 12th District in Budapest. The programme allows residents to take part in replanting and taking care of self-chosen green spaces in the district. The municipality develops a plan to manage these areas and provides tools and assistance in cooperation with professional gardeners. The challenge that the Green Office of the district has faced was to provide enough incentives to make people participate in these programmes. Changes have been made in the concept has changed since its first introduction, and it now aims at offering more transparency about the whole project and mediating between the municipality and the needs and goals of residents. In general, municipalities tend to focus on the improvement of ecological concerns, whereas residents are more inclined to focus on the enhancement of social well-being.

Besides, movements like urban garden initiatives have arisen in past years in many cities. Topics like air pollution and concerns about urban heat islands have been gaining weight and presence in urban discourses. These concerns may be different and dependent on local resources and circumstances, but we still see increasing environmental awareness in society as a whole. As a result, people are more willing to take part in planning decisions. The number of private-led initiatives and collaborations in this vein are accumulating.

An example of a city-led campaign that involves the public relates to front-garden culture in Graz. It attempts to enthruse people to take part in revitalising these private areas with monetary incentives. Also, the project "Jacky_Cool_Jack" originated in the city. This project aims to override the urban heat islands in the Jakomini district, an area which lacks green infrastructure and spaces.

Table I. shows a selection of interesting projects from the cities where public engagement was essential.

City	Name of campaign	Aim
London	London Environmental Network	Supporting local Non-profit and community groups with an environmental focus
	Capital Growth	Supporting people to grow food in London, whether at home, on allotments or as part of a community group.
	Skip Garden at King`s Cross	A community garden that uses recycled materials and connects people of all ages and backgrounds
	Urban Farms in London	Urban Farms that make a positive impact on the environment and social well-being. Connecting people and creating communities
	South West London Environment Network (SWLEN)	Focus on preserving green spaces and biodiversity, promoting sustainability and supporting environmental groups
	Urban Bees	Encourage people and businesses to plant more pollinator-friendly trees and flowers
Graz	Bürgerinitiative für die Erhaltung von Grünflächen	Preserve south Graz from industrialisation. Make the area more liveable, improve the air quality and calm traffic pollution
	Mehr Zeit für Graz. Themengruppe Grün- und Stadtentwicklung	Preservation existing and safeguarding new urban green areas
	Several Urban Gardening Projects	Projects that are establishing urban gardens
	Förderung urbanen Begrünung	Promotion of urban greening like urban gardens, green roofs or walls
Budapest	Revitalization of Mátyás square	An initiative of the 8 th District of Budapest, which involved local people to plan and plant the open space of the square in a deprived area. Social security improved and the neighbourhood developed a lot through the project.
	Zöldfelület Gondnokság Program	Improve the green space in the 12 th District of Budapest (Hegyvidék) district with involving residents in the fostering process
	Revitalization of Teleki square	Transform the till then decrepit parc into a public parc with residents' participation. The project has an important social aspect. (8 th District of Budapest)
	Közösségi Kertek	Inform people about climate change and processes that harm the cities environment. Creation of about 30 urban gardens
Copenhagen	Urban Beekeepers of Copenhagen	Possibility to host hives and join events and skill training in return
	DYRK Nørrebro	Urban Farming Initiative in Copenhagen to expand vegetable cultivation. Focus on sustainability with the intention "think globally and acting local"
	GivRum	Facilitation of user-driven urban development with local communities. Social mobility and activation of local resources, people and stakeholder is intended.
	Outdoor Council	Request to spend more time in the nature and improve the circumstances and frame conditions for this
	KlimaKvarter Østerbro	Turn the neighbourhood into the greenest inner-city area and integration urban spaces, courtyards, buildings, streets and the neighbourhood within this

Table I. An overview of important participation projects in the four cities.

5. Results

Our analysis shows that **coherence of consistency plans** is an important part of the implementation of green space development. These plans are the cornerstones of implementation. We also need to consider that most plans were formulated around the beginning of the 20th century. As such, the whole process of green space implementation was more focused on architectural, and in some cases symbolic, values and concerns. This was minting infrastructural development, primarily. These plans were developed on a more objective basis due to geographical location and other circumstances.

As a result of the social and economic changes of the past centuries, the **planning process** has become more complex and involves more actors and fields than ever before. City councils are limited in different ways, such as lack of monetary support or other constraints; therefore, the complexity of social and economic situations requires that other methods and measures be found to ensure the integration of green areas into the urban infrastructure. This makes the involvement of other actors necessary in the entirety of the planning process. The question is: Are all affected people profiting in an appropriate way and have a say in the planning process?

In order to successfully introduce new structures, other local stakeholders or residents should be involved in the **participation process, especially in the case of small-scale projects**. The focus here lies on discovering and considering all the needs and interests that will influence the effectiveness of the implementation of the programmes. Moreover, people tend to favour such actions and take more care of the result if they feel their needs and interests are met. Transparency of all steps in the process is crucial to gain participation and acceptance for all involved actors.

From an interferential point of view, one must draw attention to the fact that cooperation has gained much weight in past years. Practice of green space planning is to incorporate, and make essential part of, cooperation and combined efforts of stakeholders and local actors. For a good implementation, the right communication with transparency is important, since the size of cities and the dissimilarities and distinct characteristics between districts, for example, may create a big difference.

A novel phenomenon of recent years is the connection of green infrastructure and climate issues in planning. In the past, green areas were more preferred in residential quarters mostly due to aesthetic values, but nowadays the positive effects in abating negative effects (e.g. heat in summer and cold in winter, dust and noise) have been realised, and thus green infrastructure has become an acknowledged measure in urban planning against climate issues.

Acknowledgements

The authors wish to acknowledge a Fulbright Student Research Award from the Fulbright Commission for Educational Exchange which enabled scientific exchange between the Hungarian Urban Knowledge Centre and the University of Tennessee.

János B. Kocsis's work was completed in the ELTE Institutional Excellence Program (783-3/2018/FEKUTSRAT) supported by the Hungarian Ministry of Human Capacities.

The authors acknowledge the essential help of Peter Massini, the Greater London Authority's Green Infrastructure Principal Policy Officer, who shared valuable knowledge and information about GLA's green infrastructure management.

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