Human-Computer Interaction in Industry: A Systematic Review on the Applicability and Value-added of Operator Assistance Systems

Other titles in Foundations and Trends® in Human-Computer Interaction

Modes of Uncertainty in HCI
Robert Soden, Laura Devendorf, Richmond Wong, Yoko Akama and Ann Light
ISBN: 978-1-63828-054-5

A Design Space of Sports Interaction Technology
Dees B.W. Postma, Robby W. van Delden, Jeroen H. Koekoek, Wytse W. Walinga, Ivo M. van Hilvoorde, Bert Jan F. van Beijnum, Fahim A. Salim and Dennis Reidsma
ISBN: 978-1-63828-064-4

Designs on Transcendence: Sketches of a TX machine
Mark Blythe and Elizabeth Buie
ISBN: 978-1-68083-846-6

Auditing Algorithms: Understanding Algorithmic Systems from the Outside In
Danaë Metaxa, Joon Sung Park, Ronald E. Robertson, Karrie Karahalios, Christo Wilson, Jeff Hancock and Christian Sandvig
ISBN: 978-1-68083-916-6

Design Framework for Interactive Highlighting Techniques
Joshua Leung and Andy Cockburn
ISBN: 978-1-68083-924-1

Human-Computer Interaction in Industry: A Systematic Review on the Applicability and Value-added of Operator Assistance Systems

Mirco Moencks
University of Cambridge

Elisa Roth
University of Cambridge

Thomas Bohné
University of Cambridge

Per Ola Kristensson
University of Cambridge
pok21@cam.ac.uk

the essence of knowledge
Boston — Delft

Foundations and Trends® in Human-Computer Interaction

Published, sold and distributed by:
now Publishers Inc.
PO Box 1024
Hanover, MA 02339
United States
Tel. +1-781-985-4510
www.nowpublishers.com
sales@nowpublishers.com

Outside North America:
now Publishers Inc.
PO Box 179
2600 AD Delft
The Netherlands
Tel. +31-6-51115274

The preferred citation for this publication is

M. Moencks *et al.*. *Human-Computer Interaction in Industry: A Systematic Review on the Applicability and Value-added of Operator Assistance Systems*. Foundations and Trends® in Human-Computer Interaction, vol. 16, no. 2-3, pp. 65–213, 2022.

ISBN: 978-1-63828-123-8

Foundations and Trends® in Human-Computer Interaction

Volume 16, Issue 2-3, 2022

Editorial Board

Editorial Scope

Topics

Foundations and Trends® in Human-Computer Interaction publishes survey and tutorial articles in the following topics:

- History of the research community
- Theory
- Technology
- Computer Supported Cooperative Work
- Interdisciplinary influence
- Advanced topics and trends

Information for Librarians

Foundations and Trends® in Human-Computer Interaction, 2022, Volume 16, 4 issues. ISSN paper version 1551-3955. ISSN online version 1551-3963. Also available as a combined paper and online subscription.

Contents

Human-Computer Interaction in Industry: A Systematic Review on the Applicability and Value-added of Operator Assistance Systems

Mirco Moencks, Elisa Roth, Thomas Bohné and Per Ola Kristensson

Department of Engineering, University of Cambridge, UK; pok21@cam.ac.uk

ABSTRACT

In industry, the Fourth Industrial Revolution is transforming the roles of people, technology and work on the shop floor. Despite ongoing strides towards automation, people are anticipated to remain integral contributors in future manufacturing. Where full automation is ineffective or infeasible, Operator Assistance Systems (OAS) can augment workers' cognitive or physical capabilities. We frame OAS as a subset of Human-Computer Interaction (HCI) systems designed for the purpose of workforce augmentation in production systems. However, while OAS are anticipated to address key needs in industry, a challenge for both OAS researchers and industrial practitioners is to identify the most promising applications of OAS and justify them from a value-added perspective. This contribution addresses this challenge by presenting a systematic literature review of 2,928 papers, revealing (a) 11 application areas for OAS; and (b) 12 approaches for assessing the value-added of OAS.

Mirco Moencks, Elisa Roth, Thomas Bohné and Per Ola Kristensson (2022), "Human-Computer Interaction in Industry: A Systematic Review on the Applicability and Value-added of Operator Assistance Systems", Foundations and Trends® in Human-Computer Interaction: Vol. 16, No. 2-3, pp 65–213. DOI: 10.1561/1100000088.

Moreover, we discuss implications for OAS, with a particular focus on integrating OAS in industry.

1

Introduction

1.1 Motivation

We live in a manufactured world. The manufacturing and production industry is one of the primary sources of economic prosperity for most countries (Sainsbury, 2020). In general, production deals with (a) the transformation of materials into goods by applying energy, labor, information, and other means of production; and (b) operations which enable or support this transformation (Dyckhoff, 2006). Industries typically strive to produce the right goods for the right customer at the right time, location, quantity, quality, and cost. In addition to this overarching objective, manufacturing industries are faced with a set of challenges, such as (a) meeting increased customer requirements; (b) addressing increasing complexity of products and supply chains; (c) ensuring machine and workforce productivity; and (d) empowering the workforce by creating opportunities for training and lifelong learning (Moencks *et al.*, 2022c; Kochan, 2017; Drucker, 1999).

In order to increase productivity, organizations have leveraged technologies in production systems since the beginning of industrialization, ranging from simple tools to sophisticated assembly lines. In the 1960s, two approaches to improve production emerged: *automation* and *aug-*

mentation (Engelbart, 1962). In the context of *Levels of Automation* (LoA) (Frohm *et al.*, 2008), full automation typically aims to replace humans with autonomous agents or processes. Augmentation strives to identify the optimal combination of humans and technology in production environments. Until recently, physical and mechanical *automation* dominated industrial research. However, with the emergence of concepts such as the Fourth Industrial Revolution (I4.0), the potential of HCI serving a transformative role in manufacturing has gained significant interest and relevance in industry (Figure 1.1).

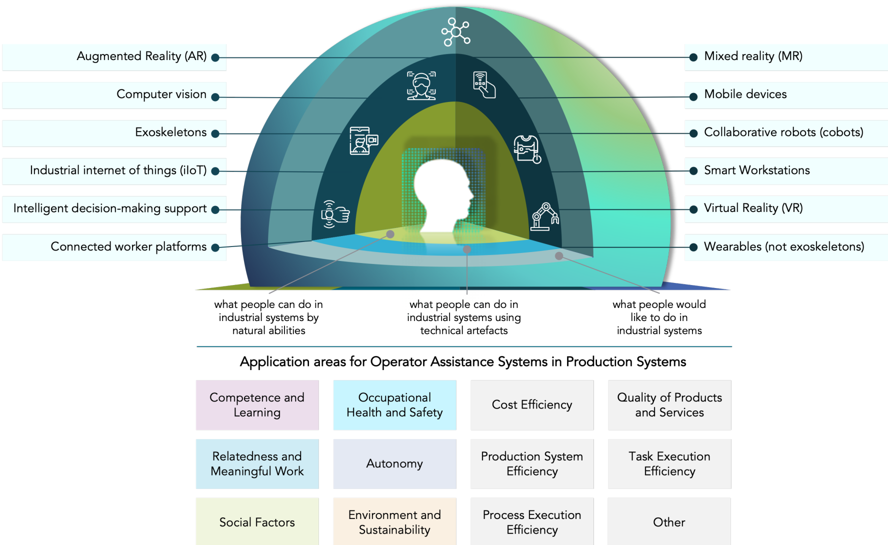

Figure 1.1: Operator Assistance Systems in Industry. The review revealed 12 types of Operator Assistance Systems that can augment the capabilities of operators.

