

# **Impact of Industry 4.0 on Supply Chain Sustainability**

This page intentionally left blank

# Impact of Industry 4.0 on Supply Chain Sustainability: Current Status and Future Pathways

EDITED BY

**K. MATHIYAZHAGAN**

*Thiagarajar School of Management, India*

**AAKANKSHA KISHORE**

*FORE School of Management, India*

**BEHZAD BEHDANI**

*University of South-Eastern Norway, Norway*

AND

**HEENA THANKI**

*Shri Jairambhai Patel Institute of Business Management and  
Computer Applications, India*



United Kingdom – North America – Japan – India – Malaysia – China

Emerald Publishing Limited  
Emerald Publishing, Floor 5, Northspring, 21-23 Wellington Street, Leeds LS1 4DL

First edition 2025

Editorial matter and selection © 2025 K. Mathiyazhagan, Aakanksha Kishore, Behzad Behdani and Heena Thanki.

Individual chapters © 2025 The authors.

Published under exclusive licence by Emerald Publishing Limited.

**Reprints and permissions service**

Contact: [www.copyright.com](http://www.copyright.com)

No part of this book may be reproduced, stored in a retrieval system, transmitted in any form or by any means electronic, mechanical, photocopying, recording or otherwise without either the prior written permission of the publisher or a licence permitting restricted copying issued in the UK by The Copyright Licensing Agency and in the USA by The Copyright Clearance Center. Any opinions expressed in the chapters are those of the authors. Whilst Emerald makes every effort to ensure the quality and accuracy of its content, Emerald makes no representation implied or otherwise, as to the chapters' suitability and application and disclaims any warranties, express or implied, to their use.

**British Library Cataloguing in Publication Data**

A catalogue record for this book is available from the British Library

ISBN: 978-1-83797-778-9 (Print)

ISBN: 978-1-83797-777-2 (Online)

ISBN: 978-1-83797-779-6 (Epub)



INVESTOR IN PEOPLE

# Contents

|   |    |
|---|----|
| About the Editors   | ix |
| List of Contributors  | xi |
| <b>New-Age Digitalization Impact on Sustainability in Industry 4.0</b><br><i>Yusuf Ismaila Mustapha and Abdulazeez Olamide Abdulquadri</i>  | 1  |
| <b>Balancing Industry 4.0 With Sustainability: Human-Centric Approach</b><br><i>Sakshi Arora, Divyansha Kumar and Poonam Gulati</i>   | 15 |
| <b>Role of Industry 4.0 on Achieving SDG'S</b><br><i>R Bargavi and Maria Evelyn Jucunda. M</i>  | 31 |
| <b>A Review Study on Challenges and Potential Solutions of Sustainable Supply Chain Management</b><br><i>Vishal Sharma, Rajesh Kumar and Kirti Sood</i>   | 49 |
| <b>Technology Trends and Challenges of Blockchain-enabled Smart Contracts in Liner Shipping Industry</b><br><i>Sedat Baştuğ, Fevzi BİTİktaş, Kazim Yeni, Enes Emİnoğlu and Kee-Hung Lai</i>                 | 67 |
| <b>Navigating the Future: Blockchain Strategies for Reinventing Retail Supply Chains</b><br><i>Ajay Khurana, Shanul Gawshinde and Aamer Al-Aflak</i>  | 79 |
| <b>The Integration of Internet of Things into Supply Chain Management: Evolution, Impact, Benefits, and Challenges</b><br><i>Narendra Gariya, Amir Shaikh, Anzar Ahmad, Kapil Sharma and Ashwini Sharma</i> | 97 |

