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Delivering in Urban Areas: A Dynamic Approach to Utility and Choice Updating Enhanced by Emerging Technologies

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Abstract

This paper focuses on smart delivery and, in particular, on models to develop smart path advisory systems which, in providing route suggestions, take into account real-time and past states of the road network and the preferences of truck drivers. This work allows one to unify the advances in transport systems and emerging information and communication technologies (e-ICT), having the sustainability problem as a priority goal. The paper examines the choice process of truck drivers when conducting deliveries in an urban area. First, the general modeling framework is introduced. Then, a path cost updating model is recalled, and, subsequently, a dynamic choice updating model is formalized, which can be directly applied in the case of a given and defined choice set of alternatives. It is developed within the approach of sequential analysis.

Keywords: city logistics; emerging ICT; dynamic demand model; sequential approach; choice updating.

1. Introduction

Several public territorial administrations have started to recognize and address the difficulties surrounding urban goods mobility by developing visions and policies for the movement of products in cities at the regional or municipal level. However, as the COVID-19 pandemic has demonstrated, there are often insufficient techniques for the last-mile freight distribution within inner cities (Bian et al., 2023; Campisi et al., 2021; Comi and Polimeni, 2024; Marcucci et al., 2024). Moreover, as the internet industry continues to grow rapidly, difficulties related to urban sustainability are

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becoming more severe. In addition to dealing with constraints of urban infrastructure (such as congested streets and street furniture), truck drivers in cities also have to deal with vulnerable road users, such as cyclists and pedestrians. According to requests from both international and local authorities, carriers can and should have technological solutions to increase the sustainability and effectiveness of their urban freight transport operations.

This work focuses on smart delivery and, in particular on models to develop smart route advisory systems, which, when providing route suggestions, take into account the real-time and past states of the road network and truck drivers' preferences. Current research does not focus on the optimization of multi-stop routes (traditional routing problem) but on dynamic path choice modelling updating which consists of path utility (disutility) and choice. This work allows one to unify the advances in transport systems and emerging information and communication technologies (e-ICTs), having the sustainability problem as a priority goal (Thompson and Zhang, 2018; Ruiz-Meza et al., 2021; Comi and Russo, 2022). For example, it aims to reduce the generalized cost of low- or zero-emission systems (*environmental* impact) during their use in last-mile deliveries. In particular, the analysis evolves to review the learning process of generalized travel costs related to innovations derived from the use of e-ICTs and to point out the benefits both in terms of internal (operational) and external costs. Then, how choices can be updated is investigated and formalized. In fact, while there is significant literature on utility updating, little work has been made to investigate choice updating (Comi and Russo, 2022).

In particular, the internet of things (*IoT*) and big data (*BD*) can be considered as the main e-ICTs impacting the choice of path between two intermediate stops/deliveries/customers (updating both the path utility and the choice model), even though artificial intelligence (*AI*) could better exploit the opportunity offered by real-time information. On the other hand, block chain (*BC*) allows one to manage the exchange of values and protected/reserved data of the delivery (in this way, it is also called the internet of values - *IoV*), while *AI* supports path choice decisions. Then, digital twins (*DT*) are an integrated soft-hardware system, where the methods for planning and those for assessing the general product as a service business models can be tested for city logistics. On the other hand, *BC* allows the exchange of values and protected/reserved data of the delivery (i.e., Internet of Values – *IoV*) to be managed. In fact, it allows researchers to manage the transfer of values among different actors of the supply chain, for example, between shippers and retailers, as well as couriers and end consumers (home deliveries). Several projects are implementing block chain to improve transparency as well as to monitor supply chains (Comi and Russo, 2022). Therefore, in the near future, its growth potential is very high.

The literature considers the dynamic demand models used in the analysis of transport systems working in ordinary conditions and for passengers (Cantarella, 2020; Russo et al., 2024; Cantarella et al., 2025). Then, the paper examines the choice process for truck drivers that deliver in urban areas. No dynamic path choice model for freight vehicles is present in the literature, to the authors' knowledge. Consider that the choice of path is the most important because it is supported by the *IoT* and can really reduce operational costs, but at the same time it is the most complex due to the considerable quantity of path alternatives available to the user in urban and metropolitan areas. Therefore, this paper presents a general framework for path cost updating and the subsequent path choice updating.

