CITY LOGISTICS AND SUSTAINABILITY

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Abstract: The increase in transport flows has caused a negative impact on the environment, especially in urban centres where, as the network and demand continue to expand, the problem of environmental sustainability has been neglected.
In the different economic and territorial realities, the economic and territorial conditions have, in fact, indicated a necessary rethinking of consumption and new models of approach to markets, with a preference for the naturalistic and eco-sustainable aspect.
The importance of rationalisation and, consequently, the optimisation of logistical activities at every level, with specific attention to eco-sustainability, can generate the will to produce a shared diffusion of knowledge and culture of environmental awareness and start a resolute path of change.
In the literature many authors, from different scientific fields, have, over the years, dealt with the theme of urban distribution of goods, many are the experiments conducted and City Logistics projects implemented.
Moreover, both at the level of each individual State and at the European level, it is now several years that the regulations and planning interventions highlight the attention on this problem.
The cities, places where the greatest number of inhabitants are concentrated, need interventions aimed at the remediation of critical issues such as congestion, noise and air pollution which, in their sum, determine a poor quality of life.
For several years now, City Logistics has continued to represent a topic of discussion and an effective response to the critical issues raised, in the awareness that an improvement in quality of life necessarily depends on the improvement of the places where we live and on environmental sustainability policies.
The present work, from an analysis of the literature and data from experiments conducted, aims to verify if City Logistics and good practices of urban distribution of goods can generate positive effects and improve the quality of life.
Keywords: Logistics, urban distribution of goods, City Logistics, sustainability.

1. INTRODUCTION

In recent years, the socio-environmental impact of urban distribution activities, in terms of pollution and congestion, has taken on an increasing dimension (EEA Report, 2020).
This impact has been generated on the one hand by the normal increase in demand and the increase in traffic, and on the other, especially in Italy, by the lack of proper planning of city expansion and the reduced adaptability of roads and goods flows.
In this particular historical moment, the need to rethink and "readapt" freight logistics in urban areas is a complex challenge to be faced because of the need to generate more sustainable environments and the need to rethink cities (Agostino, M., Caballini, C., Dalla Chiara, B., 2020).
Today it is even more urgent than in the past to push the system to reach a new point of equilibrium in terms of economic, environmental and social efficiency.
A deep reflection is needed on urban planning, on the rationalization of the quality of life which, in close dependence with transport and mobility, can be summarized in the efficiency of the dimensions of noise and air pollution in central areas (Chiodi, 1935; Dodi, 1972; Newman & Kenworthy, 1999; Banister, 2005; Busi, 2011).
It will not be easy and undoubtedly it will be necessary to rethink the way of reasoning, a greater sharing of knowledge, a more careful use of technologies (Rovelli, 2020).
It remains, however, the conviction that any challenge, even the most arduous, when faced with the achievement of a common goal, which generates well-being for all and for the planet, deserves the greatest commitment from all and each of us is called to make our own contribution.
This requires closer cooperation between all stakeholders in the area; we need to eliminate, or at least reduce, information asymmetries, rely on knowledge and ensure that industry, policy makers, urban planning authorities, real estate experts and citizens can think innovatively and work together (Afshin Jamshidia, Farzad Jamshidi, Daoud Ait-Kadi and Amar Ramudhin, 2017).

In this article we present the City Logistics model as a tool for the sustainable optimization of transport and mobility in cities, starting from the study of the reference literature, we will report the results of an experimentation conducted.

2. LITERATURE BACKGROUND

Freight logistics, almost always excluded from urban planning processes, overlapping the habitual use of public infrastructure (network and parking) and urban space by the inhabitants, interferes with their daily life, generating significant economic and operational inefficiencies (Fasolino, I., 2019).

The problem of urban freight transport - and, as a consequence, the growing attention to social and environmental costs resulting from the rapid increase in logistic flows - has led the doctrine - and with it public and private operators - to develop strategies and policies to support a renewed distribution culture that respects environmental needs and promotes a renewed liveability of city centres.

This has led to the development of new theoretical strands, the first of which is that of City Logistics, i.e. the establishment of measures aimed at rationalizing the high flows of goods and thus reducing the number of vehicles in circulation and harmful emissions into the urban area.

