

Urban transformation: environmental issues, wicked problems, and transport development in the context of circular economy

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Abstract

The paper brings some perspectives on new challenges for the synergy of urban transformation, environmental issues and transport development in the circular economy (CE) context. Considering that the number of studies on the given topics only pays attention to some selected areas, we bring a more comprehensive view of the current challenges for cities. The growing size of cities and population density are putting pressure on urban transport systems. As a result of the increasing intensity of traffic and economic activity, there is an increase in emissions in cities. Making decisions about changes in the city becomes more complex. The paper indicates the nature of “wicked” problems and obstacles in implementing the CE model in the context of sustainable transport/mobility development in big cities. It also demonstrates the situation in selected European cities regarding pollution and transport performance indicators. While the traditional city policy approach is predominantly based on the need to maintain the *status quo* and the reality of the city’s functioning is perceived as a routine matter, new approaches should work with challenges as opportunities for change towards greater efficiency and environmental sustainability and take into account new approaches to the governance of cities. One of the possible directions of urban development is using the CE in the context of the strategy of cities in the transport field. This could improve the situation within the goals of SDG 11. Solutions based on traditional approaches can cause disorders in the functioning of big cities, weaken their resilience and thus threaten their further development. In the future, the city leaders and other stakeholders will have to reevaluate traditional approaches to city governance in this area, as it can be assumed that an increasing number of “wicked” challenges will arise, which will need to be quickly/effectively resolved about the justified needs of city residents.

Keywords: governance; transport; cities; “wicked” problems; emissions; UN SDG 11 goals, circular economy

1. Introduction

Considering that the number of studies on the given topics only pays attention to some selected areas, we bring a more comprehensive view of the current challenges for cities. The growing size of cities and population density are putting pressure on urban transport systems. As a result of the increasing intensity of traffic and economic activity, there is an increase in emissions in cities. Making decisions about changes in the city becomes more complex. The paper brings some perspectives on new challenges for the synergy of urban transformation, environmental issues and transport development in

the circular economy (CE) context. This involves overcoming many barriers. The present study viewed that (1) cities will represent residences for an ever-increasing share of the world's population; (2) urban transport will require the fulfilment of many conditions regarding the ecological sustainability of the urban environment, and (3) CE has the potential to contribute to solving new “wicked” challenges. “Cities generate a significant share of global GDP, consume significant energy resources and generate substantial volumes of waste and emissions. Urban areas are home to over 75% of the EU’s population: creating around 70% of jobs and generating over 85% of the EU’s GDP. Cities, responsible for about 80% of energy use, are essential for Europe’s transformation to a climate neutral continent by 2050, as set out in the European Green Deal” (Eurocities, 2020). Air pollution has escalated to hazardous levels in many cities. With the growth of a modern industrial sector and car ownership, but without enforceable pollution and vehicle emissions regulations, various toxic chemicals are released into the atmosphere in large cities (Knox and McCarthy, 2012). Among monitored pollutants belong not only particulate matter (PM₁₀ and PM_{2.5}), but also nitrogen oxides (NO_x), Sulphur dioxide (SO₂), carbon monoxide (CO), total organic carbon (TOC), hydrogen chloride (HCl), and total dust (EPA, 2020).

The main obstacles to the development of transport in cities include economic, technical, organizational, environmental, informational, regulatory, infrastructural, and personnel. For example, in recent history, Citi Bank’s 100 bn USD Environmental Finance Goal was one of the initiatives in its Sustainable Progress Strategy. The strategy was organized into three pillars, and investment areas included renewable energy, green bonds, energy efficiency projects and green buildings, also sustainable transportation. Citi Bank’s share of environmental financing activities totalled 41.2 bn USD from 2014 through 2016 (Hoek, 2014). Sustainable transport is a significant component of sustainable urban development, and it seems that the CE can help address these challenges in this context. However, implementing changes – including support for the CE and the transport sector – may be threatened or slowed down by the nature of decision-making processes in complex entities such as large cities. The interests of various interest groups (stakeholders) are concentrated in large cities. Advocacy of these – often conflicting or significantly different – interests can slow down or completely stop decision-making processes. Wicked problems are specific forms of decision-making problems in complex entities. This paper aims to indicate the nature of “wicked” problems and obstacles in implementing the CE model in the context of transport/mobility development in big cities. It also demonstrates the situation in selected European cities regarding pollution and transport performance indicators.

