Institution: Loughborough University

Unit of Assessment: C17 – Business and Management Studies

Title of case study: Transforming Sustainability Practices of Global Logistics and Supply Chains

Period when the underpinning research was undertaken: 2014 to 2020

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g., job title):	Period(s) employed by submitting HEI:
Alok Choudhary	Reader in Supply Chain Management	October 2014 to present

Period when the claimed impact occurred: March 2015 to December 2020

Is this case study continued from a case study submitted in 2014? No

1. Summary of the impact (indicative maximum 100 words)

Maintaining cost-effectiveness while reducing carbon emissions and increasing resource efficiency is one of the most pressing challenges facing businesses today. Research led by Dr Alok Choudhary resulted in the development of optimisation methods and SUSTAIN, a data-driven sustainability toolkit for manufacturing and logistics operations, which have helped organisations from multiple sectors benchmark sustainability performance, cut emissions, optimise operations, and achieve financial benefits. Thanks to optimisation methods and SUSTAIN, six large companies in India and the UK have experienced annual cost savings of up to GBP750,000, lowered emissions by up to 24% and improved sustainability performance by up to 28%. Additionally, through research-led fora, workshops and engagement with the Carbon Trust, hundreds of SMEs and other UK organisations have received tools to enhance their sustainability and competitiveness and reduce risk.

2. Underpinning research (indicative maximum 500 words)

Businesses face mounting pressure from regulators, investors and consumers to address environmental and social issues such as climate change, carbon emissions, resource scarcity, forced labour and poor employment conditions. As a result, companies that do not integrate sustainability into their day-to-day operations increasingly risk serious financial and reputational consequences, as well as potentially failing in their duties to a wide variety of stakeholders. By developing and applying novel analytical methodologies for designing and managing sustainable supply chains, research at Loughborough has helped firms meet this challenge.

With around GBP660,000 in funding from sources including EPSRC, the Newton Fund, the European Union, and the British Council, Choudhary led or co-led six projects between 2013 and 2020. Most involved collaboration with international academic partners, such as IIT (India), as well as various organisations, many of which are beneficiaries (see section 4). Focused on the manufacturing and logistics sectors, the research specifically addressed the evaluation and benchmarking of sustainability performance based on a rigorous set of key performance indicators (KPIs) **[R4]**; the identification of hotspots and the prioritisation of low-cost interventions and best practices for operations improvement **[R4, R5]**; and the optimisation of logistics operations for cost-effectiveness, reduced emissions, and resource efficiency **[R2, R3]**.

The research developed significant innovations for designing and managing supply chains by using mathematical models for optimisation and multi-criteria decision-making (MCDM). Such methodological advances are needed to utilise large-scale, multi-objective optimisation models while recognising real-life constraints.

For example, the research developed a novel two-stage methodology that combined MCDM and multi-objective optimisation models for sustainable supply-chain decision-making **[R1]**. This allowed decision-makers to assess the impacts of environmental, social and financial sustainability and to identify trade-offs between them in selecting suppliers and designing efficient supply-chain networks.

Similarly, by integrating financial and carbon-emission objectives, the research developed and applied a novel optimisation methodology for tactical supply-chain planning decisions **[R2]**. This provided important organisational and policy insights on the financial and emissions-reduction impacts at a tactical planning level; the use of cost/emission trade-off analysis for making informed decisions on investments; and the pricing of carbon for maximum environmental returns per dollar increase in supply-chain cost. This research was further extended to logistics-related operational decision-making to optimise lead times, cost-effectiveness, environmental impact and resource efficiency **[R2, R3]**.

Building on the projects mentioned above, Choudhary led the development of the SUSTAIN toolkit, a decision support system (DSS) underpinned by mathematical optimisation models **[R1, R2]**, machine learning algorithms **[R3]** and novel multi-criteria decision-making methods **[R4, R5, R6]** for the manufacturing, freight transportation and logistics sectors. The decision-making frameworks were developed by using a rigorous mixed-method approach for KPI identification, prioritisation, and industrial validation **[R4, R5]**. An intervention database was created by using qualitative and quantitative data collected through reports, policy documents, surveys, semi-structured interviews, and active engagement of users via a series of industrial workshops in India and the UK.

SUSTAIN provides evidence-based decision-making to evaluate and benchmark sustainability performance in supply chains **[R4]**, freight transportation **[R5]** and managing risk **[R6]**. Its integrated frameworks **[R4, R5]** help companies to identify hotspots – that is, KPIs needing improvement – and prioritise low-cost interventions and best practices for operations enhancement, using multi-dimensional KPIs. SUSTAIN's flexible and modular approach also allows decision-makers to cut carbon emissions, increase cost-effectiveness, improve health and safety, and even reduce traffic congestion and road accidents.