|   |     |
|---|-----|
| <b>Smart Manufacturing to Implement Industry 4.0 in a Sustainable Supply Chain</b>  | 115 |
| <i>Sunusi Abdulkarim, Abubakar Basiru, Zuhra Junaida Husny, Nafiu Abubakar Babaji, Sadiq AB Mohammed, Farouk AB Mohammed, Umar Abdullahi Mai' Auduga and Babangida Abdulkarim</i> |     |
| <b>Industrial Green Supply Chain: A Conceptual Modelling Approach Based on Artificial Intelligence</b>  | 127 |
| <i>Sana Elhidaoui, Srinivas Kota, Khalid Benhida and Said Elfezazi</i>  |     |
| <b>Reverse Logistics and Closed-Loop Systems in UAE Supply Chains: Leveraging Industry 4.0 for Sustainable Resource Management</b>  | 143 |
| <i>Anushka Lydia Issac</i>  |     |
| <b>Exploring and Mapping the Role of Supply Chain 4.0 Technologies in Promoting Sustainability: A Conceptual Framework</b>  | 157 |
| <i>Khadija Echefaj, Abdelkabir Charkaoui and Anass Cherrafi</i>   |     |
| <b>Impact of Industry 4.0 on Supply Chain Sustainability: Moderating Role of Value Chain</b>  | 171 |
| <i>Varimna Singh, Preyal Sanghavi and Nishant Agrawal</i>   |     |
| <b>Sustainability Meets Technology: Industry 4.0 for SA8000 Compliance and Audit</b>  | 187 |
| <i>Teresa Turzo</i>   |     |
| <b>Sustainable Industry 4.0 in Operations and Supply Chain Management: A Scoping Review</b>   | 201 |
| <i>Náisy da Silva Morais, Manuela Lacerda Paiva Sampaio, Rodrigo Goyannes Gusmão Caiado and Renan Silva Santos</i>  |     |
| <b>Sustainable Wealth-Building Strategies With Supply Chain Companies Post Corona and Ukraine Russia Scrimmages: A Comparative Study</b>  | 217 |
| <i>Parul Bhatia, Niyati Chaudhary, Dheeraj and Parikshit</i>  |     |
| <b>A Framework to Overcome Supply Chain 4.0 Challenges for Sustainability: Application of BWM and DEMATEL Approaches</b>  | 237 |
| <i>Youssef Jouicha, Anass Cherrafi, Nadia Hamani, Said Elfezazi and Khadija Echefaj</i>   |     |

|  |     |
|--|-----|
| <b>An Integrated Model for Evaluation, Selection and Monitoring of Sustainable Suppliers' Performance Based on Customer-Satisfaction in Industry 4.0 Era</b> | 255 |
| <i>Nidhi Ahuja, Jyoti Dhingra Darbari and P.C. Jha</i>   |     |
| <b>Harmony in Progress: Exploring the Symbiosis of New-Age Digitalization and Sustainability in Industry 4.0</b>   | 275 |
| <i>K Anitha, Annie Sam and S Preetha</i>   |     |
| <b>Enablers of Digital Transformation for Supply Chain Sustainability</b>  | 297 |
| <i>Maroof Ahmad Mir and Anubhuti Dwivedi</i>   |     |
| Index  | 313 |

This page intentionally left blank

## About the Editors

**Dr K. Mathiyazhagan** is the Chairperson – Research Center and Associate Professor, Thiagarajar School of Management, Madurai, Tamil Nadu. He is an Assistant Editor in Technological Forecasting and Social Change (Elsevier) – IF: 12, an Associate Editor in Business Strategy and the Environment (Wiley) – IF: 13.4, Management Decision (Emerald) – IF: 4.9 and *Environment, Development and Sustainability Journal* (Springer) with an impact factor of 4.1. He is a leading Guest Editor of special issues in *Journal of Business Logistics* (JBL), *the International Journal of Physical Distribution & Logistics Management* (IJPDLM), *the International Journal of Logistics Management* (IJLM), *Sustainable Production and Consumption* (Elsevier), and *Socio-Economic Planning Science* (Elsevier). He has also been an editorial member in many reputed journals. Also, he has been listed among the Top 2% of scientists (Stanford's list World's Top 2% of scientists). He has published in numerous journals, including IJPE, IJPR, PPC, IEEE TEM, JCP, RCR, etc., with more than 5,000 research citations. One of his papers was awarded the Excellence Citation Award by Emerald Publisher Ltd. In addition, he is editing international books on Blockchain & Lean-Green & Society 4.0 in Elsevier, Taylor & Francis, and Springer publishers. He was invited to visit Roma TRE University, Italy, in February 2023 for research collaboration and invited to visit Nottingham Trent University, United Kingdom, to organize a joint international research excellence workshop on September 7, 2023. He is an active reviewer of more than 30 reputed international journals, receiving the best reviewer certificates from reputed journals.