2. Literature review

There is a wealth of literature related to the areas discussed here. This group includes works focused on (a) circular economy – e.g., COM (2015, 2018, 2019), Korhonen, Honkasalo and Seppälä (2018), Kautto and Lazarevic (2020), Milios (2017), Bocken, de Pauw, Bakker and van der Grinten (2016), Kirchherr, Reike and Hekkert (2017), Nylén and Salminen (2019), Ghisellini, Cialani and Ulgiati (2016) and COM (2015, 2018, 2019), but also works oriented (b) to wicked problems – e.g., Head (2022). Ghisellini et al. (2016) provide a very detailed overview of CE. For example, studies by Korhonen, Honkasalo and Seppälä (2018) and Kirchherr, Reike and Hekkert (2017) also deal with conceptual matters. Works focused on air pollution include, for example, EPA (2020). Hong et al. (2014) discussed challenges and opportunities for developing sustainable transportation systems (STs) – in this case, for Beijing's capital. Johansson et al. (2016) discussed issues related to the paradigm shift from mobility to sustainable accessibility. However, only a few are simultaneously devoted to urban transformation, environmental issues, and transport development in the circular economy (CE) context. Nylén and Salminen (2019), for example, deal with how the circular economy discourse affects policymaking. A circular economy perspective embraces a systemic notion that things are designed to be reused as long as possible and then recaptured and repurposed when reuse is no longer possible (Bals, Tate and Ellram (2022). In terms of methodology, the CRA (Constructed Regional Advantage) approach mentioned in the work Asheim et al. (2006), “wicked” problems approach in public policy (Head, 2022, 2008) and MLG approach (multi-level governance) mentioned in the work Brzica et al. (2014) were used. Moser et al. (2012) and Head (2008) provide good insight into “wicked problems” issues. One of the documents (Eurocities, 2022) suggests that “additional efforts are needed by the Commission and member states to enhance the quality of emission estimation methods and to maintain their quality, especially for important and ever-present source sectors, like road transport (e.g., the HBEFa emission factor database)”. Other works cover the area of (c) smart and sustainable cities – e.g., James Evans et al. (2019), Kenworthy, J. (2006), Haarstad (2017), Pereira et al. (2017), Tsun Lai and Cole (2022), Guenduez and Mergel (2022), Angelidou et al. (2022), and Przeybilowicz et al. (2022). Hikman and Banister (2014) seeks to develop achievable and low transport CO₂ emission futures in a range of international case studies, including in London, Delhi, and Auckland. The aim of

their book is that the developed scenarios and the consideration of implementation and governance issues can help city management plan for and achieve attractive future travel behaviors at the city level. The work of Johansson et al. (2016) deals with the issue of transport and co-conceptual approaches. The authors note new methods in the shift from mobility to sustainable accessibility. According to them, to reach the climate objectives, there is a need for technical solutions in energy-efficient vehicles dependent on electricity and replacing fossil fuels with biofuels. These solutions, however, are – according to them - not enough. They also need to change direction in planning and developing society and infrastructure.

3. Methodology

The article is based on a methodological approach based on several steps: decomposition of the functioning system of large cities in terms of four investigated elements (traffic, pollution, CE and wicked problems). Other studies, which are focused on only some of the problems discussed here, mostly used a combination of quantitative data analysis and case studies. Some studies examine specific cities and towns (case studies) or segments (transport, air pollution). Some other studies deal with methodological issues and concepts (wicked problems, reflexivity, resilience, multilevel governance). When it comes to wicked problems, analyzing systemic issues is often applied. This research paper uses a set of methods. Methods, concepts and approaches such as qualitative/quantitative data analysis, participatory design, ideal-type transition pathway concept, multi-level governance concept, stakeholder-agency theory, holistic approach, constructed regional advantage concept and causal explanation are used. Causal explanation represents a partially useful approach in specific situations. However, various factors - in rather complex entities as cities are - often operate simultaneously to produce an observed effect. We tried to maintain internal validity - i.e., preventing the occurrence of sample selection bias (for cities) and information bias. Wicked problems have been identified in literature across various disciplines and policy domains (e.g., business, cybernetics, ecology, agriculture, urban design, energy, transportation, health, socio-economic sciences and political, administrative sciences) (Head, 2022). Like Kenworthy (2006), this paper provides critical responses to the challenge of changing the nature of urban development to a more ecological and sustainable model.

