

# **4th International Conference on Industry 4.0 and Smart Manufacturing (ISM 2022)**

Procedia Computer Science Volume 217

Linz, Austria  
2-4 November 2022

Part 1 of 3

## **Editors:**

**Francesco Longo**  
**Michael Affenzeller**

**Antonio Padovano**  
**Weiming Shen**

ISBN: 978-1-7138-7371-6

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© (2022) The Authors. Published by Elsevier Ltd.  
Creative Commons Attribution 4.0 International License.  
License details: <http://creativecommons.org/licenses/by/4.0/>.

No changes have been made to the content of these proceedings. There may be changes to pagination, and minor adjustments for aesthetics.

Printed with permission by Curran Associates, Inc. (2024)

For permission requests, please contact the publisher:

Elsevier B.V.  
Radarweg 29  
Amsterdam 1043 NX  
The Netherlands

Phone: +31 20 485 3911  
Fax: +31 20 485 2457

<http://www.elsevierpublishingsolutions.com/contact.asp>

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2633  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)



## Table of Contents

Infrastructure Network Support and Leapfrogging Africa to Industry 4.0: The Case of Tanzania Christopher Simeon Awinia . . . . .	1
Comparison of Energy-use Efficiency for Lettuce Plantation under Nutrient Film Technique and Deep-Water Culture Hydroponic Systems Syed Abreez Gillani, Rabiya AbbasiPablo Martinez, and Rafiq Ahmad . . . . .	11
An Edge-Cloud based Reference Architecture to support cognitive solutions in Process Industry Antonio Salis, Angelo Marguglio, Gabriele De Luca, Silvia Razzetti, Walter Quadrini, and Sergio Gusmeroli . . . . .	20
Logistics 4.0 in intermodal freight transport Dr. László Vida, Prof. Béla Illés, and Dr. Ágota Bányainé-Tóth . . . . .	31
Analysis of sustainable concrete obtained from the by-products of an industrial process and recycled aggregates from construction and demolition waste Marco Bergonzoni, Riccardo Melloni, and Lucia Botti . . . . .	41
Intelligent Concrete Surface Cracks Detection using Computer Vision, Pattern Recognition, and Artificial Neural Networks Majid Mirbod, and Maryam Shoar . . . . .	52
Spatial change recognition model using artificial intelligence to remote sensing Majid Mirboda, Baback Rezaei, and Mehrnoosh Najafi . . . . .	62
Smart Trip Prediction Model for Metro Traffic Control Using Data Mining Techniques Majid Mirbod, and Hamidreza Dehghani . . . . .	72
A practical guide for implementing Zero Defect Manufacturing in new or existing manufacturing systems Foivos Psarommatis, and Gökan May . . . . .	82
Encryption and Generation of Images for Privacy-Preserving Machine Learning in Smart Manufacturing Vagan Terziyan, Diana Malyk, Mariia Golovianko, and Vladyslav Branytskyi . . . . .	91
Industry 4.0 vs. Industry 5.0: Co-existence, Transition, or a Hybrid Mariia Golovianko, Vagan Terziyan, Vladyslav Branytskyi, and Diana Malyk . . . . .	102
Using analytical and data-driven methods to develop a soft-sensor for flow rate monitoring in tube extrusion Enrico Bovo, Marco Sorgato, and Giovanni Lucchetta . . . . .	114
Energy expenditure and makespan multi-objective optimization for cobots systems design Irene Granata, Maurizio Faccio, and Martina Calzavara . . . . .	126
Enterprise IT Architecture Greenfield Design Combining IEC 62264 and TOGAF by Example of Battery Manufacturing Michael Oberle, Ozan Yesilyurt, Andreas Schlereth, Monika Risling, and Daniel Schel . . . . .	136