I4.0 is a concept subsuming current developments in advanced manufacturing environments and value chains. A core objective of I4.0 is the intelligent interconnection of operators, manufacturing machines, cyber-physical systems, and processes by the means of Information and Communication Technology (ICT) (Kagermann *et al.*, 2011). Eventually, the interconnection of these agents results in human-in-the-loop Cyber-Physical Production Systems (CPPS). As depicted in Figure 1.2, in CPPS, humans interact with both the physical world and the cyber sphere to ensure that production processes are effective. Although

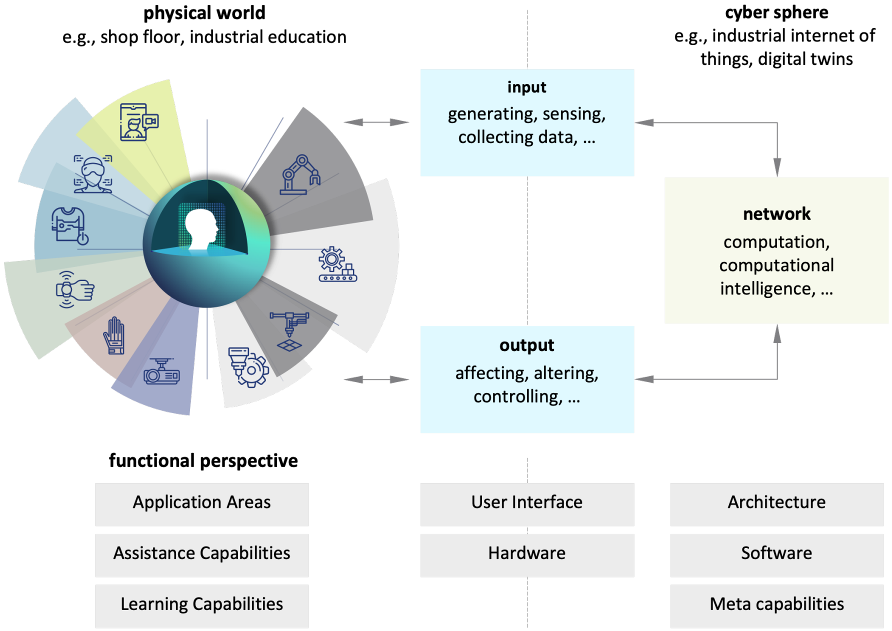

Figure 1.2: Cyber-physical Production Systems. The figure depicts the relationship between the physical world, the cyber sphere and OAS (highlighted in color) that can augment the capabilities of the workforce during the execution of industrial jobs. Building on Moencks *et al.* (2022a) and Roth *et al.* (2022).

humans have been interacting with computers for decades in manufacturing, the relationship between humans and computers is expected to become increasingly relevant, and potentially ubiquitous, for operators.

Activities related to I4.0 and OAS in CPPS typically imply a significant transformation of the roles of people and technology, as well as the nature of work on shop floors (Moencks *et al.*, 2022c; Costa *et al.*, 2019). Additionally, with an increased degree of automation technology in industrial environments, it appears to be more challenging to operate and maintain production systems (Bainbridge, 1983; Kremer, 1993). Further, many manufacturing organizations' capability to remain competitive depends on their ability to increase workforce productivity and effectively train human operators (Penesis *et al.*, 2017; Chryssolouris *et al.*, 2013). Where total automation is considered ineffective or infeasible, the presence of humans is anticipated to remain essential on future shop floors (see Figure 1.1 and Pfeiffer, 2016). In face of rising complexities in production, Operator Assistance Systems (OAS) are seen as a promising approach to increase business excellence and workforce satisfaction, resulting in more human-centric production systems (Moencks *et al.*, 2022a). This development coincides with evolving visions of work-balancing human-centric considerations with advancements in technologies (Pacaux-Lemoine and Flemisch, 2021). Although there is still no consensus on how this concept should be named and defined, some work labeled these human-centric considerations “Industry 5.0” (Breque *et al.*, 2021), or “Society 5.0” (Deguchi *et al.*, 2020).

1.2 Introduction to OAS

OAS can be conceptualized as human-computer interaction systems specifically designed to interact with industrial operators to augment their cognitive or physical capabilities whilst performing certain work tasks (Figure 1.2). For example, OAS may augment cognitive capabilities, such as communication (Mantravadi *et al.*, 2020), data capturing and data analysis (Roth *et al.*, 2020), decision-making support (Ito *et al.*, 2020), information and knowledge management (López-Ramos *et al.*, 2019), or task guidance (Liu and Chiang, 2018) for a variety of cross-hierarchical, i.e., strategic, tactic and operational, user groups (Mark *et al.*, 2019b; Moencks *et al.*, 2022a; Flemisch *et al.*, 2019).

An OAS typically leverages technologies such as (a) immersive reality, i.e., Virtual Reality (VR) (Schroeder *et al.*, 2017), eye-worn or projection based Augmented Reality (AR) (Schmiedinger *et al.*, 2020), and Mixed Reality (MR) (Munoz *et al.*, 2020); (b) computer vision (Roth *et al.*, 2020); (c) exoskeletons (Salvadore *et al.*, 2020); (d) industrial Internet of Things (iIoT) (Cecil *et al.*, 2018); (e) knowledge platforms (Ansari, 2020); (f) mobile devices (Josifovska *et al.*, 2019); (g) collaborative or mobile robots (Schmidbauer *et al.*, 2020); (h) static (desktop) setups (Boring *et al.*, 2015); or (i) other wearable devices (Minnetti *et al.*, 2020). For example, one use case of OAS is in quality inspection. Here, a computer vision-enabled application filters products based on an optical inspection and forwards products that may require another in-depth qualitative assessment by humans. During the qualitative assessment carried out by an operator, a projection-based AR application highlights those areas that may potentially be faulty and displays relevant product information, thus decreasing cognitive load and search time for the operator.

1.3 Objectives

When considering OAS in industry, it is crucial to understand the concept of economic viability, which is typically used in industrial decision-making processes (Naumann and Pflaum, 2018). This means that any investment into OAS will need to provide a positive return (Neely *et al.*, 1995). Existing work that has systematically reviewed OAS in industry focused on (a) worker capabilities (Dornelles *et al.*, 2022), (b) design principles (Gil *et al.*, 2019), (c) integration architectures (Cimini *et al.*, 2020), or (d) technological capabilities of OAS (Roth *et al.*, 2022). However, there is a lack of knowledge on the value-added of OAS in different application areas of OAS in manufacturing (Table 1.1). Despite the existence of multiple use cases of OAS in production and operations, industry seems to be lagging behind advances in OAS research. Many insights and best practices from OAS research have not been adopted by industry yet (Moencks *et al.*, 2020). One reason for this might be the non harmonized understanding of OAS' potential in industry. The current body of knowledge lacks understanding of the distinctive scenarios where OAS could be effectively integrated in production systems (Moencks *et al.*, 2020).

Table 1.1: Comparison of OAS reviews.