In literature many authors, from different scientific fields, have, over the years, dealt with the theme of urban distribution of goods (Taniguchi, E., Gonzalez, J., F., Van Duin, R., Montreuil, B.,), many are the experiments conducted and projects implemented by City Logistics.

The concept of City Logistics was introduced to address the challenge of environmental sustainability while allowing the development of freight transport and the city (Benjelloun & Crainic, 2008; Gonzalez-Feliu et al., 2014; Montreuil, 2018; Taniguchi et al., 2001; Taniguchi, 2015).

Correct planning of the urban distribution of goods is particularly complex as it concerns a large number of actors (local authorities, citizens, businesses, logistics operators) with interests and objectives that are often not easy to reconcile (Nicole K. Ward et al., 2020).

According to one of the axioms of S-D logic (Vargo and Lusch; 2004, 2008), the provision of the service, in the case of the present work, a "service" of City Logistics, takes place through the application of skills and knowledge and the exchange of resources between all parties involved for the generation of a common benefit.

The fundamental resources for the creation of competitive advantage are therefore intangible resources, such as the exchange of information and sharing of knowledge - operating resources - rather than material goods.

Value is always co-created by the multiplicity of actors involved in the exchange including the end user, the company therefore proposes a value and provides a service as input for its realization, but the beneficiary of this value proposal is an active part of the process. All economic and social actors are therefore integrators of resources that create value during the "service provision" by activating operand resources through the application of operant resources.

The dominant logic of the service conceives the client/user primarily as an operant resource, which integrates its own resources with the company/location to co-create value by actively participating in relational exchanges. The role of institutions in this context is to coordinate the process of co-creation of value by creating conditions that allow actors to achieve a growing level of service exchange over time. This last postulate allows to connect the identification of value with the environment that represents the system of laws, norms and rules, shared by the actors who are able to recognize the elements of value. Service studies argue that each service system can be interpreted as a service ecosystem, i.e. a set of entities that act according to specific context-specific roles, standards, rules and shared conventions (Akesson et al., 2014, 2020) and make services available to enable collaboration and co-creation in the ecosystem, and infrastructures to implement the design, delivery and governance of the service (Lusch and Spohrer, 2012).

The survival of the system depends on its ability to adapt to the reference environment by creating conditions of consonance and resonance with the relevant actors that make it up. In this path, promoting satisfactory dynamic evolutionary paths appears to be in line with the value creation processes in which all the actors involved are satisfied in a win-win logic, introduced by S-D logic and Service Science.

3. EXPERIMENTAL RESULTS

Since the primary objective of City Logistics is to protect a collective interest and ensure a fair use of public goods, it should be pointed out that City Logistics' approach is to identify ways to regulate the access of flows of goods rather than placing drastic restrictions on them. This is because restrictive policies would cause the "flight" of economic activities and the population, compromising the economic and social prosperity of city centres.

It follows, with a view to improving the system, the need to identify the existence of inefficiencies in city freight transport and move towards effective and effective sustainability (Savelsbergh, M., Van Woensel, T., 2016).

A first typology is linked to internal efficiency constraints, i.e. the existence of a trade-off between the objective of efficiency and that of logistic effectiveness - a very important constraint - as well as to the organization of the supply chain - since the minimization of total logistic costs, through the rationalization of flows and the increase in productivity, most often leads to a worsening of the service level -.

A second type is instead the one linked to external efficiency constraints, i.e. all those factors that affect the efficient organization of the urban distribution system. These constraints can in turn be divided into two groups. The first group concerns the structure, density, location and organisation of the activities that attract the goods as well as the population density, the location of residential poles and the extent of non-resident consumer flows (workers and tourists).

The second group, on the other hand, concerns the characteristics of the urban area, the infrastructures present in the territory and the policies for regulating traffic and parking. This is because the urban structure, the size and functionalities of the city - understood as extension, size, road layout, presence or absence of historical monuments - have a strong impact on the way distribution is organised, as they determine the number of vehicles needed to deliver goods and their size, the routes to be taken and the number of journeys per vehicle.