The Importance of Cobot Speed and Acceleration on the Manufacturing System Efficiency Robert Ojstersek, Borut Buchmeister, and Aljaz Javernik. . . . .	147
How entrepreneurial is German Generation Z vs. Generation Y? A Literature Review Christian Dreyer, and Hana Stojanová. . . . .	155
A Porter's Five Forces Model Proposal for Additive Manufacturing Technology: A Case Study in Portuguese industry Soraya Dias, Pedro Espadinha-Cruz, and Florinda Matos. . . . .	165
Fostering Engineering Education 4.0 Paradigm Facing the Pandemic and VUCA World Monica Ioniță Ciolacu, Bogdan Mihailescu, Tamara Rachbauer, Christina Hansen, Cătălin Gheorghe Amza, and Paul Svasta . . . . .	177
Improving Boosted Generalized Additive Models with Random Forests: A Zoo Visitor Case Study for Smart Tourism Fabian Obster, Josephine Brand, Monica Ciolacu, and Andreas Humpe . . . . .	187
Effective factors for estimating market share in concept testing Takumi Kato, Susumu Kamei, Takumi Ootsubo, and Yosuke Ichiki. . . . .	198
A review of advanced technologies available to improve the healthcare performance during COVID-19 pandemic Omar Ali, Ahmad AlAhmad, and Hasan Kahtan . . . . .	205
Architecture for managing AAS-based business processes William Ochoa, Felix Larrinaga, and Alain Pérez . . . . .	217
Multi-sensor cyber-physical sorting system (CPSS) based on Industry 4.0 principles: A multi-functional approach Fotios K. Konstantinidis, Savvas Sifnaios, Georgios Tsimiklis, Spyridon G. Mouroutsos, Angelos Amditis, and Antonios Gasteratos . . . . .	227
Lessons-learned on articulating and evaluating I4.0 developments at SME manufacturing companies Jenny Coenen, Rufus Fraanje, Sander Limonard, and Mirjam Zijdeveld . . . . .	238
A predictive eco-design method and tool for electric vehicles of Industry 4.0 Luca Manuguerra, Federica Cappelletti, Francesca Manes, and Michele Germani . . . . .	248
Information support for managing energy-saving technological changes at enterprises Olexandr Yemelyanov, Ihor Petrushka, Olena Zahoretska, Kateryna Petrushka, and Anatolii Havryliak . . . . .	258
Evaluation of Indicators for Simulation's Prediction Quality of Material Demand in Matrix Production Systems Daniel Ranke, Axel Bruns, Rouven Fink, Annika Lehnert, and Thomas Bauernhansl . . . . .	268
Project management and supply chain 4.0 improvement: the case of infant formulas in the face of the challenge of COVID-19 Michelle Chevalier Hernandez, Adrielly Nahomee Ramos Alvarez, and Francisca Irene Soler Anguiano . . . . .	278
Simulation in the temperature parameters control in the yogurt manufacturing process Honorato Ccalli Pacco . . . . .	286
Resilience in value creation systems through additive manufacturing: a decision model Hajo Groneberg, Timo Bock, and Frank Doepper . . . . .	296
Artificial Intelligence Task Planning of Cooperating Low-Cost Mobile Manipulators: A Case Study on a Fully Autonomous Manufacturing Application Stefan-Octavian Bezrucav, Nils Mandischer, and Burkhard Corves . . . . .	306

Federated Learning as a Privacy Solution - An Overview Mashal Khan, Frank G. Glavin, and Matthias Nickles . . . . .	316
Machine Learning and Computer Vision for the automation of processes in advanced logistics: the Integrated Logistic Platform (ILP) 4.0 M. Di Capua, A. Ciaramella, and A. De Prisco . . . . .	326
Smart Poultry Management Platform with Egg Production Forecast Capabilities Nikolajs Bumanis, Armands Kvisis, Anastasija Tjukova, Irina Arhipova, Liga Paura, and Gatis Vitols . . .	339
The key challenges of blockchain implementation in maritime sector: summary from literature and previous research findings Sergey Tsiulin, Kristian Hegner Reinau, and Olli-Pekka Hilmola. . . . .	348
Quality in production planning: Definition, quantification and a machine learning based improvement method Lukas Lingitz, Viola Gallina, Johannes Breitschopf, Luana Finamore, and Wilfried Sihm . . . . .	358
Improving the distribution of covid-19 vaccines using the blockchain technology: the Italian case study Marta Rinaldi, Maria Antonietta Turino, Marcello Fera, and Roberto Macchiaroli . . . . .	366
A new procedure for spare parts inventory management in ETO production: a case study Marta Rinaldi, Marcello Fera, Roberto Macchiaroli, and Eleonora Bottani . . . . .	376
Lessons from adopting robotic in-line quality inspection in the Swedish manufacturing industry Victor Azamfrei, Anna Granlund, and Yvonne Lagrosen. . . . .	386
Manufacturing Reliability and Cost Improvements through Data Analytics: An Industry Case Study Rob Geary, and John Cosgrove . . . . .	395
An approach towards Zero Defect Manufacturing by combining IIoT data with Industrial Social Networking Kosmas Alexopoulos, Thodoris Tsoukaladelis, Chrysa Dimitrakopoulou, Nikolaos Nikolakis, and Amit Eytan. . . . .	403
Order Management Perspective on Fluid Manufacturing Systems Theresa-Franziska Hinrichsen, Christian Fries, Manuel Hagg, and Manuel Fechter . . . . .	413
Multi-level Federated Learning for Industry 4.0 - A Crowdsourcing Approach Ihsan Ullah, Umair Ul Hassan, and Muhammad Intizar Ali . . . . .	423
Compression scenarios for Federated Learning in Smart Manufacturing Seif Allah EL Mesloul Nasri, Ihsan Ullah, and Michael G Madden . . . . .	436
Industrial Robot Training in the Simulation Using the Machine Learning Agent Karle Nutonen, Vladimir Kuts, and Tauno Otto . . . . .	446
Self-Attention Transformer-Based Architecture for Remaining Useful Life Estimation of Complex Machines Abdul Wahid, Muhammad Yahya, John G Breslin, and Muhammad Ali Intizar. . . . .	456
The contribution of Horticulture 4.0 innovations to more sustainable horticulture Sabine Ludwig-Ohm, Phillip Hildner, Marike Isaak, Walter Dirksmeyer, and Jan Schattenberg . . . . .	465
Complexity based investigation in collaborative assembly scenarios via non intrusive techniques Sotirios Panagou, Monica Sileo, Konstantinos Papoutsakis, Fabio Fruggiero, Ammar Qammaz, and Antonis Argyros . . . . .	478
Implementation Model for Digital Retrofit for Sustainable Production Markus Kröll, and Christian Cseh . . . . .	486

