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Compactness is Not Enough: Development and Trends of a Sustainable Urban Concept

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Abstract

The changing concept of sustainable development is changing the practice of designing sustainable urban forms. The article presents a variety of concepts of a sustainable urban form and their ambiguous assessment – the model of a compact city, if applied in all cases, can cost the quality of one's environment and the quality of life. New bottom-up trends are emerging in theory and in practice of the 21st century, which focus on the urban planning process which is more inclusive in terms of society. The article discusses examples of the creation of a sustainable urban narrative for the development of a relationship with the community.

Introduction

The desire to steer urban development toward sustainability is particularly relevant in various academic fields and is especially important in the context of today's socio-ecological stress. The idea of sustainable development, derived from the growing awareness of the environmental crisis caused by human activity, was one of the most influential forces in the development of cities at the end of the 20th century. However, these days the term 'sustainability' in scientific literature and practice is becoming a loud, fashionable word that is often used inexpediently and carelessly, concepts are manipulated, some claims are based on assumptions only [1, *209*], with all of this necessitating the rebirth of the idea of sustainability. A New European Bauhaus movement, that started at the end of 2020, also leads us to rethink this concept [2]. The way in which we understand the phenomenon of sustainable urban development and measures that shape a sustainable environment is reflected in cities and in the planning process [3, *5*].

This article presents a study of the 20–21st century literature and reviews the following issues:

- Evolution of the notion of sustainable development and the variety of concepts.
- Contradictory assessment of sustainable development strategies.
- Trends in the 21st century – sustainable urban form and / or sustainable process.
- Principles of designing for sustainable future.

The article seeks answers to the following questions: how models and strategies of a sustainable urban form are considered today? What ideas hide behind the term of sustainable development in the 21st century and how it changes the designing practices of an architect-urbanist?

This article is limited to the most important ideas of the authors considered, which help to reveal the variety of sustainable urban concepts and modelling principles, but a more in-depth study is needed to explore these models in more detail. The aim of the research in this article is to overview the evolution of the notion of sustainable development and then to define the emerging trends in the principles and methods of modelling a sustainable urban form in the 21st century.

I. Evolution of the Notion of Sustainable Development and the Variety of Concepts

Concerns about the gradual loss of natural resources and the loss of fertile land have been observed since ancient times [4, *85–86*], but it is only in the 18th century, in the face of the effects of the industrial revolution, that the idea of sustainability is considered to be a leap in the human

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morality – the abandonment of the ideology that man is at the top of the pyramid forming the nature's system and nature is only intended for achieving the highest economic success [5, *178–180*]. The emerging local and global environmental problems, the sharp increase in the population at the end of the 18th century and in the 19th century are reacted to in historically important works [4]: in order to eliminate the threat of food shortages, Y. Malthus offers regulation of population numbers; W. S. Jevons urges to reduce wasteful use of coal, not only because this main source of fuel is non-renewable and potentially would be exhausted in 100 years, but also because England may lose its dominant position in industry; in 1864, G. P. March in his study "Man and Nature" expresses concern that the Earth can become no longer suitable for people's normal life. These and other ideas of the 18–19th centuries inspired the contemporary nature preservation movements and had a great impact on the evolution of the notion of sustainable development, but they originated from diplomatic and pragmatic motives rather than from the belief that nature is to be protected *per se* [4, *87*].

In the second half of the 20th century, ideas about progress, population, economy and development were highly controversial. On the one hand, economic development and technological progress after World War II once again became a source of optimism and hope for a brighter future: ecological problems and resource depletion problems have remained in mind, but it was considered that in the future the lack of resources would be solved by new achievements of the humanity [6, *17–18*]. On the other hand, since 1960, humanity has been intimidated by scientific works popularized by various media, which predicted a crisis, often a catastrophe, which gave the shudders and lead one to despair. This ideological conflict derived from the belief that development (increasing use of resources) and preservation (conservation) of nature are mutually contradictory ideas [4, *91*].