4. Results

4.1 *Transport in big cities, “wicked” problems and circular economy*

Urgency and the changing nature of the challenges are the basic parameters that characterize the current situation from the point of view of the management and governance of big cities. In this section, certain views on some important issues are presented. Two important aspects can be seen from the perspective of the traditional approach to the current challenges in the transport field. The (1) aspect is underestimating the importance/scope of these challenges, and (2) underestimating the nature of these challenges. However, both of them are crucial for timely and adequate solutions. In the traditional understanding, challenges are a problem that often needs to be solved according to the intensity with which it manifests themselves. Such an approach is not always suitable, especially because phenomena do not take place linearly in a complex world, and large-scale changes on the input side do not always bring large effects and vice versa. In addition, waiting for a situation where major positive/negative breakthroughs appear (e.g., an increase in pollution, traffic jams, new efficient solution) can mean that the situation is difficult to manage or requires much higher costs.

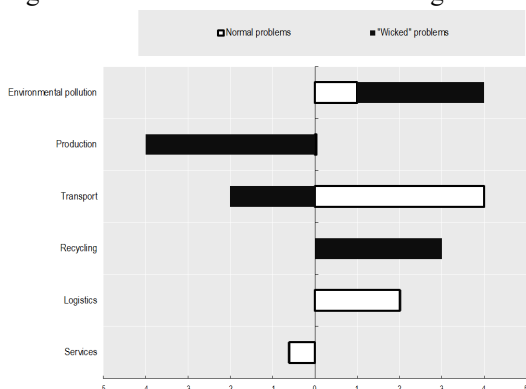
Several models exist - steady growth economy, de-growth, CE or sharing economy. These alternative ecological models challenge the economic growth model, encourage sustainable resource use, reduce waste, reuse and recycle, and nudge sustainable consumption models (Babacan, 2022). There is currently a wave of interest in transforming cities in the transport field about achieving a quality environment and safe transport network. New specifics characterizing the urban environment in terms of management and governance include, among others (OECD, 2006): • uncertainty; • specialization; • a number of actors; • interdependence; • multi-level decision-making; • time perspective, and political cycle. The CE in cities may assist in handling transport-related challenges (waste, lack of spare parts). Cities may assist in designing/supporting measures designed and optimized for reuse and re-construct. They may support set of policies easing nature-friendly and sustainable modes of sharing various transport means (not only person-to-person but also B2B) thus reducing resources needed to meet the needs of cities.

Kautto and Lazarevic (2020) point out that in connection with the circular economy, a significant challenge is “...the development and implementation of policies and regulatory instruments for accelerating the closing of material loops and phasing out unsustainable systems and practices. Currently, numerous policy instruments have been adopted to promote more sustainable resource use. However, these are often scattered, weak and disproportionately divided along economic sectors.

Thus, carefully prepared, consistent, coherent and credible policy mixes are needed.” To realize this plan, however, it is necessary to cope with the very diverse structure of the number of actors and their interests at the level of urban systems. This diverse structure of actors and interests presents wicked problems. Kautto and Lazarevic also note the problem of reflexivity. According to them “The reflexivity failure is caused by the current lack of ability to monitor, anticipate and involve actors in processes of self-governance and to implement adaptive policy portfolios that can deal with uncertainty. Due to the long-term nature of transformational change, inherent uncertainties of innovation, and knowledge gaps, change requires continuous monitoring of the goals, and reflection on the direction of change.”

The following Chart 1 shows a model of a modern view of contemporary challenges. In the case of this model, examples of the possible perception of the urgency of the solution and the nature of the challenges by top management are given. Of course, these are only fictitious values intended to document the possible range of problems.

Figure 1: Model view of current challenges



Notes: (1) negative values show a low degree of urgency of the need for a solution (2) positive values show a high degree of urgency of the need for a solution (3) the combination of colors indicating normal situations and "wicked" problems shows the expected ratio between the two components Source: Author's elaboration