Causality-Aware Convolutional Neural Networks for Advanced Image Classification and Generation Vagan Terziyan, and Oleksandra Vitko .....	495
Student-Centered Learning Tool for Cognitive Enhancement in the Learning Environment Damilola Dada, Opeyeolu Timothy Laseinde, and Lagouge Tartibu. ....	507
A review of supply chain 4IR management strategy for appraising the manufacturing industry's potentials and shortfalls in the 21st century Makinde Oluwafemi Ajayi, and Opeyeolu Timothy Laseinde. ....	513
Big Data and Labour Markets: A Review of Research Topics Lejla Turulja, Dalia Suša Vugec, and Mirjana Pejić Bach. ....	526
Development of Digital Twin of a Compact Bulk Feeder to Optimise its Functionality Ahmed Al-Ashaab, Nik Fadilah, Faiz Djafri, Sai Nikhil Kumar Jaini, Glyn Fargher, and Hugo Chester ...	536
Applications of Artificial Intelligence Techniques for trajectories optimization in robotics mobile platforms Juan Escobar-Naranjo, Gustavo Caiza, Carlos A. Garcia, Paulina Ayala, and Marcelo V. Garcia .....	543
Technology Outsourcing of 3PL firm in a B2B contractual agri-supply chain Arkajyoti De, and Surya Prakash Singh. ....	552
Simulation models for public transportation: a state-of-the-art review Carmen A. García-Cerrud, and Idalia Flores de la Mota. ....	562
A Review Study on ML-based Methods for Defect-Pattern Recognition in Wafer Maps T. Theodosiou, A. Rapti, K. Papageorgiou, T. Tziolas, E. Papageorgiou, N. Dimitriou, G. Margetis, and D. Tzovaras .....	570
Utilizing an adaptive window rolling median methodology for time series anomaly detection Dimitris Dimoudis, Thanasis Vafeiadis, Alexandros Nizamis, Dimosthenis Ioannidis, and Dimitrios Tzovaras. ....	584
IndustrialEdgeML - End-to-end edge-based computer vision systemfor Industry 5.0 Raphael Wagner, Mario Matuschek, Philipp Knaack, Michael Zwick, and Manuela Geiß. ....	594
Lasers in the manufacturing of cardiovascular metallic stents: Subtractive and additive processes with a digital tool Ali Gökhan Demir, and Barbara Previtali .....	604
Industry 4.0 Maturity and Readiness- A case of a Steel Manufacturing Organization Pinosh Kumar Hajoary. ....	614
Current State of the Inter-Organizational Information Exchange Strategies of German SME - A Survey Laura S. Thiele, and Diana Peters .....	620
Using Simulation Optimization to Improve the Performance of an Automated Manufacturing Line Patrick Ruane, Patrick Walsh, and John Cosgrove .....	630
On the development of the Digital Shadow of the Fischertechnik Training Factory Industry 4.0: an educational perspective Roberto Sala, Fabiana Pirola, and Giuditta Pezzotta .....	640
5G in Logistics 4.0: potential applications and challenges Alexandra Lagorio, Chiara Cimini, Roberto Pinto, and Sergio Cavalieri .....	650
Creation of the university curriculum in the field of Industry 4.0 with the use of modern teaching instruments - Polish case study Manuela Ingaldia, Robert Ulewicz, and Dorota Klimecka-Tatar. ....	660