2. Background

Carriers and planners face difficulty distributing goods in metropolitan areas in an efficient and sustainable manner. Truck drivers in urban areas face vulnerable road users, such as cyclists and pedestrians, who share the urban infrastructure with goods vehicles, in addition to restrictions of urban infrastructure (such as narrow streets, street furniture). To increase the sustainability and efficiency of their urban freight transport operations, carriers can and should have technological solutions, as requested by local and international authorities (Buldeo Rai et al., 2019; Galkin et al., 2021; Gomez-Marin et al., 2020; Guo et al., 2012; Mintsis et al., 2004; Russo et al., 2020). Technical vehicle solutions, such as engine solutions, typically have little effect on the number of truck kilometers in the city, but they lessen the negative effects of the kilometers driven or accidents involving goods vehicles. The number of kilometers driven in metropolitan areas can be reduced by solutions that take advantage of the opportunities presented by emerging information and communications technologies (e-ICTs), such as *IoT*, *BC*, *BD*, and *AI*. Among the latter, carriers can find the best routes thanks to navigation systems.

Navigation systems were built to offer suitable route advice using data on traffic laws (such as lane directions and road construction). The average configuration of the road network (e.g., average link travel time according to time of day, days; Cattaruzza et al., 2017; Chen et al., 2018; de Moraes Ramos et al., 2020; Letnik et al., 2020) allows navigation systems to identify the optimal routes between destinations (customers to serve).

To handle departure time and route selections, the next generation of truck travel information systems is being developed. One of the most recent developments is the building of a new navigation algorithm that offers intelligent routing and customized, proactive user assistance. The word "proactive" means that information is created to influence driver' decisions, ideally before traffic jams occur. Information about traffic conditions at the time of departure is often useless in choosing the best routes. This is because driving to the point where a route decision becomes significant takes time. Traffic conditions could be altered at that moment. Therefore, it is far more intelligent to predict traffic scenarios. Weather forecasts are included in these predictions.

In addition, it is necessary to adjust traffic information so that it is appropriate for the characteristics of the route, the intensity of traffic jams, and the demand of individual road users. Individual truck drivers receive personalized route recommendations using smart routing, which are then improved based on past recommendations (Russo and Comi, 2022). This evolution towards smart advice benefits from the innovations guided by e-ICTs specific for transportation issues, i.e., *IoT*, *BC*, *BD*, *AI*, *DT*. For details on their impact on transportation and logistics, readers can refer to the large literature (Atzori et al., 2010; Cagliano et al., 2020; Comi and Russo, 2022; Taniguchi et al., 2020).

3. Dynamic models

The dynamic process model proposed to analyze the evolution of the system is based on the theoretical formulations of inter-period dynamic processes (Cascetta, 2009; Cantarella, 2020; Cantarella et al., 2024 and 2025). These models refer to the theory of nonlinear dynamical processes when the system is studied through deterministic variables, while they refer to the theory of stochastic processes when stochastic variables are used.

The analysis of inter-period dynamic processes involves the study of two distinct phenomena that evolve over time, which, in the static approach of equilibrium, are generally considered together. The two phenomena require explicit modelling in the study of processes in order to fully understand the nature of the temporal evolution of the system:

- *Utility Updating Model*; this phenomenon affects how the user integrates information about utilities and costs experienced in the previous days with information available in real time; the increasing spread of e-ICTs has made this aspect even more central in recent years; in the literature, the utility update model has been addressed through different mathematical formulations, often explicitly considering the role of e-ICT (Comi and Russo, 2022; Russo et al., 2025);
- *Choice Updating Model*; it represents an essential pillar for the study of the temporal evolution of transport systems; the analyzed phenomenon concerns the way in which the user synthesizes choices made in the past and how this synthesis influences future decisions (Russo et al., 2024).

