https://doi.org/10.38104/vadyba.2022.1.08

Vadyba
Journal of Management
2022, № 1 (38)
ISSN 1648-7974

THE DEVELOPMENT OF SUSTAINABLE TRANSPORTATION FOR E-GROCERY

Valentas Gružauskas, Aurelija Burinskienė
Vilnius Gediminas technical university

Abstract
Growing demand for organic food products requires to rethink the current supply chain approaches for e-grocery. The shifting trend for e-commerce is requiring products to be delivered in small quantities, to multiple delivery points, which causes negative effect from sustainability perspective. The distribution of goods in urban areas, together with private traffics flow, are among the main sources of energy consumption, air pollution and noise. Thus, the goal of the research is to conduct a literature review on development of sustainable transportation for e-grocery. The literature analysis indicated that the majority of vehicle routing approaches are design for general transportation problems, not specifically related to e-grocery. Also, the changing economic trends related to growing urbanization levels and traffic congestions are not taken into consideration. Thus, the authors of the publication indicate the need to develop dynamic routing algorithms for autonomous vehicles to cope with the traffic congestions and maintain higher sustainability levels from social, economic, and environmental perspectives.
KEY WORDS: E-grocery; rout scheduling; sustainability; food quality.

Introduction

Growing demand for organic food products requires to rethink the current supply chain approaches for e-grocery. It is estimated that the world population is expected to reach 9.8 billion by 2050 (United Nations 2015), the average life expectancy in Europe will be 82 years by 2050 (Conrad, Alan, and Katherine 2015). These trends are leading to higher food demand. However, the rising awareness of healthy lifestyle is causing inefficiencies in the current supply chain processes of the food industry. Healthier lifestyle has influenced the demand for organic food products, which have short shelf life. The traditional retail distribution channel is not suitable for organic food products since it has a long supply chain. Thus, to maintain higher food quality levels the lead-time must be reduced (Euromonitor International 2017). The alternative distribution channel in this case is e-commerce. More people started to purchase grocery products online, and the growth even intensified during COVID-19 period. Euromonitor international in the “future of e-commerce” report stated that the absolute value growth of the global retail industry that will come from e-commerce during the period of 2020 – 2025 will represent in total 1.4 trillion USD (Euromonitor international 2021). The growth was even more intensified during the COVID-19 period. “Grocery was one of just a few retail subsectors that grew consistently in 2020: volume increased by around 8 percent and value by slightly more than 10 percent, in particular in categories related to the trend of spending more time at home.” (Mckinsey 2021). For the food industry to shift from retail to e-commerce new logistic approaches must be developed.

The shifting trend for e-commerce is requiring products to be delivered in small quantities, to multiple delivery points, which causes negative effect from sustainability perspective. The distribution of goods in urban areas, together with private traffics flow, are among the main sources of energy consumption, air pollution and noise (Faccio and Gamberi 2015). The growing e-commerce sector, without any intervention, the number of delivery vehicles in the top 100 cities globally will increase by 36% until 2030 (World Economic Forum 2020). It was calculated that fossil fuels are contributing to excessive release of greenhouse gases over 2005-2018 period, 1.2 billion tons of CO_2 from transport were added across the world (Euromonitor International 2019). Thus, it is estimated the emissions from delivery traffic will increase by 32% and congestion will rise by over 21%, equaling an additional 11 minutes of commute time for each passenger every day (World Economic Forum 2020). The growing urbanization levels will cause even more issues for urban areas. Urbanization will continue at an accelerated pace, and about 70% of the world population will be urban, compared to 49% today (United Nations 2014), which will cause even higher traffic congestions and negative effect to the environment. Because of the mentioned issues companies are being pressured to use green vehicles, however, they require additional capital to purchase and maintain. However, the last mile logistics is the most inefficient part of the delivery supply chain, and is estimated to account for up to 28% of the total shipment cost (Euromonitor International 2019). There is a trade-off between economic and environmental aspects, however at the same time the social aspect must also be taken into consideration. Congestion not only causes higher CO_2 emission levels, but at the same time reduces the quality of the food products (Jouzdani and Govindan 2021), (Chen, Liao, and Yu 2021). Thus, the growing e-grocery market with current supply chain management approaches cannot achieve sustainability.

