The Role of City Logistics in Pursuing the Goals of Agenda 2030

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Abstract. The issue of city logistics has historically been addressed as a problem for improving the generalized efficiency of the delivery routes under different operating conditions. The remarkable development of supplies for purchases in store and on line has posed different problems for the society in terms of the impacts produced. On the other hand, there is a growing and worldwide interest in preserving the environment where people live, which addressed the definition of Sustainable Development Goals of Agenda 2030. Therefore, today the central question is how to create a city logistics that allows us to pursue the objectives of Agenda 2030. The method to be used should analyze the goals, targets, and indicators of Agenda 2030, and subsequently, it should verify which current methodological design tools allow us to estimate the improvement of city sustainability, measured through the changes of a set of proposed indicators. On this basis, the indicators proposed are aggregated into three classes, which are related to: direct, indirect and conditioned impacts. The result obtained is thus the identification of the targets of Agenda 2030 that can be pursued by city logistics and therefore the need for researchers to change the focus moving from the only targets defined by the efficiency of the delivery routes towards the targets introduced by Agenda 2030. Such a work opens the way for new approaches to deal with the implementation of city logistics.

Keywords: City logistics · Agenda 2030 · Sustainable development goals · City sustainability · City livability

1 Introduction

Cities are particular complex systems in relation to the high concentration of population and therefore of human activities of various kinds, i.e., moving from residence toward work, leisure, and the health. This concentration of population and of these activities requires more and more goods available and therefore there is the need to manage the supply chains both of the traditional sale channels at stores, and of the new channels connected with the on-line sales. For example, in the United States, in just one year from 2009 to 2010, e-commerce sales increased by 14%. Total e-commerce sales for 2022, always in USA, were estimated at $1,034.1 billion, an increase of 7.7% from 2021, and

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O. Gervasi et al. (Eds.): ICCSA 2023 Workshops, LNCS 14106, pp. 335–348, 2023.
https://doi.org/10.1007/978-3-031-37111-0_24

has been accounted for 14.6% of total sales. In Europe, 74% of internet users bought or ordered goods for private use in 2021 [1, 2]. End users have changed their behavior and purchasing decisions over time, gradually moving from traditional distribution channels to new ones.

The increase in mobility is statistically connected with the growth of the Gross Domestic Product (GDP) per capita in the area and with collective well-being. As mobility grows, the economic and social levels of cities raise. But at the same time, the increased mobility is one of the most important elements that causes the increase of the environmental impact, both for carbon footprint and for fine particles. In fact, emissions that produce effects on the environment can be traced back to two categories: those that cause global warming and therefore the effects are at a planetary level; those that directly affect citizens and therefore the effects are only at urban level. To have an order of magnitude, consider that road transport is responsible for 95% of CO_2 emissions in the transport sector in the EU (682 million of the total 712 million tons) [3]; PM_{10} causes various types of disorders and affects the mortality rate (e.g., in Switzerland, around 25% of PM_x air pollution derives from vehicles [4].

The study of city logistics has evolved over time considering mainly the component of cost optimization, considering the most advanced telematics application [5–8] in line with what has historically been developed for the logistics of companies in the relationship between manufacturers and distributors. Other components such as social and environmental ones have not been deepened. Freight mobility is a decisive component of overall urban mobility, and in particular of the last mile [9]. This centrality implies significant economic, social and environmental impacts, and therefore an important role in the development of the cities themselves.

Economic, social, and environmental impacts are the cornerstones of sustainable development strategies, as defined by the Brundtland report [10]. The 1987 UN report introduced social and economic problems into sustainable development, whereas previously sustainability was assessed only against environmental issues. The Brundtland report has launched a wide-ranging debate at the international level among countries with different levels of development. Environmental issues were greatly explored at the Rio conferences and then in the Kyoto agreements.

The path of international sharing of the fundamental principles of sustainable development had its moment of synthesis with the drafting and signing of Agenda 2030 document by the majority of UN countries [11].