4.2 Performance of transport network and its impact on city environment

The CE Package, adopted by the European Parliament in 2018, sets new target level for the recycling of municipal waste (65% by 2035). While the traditional city policy approach is based on the need to maintain the *status quo* and the reality of city's functioning is perceived as a routine matter, new approaches should work with challenges as opportunities for change in the direction of greater efficiency and environmental sustainability and take into account new approaches to the governance of cities (Brzica, 2022). One of the possible directions of development is the use of the CE in the context of the strategy of cities in the field of transport. This could substantially improve the situation within the goals of SDG 11. Table 1 shows the structure and description of the individual categories of indicators for the analyzed SDG 11 objectives. Graph 2 shows the situation for SDG 11 including transport as well as air pollution indicators (in this case PM_{2.5})¹. It provides a more detailed comparison of the position of selected European cities. Some Central European countries report very high degree of PM_{2.5}. Overview of primary pollutants in selected cities from January 27, 2023: the primary pollutant PM_{2.5} prevails in these selected cities: Prague: 10.0 µg/m³, Warsaw: 25.0 µg/m³, Berlin 7.2 µg/m³, Kosice 12.0 µg/m³, Budapest 31.0 µg/m³, Munich 6.9 µg/m³, Brussels 3.0 µg/m³, Paris 9.6 µg/m³, Rome 30.0 µg/m³, Bucharest 29.0 µg/m³, Vienna 18.0 µg/m³, and Bratislava 22.0 µg/m³. Some cities show other primary pollutants: London (PM₁₀) 27.0 µg/m³ or Copenhagen (ozone) 41 µg/m³. Contributing to pollution in some cities and countries (especially in Central and Eastern Europe) is the fact that the age of the cars in use is high, the modernization of the transport infrastructure is insufficient and the governance of the cities is not optimal.

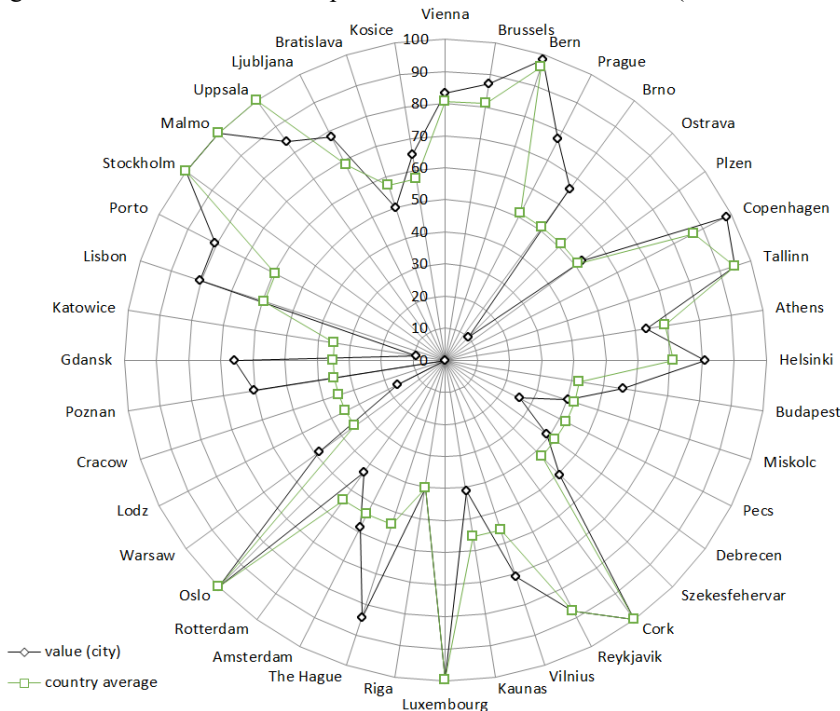
¹ The environmental indicator PM_{2.5} was used in terms of its significant impact on health, especially in big cities. Such pollution contributes to human mortality from respiratory, cardiovascular and other forms of diseases. The biggest cities are affected by the presence of substances of the PM_{2.5} type.

Table 1: Overview of selected indicators for SDG 11 "Sustainable cities and communities"

SDG goal	Indicator	Indicator - description
11.2	C110200a	Percentage of population satisfied with the quality of public transportation systems
11.2	C110201a	Performance of public transport network, ratio between accessibility and proximity to hospitals
11.2	C110201b	Performance of car transport network, ratio between accessibility and proximity to hospitals
11.3	C110301	Difference between built-up area growth rate and population growth rate (percentage points)
11.6	C110602	Exposure to PM _{2.5} in $\mu\text{g}/\text{m}^3$, population weighted (micrograms per cubic meter)
11.6	C110602a	Percentage of population satisfied with quality of air
11.6	C110602b	Percentage of people exposed to more than 10 $\mu\text{g}/\text{m}^3$ (micrograms per cubic meter) of PM _{2.5}
11.7	C110701b	Percentage of population with access to at least one recreational opportunity (theatres, museums, cinemas, stadiums, or cultural attractions) within 15 minutes of cycling

Note: Indicators C110602 and C110602b, related to PM_{2.5} secondary organic aerosol pollution, are highlighted. Graph 1 above also applies to this indicator. Omitted are indicators not related to transport, mobility and PM exposure (11.1, 11.3, 11.7a.). Source: Brzica (2022), modified, based on OECD data, 2020.