It was amid this conflict that a compromise was born – ideas of sustainable, growing society, which is not a threat for future generations, and of alternative development. The definition of sustainable development, officially recorded in the Brundtland Report 1987, describes sustainable development as one that guarantees people's welfare in the present without compromising the possibilities of people's welfare in the future [7]. The emergence of this definition was a push for discussions on the form of cities and encouraged researchers and practitioners in various disciplines to look for ways to improve the usual urban planning practices, which are perceived as the major source of environmental problems [8, *1–4*]. The resolutions of the UN's World Commission on Environment and Development were and continue to be criticized mainly for two loopholes: firstly, the ideology of economic growth is not questioned and consumption culture is not challenged [9, *1741*], [10]; secondly, the sustainability criteria have not been formulated and, as a result, the advocates of economic growth and materialism are able to use ideas of sustainable development for their own purposes [5, *142–155*]. The vague definition makes it possible to sell allegedly 'sustainable' products, services, while at the same time develop territories under the guise of fashionable words [11, *1296–1299*], [12, *73–76*]. This paper raises the question what urban form is really sustainable, in other words, what theoretical principles and tools for urban modelling achieve the lowest energy consumption and reduce pollution levels, as well as solve other sustainability related problems.

Y. Jabareen [13], through thematic analysis, has identified seven principles of urban modelling which are linked to sustainability: (1) compactness; (2) sustainable transport; (3) density; (4) mixed land uses; (5) diversity (in terms of functions, building-up and types of buildings, age, social groups, cultures, etc.); (6) use of systems of renewable energy sources; (7) 'greening' or modelling of green public spaces. Four concepts of sustainable urban form were also distinguished: neo-traditional urban development, policy of containing development, eco-city model, and compact city model which was considered by the author as the most consistent with the idea of sustainable development [13, *47*]. The diversity of concepts of sustainable urban forms is based on various combinations of and causal links among the above principles, which are revealed at different spatial levels: (1) region and city clusters; (2) city; (3) city district, neighbourhood and community; (4) building groups and scales of a building. The four concepts identified by Y. Jabareen are further analysed in this paper as mutually significant different theoretical models that reveal the variety of approaches towards sustainability.

One of the neo-traditional urban development movements – *New Urbanism* – focuses on the scale of the city district, neighbourhood and community [14]. It is argued that the sustainable design of the living environment, abundant greening of narrow and attractive streets, permeability and vitality of urban fabric, i.e., the diversity of functions, types of building-up, social groups and cultures, leads to a sense of community awareness, which encourages active participation in social life and walking [15], [16]. *Sustainable transit-oriented development*, another neo-traditional urban development movement, focuses on the optimal model of the transport system in a city cluster and in a city. It is argued that the development needs to be concentrated and the population density increased around important hubs of transport infrastructure, train stations and public transport routes, which increases the population's tendency to use modes of transport alternative to one's own car [17]. *Development containment strategies* offer efficient use of areas as a basis for sustainable development: setting boundaries of geographical development on the regional, city cluster and city scale, such as: greenbelt or urban growth boundaries