The Impact of Digital Financial Technology on Accelerating Financial Inclusion in Developing Economies	
Arnesh Telukdarie, and Aviksha Mungar . . . . .	670
Modelling for Cleaner Production & Optimization	
Lesego Mabitsela, Arnesh Telukdarie, and Megashnee Munsamy . . . . .	679
The opportunities and challenges of digitalization for SME's	
Arnesh Telukdarie, Thabile Dube, Pretty Matjuta, and Simon Philbin . . . . .	689
Water systems modeling and optimization	
Megashnee Munsamy, Arnesh Telukdarie, and Pretty Matjuta . . . . .	699
An intelligent data capturing framework to improve condition monitoring and anomaly detection for industrial machines	
Steven Robyns, Stijn Helsen, Sam Weckx, Sachin Kumar Bhoi, Mohamed El Baghdadi, Omar Hegazy, and Jasper De Smet . . . . .	709
Digital Twin – A Tool for Project Management in Manufacturing	
Brian Hickey, Dr Carine Gachon, and Dr John Cosgrove . . . . .	720
Mixed Reality or Simply Mobile? A Case Study on Enabling Less Skilled Workers to Perform Routine Maintenance Tasks	
Meike Wagner, Christian Leubner, and Jobin Strunk . . . . .	728
Additive Manufacturing for orthopedic applications: Case study on market impact	
Miriam Seiti, and Paola Ginestra . . . . .	737
Augmented Reality to support the maintenance of urban-line infrastructures: A case study	
Andrea Revolti, Patrick Dallasega, Felix Schulze, and Alexander Walder . . . . .	746
Mathematical pattern for parametric design: the case study of Grey-Scott cross diffusion model.	
Bertacchini Francesca, Beneduci Roberto, Bilotta Eleonora, Demarco Francesco, Pantano Pietro, and Scuro Carmelo . . . . .	756
A human-centered conceptual model for integrating Augmented Reality and Dynamic Digital Models to reduce occupational risks in industrial contexts	
Luca Gualtieri, Andrea Revolti, and Patrick Dallasega . . . . .	765
Simulation Modeling Of Consumer Behavior Within The Concept Of Smart Consumption	
Lyubov Krestyanpol . . . . .	774
Solving Agricultural Price Recommendation Problem Using Smart Reading Algorithms	
Fajar Delli Wihartiko, Sri Nurdianti, Agus Buono, and Edi Santosa . . . . .	784
Identification of Surrogate Models for the Prediction of Degrees of Freedom within a Tolerance Chain	
Hannah Janout, Thomas Paier, Carina Ringelhahn, Michael Heckmann, Andreas Haghofer, Gabriel Kronberger, and Stephan Winkler . . . . .	796
Fleet management systems in Logistics 4.0 era: a real time distributed and scalable architectural proposal	
Ricardo Dintén, Sebastián García, and Marta Zorrilla . . . . .	806
On Domain Randomization for Object Detection in real industrial scenarios using Synthetic Images	
Davide Pasanisi, Emanuele Rota, Michele Ermidoro, and Luca Fasanotti . . . . .	816
Fresh food shelf-life improvement by humidity regulation in domestic refrigeration	
Tuany Gabriela Hoffmann, Caroline Meinert, Felipe Ormelez, Marcelo Campani, Sávio Leandro Bertoli, Laércio Ender, and Carolina Krebs de Souza . . . . .	826
Paradigms for database-centric application interfaces	
Massimiliano Pirani, Alessandro Cucchiarelli, and Luca Spalazzi . . . . .	835

Industry 4.0 concepts within the sub-Saharan African SME manufacturing sector Onu Peter, Anup Pradhan, and Charles Mbohwa . . . . .	846
Industrial internet of things (IIoT): opportunities, challenges, and requirements in manufacturing businesses in emerging economies Onu Peter, Anup Pradhan, and Charles Mbohwa . . . . .	856
Simulation based optimization of drilling equipment logistics: a case of study Andrea Gómez Ramírez, and Francisca Irene Soler Anguiano . . . . .	866
What does Industry 4.0 mean to Industrial Engineering Education? Bertha Leticia Treviño-Elizondo, and Heriberto García-Reyes . . . . .	876
A YOLO-based Real-time Packaging Defect Detection System Thi-Thu-Huyen Vu, Dinh-Lam Pham, and Tai-Woo Chang . . . . .	886
Development of a Digital Innovation Framework that is Renowned Globally Sameh M Saad, and Samah Alnuiami . . . . .	895
The Potential of Low-Power, Cost-Effective Single Board Computers for Manufacturing Scheduling Pedro Coelho, Catarina Bessa, Jorge Landeck, and Cristovão Silva . . . . .	904
Lessons Learned from Human Pose Interaction in an Industrial Spatial Augmented Reality Application Gernot Stübl, Christoph Heindl, Gerhard Ebenhofer, Harald Bauer, and Andreas Pichler . . . . .	912
Automating dairy production lines with the yoghurt cups recognition and detection process in the Industry 4.0 era Fotios K. Konstantinidis, Vasiliki Balaska, Symeon Symeonidis, Dimitrios Tsilis, Spyridon G. Mouroutsos, Loukas Bampis, Athanasios Psomoulis, and Antonios Gasteratos . . . . .	918
Computational evaluation of the compressive properties of different lattice geometries to be used as temporary implants Pedro Nogueira, Kerman Castresana, J. Magrinho, M. Beatriz Silva, Augusto Moita de Deus, and M. Fátima Vaz . . . . .	928
Improving Virtual Sensor Models by Censored Online Data Sabrina Luftensteiner, and Michael Zwick . . . . .	938
A Prototype of Supply Chain Traceability using Solana as blockchain and IoT Mateen Ashraf, and Cathal Heavey . . . . .	948
Gathering Expert Knowledge in Process Industry Sabrina Luftensteiner, Georgios C. Chasparis, and Michael Mayr . . . . .	960
Conceptual Thoughts on Biointelligent Embedded Systems and Operating Systems Architecture Arber Shoshi, Robert Mieke, and Thomas Bauernhansl . . . . .	969
E-grocery supply chain innovation and financial inclusion: A framework Marcia Mkansi, and Godfrey Mugurusi . . . . .	979
Implementing Virtuality in Production - a Design Science Approach Manuel Brunner, Herbert Jodlbauer, Nadine Bachmann, and Shailesh Tripathi . . . . .	988
Applicability and Limitations of Change Management for Circular Economy in Manufacturing Companies Niclas-Alexander Mauss, Dominik Bühner, and Johannes Fottner . . . . .	998
Material properties of AISI H10 (32CrMoV12-28) hot work tool steel processed by Laser Powder Bed Fusion with 200°C substrate preheating temperature Norbert Wilda, Jochen Giedenbacher, and Aziz Huskic . . . . .	1008



