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ISIEA 2023

2nd International Symposium on Industrial Engineering and Automation ISIEA 2023

Towards a Smart, Resilient and Sustainable Industry

22nd – 23rd June 2023,
Bozen-Bolzano, Italy

BOOK OF ABSTRACTS

ISIEA 2023

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Towards a Smart, Resilient and Sustainable Industry

22nd – 23rd June 2023,
Bozen-Bolzano, Italy

Organized by

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PROGRAMME

DAY 1 - Thursday 22.06.2023

Main unibz Campus – Piazza Università 1

08.30 | 09.00	**Registration** *Foyer (in front of D1.02, D1.03)*
09.00 | 09.30	**Welcome session** *Room D1.02 – Aula Prof. Giustino Tonon*
09.30 | 10.15	**Keynote speech** **"Sustainable production with focus on E-Mobility"** Franz Haas *Room D1.02 – Aula Prof. Giustino Tonon – Chair: Dominik Matt*

Parallel sessions

	Room D0.02	*Room D1.02*	*Room D1.03*
	Numerical Approaches and Digitalization in Mechanical Engineering	***Smart sustainable manufacturing – part A***	***Sustainable Operations and Supply Chains – Part A***
	Chair: Lorenzo Maccioni	*Chair: Concetta Semeraro*	*Chair: Markku Kuula*
10.45 | 12.15	**120 – Digitisation for sustainable water supply systems: the case of optimal pressure management** Kostner, Michael K.; Zanfei, Ariele; Menapace, Andrea; Alberizzi, Jacopo C.; Renzi, Massimiliano; Larcher, Michele; Righetti, Maurizio	**111 – Arduino-based Machine Learning Approach for CNC Machine Predictive Maintenance** Biyrouti, Sama; Alzeir, Ayah; Jammal, Hanan; Omar, Omar Hassan; Semeraro, Concetta	**125 – Modularity effect on the manufacturing lead time of assembly processes** Modrak, Vladimir; Soltysova, Zuzana; Pitel, Jan
	154 – A combined analytical-numerical approach to evaluate the efficiency of cycloidal speed reducers Fraccaroli, Lorenzo; Pagliari, Lorenzo; Concli, Franco	**113 – Grey Relational Analysis vs. Response Surface Methodology for the prediction of the best joint strength in hybrid welding of TWIP/DP steels** Contuzzi, Nicola; Casalino, Giuseppe; Russo Spena, Pasquale	**147 – Decertification: evidence from Italian SMEs** Marcuzzi, Irene; Podrecca, Matteo; Orzes, Guido; Sartor, Marco
	161 – Numerical investigation of the mechanical performance of multilayer composite laminates under low velocity impact loading condition Taghizadeh, Seyedahmad; Concli, Franco	**124 – Demonstrating the potentials of Digital Twin in Manufacturing: an Axiomatic Design-based application for Engineering Education** Nezzi, Chiara; De Marchi, Matteo; Aruväli, Tanel; Cochran, David S.; Rauch, Erwin	**166 – Effectiveness of firm-level sustainability policies: a systematic literature review** Zecchillo, Nunzia; Molinaro, Margherita; Orzes, Guido

	162 – A finite element level-set approach for optimizing the topology of complete disc replacement in the lumbar spine Gandhi Ragul; Concli Franco; Maccioni Lorenzo	**126 – Industry 4.0 technologies and sustainable development goals (SDGs): covered publications and ranking** Alhammadi, Abrar; Semeraro, Concetta; Obaideen, Khaled; Alsyouf, Imad	**168 – Global Reporting Initiative: systematic literature review and research directions** Bais, Beatrice; Orzes, Guido; Nassimbeni, Guido
13.15 | 14.00	**Keynote speech** **"Loacker's choices between technology and sustainability"** Andreas Loacker *Room D1.02 – Aula Prof. Giustino Tonon – Chair: Dominik Matt*		
	Parallel sessions		
	Room D0.02 ***Virtual and Augmented Reality*** *Chair: Federico Morosi*	*Room D1.02* ***Smart Sustainable Manufacturing – part B*** *Chair: Michele Dassisti*	*Room D1.03* ***Beyond Industry 4.0*** *Chair: Marco Sartor*
	115 – A Framework for Digital Factory Planning and validation with Virtual and Augmented Reality: An automotive case study Angeli, Nicolò; Revolti, Andrea; Petitti, Italo; Fraccaroli, Daniel; Dallasega, Patrick	**140 – Assessing the implementation of a smart cart in a supermarket using a simulation model** Aydin, Ridvan; Jaweesh, Mohammad Braa; AlHunaiyyan, Abdulaziz; Mansour, Myriam	**132 – Toward homecare logistics 5.0: a systematic literature review** Piffari, Claudia; Lagorio, Alexandra; Pinto, Roberto
14.00 | 15.30	**118 – Projected augmented reality for industrial design: challenges and opportunities** Morosi, Federico; Caruso, Giandomenico; Becattini, Niccolò; Cascini, Gaetano	**142 – The human factor and the resilience of manufacturing processes: A case study of pharmaceutical process toward Industry 5.0** Rubini, Ramona; Cassandro, Rocco; Caggiano, Mariateresa; Semeraro, Concetta; Li, Zhaojun Steven; Dassisti, Michele	**139 – Industry 5.0. The road to sustainability** Ruiz de la Torre Acha, Aitor; Guevara Ramirez, Wilmer; Río Belver, Rosa María; Borregan Alvarado, Jon
	123 – Training support with Augmented Reality for Machine Setup: A Case Study in the Process Industry Revolti, Andrea; Gualtieri, Luca; Odorizzi, Renzo; Tosi, Paolo; Dallasega, Patrick	**143 – Implementation of Model-Based Definition-Case of Manufacturing Industry in Finland** Uski, Pekka; Ellman, Asko	**148 – Collective System Design and Industry 5.0: building community, resilience, and sustainability at Purdue University Fort Wayne** Cochran, David S.; Borbieva, Noor O.
	163 – Development of an AR-based Application for Training of Warehouse Operators Grandi, Fabio; Prati, Elisa; Mangia, Giancarlo; Peruzzini, Margherita	**164 – Assessing the effect of infill strategies on hardness properties of cuboidal parts printed with wire and arc additive manufacturing** Kuosmanen, Jari; Azadikhah, Aaron; Panicker, Suraj; Mokhtarian, Hossein; Wu, Di; Dhalpe, Akshay; Queguineur, Antoine; Coatanea, Eric	**169 – Interdisciplinary research projects: Six lessons from a family business-Industry 4.0 project** Mismetti, Marco; Appleton, Samuel; Rondi, Emanuela; Orzes, Guido; De Massis, Alfredo; Matt, Dominik
16.00 |	**Parallel sessions**		

17.45

Room D0.02	*Room D1.02*	*Room D1.03*
Sustainable and User-centric Design	***Digital Twins and AI applications***	***Healthcare 5.0***
Chair: Laura Ruiz-Pastor	*Chair: Giulia Bruno*	*Chair: Elena Pessot*
131 – A systematic review of factors considered in sustainable product design Mengistu, Azemeraw Tadesse; Panizzolo, Roberto; Biazzo, Stefano	**114 – Digital twin application for dynamic task allocation** Bruno, Giulia; Aliev, Khurshid	**102 – Role of standards and conformity in the Indian healthcare sector** Nand, Alka; Goyal, Preeti; Bhattacharya, Ananya; Sohal, Amrik
133 – Design of smart home product service systems (SH-PSS) Ganvir, Leeladhar; Kalita, Pratul	**117 – A genetic algorithm approach for medical resident scheduling in Austria** Dummer, Wolfgang; Gaal, Alexander; Sobottka, Thomas; Ansari, Fazel	**103 – The efficiency of Italian hospitals using Data Envelopment Analysis (DEA) and Classification Tree** Amlashi, Shahram Taherzadeh; Gitto, Simone
137 – Fluency of stimuli comparing two different representation forms: Image and Real product Berni, Aurora; Borgianni, Yuri; Carbon, Claus Christian	**136 – A Digital Twin-based approach for Emotion Recognition in Human-Robot Collaboration** Baratta, Alessio; Longo, Francesco; Mirabelli, Giovanni; Padovano, Antonio; Solina, Vittorio	**107 – A process-based taxonomy of medical devices for clinical pathways design and innovation** Vannelli, Sara; Visintin, Filippo
138 – Analyzing characteristics of smart home product service system through Kano Model Approach Ganvir, Leeladhar; Kalita, Pratul; Jansari, Sachin	**144 – Real-time color detection for automated production lines using CNN-based machine learning** Shaloo, Masoud; Princz, Gábor; Erol, Selim	**108 – Towards a knowledge-based Decision Support System for the management of Type 2 diabetic patients** Spoladore, Daniele; Stella, Francesco; Tosi, Martina; Lorenzini, Erna Cecilia
153 – User experience-based perception of the advantages of an adaptable product through a promotional video visualization Royo, Marta; Chulvi, Vicente; Mulet, Elena; Ruiz-Pastor, Laura; Bort-Martínez, Marina		**145 – Covid-19 pandemic impacts and long-term supply strategies of pharmaceutical manufacturers** Pessot, Elena; Albini, Teresa

19.30

Gala Dinner at Mareccio Castle

Mareccio Castle

Claudia-de'-Medici-Straße 12, Bozen
Via Claudia de Medici, 12, Bolzano

DAY 2 – Friday 23.06.2023

Main unibz Campus – Piazza Università 1

Parallel sessions

	Room D0.02	*Room D1.02*	*Room D1.03*
	Progresses in Mechanical Engineering	***Circular Economy across Industries***	***Industry 4.0: strategy and organization***
	Chair: Antonio Piccininni	*Chair: Rainer Pamminger*	*Chair: Albachiara Boffelli*
09.00 | 10.45	**104 – A FEM-based Study on the Impact of the Shot Peening Process on the Fatigue Performances of Mechanical Components** Concli, Franco	**110 – From waste to resource: a patent classification analysis for end of life mosquito nets alternative uses identification** Melani, Marco; Furferi, Rocco; Rotini, Federico; Barbieri, Luca	**105 – Exploring the Link between Strategy and Smart Manufacturing Adoption: A Study in the Automotive Industry** Arcidiacono, Francesco; Ancarani, Alessandro; Di Mauro, Carmela; Schupp, Florian
	135 – Graded lattice structures for biodegradable temporary implants: computational evaluation with two unit cell types Nogueira, Pedro; G. Magrinho, João P.; Silva, M.Beatriz; Moita de Deus, Augusto; Vaz, M. Fátima	**116 – Is digitalization making agroindustry more circular? A SWOT-AHP analysis** Agnusdei, Leonardo; Krstic, Mladen; Miglietta, Pier Paolo	**106 – The role of the human resources in the digitalization of the automotive industry: a case study-based investigation** Csiki, Ottó; Szász, Levente; Rácz, Béla-Gergely; Demeter, Krisztina; Losonci, Dávid
	152 – Estimation of hydraulic power losses in a double-row tapered roller bearing via computational fluid dynamics Maccioni, Lorenzo; Concli, Franco	**129 – A bibliometric analysis of the impact of Industry 4.0 technologies on the Circular Economy** Das, Suman Kumar; Bressanelli, Gianmarco; Saccani, Nicola	**146 – Knowledge-based maintenance management system of compressed air system** Isik, Birkan
	157 – Numerical Analysis of the Impact of Shot Peening on the Tooth Root Strength of AlSi10Mg Gears using Critical Plane Multiaxial Fatigue Criteria Pagliari, Lorenzo; Fraccaroli, Lorenzo; Concli, Franco	**141 – Pilot scale tannin extraction from chestnut wood waste using hydrodynamic cavitation** Meneguzzo, Francesco; Albanese, Lorenzo; Faraloni, Cecilia; Meneguzzo, Cosimo; Tagliavento, Luca; Zabini, Federica	**155 – Industry 4.0 and Policies: A classification** Culot, Giovanna; Podrecca, Matteo; Marcuzzi, Irene; Nassimbeni, Guido
	165 – Additive manufacturing for soft electromagnetic robots: experimental study to reduce vibration Pavone, Antonio; Stano, Gianni; Percoco, Gianluca	**156 – Environmental assessment of the introduction of digital technologies in the building industry: a literature study** Öztürk, Ece; Borgianni, Yuri; Ince, Ceren	**159 – Manufacturing Execution System in Industry 4.0 era: from implementation to impacts on job design** Colombo, Jacopo; Boffelli, Albachiara; Kalchschmidt, Matteo

Keynote speech

11.15 \| 12:00

“The Circular Economy MAY help build resilience and sustainability. But it won’t be easy”

Joseph Sarkis

Room D1.02 – Aula Prof. Giustino Tonon – Chair: Guido Orzes

12:00 | 12.45

Keynote speech

"Xtreme purchasing – the future?"

