IIMA
विद्याविनियोगाद्विकास:

Centre for Transportation and Logistics

INDIAN INSTITUTE of MANAGEMENT AHMEDABAD

NEWSLETTER

October - December 2024

CTL Thought Article

Digitizing Logistics and Supply Chain Operations: Prominent Use Cases

In the rapidly evolving landscape of global commerce, the digitization of logistics and supply chain operations has emerged as a fundamental element for businesses aiming to enhance efficiency, transparency, and resilience. Digital innovations are reshaping the way goods are produced, moved, and managed with an aim to eliminate legacy systems, automate manual processes, and enhance service quality. Moreover, errors, labor costs, delays, and losses associated with manual processes are mitigated, resulting in improved efficiency, expedited delivery, and increased reliability in goods management. However, 72% of the leaders argue that there is a dearth of a roadmap indicating necessary steps to digitize the logistics and freight systems of their company, while 76% of the logistics and freight company leaders assert that ignorance towards building digital solutions can jeopardize their businesses (Freight and Logistics: Finding the Right Path to Digital Transformation, 2023). In light of the above, this article attempts to highlight a few prominent use cases of these cutting-edge technologies, illustrating how they are not only revolutionizing traditional supply chain practices but also paving the way for a more agile future.

1) Harnessing Robotics and Drones to Optimize Supply Chain Operations

Autonomous robots are widely being employed to consistently deliver high productivity and efficiency. These advancements potentially reduce warehouse labor costs by up to 70% (Joseph, 2020). Interestingly, the rapid development of drones marks a significant technological shift, offering new possibilities for transportation and delivery within the supply chain. Initially utilized for surveillance and photography, drones are now increasingly employed in urban logistics. Drone deliveries, being faster and more sustainable, alleviate carbon emissions and road congestion. This is particularly promising for India, where 90% of the country lacks one-day delivery services (Sharma, 2024). Priced at approximately 4 rupees per km, drone deliveries are significantly more cost-effective than traditional road transportation, presenting a viable solution to India's logistical challenges.

E-commerce companies have been increasingly adopting drone technology to enhance their delivery services. For instance, Ecom Express has partnered with Skye Air to implement drone deliveries in urban areas of Gurugram. Skye Air's drone, Hexacopter, can fly 2.5 km from the warehouse hubs to the apartments with the capacity to hold goods of around 5 kg (Sharma, 2024). On the other hand, DHL, a leading logistics provider, has developed the Parcelcopter, an autonomous drone capable of delivering goods to remote areas. Meanwhile, IKEA, a leading brand in home furnishing products with over 461 stores and 80 warehouses, uses drone technology to verify its inventory. The drones capture videos and images, performing 3D scans of the inventories in the warehouse. The data collected by the drone assists in counting inventory and verifies if an item is misplaced or placed incorrectly.

However, the application of robotics and automation is not limited to drone deliveries. For instance, in the United States alone, Walmart has nearly 4600 stores within 10 miles of 90% of the country's population, with more than 4000 stores catering to one-day delivery. Their Alphabots are capable of picking up 95% of orders within 12 minutes, which exemplifies Walmart's rapid order fulfillment through automation (Revolutionizing Delivery, 2023).

2) Integrating AR/VR Technologies to Elevate Logistics Performance

Concurrently, AR and VR technologies provide an immersive, real-time training environment, simulating various scenarios to enhance employee performance. These technologies have demonstrated a capacity to reduce errors, increase productivity, and provide a virtual immersive experience to consumers. (Bartlett, 2023) highlights that the VR/AR market is expected to attain nearly $161.1 billion by 2025.

A prominent application of AR/VR is the use of smart glasses, which identify the location and arrangement of items in carts in a warehouse and track inventory and shipments. DHL, a pioneer in integrating AR into its logistics operations, has employed these smart glasses for warehouse order picking, resulting in approximately 25% higher efficiency (DHL Successfully Tests Augmented Reality Application in Warehouse, n.d.). Further, Boeing has leveraged AR to provide its technicians with visual instructions for airplane wiring schematics, resulting in wiring production time being reduced by 25% and productivity improving by 40% (Cohen et al., 2018). Meanwhile, Coca-Cola technicians have employed smart glasses to transmit their visuals to experts located remotely to reduce the expenses and delays that are associated with the transportation of the experts to the project site.

Parallelly, many e-commerce platforms are employing AR/VR to ease product returns. For instance, Myntra, L'Oreal, and Lenskart have launched features like virtual try-ons, AR-powered makeup try-ons, and skin analyzers to tailor customer preferences and recommendations. The feature diminishes the volume of parcel returns, reducing the burden on logistical operations. Myntra has increased its conversation rate twofold (2x) and reduced its returns as a result of the virtual try-on feature.

3) Artificial Intelligence and Machine Learning in Supply Chain Efficiency

AI, on the other hand, has captivated the supply chain through its applications in demand forecasting, route optimization, and inventory management. Predictive analytics, enabled by AI and ML, optimize production planning and reduce inventory levels by 20-30% through accurate demand forecasting. Nearly 46% of supply chain executives view AI, cognitive computing, and cloud applications as pivotal for their digital operations in the next three years (Supply Chain Digitalization Trends for 2024 and Beyond, 2023).

Companies like Nvidia utilize AI to optimize conveyor speeds and identify potential bottlenecks for improved flow. This real-time analysis detects package proximity and tilt, preventing congestion and streamlining storage processes. Meanwhile, Walmart demonstrates the effectiveness of AI in demand forecasting, deploying AI/ML algorithms to optimize inventory placement within fulfillment centres, further optimizing driving routes to pack trailers efficiently to minimize miles travelled. By reducing 30 million superfluous miles driven and optimizing paths to omit 110,000 redundant routes, Walmart successfully prevented the emission of 94 million pounds of CO2 (Walmart Commerce Technologies Launches AI-Powered Logistics Product, 2024).

While 60% of companies have adopted AI, 40% of businesses have been investing in Generative AI (Steinberg & Burton, 2024). GenAI identifies novel patterns and trends, as opposed to relying on predetermined outputs. It enhances decision-making by predicting unforeseen situations and potential disruptions. It aids in fraud detection, product design, financial optimization, and methods for logistics improvement. L&T has leveraged this technology to enhance the processes of its project cycle, from tendering and managing contracts to contract design and execution. GenAI is further revolutionizing customer service, with companies like Mahindra and Mahindra leveraging AI-powered chatbots to minimize human intervention and enhance customer satisfaction, leading to a 60% reduction in customer query response time. Moreover, with the help of ML models, the firm is capable of predicting possible failure or maintenance of a vehicle component enabling proactive maintenance and reduced downtime by 30% ("Mahindra and Mahindra's AI Journey," n.d.).

Interestingly, 71% of Indian CEOs anticipate increased employee efficiency within the next year with the application of GenAI, while 48% and 46% believe it will drive revenue and profitability growth, respectively (Mehta et al., 2024).

4) Virtual Models in Action: The Role of Digital Twins in Supply Chain Innovation

The era of digital twins has been gaining prominent recognition in the last couple of years. Digital twins are detailed simulation models of an actual supply chain that uses real-time data to develop, test, and manage AI-powered distribution centres in a digital world and bring those optimizations into the real world. They facilitate the creation of testing conditions for supply chain and production groups by digitally mapping real assets, networks, or processes with seamless connectivity

from start to finish. Furthermore, they assist in improving worker training through interactive learner development and scenario planning.

The application of digital twin technology has yielded significant benefits for several industries, including automobiles and oil and gas. Rolls-Royce, through the implementation of digital twins, has extended engine maintenance intervals by up to 50%, reduced parts inventory, and achieved carbon savings of 22 million tons (Fonarov, 2024). On the other hand, BMW aims to set up virtual models of its 31 factories in its production network in operation, enabling nearly 15000 of its employees to access the data through the BMW Factory Viewer. This shall assist the company in virtually inspecting specific areas, carrying out precise measurements, and collaborating simultaneously across locations and time zones (Overby, n.d.). The Port of Rotterdam implements a comparable strategy involving the use of a digital twin to ensure that operations are visible with 100% accuracy. This saves up to 1 hour in berthing time, which can result in approximately USD 80,000 in savings for ship operators, further enabling a large number of ships to pass through the port (Boyles, 2019).

Brossard et al., 2022 highlight that the digital twin market is expected to result in a revenue increase of up to 10% and a 25% improvement in quality. Moreover, its global market is expected to grow from $6.9 billion in 2022 to $73.5 billion by 2027 at a CAGR of 60.6% (Olavsrud, 2022).