A Mixed Reality application to support the design of custom prostheses Michele Gattullo, Antonio Piccininni, Alessandro Evangelista, Pasquale Guglielmi, Antonio Boccaccio, Angela Cusanno, Antonio Emmanuele Uva, and Gianfranco Palumbo. . . . .	1018
Solving large scale industrial production scheduling problems with complex constraints: an overview of the state-of-the-art Manuel Schlenkrich, and Sophie N. Parragh. . . . .	1028
Predictive maintenance on injection molds by generalized fault trees and anomaly detection Pedro Nunes, Eugénio Rocha, José Santos, and Ricardo Antunes. . . . .	1038
Identification of the characteristics of helicoidally filament wound tubes using vision systems Antonios Stamopoulos, Chiominto Luciano, Emanuela Natale, Antoniomaria Di Ilio, and Giulio D'Emilia . . . . .	1048
Training and Tuning of Neuro - Fuzzy Control Laws for the Machining of Prosthetics Mangolika Bhattacharya, Pat O'Neill, Mark Southern, and Martin Hayes . . . . .	1057
Successful digital transformations enabled by technologies or by open mind? Italian case studies Ludovica M. Oliveri, Ferdinando Chiacchio, Diego D'Urso, Alessia Munnia, and Francesco Russo . . . . .	1066
Technological Transformation Model for SMEs Alicia Mon, and Horacio René Del Giorgio . . . . .	1076
Description Model of Smart Connected Devices in Smart Manufacturing Systems Juergen Lenz, Dominik Lucke, and Thorsten Wuest . . . . .	1086
On the development and deployment of an IIoT Infrastructure for the Fish Canning Industry Sérgio Teixeira, Rafael Arrais, Rui Dias, and Germano Veiga . . . . .	1095
Convolutional neural networks for identification of moving combustion chambers entering a brazing process Rui Pereira, Eugénio Rocha, Diogo Pinho, and José P. Santos . . . . .	1106
Simulation-based Optimization of Material Requirements Planning Parameters Bernhard Werth, Johannes Karder, Andreas Beham, and Klaus Altendorfer. . . . .	1117
Variables influence analysis of gas leak testing using belief propagation over factor graphs Joana Martins, Diogo Costa, and Eugénio M. Rocha . . . . .	1127
Industry 5.0: The Arising of a Concept Pedro Coelho, Catarina Bessa, Jorge Landeck, and Cristovão Silva. . . . .	1137
Minimizing occupational risk by automation of the special processes - based on occupational risk assessment Dorota Klimecka-Tatar, Robert Ulewicz, and Manuela Ingaldi . . . . .	1145
Exploring the time-lagged causality of process variables from injection molding machines Shailesh Tripathi, Christian Mittermayr, and Herbert Jodlbauer . . . . .	1153
Linking Thermal Images with 3D Models for FFF Printing Leon Binder, Simon Rackl, Michael Scholz, and Mathias Hartmann. . . . .	1168
Effective reliability verification of a technical subsystem through prior information generated by component tests Nikolaus Haselgruber. . . . .	1178
A Petri Net Architecture for Real-Time Human Activity Recognition in Work Systems Jan-Phillip Herrmann, Alexander Atanasyan, Felix Casser, and Sven Tackenberg. . . . .	1188