Dimension of Analysis	**Dornelles *et al.* (2022)**	**Gil *et al.* (2019)**	**Cimini *et al.* (2020)**	**Roth *et al.* (2022)**	**This review**
Industry 4.0 technologies	YES	YES	YES	YES	YES
OAS application areas	YES				YES
OAS design		YES		YES	YES
Technological capabilities of OAS			YES	YES	
Augmented workforce capabilities	YES		YES		
Value-added (qualified)	YES				YES
Value-added (quantified)					YES

Following a systematic literature review, this work explores the role of OAS in industry, the application areas of OAS to support human operators on shop floors, and the value-added by OAS on the overall industrial system they are embedded in. As outlined below, this paper provides four contributions to the OAS community:

- **Application areas of OAS in manufacturing and production industries.** We outline to what extent manufacturing and production can be characterized as areas where (a) OAS are increasingly relevant; or (b) the full potential of OAS advances have not yet been realized.
- **Value-added of OAS.** The value-added that an OAS provides to a production environment is often the single most relevant criterion in the decision-making process for deploying OAS in industry. Consequently, this paper provides the OAS community with some approaches that can be used to meet this value-driven requirement. This is achieved by discussing value metrics that can be used to emphasize the usefulness of an OAS to industrial practitioners.
- **Implications.** As part of the objective to enable the OAS community to better understand how manufacturing and production industries use OAS, we shed light on OAS-related adoption barriers, contextual issues, and areas to focus on when conducting research in advanced manufacturing and production. To that end we discuss the requirements of several cross-hierarchical stakeholder groups (e.g., technology user, buyer, workforce council, manager).
- **HCI in industry.** This contribution shows that more HCI research is required for manufacturing organizations to be able to effectively integrate technologies into their production systems. We hope this contribution can act as a stimulation for further HCI research in manufacturing contexts (hence the selection of this journal). To achieve that, a dual approach seems promising, i.e. (a) fostering further HCI research in the context of manufacturing, and (b) empowering manufacturing organizations to further explore HCI to improve their production systems.

This work is organized as follows (Table 1.2): Section 2.1 delineates the applied review method. Because OAS research involves multiple, interrelated research fields such as information systems research or human-computer interaction, it was necessary to build upon complementary review methods (cf. Tranfield *et al.* (2003), Ridley (2012), Wobbrock and Kientz (2016), Denyer and Tranfield (2009), and Page *et al.* (2021)). Second, overall findings are presented to put the application areas of OAS into perspective (Section 2.2). Section 3 explores how far the value-added of OAS has been considered in related work from different perspectives. Then, emphasis is placed on OAS application areas (Section 4), and the assessment of OAS in industry (Section 5). Section 6 synthesizes the insights gained from the research. Finally, the conclusion reflects upon the immediate and broader implications of this work.

Table 1.2: Outline of the Systematic Literature Review.

#	**Focus of Review**	**Section**
1	Review method	2.1
2	Overall findings of reviewed work	2.2
3	Value-added of OAS	3
4	Identified application areas of OAS	4
5	Application area: Production System Efficiency	4.1
6	Application area: Competence and Learning	4.2
7	Application area: Relatedness and Meaningful Work	4.3
8	Application area: Task Execution Efficiency	4.4
9	Application area: Occupational Health and Safety	4.5
10	Application area: Quality of Products and Services	4.6
11	Application area: Process Execution Efficiency	4.7
12	Application area: Autonomy	4.8
13	Application area: Cost Efficiency	4.9
14	Application area: Social Factors	4.10
15	Application area: Environment and Sustainability	4.11
16	OAS Assessment in Industry	5

References

Aaltonen, I. and T. Salmi. (2014). “Experiences and expectations of collaborative robots in industry and academia: Barriers and development needs”. In: vol. 38. 1151–1158. doi: 10.1016/j.promfg.2020.01.204.

Abu Hanieh, A., S. Abdelall, and A. Hasan. (2016). “Decision Support System for Industrial Social Performance”. *Procedia CIRP*. 40: 329–334. doi: 10.1016/j.procir.2016.01.052.

Accorsi, R., A. Tufano, A. Gallo, F. G. Galizia, G. Cocchi, M. Ronzoni, A. Abbate, and R. Manzini. (2019). “An application of collaborative robots in a food production facility”. In: vol. 38. 341–348. doi: 10.1016/j.promfg.2020.01.044.

Acerbi, F., S. Assiani, and M. Taisch. (2019). “A Methodology to Assess the Skills for an Industry 4.0 Factory”. *Advances in Production Management Systems: Towards Smart Production Management Systems, Apms 2019, Pt Ii*: 520–527. doi: 10.1007/978-3-030-29996-5_60.

Adem, A., E. Cakit, and M. Dagdeviren. (2020). “Occupational health and safety risk assessment in the domain of Industry 4.0”. *Sn Applied Sciences*. 2(5). doi: ARTN97710.1007/s42452-020-2817-x.

Aehnelt, M. (2016). "Plant@Hand: Intelligent assistance systems for Industry 4.0". *WT Werkstattstechnik*. 106(4): 273–274. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85027154673%5C&partnerID=40%5C&md5=bd6184010e9123c7fdfee9ed05b19f7d.

Ahmed, B., S. Shafiq, C. Sanin, and E. Szczerbicki. (2019). "Towards Experience-Based Smart Product Design for Industry 4.0". *Cybernetics and Systems*. 50(2): 165–175. DOI: 10.1080/01969722.2019.1565123.

Aksu, V., S. Jenderny, S. Martinetz, and C. Röcker. (2019). "Providing Context-Sensitive Mobile Assistance for People with Disabilities in the Workplace". In: Cham. 3–14.

Alexopoulos, K., S. Makris, V. Xanthakis, K. Sipsas, and G. Chryssolouris. (2016). "A concept for context-aware computing in manufacturing: the white goods case". *International Journal of Computer Integrated Manufacturing*. 29(8): 839–849. DOI: 10.1080/0951192X.2015.1130257.

Alkhatib, W. and C. Rensing. (2016). "Towards a classification of learning support systems at the digitized workplace". In: vol. 1669. 188–194. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-84988851676%5C&partnerID=40%5C&md5=a69c3b23ea2f50b7ae2d544b3573bd2e.

Almquist, E. (2019). "Digitally transforming knowledge with augmented reality tools". In: 2960–2967. DOI: 10.33313/377/310.

Amrin, A. K. and N. K. Nurlanova. (2020). "Innovation Activity: Localization, New Trends and Assessment Methods". *Inzinerine Ekonomika Engineering Economics*. 31(2): 134–144. DOI: 10.5755/j01.ee.31.2.21501.

Andersen, R., C. Ketelsen, K. Nielsen, A. L. Andersen, T. D. Brunoe, and S. Bech. (2018). "A Conceptual Digital Assistance System Supporting Manual Changeovers in High-Variety Production". In: vol. 536. *IFIP Advances in Information and Communication Technology*. 449–455. DOI: 10.1007/978-3-319-99707-0_56.

Andolina, S., P. Ariano, D. Brunetti, N. Celadon, G. Coppo, A. Favetto, C. Gena, S. Giordano, and F. Vernero. (2019). "Experimenting with Large Displays and Gestural Interaction in the Smart Factory". In: *IEEE International Conference on Systems Man and Cybernetics Conference Proceedings*. 2864–2869. URL: %3CGo%20to%20ISI%3E://WOS:000521353902145.

Angelopoulou, A., K. Mykoniatis, and N. R. Boyapati. (2020). "Industry 4.0: The use of simulation for human reliability assessment". In: vol. 42. 296–301. DOI: 10.1016/j.promfg.2020.02.094.

Angerer, P., A. Müller, S. Süß, D. Lehr, A. Buchner, and N. Dragano. (2018). "Psychological risk assessment for the digitalised workplace: The DYNAMIK 4.0 system". *Arbeitsmedizin Sozialmedizin Umweltmedizin*. 53(11): 718–722. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85056698653%5C&partnerID=40%5C&md5=df96057f112a8e9dfe4f8f928bb6f916.

Ansari, F., S. Erol, and W. Sihn. (2018a). "Rethinking Human-Machine Learning in Industry 4.0: How Does the Paradigm Shift Treat the Role of Human Learning?" In: vol. 23. *Procedia Manufacturing*. 117–122. DOI: 10.1016/j.promfg.2018.04.003.