5) IoT-Driven Innovations in Supply Chain Management

However, it is captivating to witness how the Internet of Things (IoT) has revolutionized the supply chain and logistics operations by connecting physical assets with digital systems. The interconnected network of devices enables real-time data collection, analysis, and automation, optimizing processes from inventory management and warehouse operations to transportation and delivery. Its ability to provide granular visibility and actionable insights is transforming the industry's efficiency and responsiveness. (Fonarov, 2024) emphasizes that the global market value of IoT in supply chain management is projected to reach $41.8 billion by 2033, with a CAGR of 12.9% from 2023 to 2033.

Notably, IoT systems are capable of enabling automated replenishment alerts based on predefined stock levels. For instance, Coca-Cola's smart vending machines employ IoT to track inventory, analyze sales patterns, and monitor machine performance. Upon reaching predefined inventory thresholds, IoT devices autonomously initiate replenishment requests to distribution centres, preventing stockouts and excess inventory, thereby enhancing asset visibility inside the warehouse. A similar strategy is employed by Walmart, Target, and Zara using IoT-enabled RFID tags. In-store RFID implementation yields substantial benefits, including a remarkable 99% inventory accuracy, a substantial 60-80% reduction in stockouts, and a notable 2-12% sales uplift (Kaplan, 2021). At the same time, fast-food joints like Domino's and Starbucks are among the numerous culinary chains that have adopted IoT-enabled devices that capture real-time data,

including environmental conditions such as temperature and humidity, to maintain food safety and quality standards. Meanwhile, automotive companies like Volvo Trucks utilize IoT-enabled real-time tracking to optimize remote diagnostics and troubleshooting, reducing diagnostic time by 70% and repairs by 25%, thus ensuring fleet readiness for long-haul operations through proactive vehicle health monitoring. (Volvo Trucks' Collaboration with SAS Enhances Remote Diagnostics through Advanced Analytics and AI, 2018).

6) Blockchain: Enhancing Transparency and Security in Supply Chain Management

Lastly, the captivating use of blockchain has enabled an immutable and transparent record of transactions. The decentralized ledger system enhances trust, security, and efficiency, enabling real-time tracking of goods, preventing counterfeits, and streamlining complex supply chain networks. Particularly, blockchain's application to enhance food supply chain management and transparency has been widely gaining popularity. For instance, IBM Food Trust monitors product shelf life, manages food waste, and ensures regulatory compliance within a single database (IBM Supply Chain Intelligence Suite - Food Trust, 2024). It enables the creation of smart contracts, allowing automatic execution of supply chain agreements based on specific food products or transactions. IBM Food Trust has effectively reduced the call time by 80% by leveraging blockchain ("Breaking Boundaries," 2024). Similarly, Walmart has reported a 50% reduction in time to trace the origin of the foods, thereby improving the response time to food safety alerts ("Breaking Boundaries," 2024). Meanwhile, blockchain's application in pharmaceutical companies has also been gaining profound momentum. Pfizer, through blockchain, improves its pharmaceutical product's transparency and traceability. They employ blockchain to track QR codes on packaging to authenticate products. This reduces the risk of counterfeit drugs and assures patients obtain safe, unexpired, and authentic drugs. (Pareek, 2023) accentuates that blockchain's economic value in the pharmaceutical industry is expected to exceed $176 billion by 2025 and nearly $3.1 trillion by 2030.

References

Bartlett, N. (2023). How Virtual and Augmented Reality Are Revolutionizing E-Commerce Logistics. CBIP Logistics. https://cbiplogistics.com/zh-cn/%E5%8D%9A%E5%AE%A2/how-virtual-and-augmented-reality-are-revolutionizing-e-commerce-logistics

Breaking Boundaries: How IBM, Walmart, and Pfizer Lead the Blockchain Revolution. (2024, March 28). Medium. https://medium.com/@ieeecomputersocietyiit/breaking-boundaries-how-ibm-walmart-and-pfizer-lead-the-blockchain-revolution-0eb13d5cbac2

Brossard, M., Chaigne, S., Corbo, J., Mühlreiter, B., & Stein, J. P. (2022, April 28). PLM systems and the digital twin journey | McKinsey. https://www.mckinsey.com/capabilities/operations/our-insights/digital-twins-the-art-of-the-possible-in-product-development-and-beyond

Boyles, R., & Boyles, R. (2019, September 9). How the Port of Rotterdam is using IBM digital twin technology to transform itself from the biggest to the smartest. IBM Blog. https://www.ibm.com/blog/iot-digital-twin-rotterdam/

Cohen, L., Buvat, J., Khadikar, A., Duboé, P., Melton, D., & Shah, H. (2018). AR-VR-in-Operations. https://www.capgemini.com/wp-content/uploads/2018/09/AR-VR-in-Operations1.pdf

DHL successfully tests augmented reality application in warehouse. (n.d.). DHL. Retrieved July 29, 2024, from https://www.dhl.com/global-en/delivered/digitalization/dhl-successfully-tests-augmented-reality-application-in-warehouse.html

Fonarov, O. (2024, March 1). Council Post: Digital Twins And Their Role In Shaping The Future Of Manufacturing. Forbes. https://www.forbes.com/sites/forbestechcouncil/2024/03/01/digital-twins-and-their-role-in-shaping-the-future-of-manufacturing/

Freeman, O. J. (2023, March 22). 10 Companies Using Blockchain Technology for Sustainable Supply Chain. Medium. https://medium.com/@OjFRSA/10-companies-using-blockchain-technology-for-sustainable-supply-chain-6d17ca8cca25

Freight and Logistics: Finding the right path to digital transformation. (2023). https://www.accenture.com/content/dam/accenture/final/a-com-migration/r3-3/pdf/pdf-179/accenture-freight-and-logistics.pdf#zoom=40

Global CEOs are making generative AI a top investment priority—KPMG Denmark. (2023, October 11). KPMG. https://kpmg.com/dk/en/home/insights/2023/10/kpmg-ceo-outlook-2023.html

IBM Supply Chain Intelligence Suite—Food Trust. (2024, May 16). https://www.ibm.com/products/supply-chain-intelligence-suite/food-trust

Joseph, T. (2020, August 3). How Robotics in Logistics Helps Improve Supply Chain Efficiency. Fingent. https://www.fingent.com/blog/how-robotics-in-logistics-helps-improve-supply-chain-efficiency/

Kaplan, D. A. (2021, March 4). RFID's e-commerce growth spurt. Supply Chain Dive. https://www.supplychaindive.com/news/rfid-e-commerce-growth-apparel-stock-fulfillment/599284/

Mahindra and Mahindra's AI Journey: A Drive Towards the Future. (n.d.). NAROLA-AI. Retrieved July 29, 2024, from https://narola.ai/resource/mahindra-and-mahindras-ai-journey-a-drive-towards-the-future/

Mehta, R., Mitra, I., Francis, J. M. C., Mallik, R., Banerjee, R., Mohapatra, S., Dwivedi, M., & Goswami, S. (2024). Thriving in an age of continuous reinvention. https://www.pwc.in/assets/pdfs/27th-annual-global-ceo-survey-india-perspective-v1.pdf

MHI. (2024). 2024 MHI Annual Industry Report—The Collaborative Supply Chain. https://og.mhi.org/publications/report

Olavsrud, T. (2022, August 30). Digital twins: 5 success stories. CIO. https://www.cio.com/article/189121/digital-twins-4-success-stories.html

Overby, S. (n.d.). Digital Twins at Work: 8 Examples. SAP. Retrieved July 26, 2024, from https://www.sap.com/india/insights/viewpoints/digital-twins-at-work.html

Pareek, S. (2023, December 30). Blockchain in Pharma Unleashes a New Era of Trust and Efficiency—ET HealthWorld. ETHealthworld.Com. https://health.economictimes.indiatimes.com/news/health-it/blockchain-in-pharma-unleashes-a-new-era-of-trust-and-efficiency/106404339

Revolutionizing Delivery: How AI and Automation Power Walmart's Lightning-Fast Shipping. (2023, October 29). https://www.toolify.ai/ai-news/revolutionizing-delivery-how-ai-and-automation-power-walmarts-lightningfast-shipping-398857

Sharma, M. (2024, January 7). Skipping Traffic: Drones take to the skies to deliver groceries. Hindustan Times. https://www.pressreader.com/india/hindustan-times-delhi/20240701/page/13/textview

Steinberg, G., & Burton, M. (2024, January 9). How generative AI in supply chain can drive value. https://www.ey.com/en_gl/insights/supply-chain/how-generative-ai-in-supply-chain-can-drive-value

Supply Chain Digitalization Trends for 2024 and Beyond. (2023, December 4). New SCMR. https://www.scmr.com/article/supply_chain_digitalization_trends_for_2024_and_beyond

Volvo Trucks' Collaboration with SAS Enhances Remote Diagnostics through Advanced Analytics and AI. (2018, October 25). [Press release]. https://www.volvogroup.com/en/news-and-media/news/2018/oct/volvo-trucks-collaboration-with-sas.html

Walmart Commerce Technologies Launches AI-Powered Logistics Product. (2024, March 14). https://corporate.walmart.com/news/2024/03/14/walmart-commerce-technologies-launches-ai-powered-logistics-product

The article has been written by

Ms. Jesal Tejwani
Research Associate, CTL IIMA

Research Seminars & Webinars

1. System Dynamics in OM/SCM Research

The Centre for Transportation and Logistics, IIMA, hosted a research webinar on 'System Dynamics in OM/SCM Research' by Prof. Rogelio Oliva, Professor at the Mays Business School - Texas A&M University, on October 18, 2024. The webinar was moderated by Prof. Debjit Roy, Institute Chair Professor and Co-chairperson, CTL, IIMA.