Development of an integrated information system for the manufacturing of Titanium hybrid fully-custom prostheses Antonio Piccininni, Pasquale Guglielmi, Luigi Manna, Angela Cusanno, Antonio Palmacci, and Gianfranco Palumbo . . . . .	1200
An automated approach to reuse machining knowledge through 3D – CNN based classification of voxelized geometric features Eram Asghar, Andrea Ratti, and Tullio Tolio . . . . .	1209
A Novel Benchmark Environment for Dynamic Factory Crane Scheduling Johannes Karder, Bernhard Werth, Andreas Beham, Stefan Wagner, and Michael Affenzeller . . . . .	1217
Modeling the Energy Flexible Job Shop with a Disaggregated Load Approach for Changeable Manufacturing Dominik Leherbauer, and Peter Hehenberger . . . . .	1225
Job-scheduling Model For an Autonomous Additive Manufacturing: a Case of 3D Food Printing Mohammed Alghamdy, Faisal M. Almutairi, and Rafq Ahmad . . . . .	1234
Sustainable supplier selection in the oil and gas industry: An integrated multi-criteria decision making approach Joachim Gidiagba, Lagouge Tartibu, and Modestus Okwu . . . . .	1243
Transparency by Design for Blockchain-Based Supply Chains Funlade Sunmola, and Patrick Burgess . . . . .	1256
ANFIS Model for Cost Analysis in a Dual Source Multi-Destination System M.O. Okwu, L.K. Tartibu, E.O. Ojo, S. Adume, J.O. Gidiagba, and J. Fadeyi . . . . .	1266
Sustainability in the agri-food supply chain: a combined digital twin and simulation approach for farmers Sergio Gallego-García, Diego Gallego-García, and Manuel García-García . . . . .	1280
Leader skills interpreted in the lens of education 4.0 Selma Regina M Oliveira, and Marcela Alencar Saraiva . . . . .	1296
Supply chain management in case of producer disruption between external (instable) forces and effective models M. Passarelli, G. Bongiorno, P. Beraldi, R. Musmanno, and L. Filice . . . . .	1305
A new composite indicator for Manufacturing efficiency Gerarda Fattoruso, Salvatore Ammirato, Alberto Michele Felicetti, and Antonio Violi . . . . .	1316
The Truth is Out There: Focusing on Smaller to Guess Bigger in Image Classification Vagan Terziyan, Olena Kaikova, Diana Malyk, and Vladyslav Branytskyi . . . . .	1323
Ergonomics Postural Risk Assessment and Observational Techniques in the 21st Century Temitayo S. Ogedengbe, Oluranti A. Abiola, Omolayo M. Ikumapayi, Sunday A. Afolalu, Adekunle I. Musa, Abiola O. Ajayeoba, and Timothy A. Adeyi . . . . .	1335
Human-Robot Co-working Improvement via Revolutionary Automation and Robotic Technologies – An overview Omolayo M. Ikumapayi, Sunday A. Afolalu, Temitayo S. Ogedengbe, Rasaq A. Kazeem, and Esther T. Akinlabi. . . . .	1345
Artificial Intelligence as a disruption technology to build the Harmonic Health Industry Domenico Marino, Demetrio Naccari Carlizzi, and Valeria Falcomatà . . . . .	1354
Thermal behaviour of resin inserts for micro injection moulding: a FEM analysis B. Stampone, M. Ravelli, L. Giorleo, and G. Trotta . . . . .	1360

Impact analysis of Industry 4.0 in SMEs: Harmonic innovation as a virtuous evolution for the community development.	
Gabriele Zangara, Antonio Cosma, and Luigino Filice . . . . .	1370
Information sharing and multi-tier supply chain management of SMEs in the context of Industry 4.0	
Matthias Winter, Silvia Dopler, Julian M. Müller, and Alexander Zeisler. . . . .	1378
A fast feasibility tool for the assessment of fuel switch in the concept design of merchant ships	
Serena Bertagna, Luca Braidotti, Valentina Bortuzzo, Alberto Marinò, and Vittorio Bucci . . . . .	1386
Digital Transformation, Applications, and Vulnerabilities in Maritime and Shipbuilding Ecosystems	
Rafael Diaz, Katherine Smith, Serena Bertagna, and Vittorio Bucci. . . . .	1396
Integrated Security Information and Event Management (SIEM) with Intrusion Detection System (IDS) for Live Analysis based on Machine Learning	
Adabi Raihan Muhammad, Parman Sukarno, and Aulia Arif Wardana. . . . .	1406
Cases of application of blockchain on the supply chain: a literature review	
Giorgia Casella, Barbara Bigliardi, Serena Filippelli, and Eleonora Bottani . . . . .	1416
Active Transfer Prototypical Network: An Efficient Labeling Algorithm for Time-Series Data	
Yuqicheng Zhu, Mohamed-Ali Tnani, Timo Jahnz, and Klaus Diepold . . . . .	1427
Exploring blockchain-based Traceability for Food Supply Chain Sustainability: Towards a Better Way of Sustainability Communication with Consumers	
Shoufeng Cao, Hope Johnson, and Ayesha Tulloch. . . . .	1437
A transformers-based approach on industrial disaster consequence identification from accident narratives	
Vasileios Linardos, Maria Drakaki, and Panagiotis Tzionas . . . . .	1446
Data-Driven Surface Classification for Differential Drive Autonomous Guided Vehicles	
Sascha Gärtner . . . . .	1452
Modeling and controlling IoT-based devices' behavior with high-level Petri nets	
João Paulo da Silva Fonseca, Alexandre Rodrigues de Sousa, and José Jean-Paul Zanlucchi de Souza Tavares . . . . .	1462
Advanced visualization of ergonomic assessment data through industrial Augmented Reality	
Alessandro Evangelista, Vito Modesto Manghisi, Sara Romano, Vito De Giglio, Lorenzo Cipriani, and Antonio Emmanuele Uva. . . . .	1470
An improved method of job shop scheduling using machine learning and mathematical optimization	
Eiji Morinaga, Xuetian Tang, Koji Iwamura, and Naoki Hirabayashi. . . . .	1479
Integrated production and maintenance planning in hybrid manufacturing-remanufacturing system with outsourcing opportunities	
Mohammed Merghem, Mohammed Haoues, Kinza Nadia Mouss, Mohammed Dahane, and Ahmed Senoussi. . . . .	1487
Systematic mapping study on the security and efficiency of blockchain in industrial context	
Philipp Seiler, Eric Brandt, and Felix Brandt. . . . .	1497
Method of Process Optimization for LMD-Processes using Machine Learning Algorithms	
Holger Gröning, Jan Zenisek, Norbert Wild, Aziz Huskic, and Michael Affenzeller . . . . .	1506
Modelling of Wire Arc Additive Manufactured Product Cost	
Samruddha Kokare, João P. Oliveira, and Radu Godina . . . . .	1513
Advancing maintenance strategies through digitalization: A case study	
Oliver Fuglsang Grooss . . . . .	1522