The European union strongly focuses on sustainability goals, however, lacks technological and management approaches to achieve these goals. In 2021 the European union launched an urban mobility framework, which focuses on reducing environmental pollution from traffic by digitalization the public transport and promoting vehicle sharing. The framework also focuses on zero emission for last-mile delivery, since the COVID-19 pandemic has resulted in an increase in e-commerce activity and home deliveries. Thus, the deployment of rapidly developing and sustainable solutions using new distribution models, dynamic routing, and a better multimodal transportation network would support optimization of the use of vehicles and infrastructure and reduce the need for empty and unnecessary runs (European comission 2021). The European union has adapted the Sustainable Development Goals (SDGs) proposed by the United Nations and indicated key goals for 2030. For instance, one of the goals focuses on improving urban areas from the perspective of road safety and pollution (Humphreys 2017). The new program focusing on these aspects is called "Green Deal", which one of the goals is to further reduce net greenhouse gas emissions by at least 55% by 2030 (European Sustainable Development Network 2019). However, the report of European policy center stated that "The EU failed on almost all of its sustainability goals for 2020, including those regarding energy savings, biodiversity and air, water, soil and chemical pollution." (Centre European Policy 2021). Thus, there is a need to develop new technological and management approaches for e-grocery to achieve sustainability.

Some research indicated from theoretical level the need to develop new technological and management approaches for the e-grocery sector. Awad et al. (2020) conducted an extensive cold supply chain literature analysis, and indicated 20 publications, which used food quality, shelf life or similar metrics for optimization (Awad, Ndiaye, and Osman 2020). The review identified several research gaps. First, the review suggests that dynamic vehicle modeling and routing while considering products quality and environmental impacts is still an open area for research. Second, there is no consensus among researchers in terms of quality degradation models used to assess the freshness of transported cold food. As a result, an investigation of critical parameters and quality modeling is warranted. Third, and due to the problem complexity, there is a need for developing heuristics and metaheuristics to solve such models (Awad et al. 2020). Koc et al. (2020) conducted a literature review and indicated that researchers have given too little attention to the time-depended problems, to meet the challenges face in the city logistics, time-dependencies should be considered more widely (Koç, Laporte, and Tükenmez 2020). Suryawanshi and Dutta (2022) analysed a large number of scientific publications related to supply chain resilience and provided future research trends related to operation research aspects such as efficiently manage delays and disturbances, to enhance the operational flexibility of transport and warehouses (Suryawanshi and Dutta 2022). Thus, the approaches should integrate resilience and sustainability goals.

The scientific literature indicates that autonomous vehicles (AVs) and adaptive routing algorithms must be developed for the e-grocery sector. The demand for AVs is set to grow further after the pandemic as logistics and delivery companies aim to reduce costs, increase operating capacity and ease the shortage of drivers. According to DHL, time savings thanks to autonomous technologies will reduce transportation costs per km by 40% and part of these savings can be extended to logistics service buyers (Passport 2021). On the transportation analytics side, beyond the optimization of truck-fill rates, there has been a rising interest in dynamic routing (DR) solutions. The most advanced solutions optimize trucking routes in real time based on traffic conditions and disruptions, such as road accidents (Mckinsey 2021). The combination of AVs with dynamic routing algorithms could help companies achieve sustainability. Thus, the object of the study is sustainable transportation for e-grocery. The methodology of the paper consists of scientific literature analysis and synthesis. The goal of the research is to conduct a literature review on development of sustainable transportation for e-grocery. To achieve this goal the following objectives must be accomplished:

1. Identify key research aspects of vehicle routing approaches in e-grocery from the perspective of sustainability.
2. Investigate the application of vehicle routing approaches in e-grocery by considering traffic congestions.

The article consists of several main sections. The study starts with the introduction and the summary of the literature. Further, the authors present the scientific literature related to vehicle routing approaches from sustainability perspective. In the next section, the authors revised literature focusing on traffic congestion integration in vehicle routing solutions for e-grocery. Finally, the authors provided conclusions.