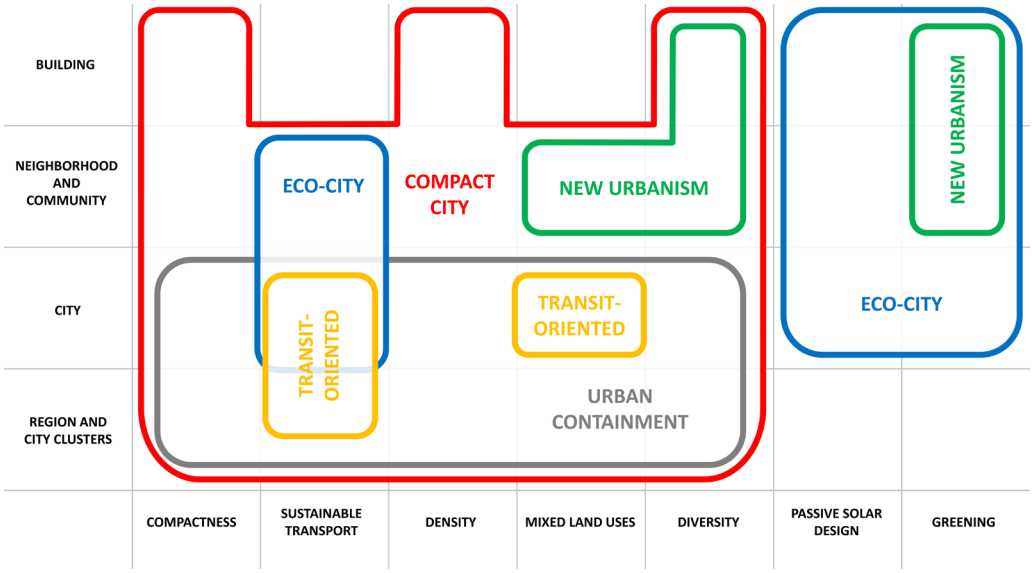

Fig. 1. The variety of concepts of sustainable urban form is created by different combinations of seven sustainability-related urban modelling principles and the application of these principles at different spatial levels (created by Authors, using [13]).

ensure the preservation of agrarian and natural areas, prevent the chaotic expansion of a city, which naturally leads to compactness, density and multifunctionality of areas in the central parts of the city, which allows efficient use of sustainable transport possibilities [18], [19]. The *eco-city* model describes a large group of strategies that focus on the use of renewable energy systems and modelling of green urban spaces, water management. The eco-city does not appear to be a specific urban form, but it stresses the importance of sustainable community: it is argued that the sustainability of a city is achieved through a society-inclusive development process, integrating ecological, social and economic solutions, which promote sustainable behaviour in everyday environments [20], [21], [22]. The *compact city* model suggests that sustainability issues should be addressed by the compactness and density of territories: a concentric city contributes to the preservation of agrarian and natural areas, the efficient organization of public transport, better accessibility of services and institutions increases the attractiveness of cycling and walking [23, *83*]. Concentrated areas also have a variety of functions, cultures, social groups, which is linked to social equality, reduced social segregation, better opportunities for low-skilled workers [24], [25].

The above-discussed concepts of sustainable urban form are summarized graphically in Fig. 1. There is no single model of sustainable urban form yet that would attach equal significance to all sustainability related principles at all spatial levels. It is also significantly important that most of the strategies aim to achieve 'sustainable transport' as a final result, for example: the supporters of neo-traditional urban development and 'eco-city' say that convenient streets, which are safe for walking, and attractive neighbourhoods result in a wish to choose alternatives to a car, but it is expected that using a compact city model or development containment strategies the compactness and intensity of the city will in itself create favourable conditions for sustainable movement because 'everything is nearby'. Various theoretical models attempt to understand and explain how and if urban form can solve environmental issues, but there is no single answer.

II. Contradictory Assessment of Sustainable Development Strategies

A sustainable city was defined by various scientists until 2000 as a user-friendly city, which is resourceful not only in its form but also in ways of achieving energy efficiency [25, *12*], which ensures social justice [25, *203*] and welfare [26] not only for this generation but also for future generations. But social justice, equality, welfare, and sustainability in cities referred to in the definitions have so far been addressed mainly through the prism of sustainable movement and use of resources and fuel and, therefore, they are directly linked to compactness of a city. Although most of the links between the compact form of a city and sustainability are kind of self-explanatory, their validity has not yet been fully studied, and contrasting consequences have become evident over the past two decades.