EOI or EOQ? A simulation study for the inventory management of a company operating in the railway sector	
Letizia Tebaldi, Barbara Bigliardi, Serena Filippelli, and Eleonora Bottani . . . . .	1532
Digital model reconstruction through 3D Stereo Depth camera: a faster method exploiting robot poses	
Ahmed Magdy Ahmed Zaki, Marco Carnevale, Hermes Giberti, and Christian Schlette . . . . .	1542
Additive Manufacturing Service Provider Selection Using a Neutrosophic Best Worst Method	
Sagar Ghuge, and Shreyanshu Parhi . . . . .	1550
Effects of milling parameters on roughness and burr formation in 3D- printed PLA components	
Mohamad El Mehtedi, Pasquale Buonadonna, Mauro Carta, Rayane El Mohtadi, Gianluca Marongiu, Gabriela Loi, and Francesco Aymerich . . . . .	1560
A DT-CWT and Data mining based approach for High Impedance Fault Diagnosis in Micro-grid System	
Tapaswini Biswal, S.K. Parida, and Sanhita Mishra . . . . .	1570
Deep learning-based robotic sorter for flexible production	
Alberto Da Rold, Marco Furiato, Ahmed Magdy Ahmed Zaki, Marco Carnevale, and Hermes Giberti . . . . .	1579
Prioritising Visibility Influencing Factors in Supply Chains for Resilience	
Funlade Sunmola, Patrick Burgess, Albert Tan, Janya Chanchaichujit, Sreejith Balasubramania, and Mustafa Mahmud . . . . .	1589
A method to estimate the remaining useful lifetime of a two-jaw parallel gripper based on experimental failure threshold data	
Serkan Mert, Günter Bitsch, and Johannes L. Jooste . . . . .	1599
Perspectives on Effectiveness of Food Safety Management Systems During Pandemic	
Thomas Maiberger, and Funlade Sunmola . . . . .	1609
Lean and Green: The Green Foundry Simulation Model	
Stefano Saetta, and Valentina Caldarelli . . . . .	1622
Actionable insights for horticulture supply chains through advanced IoT analytics	
Owen Keates . . . . .	1631
Influence of the target data in the accurate prediction of the maintenance operation for a HPDC press machine	
Sebastiano Fanelli, Antonio Piccininni, Pasquale Guglielmi, and Stefano Cafagna . . . . .	1641
Towards a B2B integration framework for smart services in Industry 4.0	
Viktor Schubert, Steffen Kuehner, Tobias Krauss, Martin Trat, and Janek Bender . . . . .	1649
Lessons learnt in industrial data platform integration	
Sylvain Lacroix, Emeric Ostermeyer, Julien Le Duigou, Florent Bornard, Sylvain Rival, Marie-France Mary, and Benoit Eynard . . . . .	1660
Ultra Wide Band communication for condition-based monitoring, a bridge between edge and cloud computing	
Andrea Bonci, Eduard Caizer, M. Cristina Giannini, Federico Giuggioloni, and Mariorosario Prist . . . . .	1670
How Important are Digital Technologies for Urban Food Security? A Framework for Supply Chain Integration using IoT	
Soujanya Mantravadi, and Jagjit Singh Srani . . . . .	1678
Effective Training of Seafarers on Energy Efficient Operations of Ships in the Maritime Industry	
Mohammud Hanif Dewan, and Radu Godina . . . . .	1688
Seafarers Involvement in Implementing Energy Efficiency Operational Measures in Maritime Industry	
Mohammud Hanif Dewan, and Radu Godina . . . . .	1699