The role of vehicle routing in e-grocery from sustainability perspective

There are multiple review papers focusing on general vehicle routing problems (Tan and Yeh 2021), (Vidal, Laporte, and Matl 2020), (Awad et al. 2020), (Koç et al. 2020), (Guo, van Blokland, and Lodewijks 2017), (Malladi and Sowlati 2018), (Gunawan et al. 2021). Vehicle routing algorithms usually focus on shortest distance or delivery time, however, the in the case of food industry food quality must be taken into consideration. A vehicle routing problem which considered perishable products was conducted by Sovald and Stirn (2008), their research was based on using time-dependent optimization and included the costs of food waste in the goal function (Osvald and Stirn 2008). Another research conducted by Rong et al. (2011) focused on optimizing the supply chain by considering the process from production to retail, their main contribution is related to the measurement of food quality loss based on product flow and quantity (Rong, Akkerman, and Grunow 2011). A recent research analyzed the influence of food quality loss in urban logistics, with a focus on inventory management strategies and delivery time (Fikar 2018; Waitz, Andreas, and Fikar 2018). One of the research projects focused on such an approach was conducted by Haass et al (2015). It focused on the delivery of bananas by sea and not by land transport (Haass et al. 2015). Their approach measured initial food quality and decided routes by optimizing the quality level. Fikar and

Braekers (2022) developed a bi-objective optimization approach of e-grocery to determine the trade-offs between traveled distance and food quality losses (Fikar and Braekers 2022). The publication stated that joint routing and store assignment reduces travel distance, however, in some cases it is beneficial to increase traveled distance and consolidate more products if cooling equipment in store is not available. Also, it was highlighted that larger vehicle fleets and more direct deliveries can reduce food quality loss even more. The mentioned publications analyzed the food quality during their simulations, however, they did not consider traffic congestions.

Other research papers on vehicle routing took into consideration CO_2 emission levels. Increasing scale of direct delivery of organic food products to the end-consumer also raises concern about CO_2 emission level due to increased travel distance, therefore, new delivery techniques should be developed (Nabot and Omar 2016). Seebauer et al. (2016) analyzed the retail channels and determined that dominant car use on the last mile substantially contributes to overall footprint of carbon emission (Seebauer et al. 2016). Carling et al. (2015) research results indicated that consumers switching from traditional to e-retailing reduce their transport CO_2 footprint by 84% on average (Carling et al. 2015). Nabot and Omar (2016) conducted a comparative study of online retailing on the environment, their results indicated that online shopping plays an important role in minimizing CO_2 emissions due to last-mile deliveries and recommend investing into making delivery processes more efficient (Nabot and Omar 2016). Kellner (2016) analyzed the impact of traffic congestion on CO_2 emission, but did not consider the impact on food quality (Kellner 2016). Tan et al. (2019) proposed pollution routing algorithm designed for last-mile deliveries to reduce negative influence on the environment (Tan et al. 2019). Another research conducted by Velázquez-Martínez et al. (2016) included altitude, cargo weight and truck power when optimizing routes based on CO_2 levels (Velázquez-Martínez et al. 2016). Thus, it is important to consider not only food quality, but environmental impact such as CO_2 emission levels.

The role of congestions in vehicle routing

Some researchers consider traffic congestions a minor issue in vehicle routing problems, however minor disturbances in traffic and transport systems can also play an important part in reducing efficiency (Calvert and Snelder 2018). Research focusing on traffic congestions are growing, however some of them focus more on traffic flow management, rather than product delivery (Jabbarpour et al. 2018), (Isa, Mohamed, and Yusoff 2015). Jabbarpour et al. (2018) conducted a survey of computational intelligence approaches for traffic congestions, one of key insights were made stating that assessment and evaluation tools for real-world cases should be developed (Jabbarpour et al. 2018). Their research focused more on general analysis of traffic congestions. Xu et al. (2013) analyzed road congestion and proposed a method do develop a data cube of flow data, which allows to analyze spatial-temporal dependency (Xu, Yue, and Li 2013). Tang and Heinimann (2018) analyzed congestion from resilience perspective, and proposed a resilience quantification method for intersections (Tang and Heinimann 2018). More recent research tries not only to analyze historical or current traffic situation, but to estimate future trends. For instance, Peng et al. (2020) proposed a neural network to forecast traffic flow (Peng et al. 2020). Estimation or analysis of traffic flow and congestions can provide management insights, however, this information should be integrated in vehicle routing process to improve decision making process.