The European Commission (EC), in line with the indications of Agenda 2030, has formalized the idea of sustainable urban mobility by issuing guidelines to prepare sustainable urban mobility plans [12]. The 2019 guidelines follow the first-edition guidelines of 2013 and previous work supported by the EC particularly important, among which the ENCLOSE project can be recalled [13] in which the guidelines for sustainable urban logistics plans (SULP) were defined.

The question that this note wants to address concerns whether the organization of urban freight traffic of the last mile can contribute to pursuing the goals of Agenda 2030, and specifically to which objectives. Therefore, we want to go beyond the traditional approach implemented daily by everyone, which considers the last mile, and the logistics connected to it, only in terms of cost efficiency. On the other hand, the sustainability

approach appears to be only theoretical. The problem also in this case, as in other dimensions of planning, is to find a synthesis among the theories of urban development, the urban rules, and the development of real implementations [14]. The dynamics among theories, rules and implementations is a particularly important path for the best evolution of city logistics [15].

To address the issues introduced earlier, Session 2 presents the structure of Agenda 2030 with the goals, targets, and indicators, recalling some main aggregations of objectives. Session 3 discusses the role of city logistics with respect to the various goals of Agenda 2030, and the related targets and indicators. In the last section, conclusions are drawn, and lines of further development are indicated.

The proposed work could be useful to decision makers and planners at the national level because it should allow them to organize general measures and possible economic support in the correct directions. It is also useful at the local level because it allows political decision makers and public technicians to implement the best sustainable solutions for the organization of urban traffic. It is also useful for the management of private transport and logistics companies because it allows to plan and program business development in line with the Agenda 2030. Finally, it is useful for researchers who deal with all the problems related to the efficiency of the delivery paths because they can give a turning point to their work by introducing, in addition to the consolidated attention paid to cost efficiency, a specific and greater attention to the sustainable development.

2 The Structure of Agenda 2030

The path taken by the United Nations (UN) since its establishment to define conditions of peace and prosperity for all the peoples of the Earth has been particularly complex. The work has always been based on a careful analysis of the phenomena. In this analysis, it has been estimated that by 2050, 66% of the world's population will live in cities. The problem of better management of cities thus becomes one of the main problems of sustainable development. If cities will not organize themselves properly, the Sustainable Development Goals cannot be pursued [16, 17].

The UN in 2015 proposes a particularly relevant document which specifies the objectives to be pursued by 2030 to aim at sustainable development of the whole planet. The document is signed by 193 countries, which undertake to adopt it for the development of national policies in the various sectors. The overall objective of the document is "peace and prosperity for people and the planet, now and in the future." [16, 18].

The basic structure of the Agenda 2030 consists of 17 general goals that must be pursued (Fig. 1). To make it possible, it needs to identify specific quantitative analyses that allow to verify the level of progress of the sustainability policies of the single countries. In 2018, the UN developed a specific document, in which, each goal is divided into specific targets, which, in turn, are disaggregated into one or more indicators that indicate the status of each goal in the generic year. Against the 17 Sustainable Development Goals (SDGs), 189 targets and 261 indicators are specified [19].

On the basis of the 261 indicators, each country must prepare an annual review of its situation. To this end, each country shall prepare the collection of adequate national statistics in order to allow the progress of specific policies to be compared. Analysis

of national statistics shows that not all UN indicators are currently recorded. Individual countries can match a UN indicator with one or more indicators if the UN indicator is not in the national collected statistics. In some cases, a UN indicator may not correspond to any indicator.

The lack of adequate national statistics is a serious limitation to the possibility of verifying what is happening in single countries. To overcome this limit, in the context of goal 17th, it is expressly indicated as a target the development of adequate national statistics. The 17 SDGs refer to different fields of human activity. However, it is possible to identify two homogeneous groups that can be considered reference for all countries [20, 21]. A first group can be defined as "*vital needs*". In the sense that they are the primary objectives for a society. It is no coincidence that the group of vital needs is composed of the first three SDGs that refer to poverty, hunger, and health.

The second group is more complex to homogenize but can be synthesized into "*optimal needs*". In the sense that once the objectives of the first group have been addressed and resolved, those of the second group constitute in some way the main guidelines for the development of society. They can be summarized with the key words: education, equity, health, and water for all.