Ansari, F., P. Hold, and M. Khobreh. (2020). "A knowledge-based approach for representing jobholder profile toward optimal human-machine collaboration in cyber physical production systems". *Cirp Journal of Manufacturing Science and Technology*. 28: 87–106. DOI: 10.1016/j.cirpj.2019.11.005.

Ansari, F. (2020). "Cost-Based Text Understanding to Improve Maintenance Knowledge Intelligence in Manufacturing Enterprises". *Computers & Industrial Engineering*. 141: 106319. DOI: 10.1016/j.cie.2020.106319.

Ansari, F., P. Hold, and W. Sihn. (2018b). "Human-Centered Cyber Physical Production System: How Does Industry 4.0 impact on Decision-Making Tasks?" In: DOI: 10.1109/TEMSCON.2018.8488409.

Ante, G., F. Facchini, G. Mossa, and S. Digiesi. (2018). "Developing a key performance indicators tree for lean and smart production systems". *IFAC-PapersOnLine*. 51(11): 13–18. DOI: 10.1016/j.ifacol.2018.08.227.

Aqel, M. J., O. A. Nakshabandi, and A. Adeniyi. (2019). "Decision support systems classification in industry". *Periodicals of Engineering and Natural Sciences*. 7(2): 774–785. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85070352900%5C&partnerID=40%5C&md5=d6f59d87960c29f6badf756899aadce4.

Ardanza, A., A. Moreno, A. Segura, M. de la Cruz, and D. Aguinaga. (2019). "Sustainable and flexible industrial human machine interfaces to support adaptable applications in the Industry 4.0 paradigm". *International Journal of Production Research*. 57(12): 4045–4059. DOI: 10.1080/00207543.2019.1572932.

Arkan, C. (2020). "Empowering Manufacturing's Firstline Statt to be better Collaborators and Communicators".

Arnaldo Valdes, R. and V. F. Gómez Comendador. (2018). "Aviation 4.0: More safety through automation and digitization". In: vol. 174. 225–236. DOI: 10.2495/SAFE170211.

Arnold, C., J. W. Veile, and K. I. Voigt. (2018). "What drives industry 4.0 adoption? An examination of technological, organizational, and environmental determinants". URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85085667297%5C&partnerID=40%5C&md5=b4e73e63fe1b5a89c18af134f3500c47.

Åsa, F.-B., D. Li, and M. Åkerman. (2018). *Creating Strategies to Improve the Use of IT- and IS- ystems in Final Assembly*. DOI: 10.3233/978-1-61499-902-7-177.

Asad, M. M., R. B. Hassan, F. Sherwani, M. Aamir, Q. M. Soomro, and S. Sohu. (2019). "Design and development of a novel knowledge-based decision support system for industrial safety management at drilling process: HAZFO Expert 1.0". *Journal of Engineering, Design and Technology*. 17(4): 705–718. DOI: 10.1108/JEDT-09-2018-0167.

Asare, A. O., P. C. Addo, E. O. Sarpong, and D. Kotei. (2020). "COVID-19: Optimizing Business Performance through Agile Business Intelligence and Data Analytics". *Open Journal of Business and Management*. 8(5): 2071–2080.

Aschenbrenner, D., M. E. Latoschik, and K. Schilling. (2016). *Industrial Maintenance with Augmented Reality: Two Case Studies. 22nd Acm Conference on Virtual Reality Software and Technology*. 341–342. DOI: 10.1145/2993369.2996305.

Autor, D., D. Dorn, L. F. Katz, C. Patterson, and J. Van Reenen. (2020). "The Fall of the Labor Share and the Rise of Superstar Firms*". *The Quarterly Journal of Economics*. 135(2): 645–709. DOI: 10.1093/qje/qjaa004.

Avalle, G., F. De Pace, C. Fornaro, F. Manuri, and A. Sanna. (2019). "An Augmented Reality System to Support Fault Visualization in Industrial Robotic Tasks". *Ieee Access*. 7: 132343–132359. DOI: 10.1109/access.2019.2940887.

Azevedo Antunes, R., L. Brito Palma, H. Duarteramos, and P. Gil. (2019). "Intelligent HCI Device for Assistive Technology". In: vol. 553. *IFIP Advances in Information and Communication Technology*. 157–168. DOI: 10.1007/978-3-030-17771-3_13.

Badave, A., R. Jagtap, R. Kaovasia, S. Rahatwad, and S. Kulkarni. (2020). "Android Based Object Detection System for Visually Impaired". In: 34–38. DOI: 10.1109/I4Tech48345.2020.9102694.

Badiru, A. B. (2013). *Handbook of industrial and systems engineering, second edition*. *Handbook of Industrial and Systems Engineering, Second Edition*. 1–1409. DOI: 10.1201/b15964.

Bainbridge, L. (1983). "Ironies of automation". *Automatica*. 19(6): 775–779. DOI: 10.1016/0005-1098(83)90046-8.

Baldauf, M., S. Müller, A. Seeliger, T. Küng, A. Michel, and W. Züllig. (2021). "Human Interventions in the Smart Factory–A Case Study on Co-Designing Mobile and Wearable Monitoring Systems with Manufacturing Staff". In: 1–6.

Barbieri, L. and E. Marino. (2019). "An Augmented Reality Tool to Detect Design Discrepancies: A Comparison Test with Traditional Methods". In: vol. 11614 LNCS. 99–110. DOI: 10.1007/978-3-030-25999-0_9.

Barbosa, A. D., F. P. Silva, L. R. D. Crestani, and R. B. Otto. (2018). "Virtual Assistant to Real Time Training on Industrial Environment". In: vol. 7. *Advances in Transdisciplinary Engineering*. 33–42. DOI: 10.3233/978-1-61499-898-3-33.

Barig, B., K. Balzereit, and T. Hutschenreuther. (2019). *Applying OPC-UA for Factory-Wide Industrial Assistance Systems*. *2019 IEEE International Workshop on Factory Communication Systems*. URL: %3CGo%20to%20ISI%3E://WOS:000490866300001.

Battini, D., M. Calzavara, F. Sgarbossa, and A. Persona. (2017). "MRP theory supporting trade-off between investments in collaborative robots and production in foreign countries for a water pumps supply chains". In: 229–234. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85051692411%5C&partnerID=40%5C&md5=814ec5b2ce6264d4bc77517e23624369.

Bauer, W., O. Ganschar, B. Pokorni, and S. Schlund. (2014). "Concept of a Failures Management Assistance System for the Reaction on Unforeseeable Events during the Ramp-Up". In: vol. 25. *Procedia CIRP*. 420–425. DOI: 10.1016/j.procir.2014.10.058.

Bauernhansl, T., M. Ten Hompel, and B. Vogel-Heuser. (2014). *Industrie 4.0 in Produktion, Automatisierung und Logistik: Anwendung-Technologien-Migration*.

Becker, T. and H. Stern. (2016). "Future trends in human work area design for cyber-physical production systems". In: vol. 57. *Procedia CIRP*. 404–409. DOI: 10.1016/j.procir.2016.11.070.

Belo, J., A. Fender, T. Feuchtner, K. Gronbaek, and Acm. (2019). *Digital Assistance for Quality Assurance: Augmenting Workspaces Using Deep Learning for Tracking Near-Symmetrical Objects. Proceedings of the 2019 Acm International Conference on Interactive Surfaces and Spaces*. 275–287. DOI: 10.1145/3343055.3359699.

Bertram, P., M. Birtel, F. Quint, and M. Ruskowski. (2018). "Intelligent Manual Working Station through Assistive Systems". *IFAC-PapersOnLine*. 51(11): 170–175. DOI: 10.1016/j.ifacol.2018.08.253.

Bertram, P., W. Motsch, P. Rübel, and M. Ruskowski. (2019). "Intelligent material supply supporting assistive systems for manual working stations". In: vol. 38. 983–990. DOI: 10.1016/j.promfg.2020.01.182.