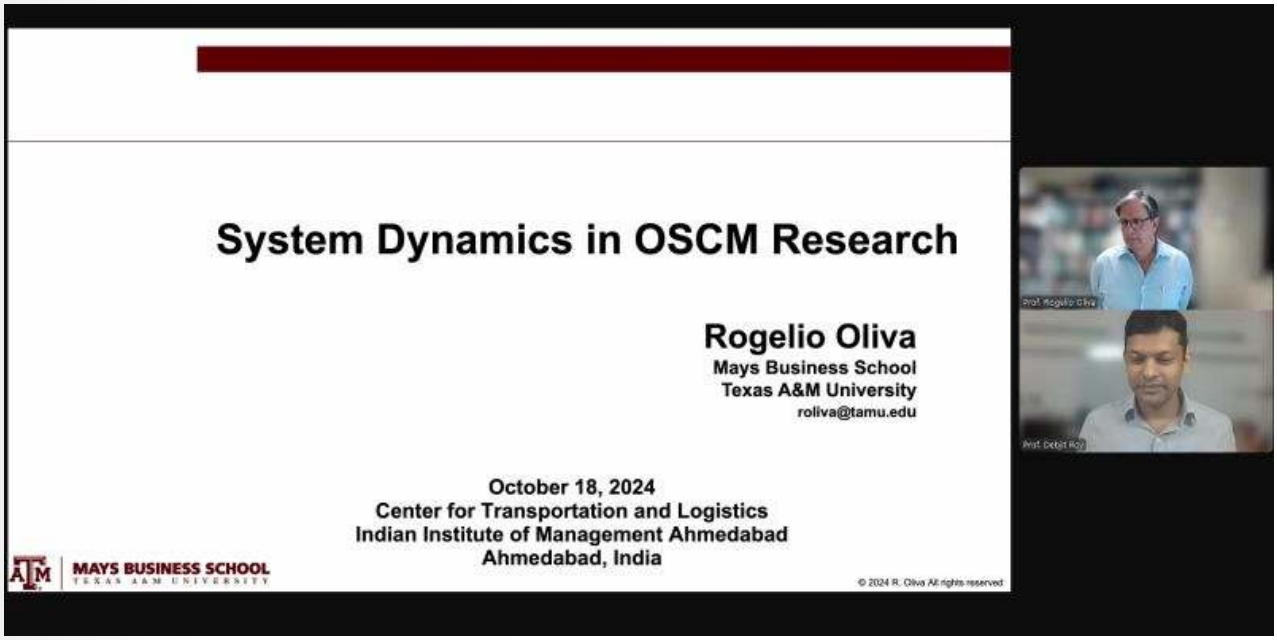
Talk Summary

Prof. Oliva introduced the concept of system dynamics by explaining the fundamentals behind it: managers transform information flows into decisions that control organizational activity. However, he emphasized that decision-making is non-linear, noisy, and hindered by perceptual and cognitive limitations. It is possible to capture the structural elements of decision-making processes by identifying the guiding policies behind those decisions. Prof. Oliva highlighted that it is crucial to comprehend the work of managers in system dynamics. He stressed that a social system includes a stream of decisions that guides operational functions. He further added that these decisions follow a pattern, making them non-linear. The concept of stocks and flows in system dynamics was further discussed. Stocks capture the state of the system (resources, memory, inertia), whereas flows capture the decision-making (control) effects. Moreover, Prof. Oliva asserted that the structure drives behavior, explaining why a system is doing what it is doing. Thus, it becomes necessary to have an endogenous explanation of behavior. Concurrently, he explained how interactions between feedback influence specific behaviors or decisions.

He discussed the methodological guidelines of system dynamics, including the structural representation of systems, the focus on disequilibrium, adopting broad model boundaries, and developing models through grounded methods. Prof. Oliva highlighted that while system dynamics models are not analytically tractable, they are easy to simulate. It involves a formal integration of operational and behavioral aspects of the system. Prof. Oliva illustrated the concept using the example of service quality erosion. The analysis showed that increased work pressure raises work intensity, prompting employees to work harder and fulfill more orders. In contrast, employees can cut corners by spending less time per order/customer since they have more orders/work to fulfill. This enhances the focus on more orders. However, if too much time is spent cutting corners, service quality declines, which may eventually lead firms to hire more employees to uphold service standards. Prof.

Oliva explained the same through graphical analysis depicting when to stop cutting corners to avoid deteriorating service quality standards.

Further, Prof. Oliva concluded the session by explaining the difference between variance theories and process theories. He highlighted that the process theories are more nuanced and that the erosion of the service quality model is an example of the same.



2. High-Dimensional Correlation using Subordinated Markov Chains: Modelling and Applications

The Centre for Transportation and Logistics, IIMA, hosted a research seminar on 'High-Dimensional Correlation using Subordinated Markov Chains: Modelling and Applications' by Prof. Vishwakant Malladi, Assistant Professor at Indian School of Business, Hyderabad, on November 11, 2024. The seminar was moderated by Prof. Debjit Roy, Institute Chair Professor and Co-chairperson, CTL, IIMA.

Talk Summary

Prof. Malladi commenced the seminar by discussing disruptive events and their impact on operations and explained the same through examples. He highlighted that disruptive events can catalyze disruption over an extended period. Thus, modelling correlation among these events would have far-reaching benefits.

However, modelling correlation is difficult in high dimensions since the correlation coefficient is applicable only in 2 dimensions. Thus, a parsimonious framework is required, and a subordinated Markov Chain is an example of the same. He further explained the role of a subordinator in subordinated Markov Chains and elaborated more on modelling dependence in continuous-time Markov Chains (CTMCs). However, his model employed partially subordinated Markov Chains, which used subordinators only for disruptions, giving an infinitesimal generator. Common shocks in the subordinator affect multiple Markov Chains at the same time.