Only a limited amount of research considered traffic congestion in vehicle routing problems. For instance, Xiao and Konak (2016) proposed a green vehicle routing method by considering traffic congestion (Xiao and Konak 2016). A more recent publication by Sabar et al. (2019) proposed a self-adaptive algorithm for vehicle routing by considering traffic congestions (Sabar et al. 2019). Koh et al. (2020) proposed a deep reinforcement learning approach for vehicle navigation by taking in to consideration traffic congestions (Koh et al. 2020). Nguyen and Jung (2021) proposed a swarm intelligence-based green optimization algorithm for route scheduling (Nguyen and Jung 2021). However, traffic congestion consideration in e-grocery has been analyzed even less. For example, Chen et al. (2021) proposed a route optimization technique for cold chain logistics of front warehouses by considering traffic congestions (Chen et al. 2021). Jouzdani and Govindan (2021) analyzed supply chain networks of food delivery from the perspective of sensibility and took in to consideration congestions (Jouzdani and Govindan 2021). Their analysis indicated that congestions impact all aspects of sustainability not only social. Thus, DR algorithms should be developed, which considers traffic congestions, food quality and environmental effect.

DR algorithms implementation in practice can be accomplished with AVs. Research focusing on autonomous vehicles started to emerge, which takes into consideration congestion risk. For instance. Rossi et al. (2018) analysed a congestion-free routing and rebalancing problem and proposed a con gestion-aware algorithm for AVs routing, which showed a good performance of network congestion and customer service time (Rossi et al. 2018). Bosona (2020) conducted an extensive literature analysis of last mile logistics, one of the main conclusions were that from management perspective it is important to develop algorithms and optimization techniques for last mile logistics and to consider real-time data, DR planning algorithms, fleet management algorithms and tracking (Bosona 2020). However, Zennaro et al. (2020) stated that it is important to consider warehouse configuration when dealing with outbound logistics and not only automation and picking strategies of the warehouses themselves (Zennaro et al. 2022). Ding et al. (2021) conducted a literature review about internet of things application in smart logistics and indicated that these technologies are essential for real-time vehicle routing and management (Ding et al. 2021). Shladover (2018) analyzed connected and automated vehicle systems, which application for urban logistics is important, since real-time decision making might be too difficult for people (Shladover 2018). Aktas et al. (2021) developed a simulation for grocery vehicle routing based on micro hubs and shared vehicles, their research concluded that this approach reduced distance 15% and routes 22% (Aktas, Bourlakis, and Zissis 2021).

Table 1. Vehicle routing simulations of e-grocery

Environment	traffic congestion, time windows, demand, network, capacity constrained.
Goal function	delivery time, delivery distance, costs, CO_2 emission, food quality, multi objective.
Algorithms	hybrid simulated annealing and tempering algorithm, ant colony, bee algorithm, particle swam reinforcement learning, adaptive large neighborhood search.

Table 1 represents the literature analysis summary of vehicle routing simulations for e-grocery. The majority of simulations takes into consideration some type of supply chain network, which can represent of distribution center, and households. Some research considers the processing stages and not only last mile deliveries. For e-grocery distribution usually time windows are set for customer orders, with random demand patterns. Practically all simulations implement constrains for truck, warehouse, or production capacity. However, only a limited amount of simulations model dynamic environment i.e. traffic congestion. The goal function of routing usually focuses on delivery time, distance or costs, however recent publications focus more on CO_2 emission level or food quality. Only a few publications analysis multiple goals functions during the vehicle routing. Vehicle routing simulations for e-grocery usually focuses on the model itself and not the optimization technique, thus the majority use neighborhood search, simulated annealing. Part of the research implements more advanced optimization techniques based on ant colony, bee, particle swarm or other type of evolutionary or genetic algorithms. However, DR approaches which focuses on vehicle routing not only daily, but real-time was not tested in e-grocery sector but were analyzed more in general routing problems related to traffic congestions.

Conclusions

The literature analysis indicated that the majority of vehicle routing approaches are design for general transportation problems, not specifically related to e-grocery. Classic goal functions for route scheduling usually takes into consideration shortest distance or duration, some paper focus on service levels. These approaches are suitable for general supply chains, however food products are sensitive to shelf-life. Thus, route scheduling for e-grocery should take into consideration not only classic approaches, but also shelf-life or food quality. Aspects of sustainability must also take into consideration environmental effect such as co2 emission level. Thus, there is a trade off between product consolidation, frequency of deliveries, and food quality.