The utility updating model is mainly linked to the evolution of the supply component, since, in dynamic systems, it influences the configuration of the system from one period to the next, for example from 10.00 am to 11.00 am. On the other hand, the choice updating model focuses on the evolution of the demand component, i.e., how the demand model can represent user's decision-making process over time. In the next section, the utility update model is presented, also with reference to the role of e-ICT. Only the main characteristics of the utility updating model are recalled, being, as mentioned, already studied in the literature, also by the authors of this study (Comi and Russo, 2022). Next, the choice updating model is presented. The general literature model and the specific case of the exponential filters used are recalled. The proposed structure is then considered with all the evolutions that the model for updating the choice can assume in relation to the different conditions of the urban systems under investigation.

3.1. Utility updating process

The process of updating the utilities (or better dis-utilities given that the reference is on cost) has to particularly consider the updating of link costs, considering the role-played linking to network nodes (e.g., two road intersections) or in terms of network centrality in the relationship with the other nodes of the analyzed network and in relation to the paths that cross it (Bell and Iida, 1997; Rindone and Russo, 2024; Campisi et al., 2025; Rindone and Russo, 2025). IoT is currently the most effective means for capturing real-time network information, while BD allows data about past system states to be stored and processed. These data concern both the components that influence path utilities, such as travel times, and the components related to the flows on network links. One of the sectors in which the use of these devices has experienced an expansion is that of urban deliveries. In this context, the presence of private operators and the need for cost-effective solutions increasingly favors the adoption of these technologies, facilitating the connection between shippers, retailers, and end consumers (Atzori et al., 2010; DHL, 2015). The issue becomes more important with the evolution of new delivery channels, such as pick-up and locker points (Comi et al., 2024; Russo et al., 2023), where the driver can realign the next route.

The more general problem is to evaluate the systematic utility ($\boldsymbol{V}$), in a generic period y or time t, on the basis of what was estimated in the previous period y-1 or t-1, and the actual costs ($\boldsymbol{g}$) that were realized in this previous period.

The general formulation for period y (similarly for time t) is therefore:

$$\boldsymbol{V}^{y} = V\left(y-1, \boldsymbol{g}^{y-1}\right) \tag{1}$$

The study of learning processes, and therefore of utility updating processes, is carried out in the literature for systems under ordinary conditions. The y-based process is commonly covered in literature. User learning, in relation to the evolution of traffic conditions, can only be obtained through information from the built environment. The update occurs at any time t on day y. The update can be performed by the e-ICT mentioned above, mainly *BD* for the evolutions related to the periods in y and *IoT* for the evolutions related to t.

3.2. Choice updating process

The general approach referred to the one proposed by Cascetta (2009). In the general formulation, the model for the choice updating is expressed through a square matrix $\boldsymbol{R}^{w}$, defined as the matrix of conditional choices. The matrix $\boldsymbol{R}$ is equal in size to the number of available paths. S is the set of feasible paths.

In the formulation of the general model, reference is made to the generic process from a period w to a subsequent period w+1 or to a prior period w-1. This formulation allows the general known model to be defined and the evolution with respect to the two processes considered below to be taken into account:

(i) the process that considers the base period equal to day y, and therefore a typical day-to-day process, and
(ii) the process that considers the period of information collection, updating and reprocessing during the day, which, like an order of magnitude, can be considered equal to the hour; this period is indicated by the variable t.

3.2.1. General dynamic model

Referring to the generic sequence of periods w, let r_{kj}^{w} be defined as the conditional choice percentage of path j chosen in period w-1, which chooses path k in period w. The path flow vector in w, $\boldsymbol{h}^{w}$, is expressed as the product of the conditional choice matrix $\boldsymbol{R}^{w}$, and the vector of path flows in the previous period w-1, $\boldsymbol{h}^{w\text{-}1}$

$$\boldsymbol{h}^{w} = \boldsymbol{R}^{w} \cdot \boldsymbol{h}^{w-1} \tag{2}$$

The elements of $\boldsymbol{R}^{w}$ can be estimated with a model as a function of the utilities of the individual paths estimated for w, in the other periods:

$$\boldsymbol{R}^{w} = R\left(\boldsymbol{V}^{w}\right) \tag{3}$$

and therefore, from *eqs. (2)* and *(3)* follows

$$\boldsymbol{h}^{w} = R\left(\boldsymbol{V}^{w}\right) \cdot \boldsymbol{h}^{w-1} \tag{4}$$

Eq. (4) provides the general formulation of reference for the update of the choices. The developments of *eq. (4)* allow dynamic choice models under different conditions to be specified and analyzed.