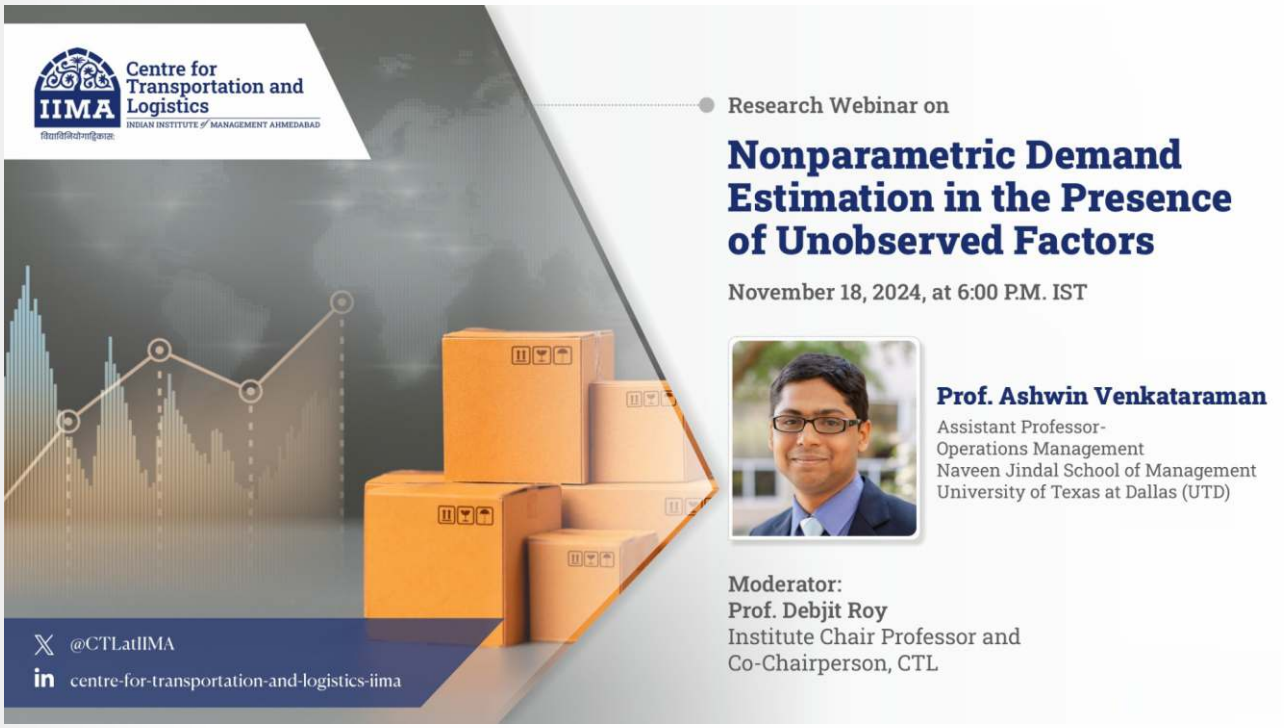
Prof. Malladi's model addressed the facility location problem with disruptions, leading to clients being serviced by other non-disrupted locations. This required considering the correlation between disruptions, using a subordinated Markov Chain to model correlation. He highlighted that for N locations, there are N Markov Chains. The model introduced subordinators K (common time shocks), which affect multiple locations, reducing the parameter size from 2^n to N (for N Markov Chains) + K (subordinators). The Disruption model thus used (N + K) parameters to model correlation in the N dimensions.

Further, the subordinate Markov Chain parameter should be calibrated using a metric that minimizes the probability of disruptions of two locations at a time. The solution should be optimized using the Precise Cut Algorithm, reducing the number of iterations for the next stage. The method was tested on a standard date set with 49 locations and multiple sets for disruptions with solutions consistently resulting in lower costs in quicker times.

He concluded the session by discussing Inter-temporal correlation in CTMCs through the example of modelling propagation in airline networks. He defined 2 CTMCs as a system of time-lagged partially subordinated Markov Chains (TLPSMCs). He employed the CTMC theory to estimate the closed forms for the intertemporal correlation. Further, the nature of the intertemporal correlation could be changed by varying the lag and the intensity. Moreover, joint probability curves could be approximated using TLPSMCs. The model detected correlation across airports and overperformed compared to the traditional route-based approach.

3. Nonparametric Demand Estimation in the Presence of Unobserved Factors

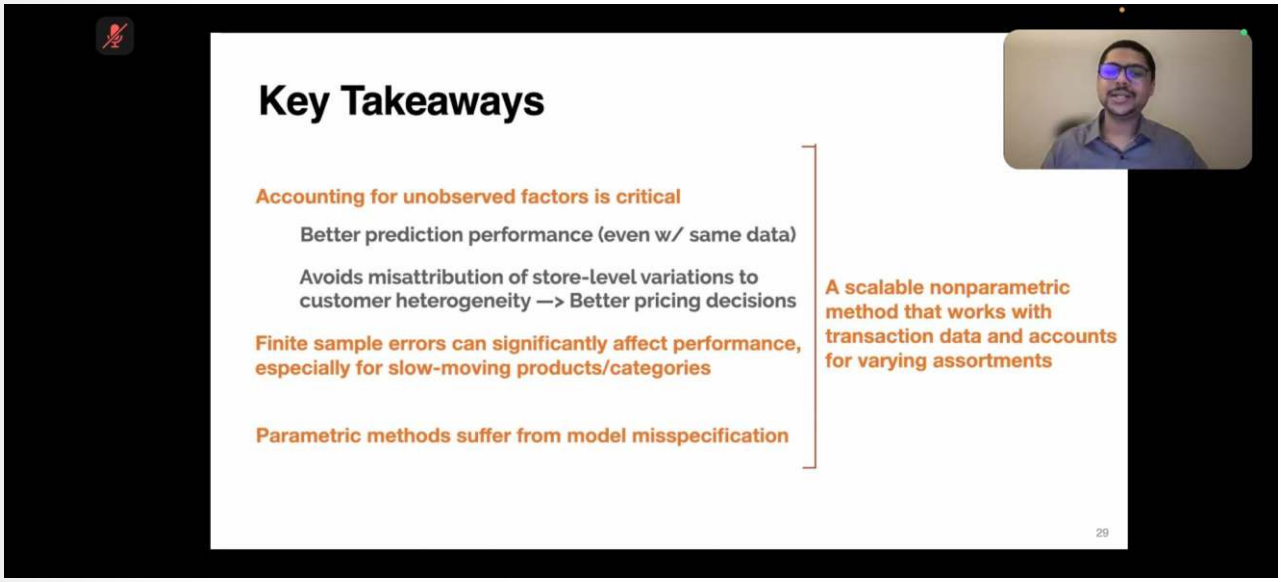
The Centre for Transportation and Logistics, IIMA, (CTL) organized a research webinar on 'Nonparametric Demand Estimation in the Presence of Unobserved Factors' by Prof. Ashwin Venkataraman, Assistant Professor, Naveen Jindal School of Management, UT Dallas on Nov 18, 2024. The webinar was moderated by Prof. Debjit Roy, Institute Chair Professor and Co-chairperson, CTL, IIMA.



Talk Summary

Prof. Venkataraman began the webinar with an overview of the demand forecasting process using sales transactions and product availability data. For estimation, choice models, that describe how customers make purchase decisions, are widely used. Factors affecting demand can be classified into observed (product specific data) and unobserved factors (shelf positioning, brand awareness and local events). For observed factors (OF), sophisticated models and estimation methods exist. However, scholars have to make strong parametric assumptions to account for UFs.

Prof. Venkataraman's study involved creating a scalable non-parametric method to deal with UFs. Their method is applicable for large scale transaction data, varying product assortment and imperfect market share estimates. The dataset used for the study had details of products, their features (in terms of price, quantity, quality etc.) and sales count for different stores. The study fit random utility maximization (RUM) principle based choice model to aggregated sales count data. In the RUM model, it is assumed that customers choose products that provide them with the maximum utility. The goal of the study was to predict demand for a product/change in assortment for the data. It was observed that the data rarely included all UF factors driving demand, and hence, a scalar UF assumption is standard in literature. However, the UFs make the model over parameterized because of high dimensionality of UFs. To counter this, their study used Instrumental Variables with an exclusion restriction to constrain UFs. The exclusion restriction implied lack of correlation between UFs and IVs. Consequently, the study proposed a constrained optimization based estimator which found best fit distribution and UFs subject to moment conditions, enforced via generalized methods of moment constraint. Their estimation algorithm used alternating minimization/descent framework which is used extensively in ML for improving solutions involving large scale optimization. BLP parametric models also suffer from misspecification. Further, finite sample errors could significantly affect performance. The model prescribed by the study was used on weekly sales transaction data for CPG in 30 products from IRI Academic Dataset. The results indicated a 63% improvement in prediction accuracy. Their method is useful for improving demand forecasting and undertake better pricing decisions.



To watch, visit: https://www.youtube.com/watch?v=6E5IWZ81vAQ& or scan

4. The Role of Product Quality in Marketplaces

The Centre for Transportation and Logistics, IIMA hosted a research seminar on 'The Role of Product Quality in Marketplaces' by Prof. Aditya Jain, Professor of Operations and Decision Analytics, Zicklin School of Business, Baruch College, CUNY, on December 23, 2024. The seminar was moderated by Prof. Debjit Roy, Institute Chair Professor and Co-chairperson, CTL, IIMA.

Talk Summary

Prof. Aditya Jain's session focused on contractual agreements between retailers and suppliers, emphasizing the heterogeneity of suppliers in marketplaces. He discussed the challenges of designing contracts for scenarios where suppliers' products are listed online, with ownership remaining with the suppliers while retailers earn a commission. Prof. Jain highlighted that retailers often adopt a hybrid approach, continuing to sell their products alongside those sourced from third-party sellers. However, he noted that products sold via marketplaces frequently suffer from quality problems and are often perceived as inferior. His study aimed to examine a retailer's contracting strategy in the presence of heterogeneity in suppliers' product quality and evaluated whether a hybrid contract is optimal.