Florian Schupp

Room D1.02 – Aula Prof. Giustino Tonon – Chair: Margherita Molinaro

Parallel sessions

13.45 | 15.15

Room D0.02	*Room D1.02*	*Room D1.03*
Biomanufacturing 4.0	***Artificial Intelligence in Mechanical Engineering***	***Sustainable Operations and Supply Chains - Part B***
Chair: Paola Ginestra	*Chair: Eric Coatanea*	*Chair: Matteo Podrecca*
127 – Assessing the viscosity of alginate – cellulose-based hydrogels: a comparison among different type of solutes, mediums culture, and gelatin influence Sughi, Sabrina; Seiti, Miriam; Ginestra, Paola Serena; Gaudenzi, Giulia	**119 – An expert system for automated quality control: a case study in a mechatronic manufacturing company** Scarton, Giorgio; Trono, Francesco; Trevisan, Caterina; Formentini, Marco	**112 – Decarbonizing Industrial Logistics through a GIS-based Approach for identifying Pareto-optimal combined Road-Rail Transport Routes** Miklautsch, Philipp; Woschank, Manuel
128 – Evaluation of Bioprinting Process by RSM Training Gaudenzi, Giulia; Mazzoldi, Elena; Ginestra, Paola; Piccininni, Antonio	**121 – Data-Driven Support Vector Machine to Predict Thin-Walled Tube Energy Absorbers Behavior** Ghasemi, Mostafa; Silani Mohammad; Yaghoubi, Vahid; Concli, Franco	**134 – Servitization opportunities for improving sustainability in the steel industry** Galimberti, Mattia; Cimini, Chiara; Cavalieri, Sergio
122 – Optimization of the FRESH 3D printing method applied to alginate – cellulose-based hydrogels Seiti, Miriam; Rovetta, Rosaria; Ferraro, Rosalba Monica; Ferraris, Eleonora; Ceretti, Elisabetta	**151 – Differentiating additive and traditional manufacturing processes through unsupervised learning and image processing** Ördek, Baris; Borgianni, Yuri	**167 – The ABC of ecological sustainability in C-parts management. A maturity model for the evaluation of sustainability in C-parts management** Burkart, Christian; Kampel, Iliana; Brunner, Uwe; Dirnberger, Johannes
160 – Mechanical behavior of novel bio composite sandwich structures under quasi-static compressive loading condition Taghizadeh, Seyedahmad; Niknejad, Abbas; Concli, Franco	**158 – Advances in machine learning techniques used in fatigue life prediction of welded structures.** Gbagba, Sadiq; Concli, Franco	———

15.15 | 15.45

Closing session and awards

Room D1.02 – Aula Prof. Giustino Tonon

KEYNOTES

Sustainable production with focus on E-Mobility

Franz Haas

Digital transformation and sustainable management of all production factors are the key challenges for the design of production plants. A serious change is currently taking place in mobility. The number of electric vehicles is increasing rapidly and with it the need for new productions of battery cells, battery systems, fuel cells, hydrogen tanks and e-axles. Product development must take into account the regulatory framework of the circular economy, where highly automated lines not only handle the assembly but also the disassembly of the components at the end of their lifetime. The keynote not only shows the current state of the art for the fabrication of the e-mobility core components, but also takes a look into the near and long-term future. The projects of the Institute of Production Engineering for battery production and battery recycling as well as the Smart Factory of Graz University of Technology will be presented as examples of which production planning and automation methods must be used for the successful handling of the future challenges.

Loacker's choices between technology and sustainability

Andreas Loacker

Digital transformation and sustainable management of all production factors are the key challenges for the design of production plants. A serious change is currently taking place in mobility. The number of electric vehicles is increasing rapidly and with it the need for new productions of battery cells, battery systems, fuel cells, hydrogen tanks and e-axles. Product development must take into account the regulatory framework of the circular economy, where highly automated lines not only handle the assembly but also the disassembly of the components at the end of their lifetime. The keynote not only shows the current state of the art for the fabrication of the e-mobility core components, but also takes a look into the near and long-term future. The projects of the Institute of Production Engineering for battery production and battery recycling as well as the Smart Factory of Graz University of Technology will be presented as examples of which production planning and automation methods must be used for the successful handling of the future challenges.

The Circular Economy MAY help build resilience and sustainability. But it won't be easy

Joseph Sarkis

Joseph Sarkis is a Management professor within the Business School at Worcester Polytechnic Institute (WPI). He earned his Ph.D. from the University of Buffalo. His scholarly interests include Environmental Sustainability, Technology, Operations and Supply Chain Management. Dr. Sarkis has authored over 500 publications appearing in a wide variety of outlets. Editorial positions include many leading journals in Operations, Transportation, Supply Chain, and Sustainability Management. Prof. Sarkis has been recognized as a *Highly Cited Researcher* for each year from 2015-2022 by Web-of-Science. He is also an international program coordinator for the Greening of Industry Network along with the Springer-Nature Greening of Industry Networks book series co-editor. He is co-chair of the Future Earth Circular Economy Working Group. Joe has been recognized as one of the most influential global scholars in general business and management—as well as the fields of supply chain management, corporate sustainability, operations research, and sustainable supply chains.

Xtreme purchasing – the future?

Florian Schupp

Purchasing is confronted with new challenges such as digitalization, risk management and sustainability. But is this all? Do we really think purchasing in a consequent way? Do we really drive purchasing to a new opportunity-oriented level of perfection and effectiveness? My speech will take these points up and will show thought provocative items that conference participants could use for advancing the field. One big part is to learn from nature and there how nature is performing the purchasing task. Another element will be consequent efficiency gain by eliminating waste as waste is the basis for destruction. Decision making based on gamification considering parametric auctioning in the context of sustainable sourcing. Supply chain sourcing while redesigning supply chains as such and introducing the concept of 'Production to go' are more items to be discovered. Finally, I will show the opportunities that result out of consequent digitalization in purchasing by transporting the purchasing task into individual metaverses. All of this is forming the new research stream that I call 'Xtreme Purchasing'. The future.

ABSTRACTS

The abstracts are ordered according to the ID number of their submission. The track of the corresponding conference session is indicated for each paper.

102

Digitalizing Indian Healthcare: The Key Role of EMR Adoption and Diffusion

Nand, Alka* (1); Goyal, Preeti (2); Bhattacharya, Ananya (1); Sohal, Amrik (1)
1: Monash University, Australia 2: Great Lakes Institute of Management, India
*alka.nand@monash.edu

Keywords: standards, conformity assessment, health sector, developing countries, electronic medical records

Standards and conformity assessment have assisted firms in service and manufacturing sectors to not just reduce transaction costs, and overcome information asymmetry but have also had a positive impact on improving the quality of products and services and enhancing international trade. Whilst the importance of standards and conformity assessment has been continuously stressed in academic papers, more recently, the COVID-19 crisis has reinvigorated the need to align standards and conformity assessment with rapidly increasing digitalization of industry and society. This paper aims to explore the degree of standardisation and conformity required for the Indian health services sector. Specifically, the paper examines how electronic medical records (EMRs) are being managed in a country where the provision of health services can be inconsistent across the different states and territories, with different priorities and decision-making processes in place. Through a series of interviews held with key stakeholders, we develop an understanding about standardisation and conformity relating to EMR implementation. Our findings explain the extent to which standardisations are necessary for hospitals to achieve national objectives; and explicate how standardisation facilitates EMRs usage during a pandemic in meeting demand for hospital services. Based on our research, we offer recommendations for enhancing standardisation and conformity.

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The Efficiency of Italian Hospitals using Data Envelopment Analysis (DEA) and Classification Tree

Amlashi, Shahram Taherzadeh; Gitto, Simone*
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Keywords: Data Envelopment Analysis (DEA), Classification Trees, Hospitals Efficiency, Health Policy, Healthcare

Comparing the efficiency of hospitals encourages transparency, and better policymaking and helps to raise the standard of healthcare provided. In our study, we measure the efficiency of Italian hospitals using the data envelop analysis (DEA) method and the classification and regression tree (CART) to discover the most critical parameters affecting efficiency. Hospitals with more disciplines are more efficient than those with fewer, and large hospitals are typically more efficient. Furthermore, we examine the efficiency of different Italian provinces. We concluded that most Italian provinces have comparable efficiency scores, so the Italian healthcare system is more balanced at the upper level.

104

A FEM-based Study on the Impact of the Shot Peening Process on the Fatigue Performances of Mechanical Components

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Keywords: FEM, shot peening, simulation

Fatigue is a well know phenomenon where components made of metals fail even for level of stresses significantly below the yielding. The maximum level of stress that a material can withstand depends on the number of cycles the component is subjected. It exist a threshold, called fatigue limit, that, if not overtaken, ensures the infinite life. For this reason, most of the mechanical components are designed to operate at a level of stress below this limit. In some cases, mainly due to lightweight constrains, this is not possible. However, specific treatments allow to induce a compressive state of stress in the proximity the surfaces. These compression stresses will promote a decrease of the tensile stress peaks, especially for pure bending or notched traction. The most adopted treatment that can be used independently from the alloy, is the shot peening. It foresee to shot small media against the component inducing local plastic deformations and compressive states of stress. Unfortunately, beside a high compressive stress near the surface, few microns below the boundary, small local positive stresses arise. In particular loading conditions, while the shot peening ensures a decrease of the stress magnitudes near the surface, the presence of these tensile stresses below the surface could lead to a condition that is even more dangerous with respect to the one exhibited by a not-peened component subjected to the same loading condition. The goal of this paper is to understand, for different loading conditions, when the shot peening could lead to benefits in terms of fatigue. To do this, Finite Element simulations were performed exploiting the open-source software Code-Aster.