**Dr Aakanksha Kishore** is working as an Assistant Professor in the area of Operations Management at FORE School of Management, New Delhi. She is a graduate in Mathematics Honors from Sri Venkateswara College, University of Delhi, and holds a Master's degree in Operational Research from Hindu College, University of Delhi. She has a doctorate in Inventory Management from Department of Operational Research, University of Delhi. She is also CSIR-NET qualified in Mathematical Sciences in the year 2013. She is an expert in devising inventory strategies/policies for operations managers through mathematical modeling. To her credit, she has various international research publications in ABDC/SCI/SCIE/SCOPUS indexed journals viz. *Journal of Cleaner Production*, *Expert Systems with Applications*, *Process Integration and Optimization for Sustainability*, *Scientia Iranica*, *RAIRO – Operations Research*, *Control & Cybernetics*, *Mathematics*, *International Journal of Industrial Engineering Computations*,

*International Journal of Services Operations and Informatics*, and *International Journal of Mathematical, Engineering and Management Sciences*, to name a few. She has also received Best Paper Awards for four of her publications. She is a recipient of “Award of Excellence in Research 2022,” by *International Journal for Modern Trends in Science and Technology* in October 2022. She was also awarded “Distinguished Faculty Award” for her academic contribution in the session 2021–2022.

**Dr Behzad Behdani** is a Professor in Supply Chain and Operations Management at USN School of Business. He has done extensive research on some groundbreaking aspects of operations and supply chain management, among others, supply chain analytics, operations management at the early-stage innovative companies (the link between innovation/technology management and operations management), food supply chains and operation, and intermodal transport, and logistics. Behzad’s research also deals with how we can embed the UN Sustainable Development Goals in the design and operations of global supply chains.

**Dr Heena Thanki** is working as an Associate Professor for the MBA program at the Gujarat Technological University’s Shri Jairambhai Patel Institute of Management and Computer Applications (SJPI) (formerly known as National Institute of Cooperative Management) Gandhinagar, Gujarat, India. Before joining the academic and research sector, she worked at the ICICI Prudential Limited – India’s leading insurance provider. She holds a PhD in Finance, a Diploma in Export–Import Management, and has completed BBA and MBA. She was awarded Junior Research Fellow (JRF) for being among the top 6% of the University Grants Commission’s National Eligibility Test (UGC NET) qualified candidates. She has been extensively working in teaching, training, and research domain for over a decade and specializes in financial management, behavioral finance, research methodology, entrepreneurship, and ethics and corporate governance. Her research papers are published and presented at various national- and international-level journals and conferences. Most of her research work has also been published in top-ranked reputed journals of globally acclaimed ranking lists, such as the Australian Business Deans Council (ABDC) and Chartered Association of Business Schools (CABS). She has also won many awards for her research papers.

## List of Contributors

|                              |   |
|------------------------------|---|
| <i>Babangida Abdulkarim</i>  | Bauchi State University, Nigeria                          |
| <i>Sunusi Abdulkarim</i>     | Nigerian Army University Biu, Nigeria                     |
| <i>Abdulazeez Olamide</i>    |   |
| <i>Abdulquadri</i>           | University of Ilorin, Nigeria                             |
| <i>Nishant Agrawal</i>       | ICFAI Business School, India                              |
| <i>Anzar Ahmad</i>           | Graphic Era Deemed To Be University, India                |
| <i>Nidhi Ahuja</i>           | Amity University, India                                   |
| <i>Aamer Al-Aflak</i>        | Chandigarh University, India                              |
| <i>K Anitha</i>              | Meenakshi Academy of Higher Education and Research, India |
| <i>Sakshi Arora</i>          | Amity University, India                                   |
| <i>Fevzi Bİtİktaş</i>        | Dokuz Eylül University, Turkey                            |
| <i>Sedat Baştuğ</i>          | Bandırma Onyedli Eylül University, Turkey                 |
| <i>Nafiu Abubakar Babaji</i> | Tertiary Education Trust Funds, Nigeria                   |
| <i>R Bargavi</i>             | SRM Institute of Science and Technology, India            |
| <i>Abubakar Basiru</i>       | Nigerian Army University Biu, Nigeria                     |
| <i>Parul Bhatia</i>          | Shri Vishwakarma Skill University, India                  |
| <i>Abdelkabir Charkaoui</i>  | Hassan First University of Settat, Morocco                |
| <i>Niyati Chaudhary</i>      | SGT University, India                                     |
| <i>Anass Cherrafi</i>        | Cadi Ayyad University, Morocco                            |
| <i>Jyoti Dhingra Darbari</i> | University of Delhi, India                                |
| <i>Dheeraj</i>               | Shri Vishwakarma Skill University, India                  |
| <i>Anubhuti Dwivedi</i>      | EdMaestro Pvt. Ltd., India                                |