Prof. Jain's study considered different demand models and contract selection modes. The demand models included loyal demand and competition, while contract selection included scenarios where the supplier self-selected or the retailer made the decision.

The first model, focusing on loyal demand and supplier self-selection, was discussed in detail. In the context of homogeneous quality under a pure wholesale contract, the analysis revealed that decisions and profits were impacted by a double marginalization problem. Retailers' profits were adversely affected, while suppliers earned higher profits due to their first-mover advantage. In the case of homogeneous quality under a pure marketplace contract, it was discussed that suppliers might choose not to transact if commission rates were sufficiently high. In the context of heterogeneous quality under a pure marketplace contract, Prof. Jain revealed that suppliers' tolerance for commission rates varied based on their quality levels and associated costs. He observed that retailers preferred to exclude high-quality suppliers and contract only with low-quality suppliers when the difference in supplier quality was sufficiently large and the probability of high quality was not too high. Lastly, under a hybrid contract with heterogeneous quality, the study found that retailers adjusted commission rates strategically, allowing high-quality suppliers to opt for wholesale pricing if commission rates were too high. The empirical verification supported the hybrid contract model, revealing that the marketplace mode was correlated with low-quality products.

Prof. Jain concluded the session with a brief discussion of models addressing loyal demand and retailer selecting contract, competition with supplier self-selection, and competition with retailer selecting contract.




To watch, visit: https://www.youtube.com/watch?v=m9Y71Xg61aE or scan

India Management Research Conference (IMRC) 2024 - Track 06: Transportation and Logistics

The Indian Institute of Management Ahmedabad hosted a three-day academic conference, India Management Research Conference 2024, from December 07 to 09, 2024. The conference, centered around the theme of 'Confluence of Growth, Sustainability, and Resilience', featured 11 distinct thematic tracks, each hosted by the Institute's Research Centres.

The Centre for Transportation and Logistics (CTL) hosted Track 06, focusing on the research theme of Transportation and Logistics. The track facilitated approximately 40 research presentations, encompassing domains such as supply chain and optimization, managing supply chain performance, smart mobility, policy, and sustainability. Papers employed emerging data and methodologies to analyze or solve critical contemporary and futuristic transportation and logistics problems faced by industry and government. The papers contributed to scholarship, practice, and policymaking in India and globally. Moreover, the studies generated novel ideas and stimulated productive discussions. The track further added to academia-industry and academia-government knowledge exchange, improving the efficiency of multi-modal transportation systems and supply chain logistics, promoting economic growth, and fostering sustainable development.

Additionally, the event had an exclusive Keynote session by Prof. Vinod Singhal, Charles W. Brady Chair Professor of Operations Management at Georgia Institute of Technology's Scheller College of Business, discussing the 'Financial Consequences of Supply Chain Risks and Strategies for Building Resilient Supply Chains.' The track also had a 'Tutorial on Deterministic to Distributionally Ambiguous Optimization Tools for Transportation and Logistics Problems' by Prof. Manish Bansal, Associate Professor, Virginia Tech, USA. Additionally, an interactive session was conducted by the Journal of Business Logistics editors, Prof. Robert Glenn Richey Jr., Harbert Eminent Scholar, and Prof. Shashank Rao, Jim W. Thompson Professor, both from Auburn University. The event continued with an engaging session led by Prof. Debjit Roy, Associate Editor of Transportation Science.

The conference brought together various scholarly contributors and industry professionals from multiple academic and research institutions. Furthermore, the track had about five poster presentations aligning with the track's theme at the conference.

IMRC 2024 Day 01: December 07, 2024

Track 06: Transportation and Logistics commenced its sessions for the first day of the conference with a research workshop on 'Solving Contemporary Problems in Transportation and Logistics.' The workshop was conducted by Prof. Samrat Roy, Assistant Professor at IIM Ahmedabad; Prof. Debjit Roy, Institute Chair Professor and Co-Chair of the Centre for Transportation and Logistics, IIM Ahmedabad; and Prof. Sandip Chakrabarti, Associate Professor in the Public Systems Group, Chairperson of the Public Systems Group, JSW Chair in Innovation and Public Policy and Co-Chair of the Centre for Transportation and Logistics, IIM Ahmedabad. The workshop highlighted the current problems in public transport, logistics, and supply chain. The discussion centred around the potential solutions and the forthcoming challenges to cater to the same.

The second half of the day focused upon an interactive session with the Editors of the Journal of Business Logistics, Prof. Robert Glenn Richey, Jr., Editor-in-chief of the Journal of Business Logistics; Prof. Shashank Rao, incoming editor-in-chief of the International Journal of Physical Distribution and Logistics Management. The talk focused on the editorial philosophy, the submission expectations and review process from submitted papers, and the commitment to authors. The attendees had the opportunity to learn about topical research practices and interact with the experts. The track events for the day concluded with an engaging session by the Associate Editor of Transportation Science, Prof. Debjit Roy from IIMA. The discussion focused on the expectations of Transportation Science journal submissions and the positioning of research on India-centric problems for Transportation Science.




IMRC 2024 Day 02: December 08, 2024

Track 06: Transportation and Logistics commenced its sessions for the second day with a tutorial on "Deterministic to Distributionally Ambiguous Optimization Tools for Transportation and Logistics Problems" conducted by Prof. Manish Bansal, Associate Professor, Virginia Tech, USA. The session focused on various mathematical optimization tools that can be leveraged to address transportation and logistics problems that are challenging combinatorial optimization problems that require computationally efficient and effective tools to solve them.




The second half of the day continued with oral presentations dedicated to two sub-tracks. The first track concentrated on 'Supply Chain and Optimization' was chaired by session chairs Prof. Manish Bansal and Prof. Govind Kumawat, Assistant Professor at Indian Institute of Management Udaipur in the Operations Management, Quantitative Methods and Information Systems area. The second sub-track focused on 'Managing Supply Chain Performance' was chaired by session chairs Prof. Vinod Singhal, Charles W. Brady Chair Professor of Operations Management, Georgia Tech Scheller College of Business and Prof. Samrat Roy, Assistant Professor of Operations and Decision Sciences at Indian Institute of Management Ahmedabad.





The track events for the day concluded with an engaging Keynote session by Prof. Vinod Singhal directed on 'Financial Consequences of Supply Chain Risks and Strategies for Building Resilient Supply Chains.' The session elaborated on the various supply chain disruptions and their consequences. Prof. Singhal presented empirical evidence on the effect of supply chain risks on financial performance based on measures related to stock prices and profitability. Further, he compared the performance effects of three supply chain risks: supply chain disruptions, product introduction delays, and excess inventory. Moreover, the talk discussed the potential strategies firms could use to build resilience in supply chains. The track observed a footfall of more than 60 attendees in each session.

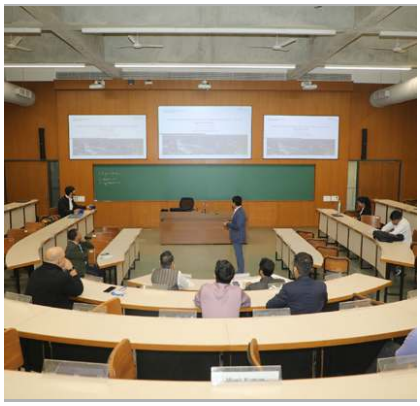



IMRC 2024 Day 03: December 09, 2024

The third day of the conference began with oral presentations spread across four sub-tracks. The first sub-track focused on 'Supply Chain and Optimization' chaired by Prof. Alok Raj, Associate Professor in the Production, Operations, and Decision Sciences Department at XLRI Jamshedpur and Prof. Tarun Rambha, Assistant Professor in the Department of Civil Engineering and the Center for Infrastructure, Sustainable Transportation and Urban Planning (CiSTUP) at Indian Institute of Science (IISc) Bengaluru.

The second sub-track focused on 'Managing Supply Chain Performance' chaired by Prof. Samrat Roy, Assistant Professor in the Department of Operations and Decision Sciences at the Indian Institute of Management Ahmedabad, along with Prof. Ankit Sharma, Assistant Professor in the area of Quantitative Methods & Operations Management at the Indian Institute of Management Amritsar.