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Exploring the Link between Strategy and Smart Manufacturing Adoption: A Study in the Automotive Industry

Arcidiacono, Francesco (1,2)*; Ancarani, Alessandro (1); Di Mauro, Carmela (1,3); Schupp, Florian (2,4)
1: University of Catania, Italy; 2: Schaeffler Automotive Bühl, Germany; 3: Corvinus Institute for Advanced Studies, Hungary; 4: Constructor University, Germany
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Keywords: Smart Manufacturing, Competitive Priorities, Survey

Although firms' strategic positioning is recognized to be one key factor influencing technology adoption, there is limited understanding of the impact that competitive priorities have on firms' adoption of Smart Manufacturing (SM) technologies. To fill this gap, this study builds on survey data from 288 firms operating as automotive suppliers to investigate how competitive emphasis relates to firms' stage of SM adoption. Results show that progression is SM is associated with a growing strategic emphasis on simultaneously competing in terms of cost, quality and delivery. Findings also point that flexibility priority is a less stringent driver of SM adoption and progression among auto-motive suppliers. This study enriches SM literature that investigates antecedents of SM adoption. Findings offer valuable indications to manufacturing executives called to solve the fragmented adoption of SM in their upstream supply chain, by throwing light on strategies of firms that engage in SM.

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The Role of the Human Resources in the Digitalization of the Automotive Industry: A Case study-based Investigation

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Keywords: Digital Manufacturing Technologies, Industry 4.0, Human Resources.

The ongoing digital transformation (identified commonly as Industry 4.0) of the manufacturing industry is not just a purely technological process: it has widespread interactions with several organizational aspects of the adopting firm, including its human resource base. Therefore, the purpose of this research is to extend previous research by investigating the role of human resources related to digital manufacturing technology adoption projects during different adoption stages and in relation with different organizational levels. Given the scarcity of results in the literature, this research adopts an exploratory, multiple case study approach. Data collection is carried out through semi-structured interviews with managers, complemented with site visits. Altogether, 5 manufacturing plants are investigated in two different countries. The results provide a more fine-grained perspective on the interrelationship between human resources and digital technologies. These technologies affect

different the identified three main human resource categories (managers, development experts and shopfloor employees), and the effect differs in the three key implementation phases (before, during and after implementation) too. From a practical perspective, we aim to provide a tool for managers responsible for digitalization to identify most important activities, skills, and competencies along the implementation journey to arrive at a successful technology adoption.

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A Process-based Taxonomy of Medical Devices for Clinical Pathways Design and Innovation

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Keywords: Taxonomy, process innovation, Parkinson's disease

The constant development of medical devices makes taxonomies - i.e., tools for grouping objects into domains based on common characteristics - very useful. Device producers typically use taxonomies to identify competing and/or complementary solutions and develop their value proposition. Several taxonomies have been proposed over the years to classify medical devices. However, these taxonomies either focus on strictly technological aspects or loosely describe the context where devices can be applied (target population, setting, etc.) and the benefits devices might bring in terms of clinical outcomes (more accurate diagnosis, treatments, etc.). These taxonomies do not allow understanding - with an adequate level of detail - how the diagnosis and treatment processes might change as a result of the adoption of a given device and the benefits stakeholders might derive. This paper fills this gap by proposing a novel taxonomy that takes a process perspective. Such a taxonomy can help device developers understand how their technology can impact care processes. Moreover, it can help healthcare managers select the technology that best fits their needs and effectively improve current care processes. The practical use of the taxonomy is illustrated through an application case concerning devices for the treatment of Parkinson's disease.

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Towards a knowledge-based Decision Support System for the Management of Type 2 Diabetic Patients

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Keywords: Ontology-based decision support system, type 2 diabetes mellitus, nutritional recommendation, diabetic patient management, healthcare 5.0

The rise of Healthcare 5.0 paradigm calls for personalization of care and management of patients' conditions. Though promising, data-driven techniques may raise some concerns as they are perceived as scarcely transparent and reliable by clinical personnel. With the emergence of Explainable Artificial Intelligence (AI), these limitations could significantly be overcome. In this regard, the exploitation of domain knowledge (properly formalized) can support explainable AI and foster the delivery of Decision Support Systems (DSS) for tailored treatment of many diseases. This work aims to present a knowledge-based DSS for managing patients with Type 2-Diabetes Mellitus (T2D), a non communicable disease that can take advantage of tailored medical nutrition therapies, taking into account patient's specific health condition and comorbidities. The DSS leverages ontological representation of domain knowledge to automatically classify the patients' phenotype and identify the potential comorbidities, then, it exploits a set of rules to provide tailored nutrition recommendations that can be adopted by general practice doctors and family clinicians to provide tailored dietary plans. In this way, the proposed DSS can support physicians and dieticians (who may lack specialized training in T2D management) in the management of diabetic patients through personalized medical nutrition therapies.

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From Waste to Resource: A Patent Classification Analysis for end of life Mosquito Nets Alternative Uses Identification

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Keywords: Circular Economy, Patent analysis, Patent classification, Idea generation, Mosquito nets.

The effects of current worldwide problems like climate change and environmental pollution must be taken into account while designing or redesigning goods or services. During this process, it is necessary to apply current techniques like the 3Rs

recovery method and the circular economy concept to reduce waste and improve recycling, regeneration, and reusability. In this context, the article discusses a research carried out for a manufacturing company to address the potential for reusing end-of-life mosquito nets, which are hard to recycle, in order to lessen their environmental impact and open up new commercial options. To attain this, the best strategy for identifying new product applications has been chosen after being analyzed alongside other options found in the literature. The approach starts with identifying the functionalities of the product, from which the Cooperative Patent Classifications (CPCs) of the resulting patents are then retrieved and used as outward stimuli during the design process. The outcomes, in terms of generated ideas, are then reported in the conclusions, indicating the true efficacy of adopted strategy.

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Arduino-based Machine Learning Approach for CNC Machine Predictive Maintenance

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Keywords: Predictive Manufacturing, Machine Learning, CNC Machine, Arduino, Digital Twin, Industry 4.0.

Predictive maintenance is the most developed type of maintenance currently existing. This paper focuses on creating a predictive maintenance system using a hybrid approach that utilizes a model-based approach and a data-driven approach, which combines their strengths and replaces the limitations of each approach if used independently. The hybrid approach is tested on a real case study that presents a servomotor shutdown in a CNC multi-die punching machine, which results in massive downtime, mainly when the shutdown occurs at unpredictable instances. The hybrid technique will prompt maintenance task completion by predicting the CNC servomotor shutdown.

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Decarbonizing Industrial Logistics through a GIS-based Approach for Identifying Pareto-optimal Combined Road-Rail Transport Routes

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Keywords: combined transport, industrial logistics, geographic information system, rail

The urge to reduce greenhouse gas emissions is omnipresent in all sectors. Freight transport is responsible for approximately 14% of European emissions, of which 70% stem from road traffic. Since transportation demands are expected to rise in the upcoming years, and short-term broad-scale application of low-carbon truck technologies is unrealistic, the shift to rail freight offers a potential solution. However, block trains are no viable choice for many industrial firms due to operational and infrastructural hurdles. Still, combined transport offers promising opportunities by enabling flexible pre- and post-haulage, centralized transhipment, and an environmentally friendly main leg. However, deployment scenarios in logistics networks are challenging to find. Thus, we present a high-level GIS-based approach to suggest Paretooptimal routes eligible for shifting to combined transports. This approach provides indications for decision-makers that strive to decarbonize their supply chain and serve as input for detailed assessments.

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Grey Relational Analysis vs. Response Surface Methodology for the Prediction of the Best Joint Strength in Hybrid Welding of TWIP/DP Steels

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Keywords: Hybrid welding, TWIP/DP steel weld, Grey Relational Analysis, Response Surface Methodology

Advanced High Strength Steels (AHSSs) have been developed to offer high strength and formability for automotive and aerospace applications. This work proposes a methodology to improve the mechanical performances of welded TWIP/Dual Phase steels by a hybrid laser/MAG process. The Response Surface Methodology (RSM) and the Grey Relational Analysis (GRA) have been used to predict the tensile strength and elongation at fracture of the TWIP/DP joints and compared each other. A grey factorial plan has been used to perform the experimental welding tests. From the regression analysis, the determination coefficient is higher than 86 %, indicating a high correlation between the experimental and predicted values. From the optimization analysis, the best combination of process parameters is 2.25 kW and 3.3 m/min for the statistical

analysis, while 2 kW and 3 m/min for the grey analysis, which lead to quite similar UTS and maximum strain values. The RSM and GRA methodology are both suitable for predicting responses in the case of gray systems.

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Digital Twin Application for Dynamic Task Allocation

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Keywords: Production Systems, Digital Twin, Dynamic Task Allocation, Dynamic Scheduling, Industry 4.0.

Dynamic task allocation methods are critical in manufacturing systems due to the presence of unpredictable events in the production process (e.g., order cancellations, worker absences, resource breakdowns). The introduction of Industry 4.0 technologies promoted the flexibility and smartness of manufacturing systems to deal with production task fluctuation. In particular, Digital Twin technology can help detecting such unpredictable events and suddenly triggering a reallocation policy, due to its ability of comparing in each moment the real behavior of the system with the planned one. This enables the dynamic reallocation and greatly reduces the deviation between the scheduled plan and the actual production process. In this paper, a Digital Twin application is proposed to perform dynamic task reallocation between two UR3e robots in case of time failure of one of the two robots. The Digital Twin application is developed by using the Flexsim software. Three scenarios were compared: (i) no time failure, (ii) time failure without dynamic reallocation, (iii) time failure with dynamic task reallocation implemented in the Digital Twin. The performances of each scenario in terms of cycle time, throughput and resource utilization were analyzed.

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A Framework for Digital Factory Planning and Validation with Virtual and Augmented Reality: An Automotive Case Study

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Keywords: Digital Factory Planning, digitalization, collaboration, Augmented Reality, Virtual Reality.

Nowadays, industrial industries are challenged by unstable and highly variable customer demand. Therefore, effective planning of industrial equipment provides companies with a significant competitive advantage by maximizing the layout efficiency and minimizing the intralogistics costs. Although industrial layout planning is a standard activity conducted in practice, it is highly time consuming requiring a large amount of data that is often difficult to gather and elaborate. On the other hand, Digital Factory Planning has the potential to significantly reduce the planning effort, by enhancing collaboration between the planning team and provide a better understanding through the immersion with virtual- and augmented reality (VR, AR). This paper proposes a framework for the collaborative Digital Factory Planning process in industrial settings. More in detail, it provides a framework to develop the digital model in collaboration between the planning actors of different hierarchical levels (e.g., supply chain manager and head of departments), exploring to which extent VR and AR can support the planning and validation process. The framework is tested within a factory re-layout project / brown field planning) conducted within a North Italian automotive supplier company and by using the digital factory planning software visTABLE®.