Agility as a force to emerge from the darkness to better days Brenda Souza Rosa Silva, and Selma Regina Martins Oliveira . . . . .	1710
Development of a novel integrated hopper briquette machine for sustainable production of pellet fuels M.O. Okwu, O.D. Samuel, O.B. Otanocha, E. Akporhonor, and L.K. Tartibu . . . . .	1719
The Paradox of Kazakhstan: Linear vs Harmonic Innovation Mariza Tsakalerou, and Almat Abilez . . . . .	1734
Physical and digital worlds: implications and opportunities of the metaverse Fabio De Felice, Cristina De Luca, Simona Di Chiara, and Antonella Petrillo . . . . .	1744
Industry 4.0 in the agrifood supply chain: a review Barbara Bigliardi, Eleonora Bottani, Giorgia Casella, Serena Filippelli, Alberto Petroni, Benedetta Pini, and Emilio Gianatti . . . . .	1755
The adoption of Open Innovation in Manufacturing: a review Barbara Bigliardi, Virginia Dolci, Serena Filippelli, Alberto Petroni, Benedetta Pini, and Leonardo Tagliente . . . . .	1765
A model to evaluate the Human Error Probability in inspection tasks of a production system Salvatore Digiesi, Francesco Facchini, Giorgio Mossa, and Micaela Vitti . . . . .	1775
A Safety 4.0 Approach for Collaborative Robotics in the Factories of the Future Luca Caruana, and Emmanuel Francalanza . . . . .	1784
Asset Administration Shell as an interoperable enabler of Industry 4.0 software architectures: a case study Walter Quadrini, Chiara Cimino, Tasnim A. Abdel-Aty, Luca Fumagalli, and Diego Rovere . . . . .	1794
Industry 4.0 and Covid-19: evidence from a case study Barbara Bigliardi, Eleonora Bottani, Giorgia Casella, Serena Filippelli, Alberto Petroni, Benedetta Pini, and Emilio Gianatti . . . . .	1803
Work break scheduling using wrist wearable devices: a conceptual and practical model Valentina Di Pasquale, Valentina De Simone, Martina Radano, and Salvatore Miranda . . . . .	1810
An overview on the use of AI/ML in Manufacturing MSMEs: solved issues, limits, and challenges Valentina De Simone, Valentina Di Pasquale, and Salvatore Miranda . . . . .	1820
A Remaining Useful Life Prediction Method for Lithium-ion Battery Based on Temporal Transformer Network Wenbin Song, Di Wu, Weiming Shen, and Benoit Boulet . . . . .	1830
On the Harmonic Innovation Hub: how the transition should be accompanied toward a new paradigm Luigino Filice, Francesco Cicione, and Luca Meldolesi . . . . .	1839
A predictive approach for enhancing outcomes performance in SAW process Conte Romina, Zangara Gabriele, Rodríguez Izquierdo David, Caruso Serafino, and Ambrogio Giuseppina . . . . .	1849
On the Integration of Google Cloud and SAP HANA for Adaptive Supply Chain in Retailing Abdulrahman Nahhas, Christian Haertel, Christian Daase, Matthias Volk, Achim Ramesohl, Heiko Steigerwald, Alexander Zeier, and Klaus Turowski . . . . .	1857
Following the Digital Thread – A Cloud-Based Observation Christian Daase, Christian Haertel, Abdulrahman Nahhas, Matthias Volk, Heiko Steigerwald, Achim Ramesohl, Bernd Schneider, Alexander Zeier, and Klaus Turowski . . . . .	1867

Modeling & Simulation as Industry 4.0 enabling technology to support manufacturing process design: a real industrial application Antonio Cimino, Maria Grazia Gnoni, Francesco Longo, Gabriele Barone, Maddalena Fedele, and Domenico Le Piane . . . . .	1877
Human Robot Collaboration in Industry 4.0: a literature review Alessio Baratta, Antonio Cimino, Maria Grazia Gnoni, and Francesco Longo. . . . .	1887
Digital Twin (DT) based methodology to support effective design of industrial production lines Antonio Cimino, Maria Grazia Gnoni, Francesco Longo, and Angelica La Rosa. . . . .	1896
Data Modeling and ML Practice for Enabling Intelligent Digital Twins in Adaptive Production Planning and Control Alessandro Chiurcoa, Mohaiad Elbasheera, Francesco Longoa, Letizia Nicolettib, and Vittorio Solinaa . . . . .	1908
Exploring the Role of Industry 4.0 and Simulation as a Solution to the COVID-19 Outbreak: a Literature Review Giovanni Mirabelli, Letizia Nicoletti, Antonio Padovano, Vittorio Solina, Karen Althea Manfredi, and Antonio Nervoso . . . . .	1918
An overview of approaches and methodologies for supporting smallholders: ICT tools, blockchain, business models, sustainability indicators, simulation models Francesco Longo, Giovanni Mirabelli, Vittorio Solina, Laura Belli, Chaima Ben Abdallah, Oussama Ben-Ammar, Eleonora Bottani, José Manuel García-Gallego, Manuella Germanos, Francisco Javier Miranda González, Sergio Rubio Lacoba, Lilia Sidhom, Giuseppe Vignali, and Gregory Zacharewicz. . . . .	1930
The Digital Supply Chain Twin paradigm for enhancing resilience and sustainability against COVID-like crises Francesco Longo, Giovanni Mirabelli, Antonio Padovano, and Vittorio Solina . . . . .	1940
Empowering Field Operators in Manufacturing: a Prospective Towards Industry 5.0 Antonio Cimino, Mohaiad Elbasheer, Francesco Longo, Letizia Nicoletti, and Antonio Padovano. . . . .	1948