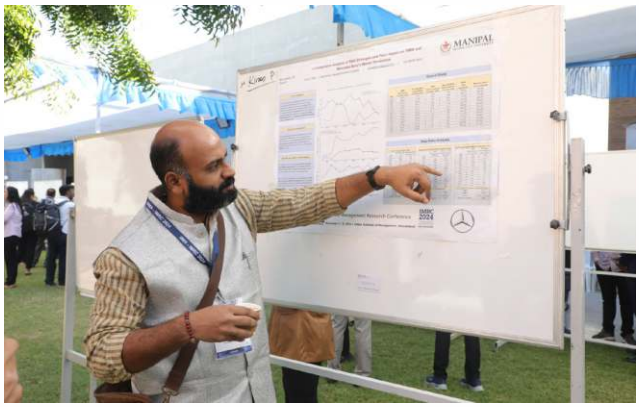
The third sub-track focused on 'Smart Mobility' chaired by Prof. Sundaravalli Narayanaswami, Associate Professor of Public Systems Group at the Indian Institute of Management Ahmedabad along with Prof. Sumit Kunnumkal, Professor and Area Leader, Operations Management at the Indian School of Business, Hyderabad, India.

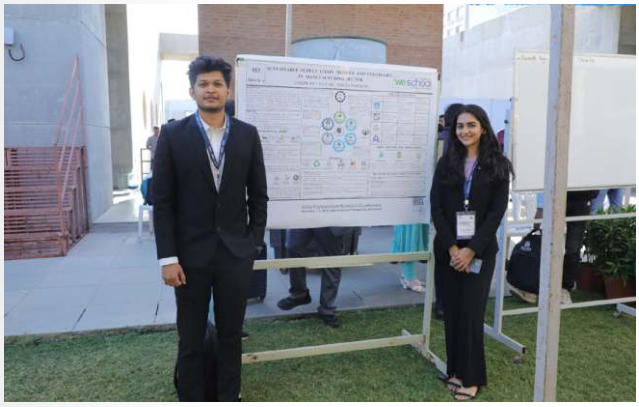
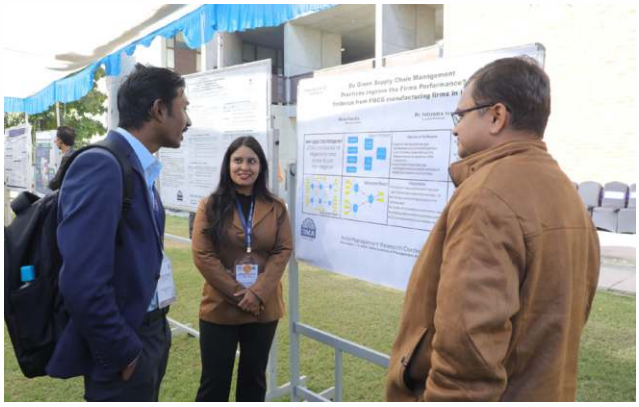
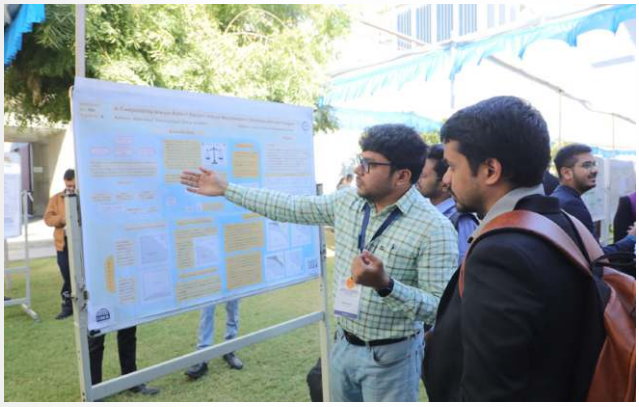

The fourth sub-track focused on 'Policy and Sustainability' chaired by Prof. Samrat Roy, Assistant Professor in the Department of Operations and Decision Sciences at the Indian Institute of Management Ahmedabad, Prof. Venkataramanaiah Saddikuti, Associate Professor in Operations Management at IIM Lucknow, Prof. (Emeritus) G Raghuram at Chanakya University, Prof. Sandip Chakrabarti, Associate Professor, Public Systems Group at IIMA, Prof. Sanjay Verma, Associate Professor of Information Systems at IIMA, Prof. Ranjan Kumar, Assistant Professor, Communications at IIML, Prof. Amit Garg, Professor of Public Systems Group at IIMA and Prof. Srikanth Krishnaprasad, Assistant Professor in Quantitative Methods and Operations Management area at Indian Institute of Management, Kozhikode.






The third day of the conference also featured a session on Poster Presentations, chaired by Prof. Debjit Roy and Prof. Sandip Chakrabarti. The poster presentations showcased a range of varied themes, including global supply chains, last-mile delivery solutions, and green supply chain management practices, to name a few.

Day 3 of the conference culminated in a closing ceremony, during which the awards were presented for the best research papers of Track 06. Track 06 of IMRC 2024 served as a platform to bring together research scholars, distinguished academicians, and industry practitioners from various domains within the transportation and logistics sector to interact, engage in discussions, and exchange ideas to advance the future of research in the Transportation and Logistics sector.

CTL Snippet

Application and Usage of AI and ML in the domain of Transportation and Logistics

Interaction with Prof. Samrat Roy, Assistant Professor, Indian Institute of Management Ahmedabad

Prof. Roy begins by highlighting that advanced statistical models help companies make their logistics and freight systems more efficient, thus assisting in decision-making. He categorizes the transportation and logistics domain into 6 categories, wherein AI and ML have been extensively used. The areas include arrival time prediction, demand forecasting, industrial process optimization, traffic flow prediction, vehicle routing problems, and anomaly detection. He further discusses various statistical methods like linear regression, logistic regression, Bayesian methods, and machine-learning methods like traditional decision tree-making processes, boosting, random forest, and bagging techniques employed in the field of transportation and logistics. Prof. Roy accentuates that no one best approach can be replicated in all scenarios. Each problem requires a different approach and, thereby, a different methodology. Moreover, he states that variables or factors that affect the accuracy of the prediction of arrival times for goods in transportation vary contextually. While elaborating on the challenges companies encounter while applying AI and ML methods, he highlights the importance of quality and quantity of data, followed by refined pre-processing methods before commencing analysis. He adds that identifying the appropriate variables and factors becomes necessary for the prediction model.

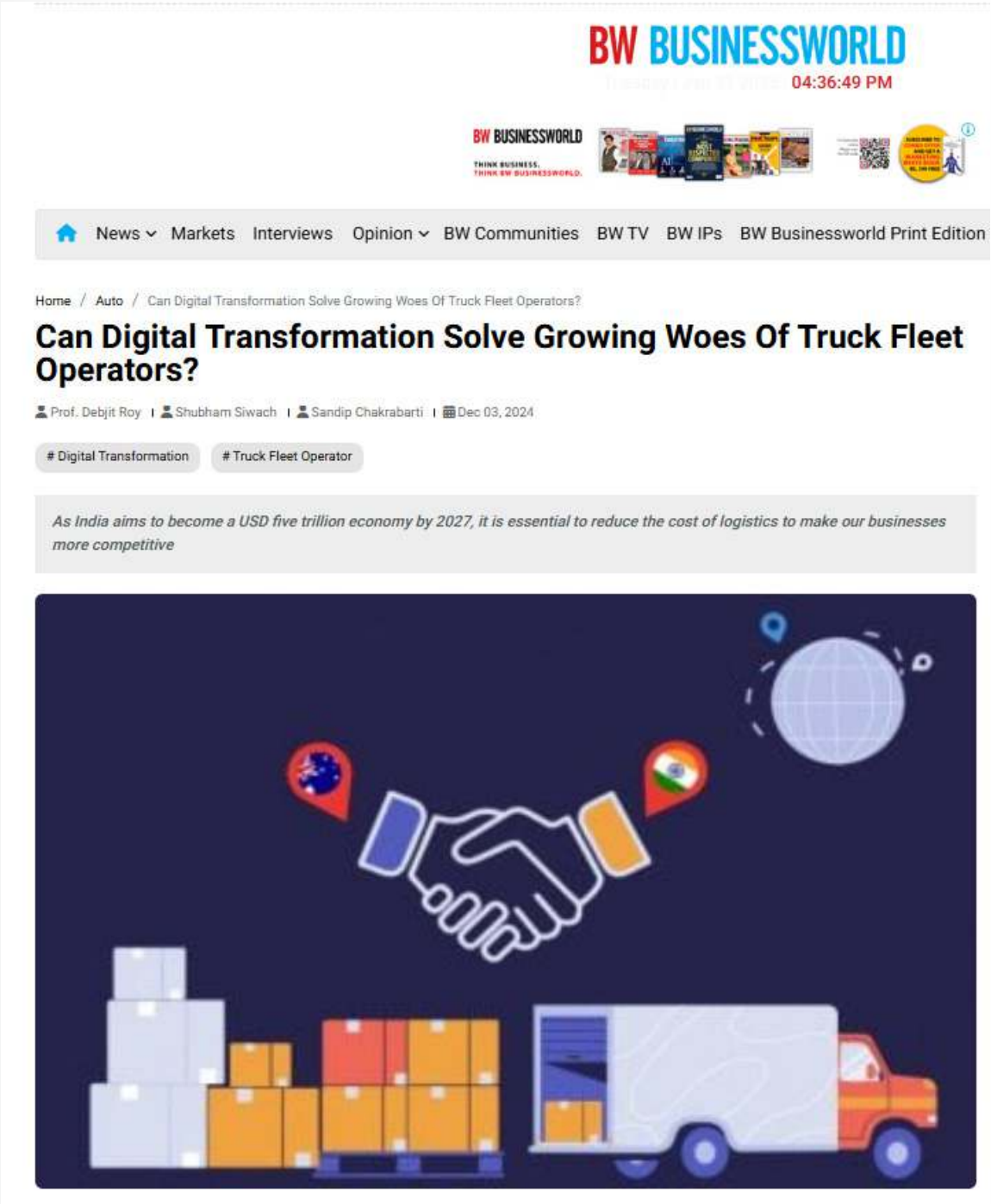
Lastly, Prof. Roy elaborates on the importance of focusing on what is appropriate for their model rather than relying on fanciful methods. He mentions that the primary objective lies in discerning the objective, timing, and rationale behind their methods.