Growing world population and increasing urbanization levels increased the attention of researchers, who started to focus on analysis of traffic congestions. More research started to take into consideration system resilience and amplifies that traffic congestions can cause minor disruptions to the supply chain, which can reduce the efficiency of deliveries. However, this research mainly focusses on traffic flow analysis, and only limited amount includes traffic congestions in to route scheduling process. Thus, there is a need to develop dynamic vehicle routing approaches for e-grocery, which would take into consideration congestion and sustainability aspects such as economic, social, and environmental.

To develop a routing algorithm for e-grocery by considering sustainability, new multi-criteria goal functions should be developed which would integrate food quality, CO_2 emission level and operational costs. The routing algorithm should analyses historical traffic congestions, and create possible routes by considering their influence. An analysis should be completed to test the efficiency of the dynamic routing algorithm by analyzing is usage weekly, daily and in real-time. The re-scheduling frequency should influence the efficiency of the algorithm, however the trade-offs should be analyzed and quantified. In future research, such algorithm will be developed and tested for e-grocery processes in an abstract environment, which will reproduce traffic congestions and stochastic food demand. During the simulation different goal functions and optimization algorithms will be tested. A focus on the rescheduling approach will made to identify the trade-offs related to weekly, daily, and real-time scheduling. Later, the same approach will be implemented and tested in a case study, to emphasize the benefits and importance of dynamic routing algorithms even more for e-grocery.

References

Aktas, Emel, Michael Bourlakis, and Dimitris Zissis. 2021. “Collaboration in the Last Mile: Evidence from Grocery Deliveries.” *International Journal of Logistics Research and Applications* 24(3):227–41.

Awad, Mahmoud, Malick Ndiaye, and Ahmed Osman. 2020. “Vehicle Routing in Cold Food Supply Chain Logistics: A Literature Review.” *International Journal of Logistics Management* 32(2):592–617.

Bosona, Techane. 2020. “Urban Freight Last Mile Logistics—Challenges and Opportunities to Improve Sustainability: A Literature Review.” *Sustainability (Switzerland)* 12(21):1–20.

Calvert, Simeon C. and Maaike Snelder. 2018. “A Methodology for Road Traffic Resilience Analysis and Review of Related Concepts.” *Transportmetrica A: Transport Science* 14(1–2):130–54.

Carling, Kenneth, Mengjie Han, Johan Håkansson, Xiangli Meng, and Niklas Rudholm. 2015. “Measuring Transport Related CO_2 Emissions Induced by Online and Brick-and-Mortar Retailing.” *Transportation Research Part D: Transport and Environment* 40:28–42.

Centre European Policy. 2021. *The European Green Deal: How to Turn Ambition into Action*.

Chen, Jiaxin, Wenzhu Liao, and Chengwei Yu. 2021. “Route Optimization for Cold Chain Logistics of Front Warehouses Based on Traffic Congestion and Carbon Emission.” *Computers and Industrial Engineering* 161(February):107663.

Conrad, Hackett, Cooperman Alan, and Ritchey Katherine. 2015. "The Future of World Religions: Population Growth Projections, 2010 - 2050."

Ding, Yangke, Mingzhou Jin, Sen Li, and Dingzhong Feng. 2021. "Smart Logistics Based on the Internet of Things Technology: An Overview." *International Journal of Logistics Research and Applications* 24(4):323–45.

Euromonitor international. 2021. *The Future of Commerce*.

Euromonitor International. 2017. *The Global State of Online Grocery*.

Euromonitor International. 2019. *The Future of Last Mile Delivery*.

European comission. 2021. *The New EU Urban Mobility Framework*.

European Sustainable Development Network. 2019. *The European Green Deal*. Vol. 53.

Faccio, Maurizio and Mauro Gamberi. 2015. "New City Logistics Paradigm: From the 'Last Mile' to the 'Last 50 Miles' Sustainable Distribution." *Sustainability (Switzerland)* 7(11):14873–94.

Fikar, Christian. 2018. "A Decision Support System to Investigate Food Losses in E-Grocery Deliveries." *Computers and Industrial Engineering*.

Fikar, Christian and Kris Braekers. 2022. "Bi-Objective Optimization of e-Grocery Deliveries Considering Food Quality Losses." *Computers and Industrial Engineering*.