Fig. 1. The Sustainable Development Goals related to human activity [18]

Even with the necessary distinctions, it is as if a sequential reading could be proposed, translating Maslow's pyramid from individual to society [22, 23]. It is emphasized that Agenda 2030 in the public version does not provide for any hierarchy in the objectives and relative targets, but a detailed reading allows the two clusters of objectives and indicators previously defined to be identified.

3 Agenda 2030 and City Logistics Measures

3.1 Types of Goals

The measures implemented to organize city logistics have significant impacts on the pursuit of the goals and targets of Agenda 2030 [13, 24]. As part of the city logistics measures, both those that transport and logistics operators daily take to deliver their goods and those that the public administration (at the different levels and branches) takes to organize the overall flows of goods vehicles produced by the various operators must be considered [25].

It is possible to control the flows of freight vehicles in urban areas, in order to verify ex ante the results of planned measures, through appropriate Transport Systems Models (TSM). For the formalization of the TSM equations, one can refer to specific literature [26, 27].

The results of the TSM can in turn be considered the inputs for other types of models that allow one to measure impacts of other types.

Environmental impacts can be specified for each link of the network:

$$\boldsymbol{e}_{\mathrm{i}}^{*} = \mathrm{e_i}(\boldsymbol{f}, \boldsymbol{\lambda}) = \mathrm{e_i}(\boldsymbol{\Delta} \times \boldsymbol{h}, \boldsymbol{\lambda}) \tag{1}$$

where:

- $\mathbf{e}_{\mathrm{i}}^{*}$ is the impact value vector;
- $\mathbf{e}_{\mathrm{i}}$ is the impact function vector;
- $\mathbf{f}$ is the link flows vector;
- $\mathbf{h}$ is the path flow vector;
- $\boldsymbol{\Delta}$ is the link–path incidence matrix;
- $\boldsymbol{\lambda}$ is the set of physical and functional parameters.

Similarly, social impacts, $\boldsymbol{s}_i$, and economic impacts, $\boldsymbol{g}_i$, can be estimated. Given these general premises, the results deriving from the TSM in terms of $\boldsymbol{f}$, and the results deriving from subsequent models, in terms of $\boldsymbol{e}_i$, $\boldsymbol{s}_i$ and $\boldsymbol{g}_i$, allow to evaluate ex ante the modifications of the indicators of Agenda 2030 based on the measures implemented.

It is possible to consider the different SDGs and related indicators in relation to their degree of connection to Agenda 2030.

Figure 2 shows the three groups of SDGs whose indicators are influenced by city logistics measures [20, 28], also considering the e-commerce logistics [29]. The three groups have the following characteristics:

- they provide a *direct impact* on sustainable development measurable through the outputs of the TSM equations alone, by intervening directly on one or more indicators;
- they provide an *indirect impact*; the impact of the measures must be quantified with a second level of technics (formalized by models) that use the results of the TSM as input and implies choices that belong to different sectors of the same public administration (at the different levels and branches).
- they provide a *conditioned impact*, the impact of the measures can be quantified with the TSM models, or with the subsequent models, but using choices made in other contexts, not dependent on the same public administration (at the different levels and branches).



Fig. 2. The Sustainable Development Goals related to city logistics [18]

3.2 Direct Impacts

The targets directly influenced by interventions in city logistics are those concerning SDG 3 and SDG 11 (Table 1). As mentioned above, SDG 3 is one of the fundamental SDGs for sustainable development.

With regard to the direct impact of city logistics, it is worth noting the heavy role that freight vehicles play in road accidents (target 3.6.1), with the probability of more serious effects in the people involved, as well as in the production of air pollution (target 3.9.1).

SDG 11 is strictly related to urban and city communities. Its main focus is thus on passenger mobility and in particular:

- target 11.2, the adoption of specific practices for the optimal location of pickup points helps passenger accessibility;
- target 11.3 is particularly important because it requires the participation of citizens in planning choices and therefore in public choices on city logistics;
- target 11.6 is central because it introduces the environmental problem directly into the SDG of cities. It is useful to note that 11.6 can also be considered in the second group because it implies the need for other technical components to measure the output that affect it.