3. References to the research (indicative maximum of six references)

R1 Allaoui, H, Guo, Y, Choudhary, A, and Bloemhof, J (2018): 'Sustainable agro-food supply chain design using two-stage hybrid multi-objective decision-making approach', *Computers & Operations Research*, volume 89, pages 369-384
https://doi.org/10.1016/j.cor.2016.10.012

R2 Fahimnia, B, Sarkis, J, Choudhary, A, and Eshragh, A (2015): 'Tactical supply chain planning under a carbon tax policy scheme: a case study', *International Journal of Production* Economics, volume 164, pages 206-215
https://doi.org/10.1016/j.ijpe.2014.12.015

R3 Choudhary, A, Sarkar, S, Settur, S, and Tiwari, MK (2015): 'A carbon market sensitive optimisation model for integrated forward-reverse logistics', *International Journal of Production Economics,* volume 164, pages 433-444
https://doi.org/10.1016/j.ijpe.2014.08.015

R4 Choudhary, A, De, A, Ahmed, K, and Shankar, R (2019): 'An integrated fuzzy intuitionistic sustainability assessment framework for manufacturing supply chain: a study of UK-based firms', *Annals of Operations Research*
https://repository.lboro.ac.uk/articles/journal_contribution/An_integrated_fuzzy_intuitionistic_sustainability_assessment_framework_for_manufacturing_supply_chain_a_study_of_UK_based_firms/10073054

R5 Pathak, DK, Shankar, R, and Choudhary, A (2021): 'Performance assessment framework based on competitive priorities for sustainable freight transportation systems', *Transportation Research Part D: Transport and Environment*, volume 90, 02663
https://doi.org/10.1016/j.trd.2020.102663

R6 Choudhary, D, Shankar, R, and Choudhary, A (2020): 'An integrated approach for modeling sustainability risks in freight transportation systems', *Risk Analysis: An International Journal*, volume 40, issue 4, pages 858-883
https://doi.org/10.1111/risa.13435

All the above outputs are published in peer-reviewed academic journals with established international reputations and editorial boards. The research reported in these outputs has been enabled by competitively-awarded funding of nearly GBP660,000 from diverse international sources including EPSRC.

4. Details of the impact (indicative maximum 750 words)

This research has had commercial, environmental and social impact. The benefits derived from the application of logistics optimisation models and the SUSTAIN toolkit are widespread across many organisations, ranging from start-ups and SMEs to large MNCs in India and the UK **[S1-S8]**.

The research team chose organisations in light of the nature of their business and the severity of the challenges they face, collaborating through funded projects and observing improvements. Below are specific examples of impact achieved between 2016 and 2020 across six organisations. In addition, impact has been extended through capacity-building for hundreds of members of UK business associations, forums and Chambers of Commerce **[S7, S8, S9]**, equipping them to win new contracts, reduce risk and gain competitive advantage.

• ***Safexpress Group (Safex)***

Safex, India's largest logistics company, collaborated with the research team through Nex-GIFT, a UK-India project, to develop SUSTAIN for logistics operations. SUSTAIN played a pivotal role in the transformation of the company's operational practices and the implementation of several initiatives, including a solar rooftop project, rainwater harvesting, intermodal transhipment and the introduction of Green Dost and other schemes under India's Safeducate programme. In 2016 Safex's Head of R&D credited the research with improving the company's global competitiveness and delivering long-term benefits, remarking: "These initiatives led to estimated revenue of INR29.7 million [≈ GBP370,000 in December 2020], energy cost savings of INR3.5 million [≈ GBP44,000] annually and significant reduction in carbon footprint through low-carbon last-mile delivery... Based on your research, we have embedded and improved the culture of environmental sustainability into our practices, making them globally competitive." **[S1]**

• ***Flui Connecto (Manuli Group)***

Flui Connecto is a global manufacturing, distribution and services organisation based in Manchester, UK. It engaged with the research team as part of the UK-India project in 2017 and benefited by implementing SUSTAIN in 2018 for its manufacturing operations. SUSTAIN's assessments and recommendations influenced the introduction of a new set of environmental and social KPIs into the company's monthly monitoring list and the incorporation of more environmentally friendly processes into global operations. In 2019 Flui Connecto's Global Operations Director stated that the research had helped the business increase operational performance by 10%, on-time delivery by 5% and the triple-bottom-line of operations by 8% on a global scale during the 2018-2019 financial year by driving "process changes in terms of reducing cost, minimising environmental footprint and improving responsiveness to customers" **[S2]**. The research has guided significant investments of around GBP500,000 in Flui Connecto's

supply chain, generating tangible business value (more than GBP700,000) over the life of the investments and contributing to competitive differentiation **[S2]**.