In conclusion, the inefficiencies of urban transport, according to the above, are linked to the difficulty of reconciling three very different objectives, which summarize the different needs mentioned above, namely: i) economic efficiency; ii) environmental efficiency; iii) social efficiency.

These interlinked components are those that enable sustainable development to take place in urban areas (Latuso, 1998). The objectives that must therefore be pursued, in order to make urban freight transport more efficient, are: a) minimisation of the consumption of space and natural resources while respecting the needs in terms of environmental sustainability; b) rationalisation and efficient management of urban flows; c) protection of citizens' health; d) guarantee of equal access to resources and services in terms of social efficiency.

As part of a research project developed in 2016 in a city of about 35,000 inhabitants in the Campania region (Romeo, E., et al., 2016).

In this study it was found that the most relevant diseconomies that manifest themselves in the "last mile" of freight transport derive from the level of congestion in which freight vehicles are forced to move. This leads to longer travel times and lack of space for stops, forcing the goods to be unloaded away from their destination, increasing the overall distribution time even further; all of which results in higher costs and therefore higher tariffs.

To these diseconomies are added those deriving from the bad use of vehicles, which, even if they depart with a full load, having to deliver to points even very far away in the same urban area, covering very long routes, are progressively emptied as they make their deliveries, eventually recording very low filling coefficients.

In addition, each recipient is served by several carriers, each of which makes deliveries for a few parcels, using, for each delivery, slightly shorter times than those required for large deliveries and, in fact, increasing the level of air pollution and, in general, the urban environment.

Alongside these problems, internal to the distribution system adopted, there are those that fall on the city and its inhabitants.

These are externalities that primarily concern traffic which, while on the one hand, is a diseconomy for the haulier, on the other hand it is heavily burdened by the presence of goods vehicles in transit and parked for loading and unloading. This congestion affects the users of the transport system, both if on individual vehicles, Italy with 645 cars per 1000 inhabitants has the highest rate in Europe (ACEA, 2020), and if on collective vehicles, in terms of lost time, higher fuel consumption, dangerousness and accidents. But the greatest damage caused by the transport of goods concerns the environment: just think of the air pollution (atmospheric and acoustic), the alteration of the landscape, the corrosion of the historical and monumental heritage of cities, up to the damage to the road infrastructure (worn in its pavement by the repeated transit of heavy vehicles).

In addition, it highlighted how the distribution of goods in urban areas is affected and in turn influences passenger traffic in the city centre.

In the experimentation related to the above mentioned project, after estimating the demand for transport, passengers and goods, and evaluating the factors that determine it, we moved on to determine the variation of the same due to the interventions foreseen by the project or possible external elements.

In order to simulate the demand for passenger transport, the network was pre-loaded with a value of equivalent vehicles, obtained as a percentage rate of the capacity value of the specific arc according to the traffic situation at peak times; the results of the questionnaires administered in the preparation of the project showed that 38% of the sample declared to make deliveries in the time slot between 6 and 9, while 40% declared to deliver goods in the time slot 9-13.

As the simulations needed to be based on a single hour, the time slot 9-10 was chosen. The estimate of demand for transport of the goods was based on sample surveys carried out by administering a questionnaire to the respective managers of the shops belonging to a sample examined.
Of the information obtained from the surveys, those relevant to the estimate of demand for the transport of goods are given below:
- Type of Loading/Unloading Operations;
- Type of Vehicle;
- Procurement of the goods;
- Quantity of goods;
- Days of delivery;
- Time of delivery of goods