The general formulation of the utility updating model, expressed in terms of period w, is given by:

$$\boldsymbol{V}^{w} = V\left(\boldsymbol{V}^{w-1}, \boldsymbol{g}^{w-1}\right) \tag{5}$$

By combining *eq. (5)* with *eq. (4)*, the relationship between the flows $\boldsymbol{h}^{w}$ in the period w, the utilities $\boldsymbol{V}^{w-1}$ and the costs $\boldsymbol{g}^{w-1}$ is obtained:

$$\boldsymbol{h}^{w} = R\left(V\left(\boldsymbol{V}^{w-1}, \boldsymbol{g}^{w-1}\right)\right) \cdot \boldsymbol{h}^{w-1} \tag{6}$$

3.2.2. Dynamic model with exponential filtering

The general model, in its overall formulation, given by *eq. (6)* is usually specified using an exponential model (filter) to obtain the matrix $\boldsymbol{R}$.

For the formalization of the model, it is assumed that:

- some users directly repeat the choices made the day before without reconsidering them;
- some users reconsider their choices and can remake those of the previous day y;
- the choices made on day y are independent to those made on day y-1;
- α is the probability that a user will reconsider the choice made on day y-1;
- from the previous assumptions, it follows that for $\alpha=1$ (*eq. 7*) all users reconsider the choices made in y-1;
- p^{wk} is the probability that a user, that reconsiders the choice made in w-1, will choose the path k in y.

Therefore, the path flows are obtained as follows:

$$\boldsymbol{h}^{w} = \alpha \cdot d \cdot \boldsymbol{p}^{w} + \left(1-\alpha\right) \cdot \boldsymbol{h}^{w-1} \tag{7}$$

where

$$\boldsymbol{p}_{k}^{w} = \boldsymbol{p}_{k}^{w}\left(\boldsymbol{V}^{w}\right)$$

Then, *eq. (7)* becomes as follows:

$$\boldsymbol{h}^{w} = \alpha \cdot d \cdot \boldsymbol{p}^{w}\left(\boldsymbol{g}^{w}\right) + \left(1-\alpha\right) \cdot \boldsymbol{h}^{w-1} \tag{8}$$

and considering the exponential filter for the updating of the path utilities, *eq. (8)* finally becomes:

$$\boldsymbol{h}^{w} = \alpha \cdot d \cdot \left(-\beta \cdot \boldsymbol{g}^{w-1} + \left(1-\beta\right) \cdot \boldsymbol{V}^{w-1}\right) + \left(1-\alpha\right) \cdot \boldsymbol{h}^{w-1} \tag{9}$$

3.2.3. Proposed sequential model

Having the general formulation of the dynamic model given by *eq. (4)* and the specification with exponential filters given by *eq. (8)* and *eq. (9)*, for the actualization of utility and choice, it is useful to deepen the formalizations that $\boldsymbol{R}^{w}$ can assume in relation to the conditions connected with the individual system to be studied: both for the state of supply and for the state of demand.

3.2.3.1. Basic model

It is useful to point out that considering *eq. (9)*, the changes in the path flows in the period w determine a new route flow vector, $\boldsymbol{h}^{w}$, and depend on the model of updating utilities, while the variations dependent on the choice are to be traced back by α and to the model of choice summarized by probability p.

In this sense, it can be considered as a basic model the one that considers the progress of the system for periods of amplitude equal to one day. The variable w indicates the reference day, previously indicated by y. Under these conditions, models from *eq.(8)* and *eq.(9)* can be traced back to cases in the literature.

