Guest Editorial Introduction to the Special Issue on Intelligent Supply Chain in Modern Challenges

EVER-GROWING supply chain challenges and disruptions directly or indirectly impact all industries. The global pandemic and war situations have caused a significant imbalance in the demand and supply of goods and services worldwide. These horrendous situations elevated the need for more effective supply chain management strategies. Intelligent systems and tech-led solutions are noticeably transforming almost every industry worldwide, and the supply chain and logistics sectors are facing the most significant impact. Many companies worldwide are investing heavily in intelligent supply chain management solutions to address modern global challenges.

A total of 22 submissions were received in response to our open call for papers on the Special Issue. The papers were rigorously evaluated according to the standard reviewing process of the IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS. The evaluation process considered such factors as originality, technical quality, presentation quality, and overall contribution. In all, ten articles were accepted for publication. The articles cover various areas, including planning, design, operations, maintenance, modeling, and security. Highlights of each article are presented next.

In the planning area, in [A1], Li et al. propose a novel parallel optimization of route planning based on a dynamic road network. A dual-level grid index is presented to support the parallel route planning model to solve the longer response time caused by massive concurrent queries derived from the high degree of urbanization and the high number of vehicles. Considering the evolving traffic condition, an LSTM neural network is introduced to predict traffic information periodically. The trust model is used and improved to avoid the queries of malicious vehicles, effectively preventing the query from extra computing consumption. The experimental results confirm the effectiveness and superiority in the specific scenario.

In the design area, in [A2], Pei et al. analyze the distribution of bus stops and subway stations to determine the area range that needs to be optimized in the traffic net from the perspective of time and space. Then, an optimization method, "partial area clustering" (PAC), is proposed to improve utilization by changing and renewing the original distribution. PAC worked to search the suitable bus platforms as the center and modified the original one to the subway. The experiment shows that public transport resources have increased by 20%. The study uses a similar cluster algorithm to solve transport networks' problems in a novel but practical term. As a result, the PAC is expected to be used extensively in the transportation system construction process.

In the operations area, three articles are presented. In [A3], Han et al. propose a new optimized lidar and camera sensor fusion method for road environment sensing of intelligent vehicles. A road boundary detection method is proposed for boundary search, boundary seed point growth, and obstacle clustering based on laser data. Based on the sensor data fusion, the team used the identified road information to predict the missing lane line location and identify the lane lines. Finally, numerous experiments are performed on the dataset, and actual vehicle experiments are used to verify the identification method's feasibility in special cases, such as rainy, cloudy, and night. The experimental results show that the proposed calculation method outperforms the existing calculation methods.

In [A4], Sorbelli et al. investigate using drones in a delivery scenario formed by two contiguous areas: one where the drones can freely fly on straight lines between any two locations (Euclidean metric) and one where drones follow the open space above the roads (Manhattan metric). This delivery scenario is modeled as a Euclidean-Manhattan-Grid (EM-grid). Given the customers to be served, the objective is to find the distribution point (DP) for the drone that minimizes the traveled distance, considering that the drone must make multiple round trips to/from the DP. The Single Distribution Point Problem is defined, and its sub-optimal time-efficient algorithms are developed. Then, the cost of the proposed sub-optimal solutions is compared with that of an optimal brute-force approach solution. Finally, using the BlueSky simulator, the costs of our best solutions are compared with the cost of a solution that serves the customers from a fixed DP, like the location of a delivery company's depot.

In [A5], Zeng and Qu propose a mixed-flow public transit system in urban–rural regions. The system combines passenger and freight transport to offer a carrier for logistics while compensating for the low utilization of passenger transport. Furthermore, a space–time–state network is constructed to help optimize the bus schedule by considering physical bundling, bus rescheduling, and rerouting strategies. Real-world case and experimental results attest to the effectiveness of the proposed mixed integer programming model and the Lagrangian relaxation-based algorithm.

In the maintenance area, two articles are presented. In [A6], Yang et al. propose a method to identify mode shapes and detect local damages in a simply-supported bridge by

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a portable sensory system. Two stationary vehicles are adopted in this study to perform as a mobile sensory system to detect local stiffness reduction in the bridge. A numerical study is conducted to validate the proposed method, and the effect of bridge damping, vehicle damping, measurement noise, and traffic flow is investigated. Moreover, field testing is conducted on the Li–Zi–Wan Bridge, and the results showed that the proposed method can re-construct the mode shapes and evaluate element bending stiffness as accurately as the conventional direct approach. The proposed method is easy to implement in practice; it is more robust because it is not affected by road surface roughness.

In [A7], Ji et al. develop a fault detection model based on the action curve for railway turnout considering both single and double action types. A series of experiments are performed based on the actual turnout operation records of the railway bureau China. The experimental results showed that, although the double action type curves increase data complexity in dimension and size, the diagnosis accuracy of the proposed model can still be up to 98.2%, with the best time costs.

In the modeling area, two articles are presented. In [A8], Zhang et al. propose a manager-worker framework based on deep reinforcement learning to tackle a hard yet nontrivial variant of the Travelling Salesman Problem (TSP). This problem involves multiple-vehicle TSP with time window and rejections (mTSPTWR), where customers who cannot be served before the deadline are subject to rejections. In particular, in the proposed framework, a manager agent learns to divide mTSPTWR into sub-routing tasks by assigning customers to each vehicle via a Graph Isomorphism Network (GIN)-based policy network. A worker agent learns to solve sub-routing tasks by minimizing the cost of both tour length and rejection rate for each vehicle, the maximum of which is then fed back to the managing agent to learn better assignments. The experimental results show that the proposed framework outperforms strong baselines regarding higher solution quality and shorter computation time. More importantly, the trained agents achieve competitive performance in solving unseen, more significant instances.