Subsequently, the results obtained in the project and non-project scenarios were compared in order to assess the cost-effectiveness of the intervention.
The experimentation showed that the number of vehicles in the project scenario was significantly lower than in the non-project scenario. In fact, in addition to the advantages of collecting the goods in a single point, City Logistics' policies allow the further advantage of optimizing the trips by collecting the loads destined to nearby areas in the same vehicle, so that a smaller number of vehicles (63 in spite of the 302 of the non-project scenario) and always fully loaded, can travel.
On the basis of the objectives to be pursued with the planned interventions, the most appropriate variables were chosen and for these were determined, through estimates, performance indicators representative of some variables that highlight the strengths and weaknesses of the Project Scenario (Scenario 1) compared to the starting Scenario (Scenario 0), thus identifying the criteria against which to assess how each design alternative meets a given objective, and then choose the best alternative from all of them.
Each indicator, therefore, allows to evaluate the degree of achievement of the various objectives for each project hypothesis analyzed. In particular, since they are interventions aimed at improving general traffic conditions and road safety, the following indicators have been considered:
- Vehicles-km on the network
- Average speed on network
- Average travel time
- Average Criticality
- Incidentality
- Estimate Pollutant emissions
- Estimate Average costs

In the baseline scenario, the values of all indicators whose minimisation leads to an increase in environmental and social sustainability are higher than those obtained in the project scenario, only the average speed indicator to be maximised is higher in the project scenario.
The results, therefore, highlight how implementing a rational distribution of goods inspired by the core principles of City Logistics can achieve clear improvements in mobility in the study area.
In particular, analyzing the estimates of the indicators in detail, it can be noted that in Scenario 1 the number of vehicles on the network is drastically reduced (from the value of 740 vehicles/km in Scenario 0 to the value of 206 vehicles/km in Scenario 1), as well as the average value of the saturation flow on the network (VOC) that goes from 0.36 to 0.1.
The results of these two indicators already show how the intervention of City Logistics determines a strong reduction of goods vehicles on the urban network, to the benefit of the traffic that is strongly reduced, thus also reducing air pollution, as also demonstrated by the representative indicator of average pollutant emissions and as it is clearly indicated in the following tables.

Table 1: Estimated indicator values for Scenario 0 and Scenario 1

Indicators	**Scenario 0 'without project'**	**Scenario 1 'with project''**
Veic/km	740	206
$\bar{v}$ (km/h)	36	37
$\bar{T}$ (min)	38.296	38.292

$\overline{VOC}$	0.36	0.1
$N_{incidenti}$	0.013	0.004
Cmedio (€)	1071	355

Source: "*City Logistics e management della distribuzione urbana in Campania, dal modello alla sperimentazione" (2016)*

Table 2 - Estimated average pollution emission values for the two Scenarios

	Average pollution emission (g)			
SCENARIO	**CO**	**NO_x**	**HC**	**TOT**
Scenario 0	**45003**	**6300**	**6300**	**57603**
Scenario 1	**14904**	**2087**	**2087**	**19078**

Source: "*City Logistics e management della distribuzione urbana in Campania, dal modello alla sperimentazione" (2016)*

The average travel speed increases only slightly (by about 1 km/h) in the project scenario, and the average travel time on the network is also reduced to a limited extent. The reason why, for these values, no drastic changes are obtained in the two scenarios is that it has been assumed that passenger transport demand would remain unchanged, and consequently, with the characteristics of the infrastructure also remaining unchanged, the change in the number of freight vehicles on the network does not have a strong impact in terms of changes in speed and travel time.

4. CONCLUSION

The results obtained show that the implementation of a City Logistics project, which in the case mentioned above envisages the construction of a goods sorting centre within a freight village adjacent to the city, is advantageous not only in terms of reducing distribution times and costs to the benefit of individual businesses, but also from the community's point of view for the improvement of living conditions that would result from the reduction of vehicles on the network, the reduction of congestion and air pollution and thanks to the reduction in the number of harmful accidents.

These results lead to continue, as the literature shows, the study on City Logistics, to look for new evolutionary models, to implement new projects (Taniguchi, E., 2020).

The focus on logistics for the city arises not only from an unavoidable need to improve environmental conditions, and especially at this time, but also from the observation of the role of urban centers in economic activity, for their ability to attract investment and generate employment in sectors such as advanced tertiary or industry.

The devastating impact of COVID 19 on our lives has revived the debate on sustainability and many cities are looking to economic recovery through a sustainability target.

Trevor Hoyle (2020), in the wake of the Covid-19 health emergency, calls for greater attention to be paid to cities so that they can be the drivers of necessary and sustainable economic and social prosperity and, in this challenge, logistics has proven to play a leading role.

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