3.3 Conditioned Impacts

This group must include the SDGs to which city logistics can contribute, but whose results are conditioned by choices of other public administrations The SDGs to consider are: 7, 13 and 17 (Table 2). In fact, SDG 17 must also be considered because it aims. SDG 7, related to energy components, can be considered in various targets and indicators. It immediately emerges that the policies of local authorities can also impose different energy mixes or the use of renewable sources, this depends on the availability of network operators to supply energy from renewable sources in that place. Consider that modest

quantities can be produced with photovoltaic panels or other renewable sources, and these quantities can support the use of urban distribution centers, but certainly not the used vehicles. The evolution of the industrial energy sector strongly conditions the pursuit of goals by means of city logistics.

Table 1. Direct impacts: targets and indicators related to city logistics (based on [19])

SDG	Goals and targets	Indicators
SDG 3 – Good health and well-being	3.6 By 2020, halve the number of global deaths and injuries from road traffic accidents	3.6.1 Death rate due to road traffic injuries
	3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water, and soil pollution and contamination	3.9.1 Mortality rate attributed to household and ambient air pollution
SDG 11 – Sustainable cities and communities	11.2 By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, people with disabilities and older persons	11.2.1 Proportion of population that has convenient access to public transport, by sex, age, and persons with disabilities
	11.3 By 2030, improve inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries	11.3.2 Proportion of cities with a direct participation structure of civil society in urban planning and management that operate regularly and democratically
	11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management	11.6.2 Annual mean levels of fine particulate matter (e.g. $PM_{2.5}$ and PM_{10}) in cities (population weighted)

SDG 13 is the one that collects the history of all environmental impacts. The main reference is to 13.2 and therefore to the carbon footprint. Consider that within the framework of 13 all other greenhouse gases whose values must be translated into CO_2 according to the parameters of international equivalence must be considered. In this case, while the

reduction of CO_2 for the same circulating fleet, can be obtained both by making delivery cycles more efficient and by using better vehicles from the point of view of environmental impact. It is precisely this last category that is clearly dependent on industrial production and the costs with which the most advanced production of vehicles goes on the market. The evolution of the automotive industrial sector strongly conditions the pursuit of the goals through city logistics.

Table 2. Conditioned impacts: targets and indicators related to city logistics (based on [19])

SDG	Goals and targets	Indicators
SDG 7 – Affordable and clean energy	7.2 By 2030, substantially increase the share of renewable energy in the global energy mix	7.2.1 Renewable energy share in the total final energy consumption
SDG 13 – Climate action	13.2 Integrate climate change measures into national policies, strategies and planning	13.2.2 Total greenhouse gas emissions per year
SDG 17 – Partnerships for the goals	17.18 By 2020, enhance capacity-building support to developing countries, including for least developed countries and small island developing States, to increase significantly the availability of high-quality, timely and reliable data disaggregated by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts	17.18.1 Statistical capacity indicator for Sustainable Development Goal monitoring
	17.19 By 2030, build on existing initiatives to develop measurements of progress in sustainable development that complement the gross domestic product, and support the development of statistical capacity-building in developing countries	17.19.1 Dollar value of all resources made available to strengthen statistical capacity in developing countries
		17.19.2 Proportion of countries that (*a*) have conducted at least one population and housing census in the last 10 years; and (*b*) have achieved 100% birth registration and 80 per cent death registration

3.4 Indirect Impacts

Other SDGs are influenced by city logistics choices, but the TSM results are not directly usable to assess ex-ante modifications of indicators, but additional models are needed. Often the operational fact of using different models implies that the decisions taken, although belonging to the same local authority, derive from other technical sectors and not directly from the one that coordinates mobility policies.

In this context, the targets and indicators related to SDGs 4, 5, 8, 9, 10 can be considered (Table 3).