Click to watch: https://www.linkedin.com/feed/update/urn:li:activity:7265600789010661377 or scan

CTL Opinion Article

Can Digital Transformation Solve Growing Woes Of Truck Fleet Operators?

Opinion article titled 'Can Digital Transformation Solve Growing Woes Of Truck Fleet Operators?' authored by Prof. Debjit Roy and Prof. Sandip Chakrabarti along with CTL Research Associate Mr. Shubham Siwach was published in BW Business World, on December 03, 2024.



To read the complete article, visit:
https://www.businessworld.in/article/can-digital-transformation-solve-growing-woes-of-truck-fleet-operators-540996

CTL Faculty Research

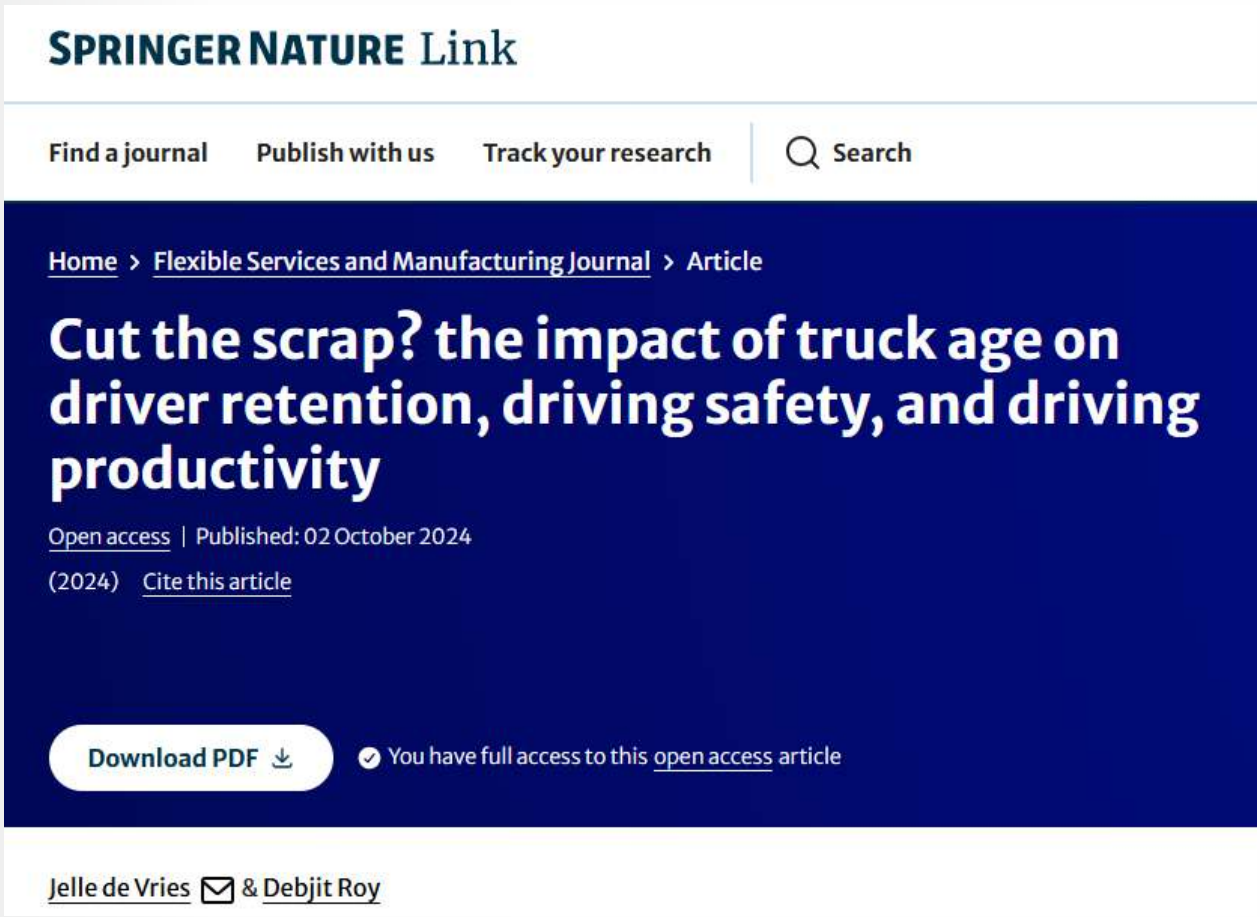
1. Cut the Scrap? The Impact of Truck Age on Driver Retention, Driving Safety, and Driving Productivity

Prof. Debjit Roy, along with Prof. Jelle de Vries, published a research article titled 'Cut the Scrap? The Impact of Truck Age on Driver Retention, Driving Safety, and Driving Productivity'.

Abstract

In many countries, vehicle replacement policies are implemented to reduce the average age of the vehicles on the road. Through these policies, policymakers typically aim to reduce emissions and to stimulate demand for automobiles through vehicle renewal. Not much is known however, about the more detailed operational consequences of vehicle age in truck transportation. In this study, we empirically address this issue by analyzing data obtained from 27 thousand trips made by 916 drivers in 355 unique trucks, over a period of 346 days. Using this data, we test the relationship between truck age and driver retention, productivity, and unsafe driving behavior. Our results demonstrate that truck age significantly impacts driver turnover, with every additional year of truck age relating to an approximate 5% higher risk of leaving the job at a given point in time. Contrarily, drivers with older trucks drove significantly less volatile, which suggests that they drive more safely. The results illustrate that vehicle age influences a broader spectrum of outcome measures than typically considered when assessing the expected impact of replacement policies. Policymakers and trucking companies can use these results to make more informed decisions about vehicle replacement, thereby also addressing the widespread issue of driver shortage.

To read the complete article, visit: https://link.springer.com/article/10.1007/s10696-024-09569-3



2. Stochastic Vehicle Routing With Delivery Choice

Prof. Prahalad Venkateshan, along with Prof. Kamlesh Mathur, published a research article titled 'Stochastic Vehicle Routing With Delivery Choice'.

Abstract

We consider the problem of designing delivery routes for vehicles where the vendor has the choice of how much of the demand from a customer to fulfill. The customer demand is known a priori only as a probability distribution. Exact customer demand is known only after visiting the customer. Different customers are able to negotiate different prices for each unit of product with the vendor. Given a route, the objective is to decide at each customer location, how much demand to satisfy so as to maximize expected profit taking into account a linear penalty cost for unfulfilled demand and the vehicle routing costs. In this article, we develop several new structural results for this problem. We illustrate how these structural results can be embedded in different heuristic frameworks commonly used for deterministic vehicle routing problems. This helps develop efficient routes for a single vehicle as well as a multiple vehicle scenario for this stochastic variant. For small-sized problems that allow for exhaustive enumeration, we demonstrate the effectiveness of the illustrated heuristic. For larger problem instances, based on structural results, we develop methods that allow the heuristic to run more efficiently than otherwise. Results are reported on instances based on benchmark instances drawn from literature for upward of 100 customers and vehicle capacity up to 600 units. Computational times needed to heuristically solve such problems are within 1100s.