*xii List of Contributors*

|   |   |
|---|---|
| <i>Khadija Echefaj</i>                    | Hassan First University of Settat,<br>Morocco                         |
| <i>Said Elfezazi</i>                      | Cadi Ayyad University, Morocco  |
| <i>Enes Emİnoglul</i>                     | Iskenderun Technical University, Turkey                               |
| <i>Narendra Gariya</i>                    | Graphic Era Deemed To Be University,<br>India                         |
| <i>Shanul Gawshinde</i>                   | Symbiosis International University, India                             |
| <i>Poonam Gulati</i>                      | Amity University, India   |
| <i>Rodrigo Goyannes Gusmão<br/>Caiado</i> | Pontifical Catholic University of Rio de<br>Janeiro (PUC-Rio), Brazil |
| <i>Nadia Hamani</i>                       | Picardie Jules Verne University, France                               |
| <i>Zuhra Junaida Husny</i>                | Universiti Teknologi, Malaysia  |
| <i>Anushka Lydia Issac</i>                | Westford University College, United<br>Arab Emirates                  |
| <i>P.C. Jha</i>                           | University of Delhi, India  |
| <i>Youssef Jouicha</i>                    | Université de Picardie Jules Verne Saint<br>Quentin, France           |
| <i>Ajay Khurana</i>                       | Chandigarh University, India  |
| <i>Divyansha Kumar</i>                    | Amity University, India   |
| <i>Rajesh Kumar</i>                       | Himachal Pradesh University, India                                    |
| <i>Kee-Hung Lai</i>                       | The Hong Kong Polytechnic University,<br>Hongkong                     |
| <i>Maria Evelyn Jucunda. M</i>            | Vellore Institute of Technology, Chennai,<br>India                    |
| <i>Umar Abdullahi Mai' Auduga</i>         | Abubakar Tafawa Balewa University,<br>Nigeria                         |
| <i>Maroof Ahmad Mir</i>                   | Asian Business School, India  |
| <i>Farouk AB Mohammed</i>                 | Nigerian Army University Bui, Nigeria                                 |
| <i>Sadiq AB Mohammed</i>                  | Nigerian Defence Academy Kaduna,<br>Nigeria                           |
| <i>Yusuf Ismaila Mustapha</i>             | University of Ilorin, Nigeria   |
| <i>Manuela Lacerda Paiva<br/>Sampaio</i>  | Pontifical Catholic University of Rio de<br>Janeiro (PUC-Rio), Brazil |
| <i>Parikshit</i>                          | Shri Vishwakarma Skill University, India                              |

|                              |  |
|------------------------------|--|
| <i>S Preetha</i>             | Vels Institute of Science, Technology & Advanced Studies, India    |
| <i>Said Elfezazi</i>         | Cadi Ayyad University, Morocco                                     |
| <i>Annie Sam</i>             | Vels Institute of Science, Technology & Advanced Studies, India    |
| <i>Preyal Sanghavi</i>       | Som -Lalit Institute of Management Studies, India                  |
| <i>Renan Silva Santos</i>    | Pontifical Catholic University of Rio de Janeiro (PUC-Rio), Brazil |
| <i>Amir Shaikh</i>           | Graphic Era Deemed To Be University, India                         |
| <i>Ashwini Sharma</i>        | Graphic Era Deemed To Be University, India                         |
| <i>Kapil Sharma</i>          | Graphic Era Deemed To Be University, India                         |
| <i>Vishal Sharma</i>         | Himachal Pradesh University, India                                 |
| <i>Varimna Singh</i>         | K J Somaiya Institute of Management, India                         |
| <i>Kirti Sood</i>            | Chandigarh University, India                                       |
| <i>Teresa Turzo</i>          | UnitelmaSapienza University of Rome, Italy                         |
| <i>Kazim Yenİ</i>            | Dokuz Eylül University, Turkey                                     |
| <i>Náisy da Silva Morais</i> | Pontifical Catholic University of Rio de Janeiro (PUC-Rio), Brazil |
| <i>Khalid Benhida</i>        | Cadi Ayyad University, Morocco                                     |
| <i>Sana Elhidaoui</i>        | Cadi Ayyad University, Morocco                                     |
| <i>Srinivas Kota</i>         | Birla Institute of Technology and Science, India                   |