Figure 2. Position of selected capitals and countries for SDG 11 (SDG 11.1 - 11.7)



Note: Index is created from values of indicators for SDG 11.1 - 11.7. A higher number of points (obtained from aggregation of points from individual SDG 11 indicators) represent a better position of the city in terms of these indicators. See Tab. 1 for more details. SDG 11 is a "Sustainable Cities and Communities" category under the UN Program.

Source: Brzica (2022), Author's elaboration based on OECD data, 2020.

It is obvious that the top management of big cities must respond not only to air pollution, "normal" challenges in transport or modernization pressures, but also to the existence of another segment of challenges - the set of "wicked" challenges. Unlike the "normal" challenges, the "wicked" challenge set exhibits some specific characteristics. These need to be taken into account – including the case of CE in transport-related areas of large city functioning - when designing effective policies in the area of environmental changes, transport policy and the approach of producers. It can be assumed that the perception of various types of challenges (including the CE) will be different among representatives of industry, the public sphere and the

management of individual big cities. While common problems appear mainly in conditions typical of stable states, "wicked" problems are typical for complex structures and unstable situations.

The circular economy and comprehensive modernization of the production capacities of cities can improve the situation. It seems important to create a complete chain "environment - modern production using CE - modern transport infrastructure with modern means of transport - effective governance with awareness of the need to solve wicked problems in related areas.

5. Discussion

Addressing the multitude of challenges that big cities face today in the environmental field is not an easy task. Nevertheless, the issue of the sustainability of the urban environment is becoming more relevant with increasing economic activity and technological changes. As the paper indicated, the existing challenges are serious not only in their content and scope, but also in the difficulty of finding solutions, as is the case of "wicked" challenges. Policy decision-making is structured through organisational processes that reflect historical institutional arrangements. Complex policy problems often involve conflicting interests and divergent perceptions among various stakeholder groups. Disagreements about problems and policies arise from many factors, including material interests, sociocultural values and political (dis)trust (Head, 2022). This fact further limits quick and effective solutions, especially regarding wicked problems.

The responsibility of city representatives is considerable. However, it is related not only to micro-management but especially to the conceptual planning of urban development and to the strategic orientation towards reducing the ecological burden. Effective multi-level city governance and the effort to solve "wicked" challenges also require city management to have the ability to find a consensus when solving important "wicked" challenges related to transport and environmental issues in big cities.

6. Conclusion

There are different approaches to emerging challenges. Solutions based on traditional approaches can cause upheavals in the functioning of big cities, weaken their resilience and thus threaten their further development. In the future, the city leaders and other stakeholders will have to reevaluate traditional approaches to city governance in this area, as it can be assumed that an increasing number of "wicked" challenges will arise, which will need to be quickly/effectively resolved about the justified needs of city residents. Compared to other works focused on some of the areas analyzed here, we tried to balance a set of key structures (for example, cities and transport systems) and processes (for example, air pollution, solving wicked problems, and governance processes). The holistic view of an integrated approach to the solution of urban ecology and transport in the circular economy context can be used for further research in several possible directions. Understandably, the holistic approach raises some doubts about the breadth of coverage, the depth of analysis (use of comparison), the choice of indicators, working with a time frame, and problems with the unification of approaches and definitions. The last point is quite complex due to the "fuzzy" boundaries of many dimensions addressed in the article. These are mainly the concepts of multi-level governance, wicked problems or the urban system. It is their exact characteristics that - due to their complexity - they run into the problem of precise and generally accepted definitions, and it is often possible to consider their characteristics as "fuzzy".

From the results of our study, it can be concluded that the situation in the large cities in our sample corresponds to the seriousness of the situation, as indicated in other publications. In contrast to more narrowly focused works, we bring an approach that should consider the complexity of the challenges regarding city transport requirements in terms of their growth and ecological burden (here, specifically, air pollution with PM_{2.5} particles). We are trying to point out the effort through new approaches (both conceptual in the field of technology /CE/ as well as conceptual in the field of decision-making regarding difficult and complex situations /wicked problems/ to solve new challenges in the field of transport and related ecological burden. However, a quick and effective solution to a certain extent is hindered by increasingly complicated and complex relationships between growing groups of actors with different, often conflicting, interests.

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