3.2.3.2. Inter-period models with update utility

Multiple developments can be considered in relation to the specifications that can be given to *eq. (8)* and more generally to *eq. (4)*. The developments proposed here are divided into two different advances. The two advances are connected with the model studied and refer to the real case of freight transport on an urban scale. Drivers use vehicles with different degrees of e-ICT accessories; public/private control panels instrumented with e-ICT and connected to all the vehicles in their company fleets are considered.

The first advance concerns the use of the updating costs, from one day to the next, i.e., in period y, with models in α and p defined by the general model. In this case, the actualizations of the utilities related to the different levels of e-ICT present in the study system are considered, and then the advances, provided by the use of updating models that make explicit the presence of *BD* with respect to the information relating to what happened in the system in the past, and the presence of *IoT* that provides information at the time when the first choice of path is made, are considered.

The second advance concerns the two classes of periods y and t defined. In this case, the specifications are different in relation to the types of e-ICTs in the study area. *BD* makes it possible to reconstruct everything that happened in the different paths, even in those not used by the user both in the previous periods up to y-1 and t-1. IoT makes it possible to disseminate the current information on the state of the system at the time the choice is made, i.e., in t.

3.2.3.3. Inter-period models with modification of choices

The two proposed advances internalize the updating of utilities in the choice model. A particularly significant class is one in which the matrix $\boldsymbol{R}$, and therefore the specific probability of choosing k in w, depends on the choice made in w-1 of j.

This approach involves rewriting *eq. (9)*, in the case of using a model with exponential filters, because the probability $\boldsymbol{p}$ is no longer independent of the path chosen in w-1; conversely, $\boldsymbol{p}$ is conditioned by the path j chosen in w-1.

Then, referring to the basic process with a period defined by the day, it is possible to rewrite *eq. (2)* with the following equations in a formally similar way, but inserting the $R^{w}{}_{jk}$ to indicate that the probability of choosing on the day w is not independent but, in contrast, depends precisely on the choice j made in w-1:

$$\boldsymbol{h}^{w} = \boldsymbol{R}^{w}_{jk}\left(\boldsymbol{V}^{w}\right)\cdot \boldsymbol{h}^{w-1} \tag{10}$$

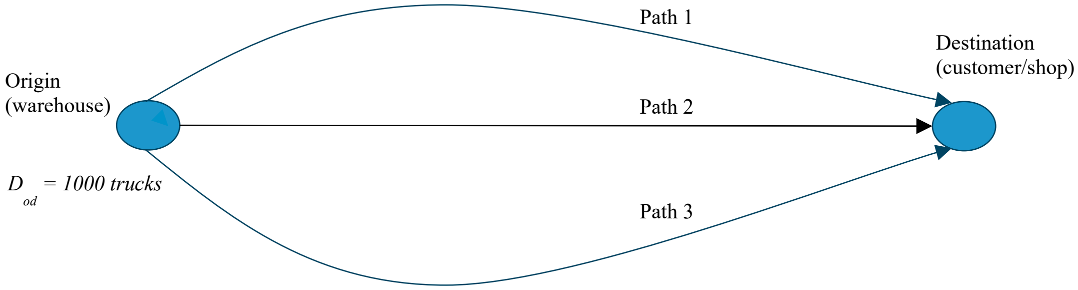
In *eq. (10)*, each row is determined by a model connected to the characteristics of the path chosen in w-1. In case studies, if there are no differences in the models to be used for *eq. (10)*, it is possible to return directly to *eq. (3)*.