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Is digitalization making agroindustry more circular? A SWOT-AHP analysis

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Keywords: Digitalization, circular transition, Agro-industrial systems, SWOT-AHP analysis

In the digital transformation era, technological innovations have given rise to process automation, networking and new methods of communication, producing at the same time a boost towards circular economy. This is evident in the agro-industrial systems where environmental impacts, losses and waste arise constantly along the whole supply chain. This study provides recommendations aimed at leading managers' decisions towards the adoption of digital technologies which ensure the highest circularity of the agro-industrial supply chain. A SWOT matrix was developed to evaluate the strengths, weaknesses, opportunities and threats of digitalization in enhancing circularity of agro-industrial supply chains, while through the Analytic Hierarchy Process (AHP) a rank of critical factors (CFs) was provided by using the eigenvalue method. Results reveal a key function of digitalization in fostering circularity within the agroindustry, emphasizing that a complete transition towards circular economy requires adequate management decisions based on the rank of the abovementioned CFs. Thereby, managers and practitioners should address their efforts to digitize or automate agro-industrial systems, developing focused investment plans

aimed at achieving sustainability and circularity, while policymakers should elaborate how to incentivize the adoption of emerging digital technologies which enable circularity.

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A genetic algorithm approach for medical resident scheduling in Austria

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Keywords: Resident scheduling, genetic algorithm, personnel scheduling, multi-objective optimization

In the digital transformation era, technological innovations have given rise to process automation, networking and new methods of communication, producing at the same time a boost towards circular economy. This is evident in the agro-industrial systems where environmental impacts, losses and waste arise constantly along the whole supply chain. This study provides recommendations aimed at leading managers' decisions towards the adoption of digital technologies which ensure the highest circularity of the agro-industrial supply chain. A SWOT matrix was developed to evaluate the strengths, weaknesses, opportunities and threats of digitalization in enhancing circularity of agro-industrial supply chains, while through the Analytic Hierarchy Process (AHP) a rank of critical factors (CFs) was provided by using the eigenvalue method. Results reveal a key function of digitalization in fostering circularity within the agroindustry, emphasizing that a complete transition towards circular economy requires adequate management decisions based on the rank of the abovementioned CFs. Thereby, managers and practitioners should address their efforts to digitize or automate agro-industrial systems, developing focused investment plans aimed at achieving sustainability and circularity, while policymakers should elaborate how to incentivize the adoption of emerging digital technologies which enable circularity.

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Projected augmented reality for industrial design: challenges and opportunities

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Keywords: Augmented Reality, Design activity, Technology assessment

Spatial-Augmented Reality (SAR) technology has the potential to impact decision-making in various design fields, such as architecture, engineering, and product design. However, despite its benefits, SAR technology has not yet been fully embraced by professionals. This study aims to identify the essential features of a SAR platform that would meet the demands and expectations of different design activities, including product appearance, interface, and ergonomics. The research involved experts who used a SAR platform in real-life product development, and data was collected through semi-structured questionnaires and interviews. The analysis revealed a significant correlation between the features of the technology, considering both potential and already available ones, and the needs of specific design sectors during product development processes. The study's outcomes provide valuable insights for advancing SAR technology in the design field and promoting its adoption by professionals.

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An expert system for automated quality control: a case study in a mechatronic manufacturing company

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Keywords: Expert System, Quality Control, Industry 4.0

The spreading of Industry 4.0 technologies in the manufacturing industry has led to an unprecedent availability of data. Companies are exploiting these data for monitoring and improving their operations and supply chain management processes; however, managers and practitioners are increasingly requiring advanced solutions to better capture value from them. In this study, we collaborated with a manufacturing company to design and develop an Artificial Intelligence system for automated quality control which is powered by data generated during the assembly process of mechatronic components in a semi-automated assembly line. Based on the data collected through sensors placed on press machines, the designed expert system is able to compare each new assembly's curve with the learned ideal curve for its reference configuration, in order to detect deviations eventually leading to faulty items. The model has been tested on a dataset of historical data, related to about 175.000 joining operations carried out in two years of production. As a result of using our solution, the frequency of identification of failure is increased by 10%, improving in turn the efficiency of the quality check and the identification of non-critical errors. The developed system is easily adaptable to a huge variety of processes which involve correlated physical

measures, thus being suitable also for companies lacking sophisticated quality control procedures. Moreover, its transparency allows for an easy understanding of the analysis process, generating trust in the users.

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Digitisation for sustainable water supply systems: the case of optimal pressure management

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Keywords: Water Supply Systems, Digitisation, Hydraulic Modelling, Optimal Pressure Control, Sustainability, Water Smart Systems
The spreading of Industry 4.0 technologies in the manufacturing industry has led to an unprecedent availability of data. Companies are exploiting these data for monitoring and improving their operations and supply chain management processes; however, managers and practitioners are increasingly requiring advanced solutions to better capture value from them. In this study, we collaborated with a manufacturing company to design and develop an Artificial Intelligence system for automated quality control which is powered by data generated during the assembly process of mechatronic components in a semi-automated assembly line. Based on the data collected through sensors placed on press machines, the designed expert system is able to compare each new assembly's curve with the learned ideal curve for its reference configuration, in order to detect deviations eventually leading to faulty items. The model has been tested on a dataset of historical data, related to about 175.000 joining operations carried out in two years of production. As a result of using our solution, the frequency of identification of failure is increased by 10%, improving in turn the efficiency of the quality check and the identification of non-critical errors. The developed system is easily adaptable to a huge variety of processes which involve correlated physical measures, thus being suitable also for companies lacking sophisticated quality control procedures. Moreover, its transparency allows for an easy understanding of the analysis process, generating trust in the users.

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Data-Driven Support Vector Machine to Predict Thin-Walled Tube Energy Absorbers Behavior

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Keywords: Thin-walled tube, Energy absorber, Finite element, Machine learning, SVM, Surrogate model, Sensitivity analysis
To design a more efficient energy absorber, it is critical to evaluate how changing the design parameters affects its performance, and also determine each one's order of significance. In this paper, using a new approach, the behavior and response of straight, double-tapered, and triple-tapered thin-walled tubes with rectangular cross sections under axial and dynamic loading are investigated by performing a sensitivity analysis on a support vector machine (SVM) as a surrogate machine learning model. First, a finite element model of the energy absorber is constructed and validated with available experimental and theoretical studies. Next, a design of experiments was developed using the Sobol series sampling method and an appropriate dataset was created. This information is then used to develop an SVM model to predict the initial peak load and mean load of tubes. The accuracy of the machine learning created in this study is then assessed, and it is demonstrated that the developed model can precisely predict the performance of the absorber. The machine learning model is then subjected to a Sobol sensitivity analysis, and the outcomes are compared to those of the parametric study. The results suggest that the thickness of the tube has a stronger effect on the absorber performance than other geometric parameters. Comparing the effects of different material parameters on the behavior of tubes, the results show that yield strength has the greatest impact on the response of the energy absorber. It is also observed that the tapered tubes have a much lower initial peak load compared to straight ones.

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Optimization of the FRESH 3D printing method applied to alginate – cellulose-based hydrogels

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Keywords: FRESH 3D printing, alginate, cellulose, process optimization

In recent years, a new additive manufacturing (AM) method for three-dimensional (3D) syringe-extrusion (bio)printing of soft hydrogels has been introduced under the name of Freeform Reversible Embedding of Suspended Hydrogels (FRESH). The most common FRESH bath contains gelatin as the main compound and low concentrations of crosslinker(s) (whose nature depends on the hydrogel) for the initiation of an in-situ pre-crosslinking process during printing. In the case of sodium alginate (SA)-based hydrogels ionically crosslinked via calcium chloride (CaCl2), the crosslinker percentage in the gelatin bath is equal to ~10 mM, usually combined with a post-crosslinking at higher concentrations. However, according to the best authors' knowledge, no study has ever reported the combined effect of pre- and post-process crosslinker concentrations over printability using the FRESH method. Therefore, this manuscript aims to systematically investigate via a full-factorial design, the printing of two low viscous SA – cellulose-based hydrogels, containing carboxymethylcellulose (CMC) or micro-fibrillated cellulose (mFC). Different concentrations of CaCl2 are selected for the gelatin-based FRESH support bath (10, 30, or 50 mM) and for the post-crosslinking process (0.0, 1.0, or 3.0 w/w%). A printability index Pr is chosen as the response of interest and further compared against swelling and water uptake ratios. Eventually, the overall best performances were obtained for SA-CMC at CaCl2 (30 mM + 1.0 w/w%), with a Pr = 1.021, swelling and water uptake ratios at 48h equal to 5.99 and 88%, respectively. Therefore, this work offers new insights over the control and optimization of the crosslinker concentration in the FRESH method.

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Training support with Augmented Reality for Machine Setup: A Case Study in the Process Industry

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Keywords: Augmented Reality, Visual Management, Machine Set-Up, Training, Process Industry.

The process industry is often characterised by complex, labour-intensive machine set-up sequences. The cost of downtime and defective products can be very high, so an error-free machine set-up is required. The paper proposes a Visual Management (VM) and Augmented Reality (AR) approach to support the machine set-up training process, with the aim to mitigate the risk of errors and reduce the learning curve for operators. Together with the company GlobalWafers, a specific VM-AR-based machine set-up training was developed and pre-tested in a laboratory environment. Layers and colour codes were developed in order to facilitate the understanding of the correct set-up. Furthermore, information on potential strengths and weaknesses was collected by means of a semi-structured interview during the laboratory tests. Future research activities consist in testing and applying the VM-AR-based machine set-up process in practice, also setting up a specific testing area dedicated to the operators training, at the company's facilities.

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Demonstrating the potentials of Digital Twin in Manufacturing: an Axiomatic Design-based application for Engineering Education

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Keywords: Axiomatic Design, Digital Twin, Manufacturing, Engineering Education, Demonstrator

Due to the spread of digitalization across every industry sector, technologies enabling digital transformation are nowadays capturing increasingly high attention. For instance, the use of Digital Twin as a real-time synchronized virtual representation of a physical system is gaining ground in many applications, particularly in the manufacturing sector. One of the main reasons behind this trend is the opportunity to visualize and optimize manufacturing system/process parameters, such as productivity, competitiveness, or sustainability, inside the digital world at a first glance. Hence, the potentials of Digital Twin in manufacturing can be manifold. The present paper intends to demonstrate Digital Twin potential applied to a practical case study for education purposes. An Axiomatic Design-based approach is utilized to design a physical laboratory demonstrator, which will be

exploited in the future in occasion of organized lab visits for students and practitioners from industry. This demonstrator will be designed with the main scope to transfer detailed knowledge about Digital Twin related concepts applied to the manufacturing field. The final outcomes of this work will include the design, behavior modelling and validation of the demonstrator in exam.

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Modularity effect on the manufacturing lead time of assembly processes

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Keywords: Modularity, Optimal Modularity, Process Structures, Manufacturing Lead Time.

Industry 4.0 has driven the era of mass customized production to higher level as it is needed to satisfy increasing customer needs and demands. To keep up with these ever-increasing and changing requirements, the highly flexible and rapid reconfigurable manufacturing lines have to be used to ensure quick and easy change the type of product being produced. Moreover, application of modular production makes manufacturing systems more flexible and contributes to reducing manufacturing lead time. Therefore, this paper is aimed to provide the evidence that modularity has positive impact on manufacturing lead time. For this purpose, the relation between the process modularity and manufacturing lead time will be investigated.