In [A9], Elgharably et al. address the Vehicle Routing Problem (VRP), which is one of the most studied combinatorial optimization problems in operations research, classified as NP-hard. The sources of uncertainty in a VRP include travel times, service times, and unpredictable demands of customers. Ignoring these sources may lead to inaccurate modeling of the VRP. This article aims to study the stochastic multi-objective VRP in a green environment. The stochastic Green VRP (GVRP) deals with three objectives simultaneously that consider economic, environmental, and social aspects. First, a new hybrid search algorithm to solve the VRP is presented and validated. The algorithm is then employed to solve the stochastic multi-objective GVRP. Finally, the Pareto fronts are obtained, and trade-offs between the three objectives are presented. Furthermore, an analysis of the effect of customers' time window relaxation is presented.

We hope this Special Issue, with its broad coverage of various supply-chain areas, will be helpful to researchers and practitioners in supply chain management.

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APPENDIX: RELATED ARTICLES

[A1] B. Li et al., "A trusted parallel route planning model on dynamic road networks," *IEEE Trans. Intell. Transp. Syst.*, early access, Oct. 27, 2022, doi: 10.1109/TITS.2022.3216310.

[A2] J. Pei, K. Zhong, J. Li, and Z. Yu, "PAC: Partial area clustering for re-adjusting the layout of traffic stations in city's public transport," *IEEE Trans. Intell. Transp. Syst.*, early access, Jun. 10, 2022, doi: 10.1109/TITS.2022.3179024.

[A3] Y. Han et al., "Research on road environmental sense method of intelligent vehicle based on tracking check," *IEEE Trans. Intell. Transp. Syst.*, early access, Jun. 27, 2022, doi: 10.1109/TITS.2022.3183893.

[A4] F. B. Sorbelli, C. M. Pinotti, and G. Rigoni, "On the evaluation of a drone-based delivery system on a mixed Euclidean-manhattan grid," *IEEE Trans. Intell. Transp. Syst.*, early access, Jul. 18, 2022, doi: 10.1109/TITS.2022.3189948.

[A5] Z. Zeng and X. Qu, "Optimization of electric bus scheduling for mixed passenger and freight flow in an urban-rural transit system," *IEEE Trans. Intell. Transp. Syst.*, early access, Nov. 14, 2022, doi: 10.1109/TITS.2022.3221332.

[A6] Y. Yang, H. Lu, X. Tan, R. Wang, and Y. Zhang, "Mode shape identification and damage detection of bridge by movable sensory system," *IEEE Trans. Intell. Transp. Syst.*, early access, Nov. 11, 2022, doi: 10.1109/TITS.2022.3151529.

[A7] W. Ji, Y. Zuo, R. Fei, G. Xie, J. Zhang, and X. Hei, "An adaptive fault diagnosis model for railway single and double action turnout," *IEEE Trans. Intell. Transp. Syst.*, early access, Nov. 21, 2022, doi: 10.1109/TITS.2022.3221484.

[A8] R. Zhang et al., "Learning to solve multiple-TSP with time window and rejections via deep reinforcement learning," *IEEE Trans. Intell. Transp. Syst.*, early access, Sep. 23, 2022, doi: 10.1109/TITS.2022.3207011.

[A9] N. Elgharably, S. Easa, A. Nassef, and A. El Damatty, "Stochastic multi-objective vehicle routing model in green environment with customer satisfaction," *IEEE Trans. Intell. Transp. Syst.*, early access, Mar. 14, 2022, doi: 10.1109/TITS.2022.3156685.

Said M. Easa received the Ph.D. degree in transportation engineering from the University of California at Berkeley, Berkeley, CA, USA, in 1982. He has served as the Chair of the Department of Civil Engineering, Toronto Metropolitan University (TMU), Canada, and the Director of Quality Assurance for the Faculty of Engineering and Architectural Science. He is currently a Professor of civil engineering at TMU. He has published more than 400 refereed journal articles and 60 book chapters, edited books, and national magazine articles, and 220 conference papers, presentations, and reports. He is an Editor of a bestselling book *Urban Planning and Development Applications of GIS* [American Society of Civil Engineers (ASCE)]. His research interests cover broad transportation areas, including planning, design, operation, and management. In addition, he has conducted multidisciplinary research in such areas as intelligent transportation systems, highway construction, road drainage, and geomatics engineering. He is a fellow of the Canadian Academy of Engineering, Engineering Institute of Canada, Canadian Society for Civil Engineering (CSCE), and International Association of Advanced Materials. He was a member of the Board of Directors and Vice-President (Administration) of CSCE. In 2012, he was selected by the Chinese Central Government as a Global Expert in the Thousand Talents Program. His work received more than 40 international, national, and regional awards/honors from Canadian, U.S., and European organizations, including the Frank M. Masters Transportation Engineering Award from ASCE in 2001, the Sandford Fleming Award from CSCE in 2003, the Wellington M. Arthur Prize from ASCE in 2005, the Award of Academic Merit from Transportation Association of Canada in 2010, the James A. Vance Award from CSCE in 2010, the IAAM Medal from the International Association of Advanced Materials in 2018, and the Best Paper Award from the *Journal of Transportation Engineering: Part A—Systems* in 2018. He was the chair of 12 national conferences sponsored by ASCE, CSCE, and IAAM. He serves as an Associate Editor for the *Journal of Transportation Engineering: Part A—Systems*, *Journal of Surveying Engineering*, and *Canadian Journal of Civil Engineering*. He served as the President of the Online Network Enabled ITS Research Society, guest journal editor, leader of a national delegation to China, keynote speaker on a nationwide lecture tour, Judge for annual Canadian Consulting Engineering awards, member of federal grant selection committees, and a Consultant for The World Bank.

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