Betti, F. and E. de Boer. (2020). "White Paper - Global Lighthouse Network: Four Durable Shifts for a Great Reset in Manufacturing". *Report*. World Economic Forum.

Bhatia, M. (2020). "Game theory based framework of smart food quality assessment". *Transactions on Emerging Telecommunications Technologies*. DOI: ARTNe392610.1002/ett.3926.

Biegler, C., W. Sihn, A. Steinwender, V. Rocchi, and A. Sala. (2018). "Adoption of Factory of the Future technologies Concept of an impact indicator system to track the path towards the Factory of the Future". In: *International ICE Conference on Engineering Technology and Innovation*. URL: %3CGo%20to%20ISI%3E://WOS:000445499800061.

Bildstein, A. and J. Seidelmann. (2014). "Industrie 4.0-Readiness: Migration zur Industrie 4.0-Fertigung". In: Wiesbaden. 581–597. DOI: 10.1007/978-3-658-04682-8_30.

Bocciarelli, P., A. D'Ambrogio, A. Giglio, and E. Paglia. (2017). "A BPMN extension for modeling Cyber-Physical-Production-Systems in the context of Industry 4.0". In: *IEEE International Conference on Networking Sensing and Control*. 599–604. URL: %3CGo%20to%20ISI%3E://WOS:000463480000102.

Bodi, S., R. Comes, A. Weckenmann, and S. Popescu. (2016). *ASSISTIVE AUGMENTED ENVIRONMENT IN QUALITY INSPECTION AND STATISTICAL PROCESS CONTROL. 2016 International Conference on Production Research - Regional Conference Africa, Europe and the Middle East*. 493–498. URL: %3CGo%20to%20ISI%3E://WOS:000436122900083.

Böhm, M. and B. Stiglbauer. (2020). "Psychosocial vocational rehabilitation in a world of work 4.0—Between demands and needs". *Neuropsychiatrie*. 34(1): 5–14. DOI: 10.1007/s40211-019-0316-3.

Bojko, M., R. Riedel, and M. Tawalbeh. (2019). "Computer-Aided Selection of Participatory Design Methods". In: *IFIP Advances in Information and Communication Technology*. 466–474. DOI: 10.1007/978-3-030-29996-5_54.

Borangiu, T., O. Morariu, S. Raileanu, D. Trentesaux, P. Leitao, and J. Barata. (2020). "Digital transformation of manufacturing. Industry of the Future with Cyber-Physical Production Systems". *Romanian Journal of Information Science and Technology*. 23(1): 3–37. URL: %3CGo%20to%20ISI%3E://WOS:000508927500001.

Bordel, B., R. Alcarria, and T. Robles. (2019). "Industry 4.0 paradigm on teaching and learning engineering". *International Journal of Engineering Education*. 35(4): 1018–1036. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85073659264%5C&partnerID=40%5C&md5=eeda33b6b734d13ba012ade08aafa892.

Boring, R., K. Thomas, T. Ulrich, and R. Lew. (2015). "Computerized Operator Support Systems to Aid Decision Making in Nuclear Power Plants". *6th International Conference on Applied Human Factors and Ergonomics (Ahfe 2015) and the Affiliated Conferences, Ahfe 2015*. 3: 5261–5268. DOI: 10.1016/j.promfg.2015.07.604.

Bortolini, M., M. Faccio, M. Gamberi, and F. Pilati. (2020). "Motion Analysis System (MAS) for production and ergonomics assessment in the manufacturing processes". *Computers & Industrial Engineering*. 139. DOI: UNSP10548510.1016/j.cie.2018.10.046.

Botha, D. (2018). "Knowledge management and the future of work". In: vol. 2. 1142–1150. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055477016%5C&partnerID=40%5C&md5=f873a2faeacf966ca181392c55b9c417.

Bower, M. (2019). "Technology-mediated learning theory". *British Journal of Educational Technology*. 50(3): 1035–1048.

Bragança, S., E. Costa, I. Castellucci, and P. M. Arezes. (2019). "A brief overview of the use of collaborative robots in industry 4.0: Human role and safety". In: vol. 202. 641–650. DOI: 10.1007/978-3-030-14730-3_68.

Brauner, P. and M. Ziefle. (2019). "Why consider the human-in-the-loop in automated cyber-physical production systems? Two cases from cross-company cooperation". In: *IEEE International Conference on Industrial Informatics INDIN*. 861–866. URL: %3CGo%20to%20ISI%3E://WOS:000529510400126.

Breque, M., L. De Nul, and A. Petridis. (2021). "Industry 5.0: towards a sustainable, human-centric and resilient European industry". *Luxembourg, LU: European Commission, Directorate-General for Research and Innovation*.

Bruno, F., L. Barbieri, E. Marino, M. Muzzupappa, and B. Colacino. (2020). "A Handheld Mobile Augmented Reality Tool for On-Site Piping Assembly Inspection". In: 129–139. DOI: 10.1007/978-3-030-31154-4_12.

Bruno, F., L. Barbieri, E. Marino, M. Muzzupappa, L. D'Oriano, and B. Colacino. (2019). "An augmented reality tool to detect and annotate design variations in an Industry 4.0 approach". *International Journal of Advanced Manufacturing Technology*. 105(1-4): 875–887. DOI: 10.1007/s00170-019-04254-4.

Bruzzone, A. G., M. Massei, K. Sinelshchikov, F. Longo, M. Agresta, L. Di Donato, and C. Di Francesco. (2019). "Wearable mixed reality solutions for industrial plants and production lines". In: 181–185. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85074193934%5C&partnerID=40%5C&md5=62cc9bc47d2a66010888ba9633a6be1b.

Buddhan, A., S. Eswaran, D. Buddhan, and S. Sripurushottama. (2019). "Even driven multimodal augmented reality based command and control systems for mining industry". In: vol. 151. 965–970. DOI: 10.1016/j.procs.2019.04.135.

BuHamdan, S., A. Alwisy, and A. Bouferguene. (2020). "Explore the application of reinforced learning to support decision making during the design phase in the construction industry". In: vol. 42. 181–187. DOI: 10.1016/j.promfg.2020.02.068.

Butean, A., M. L. Olescu, N. A. Tocu, and A. Florea. (2019). "Improving Training Methods for Industry Workers though AI Assisted Multi-Stage Virtual Reality Simulations". In: *eLearning and Software for Education*. 61–67. DOI: 10.12753/2066-026x-19-007.

Buttner, S., O. Sand, and C. Rocker. (2017). "Exploring Design Opportunities for Intelligent Worker Assistance: A New Approach Using Projetion-Based AR and a Novel Hand-Tracking Algorithm". In: vol. 10217. *Lecture Notes in Computer Science*. 33–45. DOI: 10.1007/978-3-319-56997-0_3.

Cachada, A., J. Barbosa, P. Leitao, L. Deusdado, J. Costa, J. Teixeira, C. Teixeira, L. Romero, P. M. Moreira, and Ieee. (2019). "Development of Ergonomic User Interfaces for the Human Integration in Cyber-Physical Systems". In: *Proceedings of the IEEE International Symposium on Industrial Electronics*. 1632–1637. URL: %3CGo%20to%20ISI%3E://WOS:000500998700245.

Calabrese, M., M. Cimmino, M. Manfrin, F. Fiume, D. Kapetis, M. Mengoni, S. Ceccacci, E. Frontoni, M. Paolanti, A. Carrotta, G. Toscano, and Asme. (2020). *AN EVENT BASED MACHINE LEARNING FRAMEWORK FOR PREDICTIVE MAINTENANCE IN INDUSTRY 4.0. Proceedings of the Asme International Design Engineering Technical Conferences and Computers and Information in Engineering Conference, 2019, Vol 9*. URL: %3CGo%20to%20ISI%3E://WOS:000519338500037.