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Industry 4.0 technologies and sustainable development goals (SDGs): covered publications and ranking

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Keywords: Industry 4.0, Sustainable Development Goals, Bibliometric Analysis

Rapid security, connectivity, and data storage advancements have encouraged organizations to integrate Industry 4.0 technologies into their processes to improve sustainability performance. As a result of integrating Industry 4.0 technologies into the organization's processes, significant improvements in sustainability have been achieved. This research aims to analyze the coverage and ranking of publications related to the integration of Industry 4.0 technologies and Sustainable Development Goals (SDGs). We conducted a bibliometric analysis of related research between 2017 and 2022 using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). SDG 4: Quality Education was most widely discussed, with 30% of publications, followed by SDG 3: Good Health and Well-being with 16%. Also, the paper found that IoT is the most widely used technology within Industry 4.0, accounting for 35% of the total, followed by Big Data at 22%. The findings of the paper enable us to identify and highlight the "ranking" and covered publications of concern related to Industry 4.0 and the Sustainable Development Goals.

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Assessing the Viscosity of Alginate – Cellulose-based Hydrogels: A Comparison among Different Type of Solutes, Mediums Culture, and Gelatin Influence

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Keywords: soft hydrogels, viscosity, alginate, carboxymethyl cellulose, mediums culture.

3D bioprinting is spreading as a helpful tool in tissue engineering and personalized medicine, where syringe extrusion-based techniques play an important role for the fabrication of cell laden scaffolds. Among the scaffold properties, the viscosity of a hydrogel is well-known to strongly influence the geometrical accuracy and the cellular viability. However, few studies reported the influence of thickening agents at different molecular weights (Mw) on the viscosity and their interaction with different medium cultures. Therefore, this innovative work firstly aims to systematically investigate the influence of two types of sodium alginate (SA low and medium viscosity) and three of carboxymethyl cellulose (CMC Mw: 90000 Da, 250000 Da and 700000 Da) in relation to a hydrogel viscosities. Results show that CMC is the main thickener factor (an order of magnitude of difference) while SA approximately doubles the values. Secondly, the influence of gelatin as hydrogel thickener compound on the final viscosity was also investigated. The combinations with and without gelatin were analyzed with three different common solvents as milliQ water, PBS and IMDM, in order to show also the effect of different solvents to the final viscosity. Gelatin generally leads to an increment of the hydrogel viscosity, mostly in combination with PBS. For instance, at 1.4 s-1 without gelatin, the viscosity is 23048 mPa·s in milliQ water and 24640 mPa·s in PBS instead, with gelatin the viscosity arises at

34932 mPa·s and 83887 mPa·s respectively. This work gives more insights in the selection of a proper hydrogel composition to be used as bioink for bioprinting applications.

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Evaluation of Bioprinting Process by RSM Training

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Keywords: Additive Manufacturing, Bioprinting, RSM Training, tissue engineering, genetic algorithm.

Bioprinting is one of the newest but mostly studied additive manufacturing processes of the last decade. Despite the huge amount of literature on this topic, a huge amount of aspects still have to be fully investigated. Precisely, each 3D printing process is characterized by a low stability and difficult replicability, in relation to conventional processes. For this reason, research on process control and optimization is one of the trending aspects nowadays. In this work, the Response Surface Methodology (RSM) approach is applied to 3D printing of hydrogel for biomedical applications and specifically of biocompatible hydrogels for cell-laden direct bioprinting purposes. Natural polymers are usually very difficult to control and, during a bioprinting process, several parameters are responsible for cell viability and proliferation. The RSM indicated a specific hydrogel composition and precise values of pressure and velocity of printing to assure a proper process stability to obtain uniform and steady filaments. The RSM approach can be therefore used to evaluate the 3D performance of natural polymer-based hydrogels before cell printing.

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A Bibliometric Analysis of the Impact of Industry 4.0 Technologies on the Circular Economy

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Keywords: Circular Economy, Sustainability, Industry 4.0, Digital technologies, VOS viewer, Bibliometrics

The concepts of circular economy (CE) and Industry 4.0 (I4.0) have grown in popularity among policymakers, researchers, academics, and manufacturers since 2013. CE represents a suitable strategy for achieving sustainability. I4.0 technologies, besides allowing manufacturing companies to increase their effectiveness and efficiency, can enable the adoption and implementation of CE. Comprehensive bibliometric mapping and clustering approaches would enable the visualization and organization of the most influential research literature in the area. However, bibliometric review articles have not properly discussed the research hotspot, knowledge base and CE research evolution in the context of I4.0 technologies. So, this research aims to analyse the literature dealing with CE and I4.0 technologies, to provide a preliminary picture of the field. The research methodology consists of a bibliometric study from the Scopus database, analyzing a sample of 2632 articles published between 2009 and June-2022 and then the final sample of 925 articles is used to conduct the cluster analysis. The study utilized PRISMA methodology with VOS Viewer and Biblioshiny for bibliometric analysis and visualization. The analysis revealed influential authors, journals, institutions, and trending articles within the CE and I4.0 technologies literature, and relationships between these streams. This may benefit academics and practitioners in understanding the main investigated areas and persisting gaps in CE and I4.0 research, giving suggestions for future studies in these fields.

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A Systematic Review of Factors Considered in Sustainable Product Design

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Keywords: Design factor, Triple bottom line, Sustainable product, Product sustainability, Industrial sustainability, Sustainable manufacturing

The purpose of this paper is to provide a review of the factors that have been considered for sustainable product design (SPD). To achieve this, a systematic literature review was carried out to identify design factors published in peer-reviewed articles that are relevant to SPD and/or product sustainability assessment. As a result, a total of 272 design factors (i.e. 63 economic design factors, 120 environmental design factors and 89 social design factors) were identified considering triple bottom line approach. The majority of the design factors were used (mentioned) only once in the reviewed literature, implying inconsistency in their application (more specifically, the type of product affects the use of design factors). While, a few design factors were found to be frequently used (frequently mentioned) in the reviewed literature. These factors have been considered for SPD related to quality and reliability, assembly, costs, financial gain, resources, waste and emissions, post-use (end-of-

life management), functionality and usability, and the well-being of employees, customers and community. The paper have considerable academic, managerial and policy implications and will provide a theoretical foundation for future research on SPD and product sustainability assessment.

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Toward Homecare Logistics 5.0: A Systematic Literature Review

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Keywords: homecare, logistics, healthcare 5.0, resilience, sustainability, human-centred design

The increased demand for homecare services – driven by the ageing population and the significance of homecare during the Covid-19 pandemic – has led to a need for greater rationalisation and organisation of the available resources, which must increasingly tend towards more resilient, sustainable, and human-centred approaches, collectively identified as healthcare 5.0. The current paper aims to comprehend, through a review of relevant literature, the state of the research regarding homecare logistics concerning the pillars of healthcare 5.0. The literature review shows that healthcare 5.0 pillars in homecare services are little considered. Only environmental sustainability is addressed, while resilience and human-centricity are little investigated. Additionally, “human-centred” is considered a synonym of “patient-centred”. However, given the impact of the covid pandemic on healthcare operators, it is necessary to consider workforce well-being. Only a few papers analysed human factors related to the operators, such as the workload or skills requirements. Other factors, such as stress, time pressure, and fatigue, are not considered. To complete the analysis of this sector from the perspective of healthcare 5.0, future research should include resilience considerations to demand increases and human-centred process design to improve the operators’ well-being.

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Design of Smart Home Product Service Systems (SH-PSS)

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Keywords: Smart Home, Smart Product Service System, User Experience, User Centric Design, Integrative Review

Smart homes are integrating more and more into our daily lives. Smart Home Product Service Systems (SH-PSS) originated as a revolutionary technique for integrating smart home products with cutting-edge digital capabilities and their associated e-services to meet users' needs in highly contextualized environments to improve their quality of life. Previous research suggests limited user-centric research published in this SH-PSS domain. This report presents a literature review to explore SH-PSS, their characteristics, and the user experience perceived by the consumer. The aim to the study to understand smart home with the lens of user-centric design and conceptualize Smart Home Product-Service-System Framework. This paper investigates various factors influencing the connections of User-centric Design (UCD) and SH-PSS; and the current gaps and challenges in the design of SH-PSS to satisfy user needs and improve UX. The study is an integrative review of papers from major journals in design, engineering, consumer research, management, and marketing on the topic of smart home and PSS from 2015 to 2022; relevant articles were shortlisted and analyzed considering the purpose, method, and main findings of the studies. The three major categories that emerged through the analysis of the shortlisted articles. A multi-faceted evaluation of articles of the first category resulted in proposing a new theoretical framework investigating characteristics of smart home product service systems and; the interconnection between these characteristics and advantages of PSS. The framework illustrates key characteristics and associations between them with future directions on SH-PSS.

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Servitization Opportunities for Improving Sustainability in the Steel Industry

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Keywords: Steel production, Servitization, Sustainability, Circular economy

This paper examines the iron and steel industry's efforts to reduce carbon emissions and achieve environmental sustainability goals in line with global climate change policies. The paper investigates the potential for product-service solutions as a viable business model option to reduce the sector's environmental impact. By taking into account articles from the literature, funded research projects documentation and websites of some of the most important European plant manufacturers or service providers for the steel industry, the study aims to understand the state of the art of the steel sector in terms of servitization

and identifies servitization opportunities that can assist steelmakers in achieving sustainability goals, through the deployment of green technologies and improvement in the steel processes sustainability. The study finally discusses the adoption of servitization solutions that could be used, along with other technological strategies, to guide steelmakers or steel technology producers in partially changing their business model to meet the environmental targets set by policymakers.

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Graded Lattice Structures for Biodegradable Temporary Implants: Computational Evaluation with Two Unit Cell Types

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Keywords: Graded Lattices, Young's Modulus, Biodegradable Implants, Iron
Iron graded lattice structures have the potential to be employed in biodegradable temporary implants and play a key role in the reduction of stress shielding. In this work, two graded specimens made of lattices with two unit cell types, truncated octahedron (TO) and rhombitruncated octahedron (RTCO), were analysed under compression, by means of the finite element method. Specimens of different unit cell types were designed with different values of relative density. Graded unit cells were chosen in the design of grad-ed lattice structures. The results show that, under compression, graded lattices can achieve the same mechanical properties as non-graded lattices with a low-er relative density. The relative density is verified to be an important property, for comparison of results in different cell structures, where different relative densities can lead to similar compressive behaviours. An equivalent density parameter, proposed in the current work, can be used to interchange the unit cell types used in temporary implants, while maintaining the mechanical properties.

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A Digital Twin-based approach for Emotion Recognition in Human-Robot Collaboration

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Keywords: human-robot collaboration, emotion recognition, human-centred manufacturing
In a Human-Robot Collaboration scenario of a manufacturing system, one of the main issues regarding the interaction between the two agents is the way in which communication takes place. Communication can happen in various ways: it can be voluntary or involuntary, explicit or implicit. In this paper we explore the domain of involuntary-implicit communication: emotions. Concerning how emotions are expressed by a human operator we analyze how through a multimodal analysis system for the Emotion Recognition a simulation-based Digital Twin can be integrated for the human operator's ergonomics.

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Fluency of Stimuli Comparing Two Different Representation Forms: Image and Real Product

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Keywords: Fluency perception, Representation forms, Cognitive experience, Product evaluation.
This study examines the perception of cognitive fluency of products in accordance with the Fluency Amplification Model. An experiment was conducted to compare the differences in product evaluations between two types of product representations, a tangible product and an image thereof, each assigned to a different group of participants. The results showed that although there were no significant differences between the image and real product groups, the "image" group exhibited a higher mean value for a greater number of variables, with the "real object" group having fewer variables with a higher discrepancy in mean values. The results suggest that individuals tend to have a stronger perception of the product after physically interacting with it rather than simply observing its image. The image appeared to increase fluency in affective aspects, while the real product appears to increase fluency in cognitive aspects. These findings provide a promising direction for future research to further investigate the comparison of designs' representation forms on perception fluency.