First, the compactness achieved through making a city denser in its central part may lead to the loss of green and open areas of the city, the variety of public spaces, the habitat of living organisms, including trees, shrubs, and private gardens, which reduces the tendency to move on foot [27]. It is also argued that the compact form of a city creates favourable conditions for better accessibility of services and institutions, thus increasing the attractiveness of cycling and walking. In dense, multifunctional areas, a decrease in the number of car trips for small purchases is observed, however, the

compactness does not reduce the habit of using a car or other means of transport for leisure and more varied shopping possibilities [28], [29, *41*]. The likelihood of a job being very close to one's place of residence is relatively low; therefore, multifunctional, compact territories do not contribute to better accessibility of specialized work places [29, *40*]. The main criticism is for the assertion that compactness promotes social equality, reduces social segregation, creates better opportunities for low-skilled workers, ensures social protection, and other assertions in connection with fundamental human rights. The consequences of the compact urban form, which are contrary to the 'social' aspect of sustainability [30]: worse health – general, mental and especially of the respiratory tract; tendency towards decreasing inner living space; less affordable housing prices; worse access to green spaces; a new development in the formed historical urban fabric may be taken unfavourably, as it causes noise and traffic, which is considered having a negative impact on the quality of life.

In summary, the compact urban form can achieve the goals associated with sustainability, but compactness is not sustainable *per se* [31, *12*], [32]. The term, which is so often used in the field of architecture and urbanism, describes measures that are necessary but insufficient. Balancing the consequences of sustainable development strategies or identifying which indicators should be prioritized at different urban spatial levels is problematic. The choice of principles and means to achieve the desired result depend on political and professional choice of which concept of sustainability is most in line with the socio-cultural context of the 21st century and on spatial levels at which these means and principles will be applied.

III. Trends in the 21st Century – Sustainable Urban Form and / or Sustainable Process

The scientific literature of the 21st century already discusses not only the sustainable urban form, the definition of sustainable development encompasses the importance of the process as such and public involvement, as well as education, infrastructure support and encouragement of initiatives [30, *3*]. Sustainability is claimed to be a local, informed, inclusive process, in search of a balance that does not create problems beyond the boundaries of its territory [33, *293*]. A sustainable city is reflective – perfectly aware of the inner dynamics of the city, seeking to reflect its citizens, cultural and natural heritage [34], responsive to the needs of its citizens and flexible [35]. The compact city model, which is heavily criticized for neglecting social aspects of sustainability, can be truly sustainable if combined with a sustainable process that allows communities to be proud of their living environment and build it in dialogue with natural environment, using efforts to create local identity. Trends show that successful sustainability-enhancing strategies foster people's tendency to behave in a nature-friendly way and enable them to respond to socio-ecological change [36].

Sustainable behaviour is defined as voluntary actions which have a positive impact on the natural and general environment of human activity and on the society, groups of people, including oneself [35], and is divided into two categories: (1) environment-friendly behaviour, which is characterized by consumption restraint, resource saving, sustainable movement and recycling; (2) social and moral responsibility, which is characterized by maintaining health and safety, public order, local economy and by social ethics and justice. The behaviour-forming core, due to the limited scope of this paper, is considered to be the streamlined model A-I-D-A (Awareness-Information-Decision-Actions), where behaviour is the result of awareness, information and decision [38]. Awareness, psychological and socio-cultural background, which also includes psychological variables (age, gender, education, etc.), sustainable approach and prevailing norms of conduct are the object of psychological and sociological research, but the influence of providing information on sustainable behaviour can have a significant role in the designing practices of an architect-urbanist. With this in mind, it is concluded that there is no need for rational specialists of one field any more, but for planners who have a deep understanding of the various aspects of urban development and are ready to use various tools of providing information and to work with different stakeholders in collective processes to create sustainable communities that foster nature.

Three main aspects of information reception are pointed out, which have the greatest impact on behaviour and motivation [39]:

- People are motivated to know and understand what is happening; in other words, disorientation and confusion are demotivating.
- People are motivated to learn, discover and explore; they prefer to receive information at their own pace and answering questions they ask themselves.
- People want to participate, play an important role; in other words, incompetence and helplessness are demotivating.

On the basis of these aspects, new bottom-up trends focusing on people are emerging in practice [40]: involvement-based planning procedures, e.g., creation of a narrative, community surveys, study of local feeling, creation of public spaces of 'human scale'.

The next chapter of the article reviews a number of approaches that through involvement of the public contribute to the formulation of the objectives of a sustainable development strategy and to foreseeing consequences in advance.