In the same way, a further advance can be made by considering the choice that can be actualized in the different bands in which the day is divided, i.e. following the process in which w is equal to t. In both cases, it is necessary to rewrite *eq. (10)* in y and t as follows:

$$\boldsymbol{h}^{y} = \boldsymbol{R}^{y}_{jk}\left(\boldsymbol{V}^{y}\right)\cdot \boldsymbol{h}^{y-1} \tag{11}$$

$$\boldsymbol{h}^{t} = \boldsymbol{R}^{t}_{jk}\left(\boldsymbol{V}^{t}\right)\cdot \boldsymbol{h}^{t-1} \tag{12}$$

Figure 1 reports an example of the general dynamic framework. The example refers to a network where there are three paths for traveling from the warehouse zone (zone o) to customer/shop zone (zone d). The demand for the origin-destination pair od is *1000* trucks. The example allows readers to go inside the earlier equations and to capture the dynamics of the simulation through the evolution of path flows from w-1 to w according to the $\boldsymbol{R}^{w}$ matrix that describes the evolution of path choices by users.



		w-1		
	$\mathbf{R}^{w}_{ij}$	Path 1	Path 2	Path 3
w	Path 1	0.10	0.30	0.50
	Path 2	0.50	0.60	0.40
	Path 3	0.40	0.10	0.10

	$\boldsymbol{h}^{w-1}$
Path 1	100
Path 2	500
Path 3	400

	$\boldsymbol{h}^{w}$
Path 1	10+150+200
Path 2	50+300+160
Path 3	40+50+40

Figure 1. Example of the general dynamic model.

4. Conclusions

This paper discussed the innovations that can be guided by e-ICT in simulating path choices in urban freight transport. Then, the general framework is first considered, then a path cost updating model is recalled, and, subsequently, a dynamic choice updating model is formalized, which can be directly applied in the case of a given and defined choice set of alternatives. The proposed updating choice model allows researchers to select data from a user behavioral process to demonstrate how to record observation data, related to the user's behavior, identifying a method that allows them to verify if there are significant sequential characteristics.

Future developments will concern the integration with dynamic models (choice and utility) into vehicle routing and scheduling systems. This integration can be developed in two levels: in the former, only the advances allowed by *BD* are considered and therefore directly in the current systems that optimize before starting delivery tours, intervening on y; in the latter level, both *BD* and *IoT* information are considered, and then re-optimizing at the start of each stop during the tours, intervening on t.

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References

Bell, M.G.H., Iida, Y., 1997. Transportation network analysis. J. Wiley, Chichester ; New York.

Buldeo Rai, H., Verlinde, S., Macharis, C., 2019. City logistics in an omnichannel environment. The case of Brussels. Case Studies on Transport Policy 7, 310–317. https://doi.org/10.1016/j.cstp.2019.02.002

Campisi, T., Russo, A., Trwdy, E., Zanne, M., Tesoriere, G., 2025. Some considerations on the analysis of port centrality in the Adriatic basin for tourist transport purposes. Transportation Research Procedia 83, 125–132. https://doi.org/10.1016/j.trpro.2025.02.018

Cantarella, G.E., 2020. Dynamics and stochasticity in transportation systems: tools for transportation network modelling. Elsevier, Amsterdam, Netherlands.

Cantarella, G. E., Fiori, C. and Velonà. P., 2025. Moving average vs. exponential smoothing cost-updating filters for day-to-day dynamic assignment: fixed-point stability and bifurcation theoretical analysis. Transportation Research Part B: Methodological 199: 103253.

Cascetta, E., 2009. Transportation Systems Analysis, Springer Optimization and Its Applications. Springer US, Boston, MA. https://doi.org/10.1007/978-0-387-75857-2

Cattaruzza, D., Absi, N., Feillet, D., González-Feliu, J., 2017. Vehicle routing problems for city logistics. EURO Journal on Transportation and Logistics 6, 51–79. https://doi.org/10.1007/s13676-014-0074-0

Chen, Y., Yu, J., Yang, S., Wei, J., 2018. Consumer's intention to use self-service parcel delivery service in online retailing: An empirical study. INTR 28, 500–519. https://doi.org/10.1108/IntR-11-2016-0334

Comi, A., Russo, F., 2022. Emerging Information and Communication Technologies: the Challenges for the Dynamic Freight Management in City Logistics. Front. Future Transp. 3, 887307. https://doi.org/10.3389/ffutr.2022.887307

de Moraes Ramos, G., Mai, T., Daamen, W., Frejinger, E., Hoogendoorn, S.P., 2020. Route choice behaviour and travel information in a congested network: Static and dynamic recursive models. Transportation Research Part C: Emerging Technologies 114, 681–693. https://doi.org/10.1016/j.trc.2020.02.014