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Analyzing Characteristics of Smart Home Product Service System through Kano Model Approach

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Keywords: Smart Home Product Service System, Kano Model, Smart Home Functions, Product Smartness

A smart house is a residence integrated with smart technology designed to provide users customized services. Smart technologies provide functions like comfort, monitoring, health-related benefits, consulting, assisting and supporting the residents, which may improve the quality of life and encourage independent living. This paper aims to understand the smart home product-service system (SH-PSS) factors influencing the smart home acceptance and adoption. This study also provides the factors which help achieve sustainability through SH-PSS adoption. In this study we identify the potential for user satisfaction and dissatisfaction with functions of smart home, product smartness and qualities of smart home product service systems (SH-PSS). We employ sequential processes to develop the Kano Model, and we begin by defining 22 characteristics reflecting future SH-PSS enhancement recommendations. These characteristics are divided into three themes; functions of SH-PSS; product smartness and quality residents looking for in SH-PSS. The characteristics that define a product as smart are independent, adaptive, reactive, multi-functional, ability to cooperate, humanlike interaction and personality. The qualities consumers are looking for in SH-PSS are context awareness, interpretation, proactive, self-description, personalisation, user friendly interaction, communication, cooperation, openness, collaboration. The Kano questionnaire was designed using functional and dysfunctional questions for each characteristic. The relevant survey was performed with SH-PSS users (n=226) in the Indian context. The responses of respondents are evaluated using the Kano evaluation table. User satisfaction and dissatisfaction are calculated, and findings show which characteristics fall into the category of attractive, one-dimensional, must-be, reverse, indifferent or questionable.

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Industry 5.0. The road to sustainability

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Keywords: Industry 5.0, Sustainability, Society 5.0, Human-centered design, Resilience.

This research presents a bibliometric study of the scientific-technological field of Industry 5.0 focusing on sustainability, after considering its relevance with the evolution since its emergence in 2019. It is deepened by studying authors' keywords of "Industry 5.0" and "Sustainability" respectively in the Scopus and Web of Science databases, developing the analysis of the data considering its evolution, keywords and relevant organizations. The results show an increase in sustainability due to the fact that Industry 5.0 facilitates its development compared to previous industrial revolutions: detecting strong connections between Industry 5.0 and sustainability with the terms "Society 5.0", "Human-centered design", "Resilience", "Artificial intelligence", "Circular economy" and "Sustainable development". Finally, as Industry 5.0 is a completely new field, it is expected that sustainability will gain more importance in the future, where the associated social aspects that will arise from the development of new technologies will be as relevant as the economic and environmental ones.

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Assessing the Implementation of a Smart Cart in a Supermarket using a Simulation Model

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Keywords: Smart cart, sensors, simulation, RFID, Internet-of-Things (IoT).

Recently, smart carts have been utilized as an innovative and modern solution to enhance the shopping experience for customers in supermarkets. These smart shopping carts utilizing Internet of Things (IoT) have several benefits and can significantly reduce waiting times of customers in checkout queues and impact the operations of the supermarket. This study aims to assess the effectiveness of implementing a smart cart in a supermarket using a simulation model. The smart cart and the mobile applications were designed to allow customers to scan items and make payments at the end of their shopping without having to visit a traditional checkout counter. A simulation model was developed to replicate the supermarket's checkout process for the current (traditional cart) system and smart shopping experience with 30% of customers. The model

was calibrated using empirical data collected from the supermarket. The simulation results showed that the smart cart implementation had a positive impact on shoppers' experience, reducing the time taken to complete their shopping. Additionally, the smart cart implementation led to improvements in the supermarket's operational efficiency, such as reducing the number of required cashiers and managing inventory in real-time. Furthermore, paired t-test is conducted to determine whether there is a statistical difference between the average waiting times for the traditional and smart cart shopping systems. The results of this study suggest that implementing a smart cart in a supermarket can benefit both shoppers and the supermarket's management.

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Pilot Scale Tannin Extraction from Chestnut Wood Waste using Hydrodynamic Cavitation

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Keywords: Antioxidant activity, Bioeconomy, Chestnut, Hydrodynamic cavitation, Tannin.

Tannins, extracted from various plant sources, are worldwide commodities used in several different fields, including leather manufacturing and the production of bio-based adhesives, with emerging use in technical, environmental, food and feed sectors, pharmacology. Due to increasing market demand, few emerging techniques were proposed besides the conventional hot water extraction usually performed under pressurized conditions. For the first time, hydrodynamic cavitation, an emerging and straightforwardly scalable green extraction technique, was applied to the extraction of tannins from chestnut wood waste in water only and at room pressure, without any pretreatment of the raw material except for mild grinding. Promising performances were shown based on tests carried out from room temperature up to 100°C. Extraction rates close to 300 mg of tannin per gram of chestnut wood material (dry basis) were achieved, as well as high levels of the DPPH antioxidant activity of the obtained extract (IC50 up to about 2.45 mg of extracted tannin, corresponding to 10.8 mg of chestnut wood waste, per mL of solution). The proposed technique allows ample room for improvement with regards to process time, extraction rate and specific energy consumption, and suitable for both small-scale and industrial extraction facilities.

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The human factor and the resilience of manufacturing processes: A case study of pharmaceutical process toward Industry 5.0

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Keywords: Industry 5.0, Human Factor, Disruptive Events, System Vulnerability.

Due to the introduction of technologies following the introduction of Industry 4.0, emerging manufacturing trends are changing the operational conditions within factories. This mainly leads to the increased interconnection between systems and machines to increment production efficiency, reducing the use of raw materials, production time, and costs where the human factor should be addressed. Only recently, in 2021, an increasing interest has been devoted in the scientific literature to conceptualize an evolution of Industry 4.0 toward Industry 5.0 to account for the role of human factors within these operational transformations, where human experts are thought to cooperate with human-oriented intelligent machines. Alongside the unprecedented opportunities of knowledge management that the systems adopting an Industry 4.0 model embrace, impactful potential risks related to cyber and physical vulnerabilities need to be considered and addressed. This study aims to develop a methodology for evaluating the vulnerability of the human factor in a production process. An industrial case study is conducted to explore potential scenarios of reduced performance due to the cyber system, while also considering the role of the human factor. As one of the initial approaches, the paper examines how the system's ability to return to its normal state depends on the interplay between human skills (operator 5.0) and the cyber system.

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Implementation of Model-Based Definition-Case of Manufacturing Industry in Finland

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Keywords: Semantic MBD, PMI, Ideal Digital Product Process

Model-Based Definition (MBD) supplies benefits in digital product process, especially in communication between engineering and downstream processes. This is possible due to a semantic machine-readable 3D model, which is gaining popularity in modern CAD/CAM systems. Particularly aerospace and automotive industries have utilized MBD in their processes. However, MBD is less used in Small and Mid-Size Enterprises (SME), where manufacturing series are typically small, but products can be highly configured. This inspired us to make a survey for Finnish Mechanical Engineering companies which typically are SME companies with highly specialized products. We wanted to find out, how familiar MBD is to them, how they transfer Product and Manufacturing Information (PMI) from design to manufacturing, what are their objectives in MBD, and what barriers need to be overcome before introducing MBD in companies. Most of the informants in our survey are familiar with the MBD, but less than half of them is either using or introducing the MBD in their companies and suppliers. Despite developed digital design and manufacturing tools in the Mechanical Engineering Industry, lack of skills in using MBD both among companies and their suppliers was the main reason for not utilizing MBD.

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Real-Time Color Detection for Automated Production Lines Using CNN-Based Machine Learning

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Keywords: Color Detection, Yolov8, Image Processing, Machine Vision, Light Impact.

Color detection using computer vision is a method used in various industries for quality control, sorting, and packaging. Different algorithms such as thresholding, histogram, K-means clustering, and Convolutional Neural Networks (CNNs) based algorithms, such as YOLO (You Only Look Once) are employed for this purpose. The accuracy of these techniques is greatly impacted by ambient illumination conditions, reflective properties of objects, and the dynamic nature of production environments. As a result, more reliable techniques must be developed to address these challenges and ensure accurate color detection in real-world settings. To address this, in this study, two algorithms, one with the limited number of images under specific light condition and second with a larger number of images with varying illuminations were proposed using YOLOv8 and their accuracy was evaluated with respect to the effects of light intensity, illumination angle, and training data. This study evaluated the performance of color detection algorithms using different colored parts, illuminations, and the number of training data. The algorithms were tested on an automated production line with light intensities ranging from 7 to 800 lux at intervals of almost 100 lux and illumination angles of 0° and 45° to the camera. The study found that the accuracy of the algorithms was significantly affected by the color of objects, illumination intensity, illumination angle, and the number of trained images. White, red, and grey parts were not accurately identified under illumination intensity of 700 lux or higher, while color chrome was detected with 100% accuracy using lower-trained images.

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Covid-19 pandemic impacts and long-term supply strategies of pharmaceutical manufacturers

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Keywords: Coronavirus, Pharmaceutical supply chain, Case study.

The Covid-19 outbreak has seriously disrupted the pharmaceutical supply chain, with manifold impacts on the production and delivery capacity of pharmaceutical manufacturers. Several contributions in literature investigated the strategies and managerial practices of pharmaceutical supply chains to face the pandemic impacts. However, a major focus has been on the downstream supply chain of manufacturers, and the distribution and transportation issues of final products, i.e. vaccines and other critical drugs, especially during the outbreak and the period of emergency. This paper aims to investigate the strategies carried out by pharmaceutical manufacturers during and especially post pandemic era, considering the supply side

and related contextual variables. We conducted a multiple case study research with two pharmaceutical manufacturers operating globally and with manufacturing plants based in Italy. Results show significant impacts on supplies of critical materials, and increase in bargaining power of suppliers, depending on the contextual variables of product portfolio, regulatory environment, risk-based perspective, and company size. Strategies are distinguished into buffering and bridging strategies, following literature on mitigations of supply chain disruptions and resilience.

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Knowledge-Based Maintenance Management System of Compressed Air System

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Keywords: Compressed Air System, Knowledge-Based Maintenance Management System, Industry 4.0..

Industry 4.0 is used to describe the current trend towards automation and data exchange in the manufacturing process, including machine learning with the help of artificial intelligence and the Internet of Things. It is revolutionising not only the production process, but also maintenance policies. Maintenance policies applied from the past to the present provide limited support in providing the optimum maintenance management system (MMS) to increase economic efficiency. For this reason, industrial companies are starting to switch to knowledge-based maintenance (KBM) management systems supported by prescriptive maintenance policies in their production processes. One of the vital energy suppliers of production processes is compressed air system (CAS). Most manufacturing processes require so much compressed air that, for example, around 10% of the annual electrical energy consumption of industries in Europe comes from CAS. Although its importance in production processes is so high, appropriate MMS applications are insufficient for choosing the right maintenance policies in CAS. Although there are studies on the management system of CAS, there is no knowledge-based compressed air maintenance management model with integrated prescriptive maintenance policy. This article aims to examine the concept of maintenance, policies, and management systems in Industry 4.0 and CAS. This paper presents a knowledge-based maintenance management of compressed air system framework compatible with Industry 4.0. In conclusion, this research is a preliminary article for CAS. KBM management system supported by Industry 4.0 technologies and other research.