Gunawan, Aldy, Graham Kendall, Barry McCollum, Hsin Vonn Seow, and Lai Soon Lee. 2021. "Vehicle Routing: Review of Benchmark Datasets." *Journal of the Operational Research Society* 72(8):1794–1807.

Guo, Wenjing, Wouter Beelaerts van Blokland, and Gabriel Lodewijks. 2017. "Survey on Characteristics and Challenges of Synchromodal Transportation in Global Cold Chains." *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)* 10572 LNCS(September):420–34.

Haass, Rasmus, Patrick Dittmer, Marius Veigt, and Michael Lütjen. 2015. "Reducing Food Losses and Carbon Emission by Using Autonomous Control - A Simulation Study of the Intelligent Container." *International Journal of Production Economics* 164:400–408.

Humphreys, Matthew. 2017. *Sustainable Development in the European Union*.

Isa, Norulhidayah, Azlinah Mohamed, and Marina Yusoff. 2015. "Implementation of Dynamic Traffic Routing for Traffic Congestion: A Review." *Communications in Computer and Information Science* 545(March):174–86.

Jabbarpour, Mohammad Reza, Houman Zarrabi, Rashid Hafeez Khokhar, Shahaboddin Shamshirband, and Kim Kwang Raymond Choo. 2018. "Applications of Computational Intelligence in Vehicle Traffic Congestion Problem: A Survey." *Soft Computing* 22(7):2299–2320.

Jouzdani, Javid and Kannan Govindan. 2021. "On the Sustainable Perishable Food Supply Chain Network Design: A Dairy Products Case to Achieve Sustainable Development Goals." *Journal of Cleaner Production* 278:123060.

Kellner, Florian. 2016. "Insights into the Effect of Traffic Congestion on Distribution Network Characteristics – a Numerical Analysis Based on Navigation Service Data." *International Journal of Logistics Research and Applications* 19(5):395–423.

Koç, Çağrı, Gilbert Laporte, and İlknur Tükenmez. 2020. "A Review of Vehicle Routing with Simultaneous Pickup and Delivery." *Computers and Operations Research* 122.

Koh, Songsang, Bo Zhou, Hui Fang, Po Yang, Zaili Yang, Qiang Yang, Lin Guan, and Zhigang Ji. 2020. "Real-Time Deep Reinforcement Learning Based Vehicle Navigation." *Applied Soft Computing Journal* 96:106694.

Malladi, Krishna Teja and Taraneh Sowlati. 2018. "Sustainability Aspects in Inventory Routing Problem: A Review of New Trends in the Literature." *Journal of Cleaner Production* 197:804–14.

Mckinsey. 2021. "The State of Grocery Retail 2021." *McKinsey & Company*.

Nabot, Ahmad and Firas Omar. 2016. "Comparative Study of the Impacts of Conventional and Online Retailing on the Environment: A Last Mile Perspective." *International Journal of Computer Applications* 138(3):6–12.

Nguyen, Tri Hai and Jason J. Jung. 2021. "Swarm Intelligence-Based Green Optimization Framework for Sustainable Transportation." *Sustainable Cities and Society* 71(April):102947.

Osvald, Ana and Lidija Zadnik Stirn. 2008. "A Vehicle Routing Algorithm for the Distribution of Fresh Vegetables and Similar Perishable Food." *Journal of Food Engineering* 85(2):285–95.

Passport, Euromonitor international. 2021. *The New Normal : Future of Consumer Mobility , Urban*.

Peng, Hao, Hongfei Wang, Bowen Du, Md Zakirul Alam Bhuiyan, Hongyuan Ma, Jianwei Liu, Lihong Wang, Zeyu Yang, Linfeng Du, Senzhang Wang, and Philip S. Yu. 2020. "Spatial Temporal Incidence Dynamic Graph Neural Networks for Traffic Flow Forecasting." *Information Sciences* 521:277–90.

Rong, Aiying, Renzo Akkerman, and Martin Grunow. 2011. "An Optimization Approach for Managing Fresh Food Quality throughout the Supply Chain." *International Journal of Production Economics* 131(1):421–29.

Rossi, Federico, Rick Zhang, Yousef Hindy, and Marco Pavone. 2018. "Routing Autonomous Vehicles in Congested Transportation Networks: Structural Properties and Coordination Algorithms." *Autonomous Robots* 42(7):1427–42.