Calzavara, M., D. Battini, D. Bogataj, F. Sgarbossa, and I. Zennaro. (2020). "Ageing workforce management in manufacturing systems: state of the art and future research agenda". *International Journal of Production Research*. 58(3): 729–747. DOI: 10.1080/00207543.2019.1600759.

Capaci, R. B. di and C. Scali. (2020). "A Cloud-Based Monitoring System for Performance Assessment of Industrial Plants". *Industrial & Engineering Chemistry Research*. 59(6): 2341–2352. DOI: 10.1021/acs.iecr.9b06638.

Caputo, F., E. D'Amato, A. Greco, I. Notaro, and S. Spada. (2018a). "Human posture tracking system for industrial process design and assessment". In: vol. 722. 450–455. DOI: 10.1007/978-3-319-73888-8_70.

Caputo, F., A. Greco, E. D'Amato, I. Notaro, and S. Spada. (2018b). "On the use of Virtual Reality for a human-centered workplace design". In: vol. 8. *Procedia Structural Integrity*. 297–308. DOI: 10.1016/j.prostr.2017.12.031.

Caputo, F., A. Greco, M. Fera, G. Caiazzo, and S. Spada. (2019). "Simulation Techniques for Ergonomic Performance Evaluation of Manual Workplaces During Preliminary Design Phase". In: vol. 822. *Advances in Intelligent Systems and Computing*. 170–180. DOI: 10.1007/978-3-319-96077-7_18.

Caricato, P. and A. Grieco. (2017). “An application of Industry 4.0 to the production of packaging films”. In: vol. 11. *Procedia Manufacturing*. 949–956. DOI: 10.1016/j.promfg.2017.07.199.

Carvalho, H., C. Pimentel, S. Azevedo, and J. Velez. (2021). “Advanced technologies supporting smart supply chain business processes”. In: 492–500. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050975582%5C&partnerID=40%5C&md5=116325a05cbe0f3c5a73ac619dc9edfd.

Cazzolla, A., R. Lanzilotti, T. Roselli, and V. Rossano. (2019). “Augmented Reality to support education in Industry 4.0”. In: *International Conference on Information Technology Based Higher Education and Training*. URL: %3CGo%20to%20ISI%3E://WOS:000526385500035.

Cecil, J., S. Albuhamood, and A. Cecil-Xavier. (2018). “An Industry 4.0 Cyber-Physical Framework for Micro Devices Assembly”. In: *IEEE International Conference on Automation Science and Engineering*. 427–432. DOI: 10.1109/COASE.2018.8560557.

Ceruti, A., P. Marzocca, A. Liverani, and C. Bil. (2019). “Maintenance in aeronautics in an Industry 4.0 context: The role of Augmented Reality and Additive Manufacturing”. *Journal of Computational Design and Engineering*. 6(4): 516–526. DOI: 10.1016/j.jcde.2019.02.001.

Chen, C. N., T. K. Liu, and Y. M. J. Chen. (2019). “Human-Machine Interaction: Adapted Safety Assistance in Mentality Using Hidden Markov Chain and Petri Net”. *Applied Sciences-Basel*. 9(23). DOI: 10.3390/app9235066.

Cheng, Y. J., M. H. Chen, F. C. Cheng, Y. C. Cheng, Y. S. Lin, and C. J. Yang. (2018). *Developing a Decision Support System (DSS) for a Dental Manufacturing Production Line based on Data Mining. Proceedings of 4th IEEE International Conference on Applied System Innovation 2018*. 638–641. URL: %3CGo%20to%20ISI%3E://WOS:000437351700169.

Choi, J., H. Kim, W. Jung, and S. J. Lee. (2019). “Analysis of interface management tasks in a digital main control room”. *Nuclear Engineering and Technology*. 51(6): 1554–1560. DOI: 10.1016/j.net.2019.04.010.

Chryssolouris, G., D. Mavrikios, and D. Mourtzis. (2013). "Manufacturing systems: skills & competencies for the future". *Procedia CIRp*. 7(2013): 17–24.

Chuang, M., Y. S. Yang, and C. T. Lin. (2009). "Production technology selection: Deploying market requirements, competitive and operational strategies, and manufacturing attributes". *International Journal of Computer Integrated Manufacturing*. 22(4): 345–355. DOI: Pii90783598210.1080/09511920802209066.

Cicconi, P. and R. Raffaeli. (2020). "An industry 4.0 framework for the quality inspection in gearboxes production". *Computer-Aided Design and Applications*. 17(4): 813–824. DOI: 10.14733/cadaps.2020.813-824.

Cimini, C., F. Pirola, R. Pinto, and S. Cavalieri. (2020). "A human-in-the-loop manufacturing control architecture for the next generation of production systems". *Journal of manufacturing systems*. 54: 258–271.

Clausen, P. (2019). "Digital Decision Support Systems for Fnhanced Human Based Decision-making at the Shop Floor Management Level". In: *Portland International Conference on Management of Engineering and Technology*. URL: %3CGo%20to%20ISI%3E://WOS:000518681200002.

Cohen, Y., M. Faccio, F. G. Galizia, C. Mora, and F. Pilati. (2017). "Assembly system configuration through Industry 4.0 principles: the expected change in the actual paradigms". *IFAC-PapersOnLine*. 50(1): 14958–14963. DOI: 10.1016/j.ifacol.2017.08.2550.

Compare, M., P. Baraldi, and E. Zio. (2020). "Challenges to IoT-Enabled Predictive Maintenance for Industry 4.0". *IEEE Internet of Things Journal*. 7(5): 4585–4597. DOI: 10.1109/JIOT.2019.2957029.

Constantinescu, C., E. Francalanza, and D. Matarazzo. (2015). "Towards knowledge capturing and innovative human-system interface in an open-source factory modelling and simulation environment". In: vol. 33. *Procedia CIRP*. 23–28. DOI: 10.1016/j.procir.2015.06.006.

Costa, D., F. Pires, N. Rodrigues, J. Barbosa, G. Igrejas, and P. Leitão. (2019). "Empowering Humans in a Cyber-Physical Production System: Human-in-the-loop Perspective". In: 139–144. DOI: 10.1109/ICPHYS.2019.8780138.

D'Aquin, M., D. Kowald, A. Fessl, E. Lex, and S. Thalmann. (2018). "AFEL - Analytics for Everyday Learning". In: 439–440. DOI: 10.1145/3184558.3186206.

Dahiya, R., D. Akinwande, and J. S. Chang. (2019). "Flexible electronic skin: From humanoids to humans". *Proceedings of the IEEE*. 107(10): 2011–2015. DOI: 10.1109/JPROC.2019.2941665.

Daling, L., A. Abdelrazeq, C. Sauerborn, and F. Hees. (2020). "A Comparative Study of Augmented Reality Assistant Tools in Assembly". In: vol. 972. *Advances in Intelligent Systems and Computing*. 755–767. DOI: 10.1007/978-3-030-19135-1_74.

Dallasega, P., M. Frosolini, and D. T. Matt. (2016). "An approach supporting real-time project management in plant building and the construction industry". In: vol. 13-15-September-2016. 247–251. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85006001520%5C&partnerID=40%5C&md5=90d57d53903bd9c5e6b9afd53e747953.

Dalle Mura, M. and G. Dini. (2020). "Augmented reality in assembly systems: state of the art and future perspectives". In: Springer. 3–22.

Damiani, L., M. Demartini, G. Guizzi, R. Revetria, and F. Tonelli. (2018). "Augmented and virtual reality applications in industrial systems: A qualitative review towards the industry 4.0 era". *IFAC-PapersOnLine*. 51(11): 624–630. DOI: 10.1016/j.ifacol.2018.08.388.