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Decertification: evidence from Italian SMEs

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Keywords: Sustainability, Decertification, Standard

This paper performs a comparative analysis of the decertifying reasons in the realm of sustainability standards (BCorp, ISO14001, SA8000, UNGC) with the use of multiple case studies. The results show both standard-specific and common causes. Furthermore, canceling reasons gravitate either towards the cornerstone of cost (i.e., excessive cost and overwhelming desk work) or lack of benefits (i.e., limited returns, and certification devaluation). The study provides theoretical and practical contributions. From a theoretical point of view, it advances the understanding of decertification causes and it broadens the application of overarching theories in the area of sustainability standards. Concerning practice, it presents an overview of joined and distinct canceling motivations.

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Collective System Design and Industry 5.0: Building Community, Resilience, and Sustainability at Purdue University Fort Wayne

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Keywords: System design, sustainability, higher education

One of the challenges facing Small-Medium Enterprises (SMEs) moving into Industry 5.0 is how to identify and implement changes that best exemplify the values of Industry 5.0—human-centricity, intelligence, and sustainability. This paper describes a method of enterprise design and improvement that can be used for implementing Industry 5.0 change in SMEs, specifically universities. For the past several decades, the American higher education system has been moving slowly into a crisis. Many universities have cut instructional costs and restructured their programs in response to funding deficits, moving American higher education away from achieving the desired outcomes of I5.0. The lifecycle system design approach described in this paper is a comprehensive method for putting American higher education institutions on a better path. The method, called Collective System Design (CSD), was previously used to design and improve manufacturing systems. It offers a human-

centric approach to sustainable design that can be used to reform any institution. The paper describes its application to a not-for-profit, educational SME, Purdue University Fort Wayne (PFW), a public university in northeast Indiana (USA). CSD has been used at PFW to turn leaders into system designers who are responsible for building collective agreement about desired student success outcomes. With outcomes in mind, solutions are being implemented as standard procedures, and they are being improved using the Plan-Do-Check Act (PDCA) cycle, which treats chosen solutions as hypotheses for how to achieve outcomes. It is not realistic for society to move toward I5.0 if the institutions that are supposed to be on the cutting edge of education and innovation are stuck in the past. CSD offers a compelling method that may be applied by SMEs everywhere who are eager to move into the era of I5.0.

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Differentiating Additive and Traditional Manufacturing Processes through Unsupervised Learning and Image Processing

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Keywords: unsupervised learning, machine learning, manufacturing process selection, image processing, hierarchical clustering

The rapid development of production methods and the introduction of additive manufacturing (AM) technologies have increased the design freedom and availability of unlabeled data. Typically, manufacturing process selection requires a large amount of labeled data which is expensive and difficult to reach. This is more critical with the continuous improvement of AM systems, which can be increasingly used to substitute traditional manufacturing technologies. Implementing unsupervised learning into manufacturing process selection and classification is beneficial since unsupervised learning uses unlabeled data. Hence, this paper aims to differentiate parts to be fabricated favorably by means of additive or traditional manufacturing technologies using image processing and unsupervised learning. The input image dataset is constructed from freely accessible web databases in which forty CAD (computer-aided design) models are available. The corresponding images of CAD models are extracted using the SOLIDWORKS 2022 software, where 42.50% are AM-ed, and the remaining are chosen from traditionally manufactured parts. The hierarchical clustering algorithm reported 87.50% accuracy, showing promising potential for manufacturing process classification and image processing applications.

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Estimation of hydraulic power losses in a double-row tapered roller bearing via computational fluid dynamics

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Keywords: Open Source, CFD, Lubrication, Hydraulic Power Loss, Bearing Efficiency, Rolling-Element Bearing

To enhance the bearings' efficiency, it is essential to determine and quantify the sources of power loss in the design stage. In oil-lubricated bearings, load-independent power losses (PLB0) can be a significant factor in energy dissipation. This study examines the PLB0 of a double-row Tapered Roller Bearing (32312-A) under different operating conditions, namely various speeds, viscosities, and lubrication conditions, i.e. Feed Lubrication (FEED-L) and Full-Flooded Lubrication (FLO-L). In this respect, a numerical tool based on Computational Fluid Dynamics has been developed within the OpenFOAM® environment. Results highlight that the estimated PLB0 in FLO-L can be an order of magnitude higher than the ones evaluated in FEED-L. The PLB0 in FEED-L are almost exclusively due to inertial effects (99%) and the PLB0 in FLOL are for the 70% caused by viscous effects. Additionally, it has emerged that the lubricant viscosity has a huge impact on PLB0 for both lubrication conditions. For instance, in the studied configurations, doubling the viscosity can lead to an increase of up to 180% for FEED-L and up to 500% for FLO-L. Moreover, in FEED-L, the flow rate has a significant effect on PLB0; on average, doubling the flow rate leads to an increase in PLB0 of more than 15%.

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User experience-based perception of the advantages of an adaptable product through a promotional video visualization

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Keywords: Perception, useful life extension, user changing needs, adaptable product, circular economy

The future benefits of a stroller which transforms into a double one are not considered when selling and promoting products. The lack of incentives for companies, the interests these practices generate, and the need to create a culture of more responsible use of objects, contribute to the scant interest in designing products which minimize the "use and discard" behavior. However, it would be interesting to determine the extent of awareness of a more rational use of objects and how it can be increased. To this end, a joint study with the company BabyEssentials was conducted to assess whether the positive perception of a promotional video - showcasing a product with longer lifespan due to its ability to adapt to future user needs compared to a commercial one - is perceived by users with and without prior experience of the product.

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A combined analytical-numerical approach to evaluate the efficiency of cycloidal speed reducers

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Keywords: Power losses, FEA, efficiency

Cycloidal reducers are nowadays widely used in various industrial fields, from robotics to their use in the latest electric motors. Their ability to achieve high reduction ratios while maintaining compact geometries is just one of the reasons why the study of such component is highly relevant. In this work, a cycloidal reducer with fixed rollers was studied. The main purpose of this research is to propose an analytical-numerical method for calculating the efficiency of the system. First, a finite element simulation of the reducer was developed. The data was then processed to calculate the gearbox efficiency. Five different combinations of rotation speed and transmitted torque were tested. Eventually, these values were compared with data collected from literature. The comparison between the two resulted in a maximum error of 1.95%, confirming that the model predicts the behavior of a real reducer with good accuracy. The numerical simulation considers only some of the causes of power losses, and in this regard, it needs further implementation of the model to be able to consider all types of losses of a real-world cycloidal reducer.

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Industry 4.0 and Policies: A classification

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Keywords: Industry 4.0, Policies, Classification

This paper proposes a classification framework of national Industry 4.0 policies based on previous contributions applied to different contexts. The sample selected for the study consists of the world's top 12 manufacturing countries and includes both developing and developed countries.(Brazil, China, France, Germany, India, Italy, Japan, Mexico, the Russian Federation, South Korea, the United Kingdom and the United States). The analysis reveals some differences (e.g. in terms of technologies, sectors and instruments) and similarities (e.g. in terms of economic objectives). The study provides policy makers with a framework of industrial 4.0 policies within which to identify and adapt the most appropriate interventions and actions.

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Environmental assessment of the introduction of digital technologies in the building industry: a literature study

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Keywords: Digital technologies, Building industry, Sustainability assessment

Digital technologies play a critical role in enhancing the safety operations, quality, and time management of projects. The building industry has been slower than other sectors to implement digital technologies. On the other hand, life cycle thinking, and sustainable awareness have become increasingly significant concepts. This literature-based research investigates the diffusion of digital technologies in the building sector in the context of their relationship with life cycle assessment (LCA) and other environmental assessment methods. The study examines an extensive database of 800 scientific documents. The findings reveal that Building Information Modelling (BIM) and 3D printing are the most diffused technologies used in conjunction with supporting the environmental assessment or evaluating the impact of the technologies in sustainability-related terms. Despite their expectedly large utilization in the building sector, the application and evaluation of some digital technologies are rarely reported. The study reveals that the end-of-life stage of buildings is associated with the smallest amount of evaluation examples in the examined papers. The integration of the life cycle thinking into approaches foreseeing the use of these technologies can provide significant advantages in terms of separation, recycling and disposal roots for the construction and demolition waste.

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Numerical Analysis of the Impact of Shot Peening on the Tooth Root Strength of AlSi10Mg Gears using Critical Plane Multiaxial Fatigue Criteria

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Keywords: Tooth root fillet, Shot Peening, Aluminum alloy, Fatigue, Finite Element

Shot peening is a frequently employed process for the surface treatment of gears. It produces an improvement of their mechanical characteristics, and among them of their tooth root bending resistance (also called tooth root strength). In recent years, with the rise and spread of additive manufacturing, the interest in the shot peening of additively manufactured components is growing, with a common example being AlSi10Mg parts produced by selective laser melting. This work aims at assessing the influence of shot peening on the fatigue behavior of AlSi10Mg gears through a finite element analysis and the Findley multiaxial fatigue criterion, which relies on the theory of critical plane. Firstly, shot peening was simulated on a gear geometry through a non-linear dynamic analysis which allowed to define the residual stresses generated by the treatment. Secondly, the Single Tooth Bending Fatigue test was simulated for a wrought (non-peened) case and for a shot peened case. This allowed to find the stress tensors at the nodes of the tooth root, and to determine how they vary during the loading cycle. By elaborating them through the Findley criterion, it was possible to compare the equivalent stresses of the non-peened to the shot peened gears, to quantify the improvement in the tooth root strength produced by shot peening, and to show how local hardening changes the point of crack nucleation on the gear tooth.

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Advances in machine learning techniques used in fatigue life prediction of welded structures

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Keywords: Machine learning, Welding, Fatigue, Structure, Finite element

Welding continues to be a significant fabrication process in the shipbuilding, construction, automotive, and aerospace industries as it can be used to manufacture large and complex welded structures which have precise dimensional requirements. With applications such as tanks, ships, and bridges, among others, these kinds of structures are vital for urbanization. However, fatigue persists to be one of the most critical forms of structural damage in these structures. Hence, there is a need to evaluate this phenomenon both in design and service. Although conventional methods such as linear elastic fracture mechanics, strain life, and stress approaches are effective to diagnose fatigue, these methods take unrealistic computation time, have low automation capabilities and most times are geometry restricted. Meanwhile, ever since the advent of machine learning, it has been promising in providing exceptional solutions to many damage problems, as it can quickly identify failure trends, reduce cost and time as well as lead to automation. This research aims to have a comprehensive

overview of the deployment of machine learning algorithms in predicting the fatigue life of structures bonded by the welding process. Furthermore, it will discuss their challenges and benefits. In the end, the most suitable and robust algorithm would be deduced, thereby creating new avenues of research and development for automation, testing, structural integrity, structural health monitoring, and fail-safe design of welded structures.