Sabar, Nasser R., Ashish Bhaskar, Edward Chung, Ayad Turky, and Andy Song. 2019. "A Self-Adaptive Evolutionary Algorithm for Dynamic Vehicle Routing Problems with Traffic Congestion." *Swarm and Evolutionary Computation* 44(April 2018):1018–27.

Seebauer, Sebastian, Veronika Kulmer, Martin Bruckner, and Eva Winkler. 2016. "Carbon Emissions of Retail Channels: The Limits of Available Policy Instruments to Achieve Absolute Reductions." *Journal of Cleaner Production* 132:192–203.

Shladover, Steven E. 2018. "Connected and Automated Vehicle Systems: Introduction and Overview." *Journal of Intelligent Transportation Systems: Technology, Planning, and Operations* 22(3):190–200.

Suryawanshi, Pravin and Pankaj Dutta. 2022. "Optimization Models for Supply Chains under Risk, Uncertainty, and Resilience: A State-of-the-Art Review and Future Research Directions." *Transportation Research Part E: Logistics and Transportation Review* 157(December 2021):102553.

Tan, Shi Yi and Wei Chang Yeh. 2021. "The Vehicle Routing Problem: State-of-the-art Classification and Review." *Applied Sciences (Switzerland)* 11(21).

Tan, Yuyang, Lei Deng, Longxiao Li, and Fang Yuan. 2019. "The Capacitated Pollution Routing Problem with Pickup and Delivery in the Last Mile." *Asia Pacific Journal of Marketing and Logistics* 31(4):1193–1215.

Tang, Junqing and Hans Rudolf Heinimann. 2018. "A Resilience-Oriented Approach for Quantitatively Assessing Recurrent Spatial-Temporal Congestion on Urban Roads." *PLoS ONE* 13(1):1–22.

United Nations. 2014. *World Urbanization Prospects*.

United Nations. 2015. *World Population Prospects*.

Velázquez-Martínez, Josué C., Jan C. Fransoo, Edgar E. Blanco, and Karla B. Valenzuela-Ocaña. 2016. "A New Statistical Method of Assigning Vehicles to Delivery Areas for CO_2 Emissions Reduction." *Transportation Research Part D: Transport and Environment* 43:133–44.

Vidal, Thibaut, Gilbert Laporte, and Piotr Matl. 2020. "A Concise Guide to Existing and Emerging Vehicle Routing Problem Variants." *European Journal of Operational Research* 286(2):401–16.

Waitz, Martin, Mild Andreas, and Christian Fikar. 2018. "A Decision Support System for Efficient Last-Mile Distribution of Fresh Fruits and Vegetables as Part of E-Grocery Operations." *Proceedings of the 51st Hawaii International Conference on System Sciences* 9:9.

World Economic Forum. 2020. "The Future of the Last-Mile Ecosystem." *World Economic Forum* (January):1–26.

Xiao, Yiyong and Abdullah Konak. 2016. "The Heterogeneous Green Vehicle Routing and Scheduling Problem with Time-Varying Traffic Congestion." *Transportation Research Part E: Logistics and Transportation Review* 88:146–66.

Xu, Lin, Yang Yue, and Qingquan Li. 2013. "Identifying Urban Traffic Congestion Pattern from Historical Floating Car Data." *Procedia - Social and Behavioral Sciences* 96(Cictp):2084–95.

Zennaro, Ilenia, Serena Finco, Martina Calzavara, and Alessandro Persona. 2022. "Implementing E-Commerce from Logistic Perspective: Literature Review and Methodological Framework." *Sustainability* 14(2):911.

RECEIVED: 11 April, 2022 **ACCEPTED: 14 June, 2022**

Valentas Gružauskas - assoc. prof., Kaunas University of Technology, School of Economics and Business, Sustainable Management Scientific Group. Field of scientific research: artificial intelligence, agent-based modelling, business analysis, valuation. Address: Gedimino str. 50-524, LT- 44239 Kaunas, Lithuania, Phone: +370 685 76870, E-mail: v.gruzauskas@gmail.com.

Aurelija Burinskienė - assoc. prof., Vilnius Gediminas technical university, the Faculty of Business Management. Topics of scientific research: e-logistics, transportation, optimization. Address: Sauletekio ave 11, LT- 10223 Vilnius, Lithuania, Phone: +370 686 03890, E-mail: aurelija.burinskiene@vilniustech.lt.