Darvish, K., F. Wanderlingh, B. Bruno, E. Simetti, F. Mastrogiovanni, and G. Casalino. (2018). "Flexible human–robot cooperation models for assisted shop-floor tasks". *Mechatronics*. 51: 97–114. DOI: 10.1016/j.mechatronics.2018.03.006.

Dassisti, M., A. Giovannini, P. Merla, M. Chimienti, and H. Panetto. (2019). "An approach to support Industry 4.0 adoption in SMEs using a core-metamodel". *Annual Reviews in Control*. 47: 266–274. DOI: 10.1016/j.arcontrol.2018.11.001.

Davies, R., T. Coole, and A. Smith. (2017). "Review of socio-technical considerations to ensure successful implementation of Industry 4.0". In: vol. 11. *Procedia Manufacturing*. 1288–1295. DOI: 10.1016/j.promfg.2017.07.256.

Dawidowicz, E., C. Beljaars, F. Maloron, D. Bouric, and M. Thibaudeau. (2019). "PVA Factory 4.0: a hardware-driven approach to assess, develop and qualify Industry 4.0 processes and means for the manufacturing of PhotoVoltaic Assemblies". *2019 European Space Power Conference (Espc)*. URL: %3CGo%20to%20ISI%3E://WOS:000528698500112.

De Amicis, R., A. Ceruti, D. Francia, L. Frizziero, and B. Simões. (2018). "Augmented Reality for virtual user manual". *International Journal on Interactive Design and Manufacturing*. 12(2): 689–697. DOI: 10.1007/s12008-017-0451-7.

De Pace, F., F. Manuri, A. Sanna, and D. Zappia. (2018). "An Augmented Interface to Display Industrial Robot Faults". In: vol. 10851. *Lecture Notes in Computer Science*. 403–421. DOI: 10.1007/978-3-319-95282-6_30.

De Pace, F., F. Manuri, A. Sanna, and D. Zappia. (2019). "A comparison between two different approaches for a collaborative mixed-virtual environment in industrial maintenance". *Frontiers Robotics AI*. 6(MAR). DOI: 10.3389/frobt.2019.00018.

Deguchi, A., C. Hirai, H. Matsuoka, T. Nakano, K. Oshima, M. Tai, and S. Tani. (2020). "What is society 5.0". *Society*. 5: 1–23.

Denyer, D. and D. Tranfield. (2009). "Producing a Systematic Review". In: London. Chap. 39. 671–689.

Deschamps, J., E. Valderrama, and L. Terés. (2016). *Digital Systems: From Logic Gates to Processors*. URL: https://books.google.co.uk/books?id=GBVADQAAQBAJ.

Dhiman, H. and C. Rocker. (2019). "Worker Assistance in Smart Production Environments using Pervasive Technologies". In: *International Conference on Pervasive Computing and Communications*. 95–100. URL: %3CGo%20to%20ISI%3E://WOS:000476951900020.

Dhole, S., A. Kashyap, A. Dangwal, and R. Mohan. (2019). "A novel helmet design and implementation for drowsiness and fall detection of workers on-site using EEG and random-forest classifier". In: vol. 151. 947–952. DOI: 10.1016/j.procs.2019.04.132.

Doll, W. J. and M. A. Vonderembse. (1991). "The evolution of manufacturing systems: Towards the post-industrial enterprise". *Omega*. 19(5): 401–411. DOI: https://doi.org/10.1016/0305-0483(91)90057-Z.

Doltsinis, S., P. Ferreira, M. M. Mabkhot, and N. Lohse. (2020). "A Decision Support System for rapid ramp-up of industry 4.0 enabled production systems". *Computers in Industry*. 116. DOI: 10.1016/j.compind.2020.103190.

Dombrowski, U., T. Rennemann, J. Wullbrandt, W. Schwarze, and A. Denkowski. (2019). "Human-centered introduction of smart devices in production and logistics". *ZWF Zeitschrift fuer Wirtschaftlichen Fabrikbetrieb*. 114(1-2): 76–81. DOI: 10.3139/104.112043.

Dornelles, J., N. F. Ayala, and A. G. Frank. (2022). "Smart Working in Industry 4.0: How digital technologies enhance manufacturing workers' activities". *Computers & Industrial Engineering*. 163: 107804.

Doshi, A., R. T. Smith, B. H. Thomas, and C. Bouras. (2017). "Use of projector based augmented reality to improve manual spot-welding precision and accuracy for automotive manufacturing". *The International Journal of Advanced Manufacturing Technology*. 89(5): 1279–1293.

Drucker, P. F. (1999). "Knowledge-Worker Productivity: The Biggest Challenge". *California Management Review*. 41(2): 79–94. DOI: 10.2307/41165987.

Dudley, J. J. and P. O. Kristensson. (2018). "A Review of User Interface Design for Interactive Machine Learning". *ACM Transactions on Interactive Intelligent Systems*. 8(2): Article 8. DOI: 10.1145/3185517.

Dyckhoff, H. (2006). *Produktionstheorie: Grundzüge industrieller Produktionswirtschaft*.

Eder, M., M. Hulla, F. Mast, and C. Ramsauer. (2020). "On the application of augmented reality in a learning factory working environment". In: vol. 45. 7–12. DOI: 10.1016/j.promfg.2020.04.030.

Egger, J. and T. Masood. (2020). "Augmented reality in support of intelligent manufacturing – A systematic literature review". *Computers and Industrial Engineering*. 140. DOI: 10.1016/j.cie.2019.106195.

Egger-Lampl, S., C. Gerdenitsch, L. Deinhard, R. Schatz, P. Hold, and Ieee. (2019). "Assembly Instructions with AR: Towards measuring Interactive Assistance Experience in an Industry 4.0 Context". In: *International Workshop on Quality of Multimedia Experience*. URL: %3CGo%20to%20ISI%3E://WOS:000482562000041.

Ehmann, D. and C. Wittenberg. (2018). "The idea of Virtual Teach-In in the field of industrial robotics". In: vol. 2018-June. 680–685. DOI: 10.1109/ICCA.2018.8444250.

Eisentrager, M., S. Adler, M. Kennel, S. Moser, and Ieee. (2018). "Changeability in Engineering Symbioses of Agile Methodologies and Virtual Engineering". In: *International ICE Conference on Engineering Technology and Innovation*. URL: %3CGo%20to%20ISI%3E://WOS:000445499800047.

Engelbart, D. C. (1962). "Augmenting human intellect: A conceptual framework". *Menlo Park, CA*.

Engineering, N. A. o. (2003). *The Impact of Academic Research on Industrial Performance*. Washington, DC. 264. DOI: doi:10.17226/10805.

Evers, H. (2017). "Industry 4.0, quality assurance for stainless steel rolling". In: vol. 2017-May. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049245997%5C&partnerID=40%5C&md5=8dc11aaea9ae9c3013fd957896c0bb27.

Faccio, M., E. Ferrari, F. G. Galizia, M. Gamberi, and F. Pilati. (2019). "Real-time assistance to manual assembly through depth camera and visual feedback". In: vol. 81. 1254–1259. DOI: 10.1016/j.procir.2019.03.303.

Fantini, P., M. Pinzone, and M. Taisch. (2020). "Placing the operator at the centre of Industry 4.0 design: Modelling and assessing human activities within cyber-physical systems". *Computers and Industrial Engineering*. 139. DOI: 10.1016/j.cie.2018.01.025.

Fast-Berglund, A., M. Åkerman, D. Li, and O. Salunkhe. (2019). "Conceptualising Assembly 4.0 through the drone factory". 52(13): 1525–1530. DOI: 10.1016/j.ifacol.2019.11.416.