To read the complete article, visit: https://doi.org/10.1002/nav.22234

3. Case study on "Marico Limited: Warehouse Automation and Technology Selection"

Prof. Debjit Roy, along with CTL Research Associate Mr. Bipin Yadu, carried out a case study on "Marico Limited: Warehouse Automation and Technology Selection"

Abstract

The case demonstrates how warehousing automation projects are pitched, initiated and executed when the management is sceptical of the success of new technologies. In FY 2020–2021, Marico achieved a record-high turnover of USD 1.3 billion. The company's future looked bright, and sales were expected to increase. The situation on the shop floor was challenging. After analysing the potential challenges associated with an expected increase in demand and considering the prevailing situation at the existing company sites, Vaibhav Kulkarni, Works Head, and Chirag Ojha, Projects and Supply Chain Manager, were convinced that the existing sites of Marico had many operational issues that could no longer be ignored. They pitched the idea of a greenfield project with automated technologies. Although the management was ready for expansion, a greenfield project with high-tech robotic systems seemed considerably aspirational for the company. What alternative technology options were available in the market? What was the cost to the company for the different options? What parameters needed to be considered? How could the options be assessed fairly? How would the new technology affect the daily operations and morale of the company?

Visit to know more: https://cases.iima.ac.in/index.php/marico-limited-warehouse-automation-and-technology-selection.html

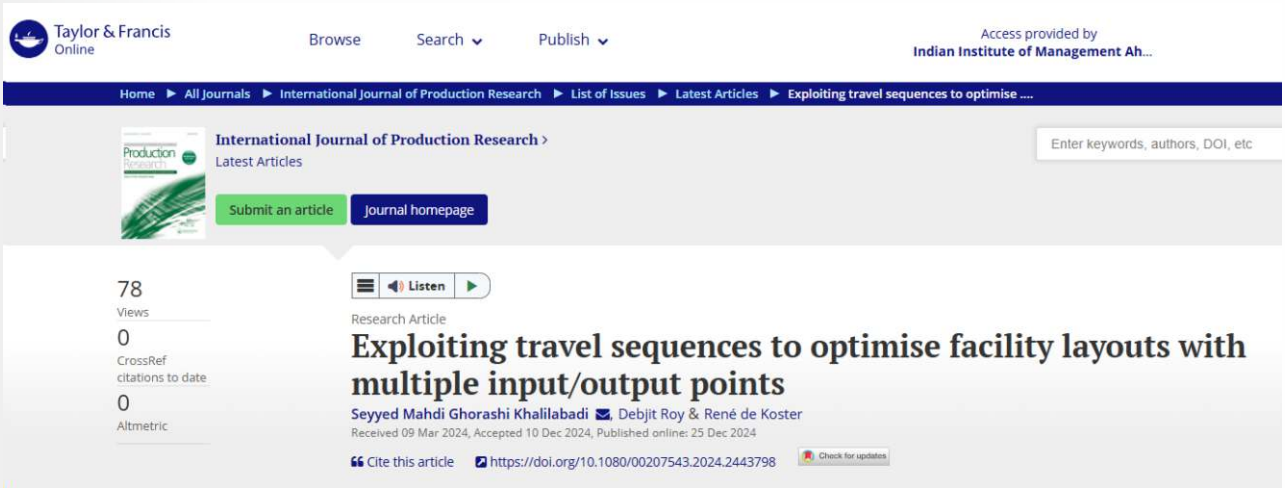
4. Exploiting travel sequences to optimise facility layouts with multiple input/output points

Prof. Debjit Roy, along with Prof. René de Koster and Mr. Seyyed Mahdi Ghorashi Khalilabadi, published a research article titled 'Exploiting travel sequences to optimise facility layouts with multiple input/output points'.

Abstract

The facility layout problem (FLP) involves arranging departments on a shop floor to optimise specific objectives, traditionally focussing on pairwise flows between departments. However, these methods often underestimate total travel distances, especially when flows involve multiple input/output points and visits to more than two departments. To address this, connected movements – actual routes taken by transporters – must be considered. This study uses data captured from an Internet of Things (IoT) network and stored on cloud servers to analyze worker movements and accurately calculate travel distances. A mixed-integer programming model is proposed to minimise total travel distance using connected movements as input. Due to the problem's complexity, a biased random key genetic algorithm is employed to find optimal layouts. A case study at a fertiliser production company demonstrates the effectiveness of the approach, achieving a 15% reduction in travel distance compared to layouts generated by traditional methods. The IoT-enabled method also minimises productivity losses by optimising worker movements. While the study focuses on fertiliser manufacturing, the findings are applicable to other settings, such as warehousing, where complex movement sequences and multiple IO points are common in processes like picking, packing, and shipping.

To read the complete article, visit: https://doi.org/10.1080/00207543.2024.2443798



CTL Faculty Engagements

Reconstitution of CTL Executive Committee for 2024-2026

The Executive Committee of the Centre for Transportation and Logistics (CTL) has been reconstituted for the 2024-2026 term. We extend our gratitude to the Executive Committee members for their contributions and support to the centre.

Prof. Debjit Roy
Institute Chair Professor in
Operations and Decision Sciences, IIMA

Prof. Sandip Chakrabarti
JSW Chair in Innovation and Public Policy,
Associate Professor in Public Systems, IIMA

Prof. Amit Garg
NIIF Chair in ESG
Professor in Public Systems, IIMA

Prof. Poornima Varma
Assistant Professor
Centre for Management in Agriculture, IIMA

Prof. Sachin Jayaswal
Professor
Operations and Decision Sciences, IIMA

Prof. Samrat Roy
Assistant Professor
Operations and Decision Sciences, IIMA

Prof. Sachin Jayaswal was invited to conduct a session on Large-Scale Optimization at the Analytics Workshop organized by SJSOM, IITB on December 15, 2024.

Prof. Debjit Roy was one of the esteemed jury members for The Unified Logistics Interface Platform (ULIP) Logistics Hackathon 2.0, which was officially launched on September 24, 2024 and concluded with its grand finale event on December 20, 2024 in New Delhi.

Read more: https://www.linkedin.com/feed/update/urn:li:activity:7276228701367812096

Prof. Debjit Roy was a part of several notable year-end academic conferences, as listed below:

1. Prof. Roy delivered a keynote address on "Digitizing E-commerce Order Fulfillment Processes: Technology, Data, Models, and New Research Areas" at the International Conference on Next-Gen Supply Chain organized by IIM Jammu on November 22–23, 2024.

2. On December 4, 2024, he co-chaired the doctoral colloquium at the 'POMS India International Conference 2024' at IIM Ranchi.

3. Prof. Roy delivered a plenary talk on "Data-driven Restaurant Operations: New Business Models and Research Opportunities" at the XXVII Annual International Conference of the Society of Operations Management, hosted by IMT Ghaziabad from December 19–21, 2024.

News Watch

New scheme for promoting electric mobility launched: PM E-DRIVE

The Union Ministry of Heavy Industries recently launched a new scheme for promoting electric mobility in the country, called PM Electric Drive Revolution in Innovative Vehicle Enhancement (PM E-DRIVE). This is in continuation of the various schemes that the GoI launched over the last decade, like FAME 1 (2014-19), FAME 2 (2019-24) and EMPS (2024). The scheme, with a budget of INR 10,900 crores (2024-26) and an average annual outlay of INR 5450 cr is substantially higher than the average annual outlay for FAME 1 (INR 179 Crore) and FAME 2 (INR 2,000 crores).

The scheme retains the demand incentive/subsidy component of the FAME scheme, which is allocated INR 3,679 cr. Notably, it includes electric trucks and electric ambulances for the first time and earmarks INR 500 cr each for both categories.

Find out more at: https://www.linkedin.com/feed/update/urn:li:activity:7249360329925685248

This News Watch was prepared by

Mr. Shubham
Research Associate, CTL IIMA

IIMA
विद्याविनियोगाद्विकास:

Centre for Transportation and Logistics

INDIAN INSTITUTE of MANAGEMENT AHMEDABAD

वस्त्रापुर, अहमदाबाद ३८००१५, भारत | Vastrapur, Ahmedabad 380015, India.

+91 79 7152 7022 ctl@iima.ac.in

https://www.iima.ac.in/faculty-research/centers/Centre-for-Transportation-and-Logistics