Table 3. Indirect impacts: targets and indicators related to city logistics (based on [19])

SDG	Goals and targets	Indicators
SDG 4 – Quality Education	4.4 By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship	4.4.1 Proportion of youth and adults with information and communication technology (ICT) skills, by type of skill
	4.7 By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development	4.7.1 Extent to which (i) global citizenship education and (ii) education for sustainable development are mainstreamed in (*a*) national education policies; (*b*) curricula; (*c*) teacher education; and (*d*) student assessment

(*continued*)

Table 3. (*continued*)

SDG	Goals and targets	Indicators
SDG 5 – Gender equality	5.1 End all forms of discrimination against all women and girls everywhere	5.1.1 Whether or not legal frameworks are in place to promote, enforce and monitor equality and non-discrimination on the basis of sex
	5.5 Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life	5.5.1 Proportion of seats held by women in (a) national parliaments and (b) local governments
SDG 8 – Decent work and economic growth	8.1 Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries	8.1.1 Annual growth rate of real GDP per capita
	8.2 Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labor-intensive sectors	8.2.1 Annual growth rate of real GDP per employed person
SDG 9 – Industry, innovation and infrastructure	9.1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all	9.1.2 Passenger and freight volumes, by mode of transport

(*continued*)

Table 3. (*continued*)

SDG	Goals and targets	Indicators
	9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities	9.4.1 CO_2 emission per unit of value added
SDG -10 Reduced inequalities	10.1 By 2030, progressively achieve and sustain income growth of the bottom 40% of the population at a rate higher than the national average	10.1.1 Growth rates of household expenditure or income per capita among the bottom 40% of the population and the total population

SDG 4 is related to education. Specifically, targets 4.4 and 4.6 are to be considered. The first relates to the increase in ICT skills, and city logistics is developing better and better with the introduction of new generation ICT. The second is related to the growth of skills in sustainable development and city logistics is, as verified in this note, one of the most interesting fields for the study of development sustainability.

Furthermore, SDG 5, which refers to gender equality, should be considered given that it refers to ensuring the end of all forms of discrimination against women and girls and favoring their active participation in the city government and specifically in a sector that historically was dominated by the presence of men (targets 5.1.1 and 5.5.1).

SDG 8 must be considered in the two components relating to per capita growth per inhabitant and per capita growth per employee, both indicators that quantify the efficiency of the measures introduced and indicators that allow us to estimate at the territorial level the income increases due to the improvement of production and, therefore, to the employment multipliers.

SDG 9 is considered under two types of targets, the first (9.1) concerns the innovation capacity of logistics with the modification of the modal share, compared to other modalities; the second typology recalls what has already been said for target 11.6, namely the environmental impacts produced by new infrastructures.

SDG 10 is to be considered because it affects the reduction of inequalities even within the same country. Specifically, target 10.1 concerns the growth capacity of the areas lagging in development, which should be higher than that of the other areas of the country. City logistics with its contribution to innovation and integration with ICT and with the most advanced energy models can provide an important boost to growth.

4 Conclusions

The results presented in this paper can be condensed to highlight the limitations of current approaches to city logistics that consider only the efficiency of route costs. Based on this element, a bridge is identified between the general objectives of Agenda 2030 and the results of specific interventions in city logistics that can be evaluated ex ante with the TSM. This bridge makes it possible to identify measures that can directly affect the targets and indicators of Agenda2030 and measures that have an indirect impact. The results are important because the set of indicators has not been studied in the literature and Agenda 2030 is considered only as a generic reference framework.

With the proposed approach, the objectives of the Agenda 2030 cease to be mere declarations of principle and become real quantitative elements on which politicians, technicians of public administrations and private companies, researchers in both logistics and other competing subjects must work. All these professionals make it possible to work on measures that link Agenda 2030 to the daily realities of cities. Besides, the opportunity offered by telematics should be explored focusing on the transport-ICT interaction, as well as on the role of energy efficiency for meeting the goals of Agenda 2030. Therefore, it is thus possible to identify the further development roadmap. First, the role of city logistics in the framework of Agenda 20230 should be defined within the context of smart city with strong reference to the three pillars: energy in terms of production and use, transport and mobility, and information and communication technologies (ICT). Secondly, the development of a complete modelling formulation, which models the integration of the three pillars, needs to be promoted in order to be able to evaluate ex ante the actions and measures for the pursuit of the SDGs of Agenda 2030.

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