• LetsTransport

LetsTransport is India's leading last-mile tech-logistics solution and urban logistics provider, with more than 78,000 light commercial vehicles. It collaborated with the research team as part of the REINVEST EU-India research project (2017-2019) with a view to optimising last-mile delivery and lowering CO_2 emissions. The company applied logistics optimisation models for CO_2 reduction and used SUSTAIN to identify a set of 27 KPIs and gaps in its practices, including a focus on Euro VI standards. LetsTransport implemented several initiatives across its fleet of vehicles. In 2020 the CEO stated: "The research contributed to reducing our fleet's logistics and resource costs by up to 18% [≈ GBP555,000], environmental emission by up to 20%... and increased fuel efficiency by 2% on average per annum." **[S3]**

• Sundar Transport/JSA Logistics

Sundar Transport/JSA Logistics specialises in the Indian paper industry and has access to more than a thousand trucks. It implemented SUSTAIN as a part of the REINVEST EU-India project (2017-2019). In 2019 the Director of Sundar Transport credited SUSTAIN with giving the company "a structured approach and vast deal of knowledge and best practices for growth", adding: "In the last two years, using a continuous improvement approach underpinned by the sustainability tool, we have transformed the way we manage our business sustainability goals... which has led to improving sustainability performance by 28%, environmental performance by 24% and increased retention of truck drivers by 20%. These figures are well above the Indian industry standard in this sector and of the size of the company – clearly a competitive differentiation for us, leading to new orders." **[S4]**

• [redacted]

[redacted] **[S5]**

• BT Plc and the telecoms industry supply chain

The research team collaborated with BT Plc's procurement group as a part of the UK-India project (2015-2016). With support from the team, the group developed an in-house sustainability assessment tool for thousands of suppliers. In 2021 a senior executive of BT Plc stated: "Your sustainability research contribution to the development of BT's Sustainability Assessor Tool (SAT) was very useful. It helped us to reach out to BT's wider pool of suppliers. Our suppliers use [SAT] to set targets and start initiatives. Since 2017 the Telecoms Industry Association has adopted it as its tool for hundreds of member companies in the ICT sector, including AT&T, which has mandated its use amongst hundreds of direct suppliers." **[S6]**

• Capacity-building for UK businesses

To extend the reach of the research, impact has been delivered via knowledge-sharing and training through industry practitioner fora and workshops **[S7]** under the banner of the UK Forum for Supply Chain Sustainability. Since 2016 Choudhary has co-led the forum, which has benefited more than 200 practitioners across the UK. For example, in 2020 the Carbon Trust UK's Head of Footprinting said: "This initiative provides supply-chain professionals in the UK access to innovative insights, solutions and best practices to pursue initiatives and tackle

sustainability challenges in the supply chain... [and] gain a competitive advantage." **[S7]** In 2020 the Senior Manager – Risk, Policy and Governance at BT Group said: "The research-led industry practitioners' event at Loughborough helped us to expand our supplier base and promote sustainability in particular UK SMEs, learn from best practices and as a result reduce supplier risk." **[S8]**

• ***Regional businesses***

Engagement with regional businesses through umbrella organisations and policy influencers has also formed part of the strategy to extend the research's impact. Since 2018 the team has collaborated with the East Midlands Chamber, which has more than 4,300 members, to deliver research-led workshops and training events to hundreds of businesses **[S9]** and thereby contribute to regional strategies for two key growth sectors, low carbon and advanced logistics, which are worth a combined GBP8.1 billion GVA to the economy **[S9]**. In 2019 the East Midlands Chamber's Director of Policy and External Affairs said: "These applied research-based best practices have helped to enhance the performance, and sustainability of key manufacturing and logistics SMEs in the region... [and] very tangibly helped improve the competitiveness of SME businesses when looking to win business with companies such as Heathrow Airport, the Carbon Trust and BT." **[S9]**

5. Sources to corroborate the impact (indicative maximum of 10 references)

S1 Testimonial from Head of R&D, Safexpress Group, June 2016

S2 Testimonial from Global Operations Director, Flui Connecto, Manuli Group, April 2019

S3 Testimonial from CEO, LetsTransport, December 2020

S4 Testimonial from Director, Sundar Transport, April 2019

S5 Testimonial from senior executive, [redacted], December 2020

S6 Testimonial from senior executive, BT Procurement Group, BT Plc, January 2021

S7 Testimonial from Head of Footprinting, Carbon Trust UK, February 2020

S8 Testimonial from Senior Manager – Risk, Policy and Governance, BT Group, October 2020

S9 Testimonial from Director of Policy and External Affairs, East Midlands Chamber, April 2019