Galkin, A., Schlosser, T., Capayova, S., Takacs, J., Kopytkov, D., 2021. Attitudes of Bratislava citizens to be a crowd-shipping non-professional courier. Transportation Research Procedia 55, 152–158. https://doi.org/10.1016/j.trpro.2021.06.016

Gomez-Marin, C.G., Serna-Uran, C.A., Arango-Serna, M.D., Comi, A., 2020. Microsimulation-Based Collaboration Model for Urban Freight Transport. IEEE Access 8, 182853–182867. https://doi.org/10.1109/ACCESS.2020.3028564

Guo, D., Zhu, X., Jin, H., Gao, P., Andris, C., 2012. Discovering Spatial Patterns in Origin-Destination Mobility Data. Transactions in GIS 16, 411–429. https://doi.org/10.1111/j.1467-9671.2012.01344.x

Letnik, T., Mencinger, M., Peruš, I., 2020. Flexible Assignment of Loading Bays for Efficient Vehicle Routing in Urban Last Mile Delivery. Sustainability 12, 7500. https://doi.org/10.3390/su12187500

Mintsis, G., Basbas, S., Papaioannou, P., Taxiltaris, C., Tziavos, I.N., 2004. Applications of GPS technology in the land transportation system. European Journal of Operational Research 152, 399–409. https://doi.org/10.1016/S0377-2217(03)00032-8

Rindone, C., Russo, A., 2024. A Network Analysis for HSR Services in the South of Italy, in: Gervasi, O., Murgante, B., Garau, C., Taniar, D., C. Rocha, A.M.A., Faginas Lago, M.N. (Eds.), Computational Science and Its Applications – ICCSA 2024 Workshops, Lecture Notes in Computer Science. Springer Nature Switzerland, Cham, pp. 217–232. https://doi.org/10.1007/978-3-031-65318-6_15

Rindone, C. and Russo, F., 2025. Intermediate results for railway capacity evaluation: a network analysis for HSR services in Italy. Transportation Research Procedia, Volume 90, pp. 718-725. https://doi.org/ 10.1016/j.trpro.2025.06.087

Ruiz-Meza, J., Meza-Peralta, K., Montoya-Torres, J.R., Gonzalez-Feliu, J., 2021. Location of Urban Logistics Spaces (ULS) for Two-Echelon Distribution Systems. Axioms 10, 214. https://doi.org/10.3390/axioms10030214

Russo, F., Calabrò, T., Iiritano, G., Pellicanò, D., Petrungaro, G., Trecozzi, M., 2020. City Logistics Between International Vision and Local Knowledge to Sustainable Development: The Regional Role on Planning and on Public Engagement. IJSDP 15, 619–629. https://doi.org/10.18280/ijsdp.150504

Russo, F., Comi, A., 2022. Providing dynamic route advice for urban goods vehicles: the learning process enhanced by the emerging technologies. Transportation Research Procedia 62, 632–639. https://doi.org/10.1016/j.trpro.2022.02.078

Russo, F., Comi, A., Chilà, G., 2024. Dynamic Approach to Update Utility and Choice by Emerging Technologies to Reduce Risk in Urban Road Transportation Systems. Future Transportation 4, 1078–1099. https://doi.org/10.3390/futuretransp4030052

Russo, F., Comi, A., Rindone, C., 2025. The Emerging ICT for Exposure Reduction in Urban Mobility: Transport Models for Risk Cycle, in: Razminia, A., Nguyen, D.H. (Eds.), Intelligent Technology for Future Transportation, Communications in Computer and Information Science. Springer Nature Switzerland, Cham, pp. 173–187. https://doi.org/10.1007/978-3-031-84148-4_14

Thompson, R.G., Zhang, L., 2018. Optimising courier routes in central city areas. Transportation Research Part C: Emerging Technologies 93, 1–12. https://doi.org/10.1016/j.trc.2018.05.016