IV. Principles of Designing for Sustainable Future

One of effective ways to bring about changes in urban form is to generate a narrative of a sustainable city – to simulate a concept of the future orally, in writing or visually [41]. This gives rise to several directions of research: research that develops the textual methodology of simulation and research that checks the application of visual and virtual simulation in architecture.

A. Textual simulation

One of the methods for developing a scenario for urban development is a *strategic conversation,* effectiveness of which was demonstrated by Australian scientists who have accumulated and described a wide range of experiences of creative workshops [34]. About 30–40 experts from various fields (environmental engineering, energy efficiency, transport engineering, urban design and planning), together with academics, consultants, entrepreneurs, regional and governmental representatives, water and energy service providers, and students were involved in the creative workshops. The conversation was centred around one question: "How could a city evolve and remain resilient to a variety of desirable and adverse developments in different future scenarios?" The main purpose of the workshops is to identify opportunities and risks, emphasizing the resistance of the urban structure to change, i.e., realizing that the future of cities cannot be fully predictable but can be steered toward the desired direction.

A difficult task in practice is to document the workshop process, systematize and make conclusions-results which would be counterbalanced in the academic field. It is proposed to coordinate workshops in the following stages [34, *224*]:

1) to identify the main question around which the entire workshop process would be centred;
2) to examine trends and events related to this question;
3) to define critical challenges' that are likely to make the greatest change in development of cities;
4) to examine how these challenges can affect urban development in different future scenarios;
5) to examine what short, medium and long-term solutions need to be adopted for achieving each of the future scenarios.

The result of the workshops is narratives, which are proposed to be treated as qualitative data for further inductive research [42] in three stages:

1. Coding and theory making: to identify key phrases, words and highlight concepts within the narratives. One of ways to do this is Nvivo software.
2. Memoing and theory making: to include notes, literature, accumulated knowledge and other sources of information in the analysis with the purpose to correctly interpret encoded concepts.
3. Integration, improvement and writing down theories: all codes and their interpreted meaning are combined into a coherent whole. It is recommended to include other stakeholders in this step to review and evaluate theories [34, *225*].

The results of the structured discussions-workshops can be used in various ways as a strategic document identifying risks and growing problems, indicating site-specific rather than general guidelines for combating climate change, changes and actions that should be implemented at certain stages at different scales of a city.

B. Visual simulation

Another method to involve city population into the decision-making process interactively is to visually demonstrate possible changes within the city, having the purpose to understand the effect of such changes beforehand [43, *349*]. Demonstrating these changes can have a number of benefits [44]: reduce use of resources due to perceived understanding of urban processes, increase productivity, improve quality; increase social capital and public involvement; highlight gaps in territory management documents and regulations. Drawings, photographs, collages, architectural models, and 3D virtual reality can be used for simulation. Unlike other research methods, simulation helps to predict both the physical and social impact of architecture, to anticipate new modes of behaviour in space, which can be steered in a sustainable direction [41, *19*]. Models processed with various analytical programs can also provide information on microclimate, energy efficiency, indoor and outdoor temperature comfort and air quality, wind and noise protection [45, *4*]. The 21st century technologies and various ways to simulate reality allow informed decisions to be made.

Denmark is considered to be one of the most advanced countries in demonstration practice for discussing a large number of pilot projects with the public, not only introducing it to potential urban development but also informing it about the applicable sustainability principles and the ecological, economic and social benefits of each project. One of the successful examples is Egebjerggård, a 38-hectare territory intensification project in the Danish city of Ballerup, publicising process of which, construction and results were studied by researcher D. R. van Vliet and described in his dissertation "Sustainable community planning and design: A demonstration project as a pathway" in 2000. In this case, the 1:1 scale model can be considered as simulation – a pilot, experimental project, the success of which is evaluated after the completion of construction: analysis is made of performance of set objectives, effectiveness of applied innovations, new, desirable and undesirable behavioural patterns and habits,

and general welfare. The benefits of such experiments can be manifold:

- a tool for public education and awareness-raising, as well as an opportunity for experts in various fields to evaluate projects and studies;
- an exemplary model of a medium-high density residential community;
- an effective form of technology transfer – giving experience and creative inspiration;
- a complex communication medium for the dissemination of novelties;
- creating a strong interest in the architectural community and the construction industry, gaining new practices, the results of which can persuade sceptical designers, land managers and users;
- testing of innovative designs and possibility of improvement before wider use;
- developing project efficiency standards and identifying sustainability components that may be considered for use in future projects;
- various information can be seen and easily accessed;
- testing platform;
- accelerating the processes of uptake of sustainable technology;
- helping to spread knowledge about new design practices.

Public response to dynamic urban systems can provide real-time insights into changes ongoing in it and emerging threats. The changing socio-ecological situation requires constant monitoring and the development of strategies not only to eliminate today's consequences but to regulate long-term processes in the changing socio-cultural context [46]. In other words, the development of a strategy for responding to socio-ecological stress considers not only available information but also unknowns, so strategies are flexible, their results can be predicted and, if necessary, suspended [47]. In summary, simulation and demonstration projects can be more effective than writing and speaking about improving standards and public attitudes because they act as a practical example [24, *204*] which generates new ideas and acts as an illustration that things may be different, preferably – better.

Conclusions

The study of the literature on the concept of sustainability and its reflections in the urban development concepts can be summarized as follows.

- Concerns about the gradual loss of natural resources and the loss of fertile land have been evidenced since ancient times, but it was only in the 18th century, with the realisation of the effects of the industrial revolution, that the idea of sustainability was recognised as a leap in the human morality leading to the abandonment of the ideology claiming that man is at the top of the pyramid forming the nature's system and that nature is meant only for achieving the maximum economic success. The 20th century was marked by a variety of concepts of sustainable urban forms. Seven principles of urban modelling linked to sustainability are identified in the analysed literature: (1) compactness; (2) sustainable transport; (3) density; (4) multifunctional use of land; (5) diversity (in terms of functions, building-up and types of buildings, age, social groups, cultures, etc.); (6) use of systems of renewable energy sources; (7) 'greening' or modelling of green public spaces.
- A compact city is one of the leading paradigms of sustainable urbanism. While the compact form of the city can achieve goals related to sustainability, compactness is not sustainable in itself. Over the past decades, testing the effectiveness of different models and strategies of sustainable urban form makes it clear that the links between urban form and sustainability indicators are indirect, heterogeneous and depend on the socio-economic context. A 'high intensity' and 'multi-purpose' sustainable urban model, if introduced in all cases, can cost the quality of the environment and, in extreme cases, the quality of life. Research of sustainable urban form tends not to focus on the search for a single universal and optimal model but on adequate ways to form a sustainable city and society at various spatial scales and taking into consideration the socio-cultural environment – the influence of the urban form on ecology, flora and fauna, favourable social environment, behaviour and welfare can have a much greater ecological impact than hopes that people will give up travelling by a private car.
- Balancing the consequences of sustainable development strategies or identifying which indicators should be prioritized at different urban spatial levels is problematic. The choice of principles and means to achieve the desired result depend on political and professional choice of which concept of sustainability is most in line with the socio-cultural context of the 21st century and on spatial levels at which these means and principles will be applied.
- The article reviews both research that develops the textual methodology of simulation and research that verifies the application of visual and virtual simulation in architecture. The reviewed research emphasizes an inclusive, adaptive urban planning process that is attractive to urban residents and focuses on the formation of sustainable habits. The above-discussed practical examples and methods to build this relationship with the community can improve conventional planning practices in the following aspects: to provide a new approach to territory planning, housing, streets, public spaces, energy and water use; to gather information on existing social

interactions and functions that can be steered towards more sustainable practices; knowing the real situation and trends, to avoid unintended consequences of development. Public involvement in urban planning is only successful when the specific context is considered and the data collected are carefully and systematically researched, monitored and evaluated.

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