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Manufacturing Execution System in Industry 4.0 era: from implementation to impacts on job design

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Keywords: Digitalisation, Manufacturing, Job design

The spread of Industry 4.0 in recent years has been remarkable in Europe, mainly due to the investments and incentives provided to upgrade manufacturing companies' production processes. This study focuses on the application of the Manufacturing Execution System (MES), often identified as an enabler of Industry 4.0. The first objective of the study is to explore the actual deployment of MES technology in manufacturing organizations and identify any links to the adoption of 4.0 enabling technologies. Second, the research aims to understand the potential impacts of MES on job design and outcomes considering the manufacturing workforce. To achieve these goals, the research is based on a mixed method that can combine the advantages of the quantitative approach with those of the qualitative one. The results of the study show how the implementation of a new technology, in the Indusrty 4.0 context, can have significant effects on the autonomy, variety and relevance of work and consequently how it can improve performance, motivation and satisfaction of workers. Where digitalization is often seen as a threat, our paper instead shows its positive side, while highlighting under what conditions this “good” dimension prevails.

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Mechanical behavior of novel bio composite sandwich structures under quasi-static compressive loading condition

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Keywords: Bio-composite structures, Damage and fracture analysis, Polyure-thane foam, Energy absorber

This study introduces a novel and environmentally friendly compo-site sandwich structures manufactured by natural oak tree cupules as the core reinforcement as well as balsa wood as face sheets. The cupules were placed in different configurations within the sandwich panel, which was made up of two balsa wood face sheets and some of them filled with polyurethane foam. The quasi-static mechanical tests were performed by compressing the specimens in a direction perpendicular to the plane using a DMG testing machine. The results of specimens with natural cores were compared to those from similar tests without the natural core to determine the effectiveness of the natural core in comparison to synthetic alternatives. The panel's damage and failure modes were visually observed and deeply analyzed. Experimental results showed that the introduced novel green composite sandwich panel has an incredible capacity in terms of load bearing, energy absorption and specific absorbed energy.

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Numerical investigation of the mechanical performance of multilayer composite laminates under low velocity impact loading condition

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Keywords: Composite laminates, Damage analysis, Low velocity impact, Numerical simulation

This research aims to numerically analyze the mechanical performance of multilayered composite laminates manufactured by carbon glass fibers under quasi-static indentation process by cylindrical indenters with different nose shapes. For this purpose, the effects of important parameters in the perforation process such as indenter nose shape, layer configurations, and boundary conditions are deeply discussed and their impacts on peak load, maximum deflection, energy absorption as well as failure mechanisms are evaluated. To investigate the boundary condition effects, two different types of rigid fixtures were considered with two different internal geometries of circular and square shapes as well as the same external square perimeter (250 mm × 250 mm). By comparing numerical results for composite laminates with different layup configurations in terms of maximum force and energy absorption, it was found that the functionality of specimens with only carbon/epoxy layers

is the best. In addition, the boundary conditions and indenter nose shape can significantly affect the mechanical response of composite laminates under the perforation process.

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A finite element level-set approach for optimizing the topology of complete disc replacement in the lumbar spine

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Keywords: Topology optimization, lumbar spine, complete disc replacement, finite element method

The study aims to optimize the topology of the complete disc replacement. In this paper, we present a stress-based topology optimization of a complete disc replacement for the lumbar spine using the finite element level set method (LS). The disc was optimized to reduce stress and strain at the level of two segments. The new modified pro disc design was proposed to increase the space for bone ingrowth and increase the stability of fixation. The intact model was tested in six degrees of freedom (compression, extension, flexion, lateral bending, and torsion). The volume of the intact model was reduced by 50 percent by optimizing the topology, and validation showed more significant results under biomechanical loading conditions. The Von Mises stress remains the same with minor differences. Topology optimization allows to increase bone ingrowth and reduces stress-shield effects in the cortical bone and cancellous bone.

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Development of an AR-based Application for Training of Warehouse Operators

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Keywords: Augmented Reality (AR), training, warehouse operation, User-Centered Design (UCD)

Nowadays, logistics is increasingly becoming a crucial process in the modern factories, and numerous companies are paying growing attention to the continuous improvement of quality and efficiency of logistic processes. Although Industry 4.0 concept introduced new digital technologies and led to high degree of automation of industrial and logistic systems, many tasks still rely on human work, especially in the warehouse. As a consequence, the consideration of the operators' needs is definitely a key topic to guarantee high quality work performance, according to Industry 5.0 paradigm. In this context, the quality of the training procedures is fundamental to speed up the knowledge transfer and empower operators through the use of digital technologies. This paper presents the development of a novel training methodology based on Augmented Reality (AR), promoting a learning-by-doing approach to enhance both operators' satisfaction and process efficiency and flexibility. A dedicated AR application has been developed for a spare parts warehouse of a large enterprise operating in the agriculture and construction vehicles sector, according to a User-Centered Design (UCD) approach. Results from field testing showed how the AR application is positively rated by the operators, guaranteeing high user satisfaction, and limiting the training effort.

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Assessing the effect of infill strategies on hardness properties of cuboidal parts printed with wire and arc additive manufacturing

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Keywords: Wire arc additive manufacturing, robot path planning, infill strategy, mechanical properties evaluation

Wire arc additive manufacturing (WAAM) has gained prominence in its utilization in the manufacturing industry due to its ability to build large functional components at high deposition rates. Among the different metal additive manufacturing processes, WAAM has the potential for adoption in the industry due to the ease with which the system can be integrated into factory's robotic welding cells. The ability to develop 3D components using welding has opened possibilities for redesigning and envisioning new product designs. However, there are still challenges related to ensuring process quality with WAAM. Path planning strategies have tremendous effects on structural integrity, mechanical and microstructural properties of the components. The current research aims to experimentally investigate the effect of different infill strategies on the hardness of cuboidal parts in WAAM. The experimental work uses high-strength low-alloy steel as the material of choice. These steels are found in many high-stress applications, such as automotive, load-bearing structures, and low-temperature applications that require a high strength-to-weight ratio. The study reported herein comprises of testing three different infill patterns and their impact on the final part performance (geometric, microscopic defects, and Vickers' hardness). It was observed that all three

strategies ensured a stable deposition process, yet with micro and macro defects. Lack of fusion defects and pores were identified in one of the infill strategies through microscopic evaluation. The hardness mapping showed uniform properties in separate planes for all printing strategies.

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Additive manufacturing for soft electromagnetic (EM) robots: experimental study to reduce vibration

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Keywords: Additive manufacturing, soft robotics, electromagnetic devices, material extrusion

Additive Manufacturing (AM) technologies have been extensively used for the fabrication of several soft robotics devices mostly based on pneumatic actuation systems and Shape Memory Materials (SMMs). Electromagnetic (EM)-based soft robots are still underexploited and results in several benefits such as cost-effectiveness, portability, no need of cooling systems and fast actuation. In the present research paper, a soft EM device has been fabricated using Material Extrusion (MEX) technology. The main contribution of this study is the vibration reduction of additively manufactured soft EM robots: the vibration has been reduced of 16% by using a joint composed of soft ribs. A Design of Experiment (DoE) approach has been used and rib orientation, thickness, and spacing has been studied. The reduction in vibration of soft EM robots, lays the foundation for the usage of MEX technology to fabricate this new appealing class of robots.

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Effectiveness of firm-level sustainability policies: a systematic literature review

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Keywords: policy, sustainability, firm

In the last few years, sustainability has become a key priority for managers, scholars and policymakers. Extensive research on government sustainability policy has been carried out, and many studies have focused on the impacts that such policies could have on firm behaviour. Nevertheless, a holistic and updated map of this research stream still lacks. Thus, the aim of this study is to offer an outline of the current knowledge about sustainability policies targeted to firms, in order to understand the effectiveness of such instruments in the improvement of social and environmental sustainability of companies. To achieve this research goal, a systematic literature review approach has been adopted. By relying on Elsevier's Scopus and combining appropriate keywords related to sustainability, policies and manufacturing industry, we identified and analysed 105 high-quality peer-reviewed papers on the topic. We then identified four main streams of studies: classification of sustainability policies; policy design and implementation barriers; effectiveness of policies, in terms of sustainability performance and/or practices of firms; and moderating role of the policies in affecting the relationship between different factors and firm sustainability performance. The study contributes to both theory and practice: from a theoretical perspective, it provides an overview of previous studies dealing with sustainability governmental policies at firm-level, besides pinpointing directions for future research. From a practical viewpoint, it can offer indications to policymakers for an evaluation of government policies and their effectiveness.

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The ABC of ecological sustainability in C-parts management. A maturity model for the evaluation of sustainability in C-parts management

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Keywords: maturity model, c-parts management, sustainability, sourcing, logistics

Sustainable business requires a holistic approach to sustainability considerations in all areas. C-parts management (CPM), which is dominated by strong efficiency and service considerations, is neither an exception nor does the sector offer excessive "low-hanging fruits" for placing sustainability at the center of economic activity in all aspects. This makes a structured consideration of sustainability aspects in this area, for example by means of maturity models at company level, all the more important. At the same time, maturity models have found multiple applications, including in the area of sustainability, but the existing literature lacks a focus on a maturity model geared towards CPM. This manuscript offers approaches to close this

gap, providing a sustainable maturity model geared for the application in CPM, while also identifying drivers of companies' maturity degree. This provides managers with the opportunity to, first, assess the status quo of their sustainability in CPM, then, second to identify improvement potential, and lastly, third, allows for cross-company benchmarking.

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Global Reporting Initiative: systematic literature review and research directions

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Keywords: Global Reporting Initiative, GRI, Systematic Literature Review, Non-financial reporting

Sustainability reporting will soon become a common practice in organizations of all sizes and sectors, due to increasing external pressures and constraints from stakeholders and regulators. The Global Reporting Initiative (GRI) Standard is the most diffused tool for corporate sustainability reporting and it envisions a sustainable future enabled by transparency and open dialogue about sustainability impacts. This systematic literature review aims at exploring the state of the art of the research on the GRI, providing relevant discussions and insights for future research directions. Findings suggest that determinants and barriers as well as content and quality of reports are quite well investigated, while impacts of GRI on firms' financial and operational practices are still unclear. Overall, GRI is a complete and valid tool for reporting, even though firms seem to lack experience in the practice of sustainability reporting and GRI´s holistic approach hinders reaching some of its quality principles.

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Interdisciplinary research projects: Six lessons from a family business-Industry 4.0 project

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Keywords: Family Business, Industry 4.0, Interdisciplinary Research

Interest in interdisciplinary research has drastically increased in recent years as societal problems require more and more heterogeneous competences and research institutions seek greater long-term impact and more socio-economic implications. Interdisciplinary projects, while combining specific expertise, generate many opportunities and challenges, resulting greater risks. Thus, interdisciplinary research offers a high-risk, high-reward scenario; and currently a disproportionality low amount of attention has been paid to the interdisciplinary research process. In our article, we aim to reflect on our interdisciplinary research project and provide specific guidelines on how to conduct interdisciplinary research projects and overcome potential issues that may arise along the project, increasing the chances of success. Our reflection is based upon our project at the Free University of Bozen-Bolzano involving the two disciplines of engineering/technology and management. We demystify the interdisciplinary research process and summarize what we have learned in 6 lessons, each one referred to a different stage of the process. The research offers practical implications in useful advice for interdisciplinary researchers at every level (i.e., Master students, PhD students, early researchers, Professors, and the overall academic community).

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