Fellmann, M., S. Robert, S. Buttner, H. Mucha, and C. Rocker. (2017). "Towards a Framework for Assistance Systems to Support Work Processes in Smart Factories". In: vol. 10410. *Lecture Notes in Computer Science*. 59–68. DOI: 10.1007/978-3-319-66808-6_5.

Fera, M., A. Greco, M. Caterino, S. Gerbino, F. Caputo, R. Macchiaroli, and E. D'Amato. (2020). "Towards Digital Twin Implementation for Assessing Production Line Performance and Balancing". *Sensors*. 20(1). DOI: 10.3390/s20010097.

Fernández-Caramés, T. M., P. Fraga-Lamas, M. Suárez-Albela, and M. Vilar-Montesinos. (2018). “A fog computing and cloudlet based augmented reality system for the industry 4.0 shipyard”. *Sensors (Switzerland)*. 18(6). DOI: 10.3390/s18061798.

Ferraguti, F., F. Pini, T. Gale, F. Messmer, C. Storchi, F. Leali, and C. Fantuzzi. (2019). “Augmented reality based approach for on-line quality assessment of polished surfaces”. *Robotics and Computer-Integrated Manufacturing*. 59: 158–167. DOI: 10.1016/j.rcim.2019.04.007.

Fessl, A., S. Thalmann, and V. P. Schindler. (2017). “Adaptive and reflective training support for improving search behaviour in industry 4.0”. In: vol. 1821. 125–126. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018453378%5C&partnerID=40%5C&md5=ff9e16e770a80fbfd495ce03787f6e0a.

Fischer, H. and B. Senft. (2016). “Human-Centered Software Engineering as a Chance to Ensure Software Quality Within the Digitization of Human Workflows”. In: vol. 9856. *Lecture Notes in Computer Science*. 30–41. DOI: 10.1007/978-3-319-44902-9_3.

Fitts, P. M. (1954). “The Information Capacity of the Human Motor System in Controlling the Amplitude of Movement”. *Journal of Experimental Psychology*. 47(6): 381–391. DOI: 10.1037/h0055392.

Fitzgerald, M., N. Kruschwitz, D. Bonnet, and M. Welch. (2013). “Embracing Digital Technology: A New Strategic Imperative”. *Report*. MIT Sloan Management Review.

Flemisch, F., D. A. Abbink, M. Itoh, M.-P. Pacaux-Lemoine, and G. Weßel. (2019). “Joining the blunt and the pointy end of the spear: towards a common framework of joint action, human–machine cooperation, cooperative guidance and control, shared, traded and supervisory control”. *Cognition, Technology & Work*. 21(4): 555–568.

Flores, E. and X. Xu. (2018). “Operator 4.0: The human factor in the new era of manufacturing”. In: URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061325735%5C&partnerID=40%5C&md5=906349f51e65a1a9f2e81e01ba2d0ba1.

Flores, E., X. Xu, and Y. Q. Lu. (2020). "Human Capital 4.0: a workforce competence typology for Industry 4.0". *Journal of Manufacturing Technology Management*. 31(4): 687–703. DOI: 10.1108/jmtm-08-2019-0309.

Flumerfelt, S. and J. Wenson. (2019). "Accelerating sustainability with lean leadership". In: 385–403. DOI: 10.1007/978-3-030-13515-7_13.

Fraga-Lamas, P., T. M. Fernández-Caramés, O. Blanco-Novoa, and M. A. Vilar-Montesinos. (2018). "A Review on Industrial Augmented Reality Systems for the Industry 4.0 Shipyard". *IEEE Access*. 6: 13358–13375. DOI: 10.1109/ACCESS.2018.2808326.

Frazzon, E. M., I. R. S. Agostino, E. Broda, and M. Freitag. (2020). "Manufacturing networks in the era of digital production and operations: A socio-cyber-physical perspective". *Annual Reviews in Control*. DOI: 10.1016/j.arcontrol.2020.04.008.

Frey, C. B. and M. A. Osborne. (2017). "The future of employment: How susceptible are jobs to computerisation?" *Technological Forecasting and Social Change*. 114: 254–280. DOI: https://doi.org/10.1016/j.techfore.2016.08.019.

Frohm, J., V. Lindström, M. Winroth, and J. Stahre. (2008). "Levels of automation in manufacturing". *Ergonomia*.

Galaske, N., A. Arndt, H. Friedrich, K. D. Bettenhausen, and R. Anderl. (2018). "Workforce Management 4.0-Assessment of Human Factors Readiness Towards Digital Manufacturing". *Advances in Ergonomics of Manufacturing: Managing the Enterprise of the Future*. 606: 106–115. DOI: 10.1007/978-3-319-60474-9_10.

Gallala, A., B. Hichri, P. Plapper, and Iop. (2019). "Survey: The Evolution of the Usage of Augmented Reality in Industry 4.0". In: vol. 521. *IOP Conference Series-Materials Science and Engineering*. DOI: 10.1088/1757-899x/521/1/012017.

Gashenko, I. V., N. N. Khakhonova, I. V. Orobinskaya, and Y. S. Zima. (2020). "Competition between human and artificial intellectual capital in production and distribution in Industry 4.0". *Journal of Intellectual Capital*. DOI: 10.1108/jic-11-2019-0275.

Gasova, M., M. Gaso, and A. Stefanik. (2017). "Advanced industrial tools of ergonomics based on Industry 4.0 concept". In: vol. 192. *Procedia Engineering*. 219–224. DOI: 10.1016/j.proeng.2017.06.038.

Gattullo, M., A. Evangelista, A. E. Uva, M. Fiorentino, A. Boccaccio, and V. M. Manghisi. (2019a). "Exploiting Augmented Reality to Enhance Piping and Instrumentation Diagrams for Information Retrieval Tasks in Industry 4.0 Maintenance". In: vol. 11883 LNCS. 170–180. DOI: 10.1007/978-3-030-31908-3_11.

Gattullo, M., G. W. Scurati, M. Fiorentino, A. E. Uva, F. Ferrise, and M. Bordegoni. (2019b). "Towards augmented reality manuals for industry 4.0: A methodology". *Robotics and Computer-Integrated Manufacturing*. 56: 276–286. DOI: 10.1016/j.rcim.2018.10.001.

Gattullo, M., A. E. Uva, M. Fiorentino, and J. L. Gabbard. (2015). "Legibility in Industrial AR: Text Style, Color Coding, and Illuminance". *IEEE Computer Graphics and Applications*. 35(2): 52–61. DOI: 10.1109/MCG.2015.36.

Gavish, N., T. Gutiérrez, S. Webel, J. Rodríguez, M. Peveri, U. Bockholt, and F. Tecchia. (2015). "Evaluating virtual reality and augmented reality training for industrial maintenance and assembly tasks". *Interactive Learning Environments*. 23(6): 778–798.

Geisberger, E. and M. Broy. (2012). "agenda CPS - Integrierte Forschungsagenda Cyber-Physical Systems". *acatech STUDIE*. DOI: 10.1007/978-3-642-29099-2.

Gerbert, P., M. Lorenz, M. Rüßmann, M. Waldner, J. Justus, P. Engel, and M. Harnisch. (2015). "The Future of Productivity and Growth in Manufacturing Industries'." *Report*. URL: https://www.bcg.com/publications/2015/engineered_products_project_business_industry_4_future_productivity_growth_manufacturing_industries.aspx.

Ghislieri, C., M. Molino, and C. G. Cortese. (2018). "Work and organizational psychology looks at the Fourth Industrial Revolution: How to support workers and organizations?" *Frontiers in Psychology*. 9(NOV). DOI: 10.3389/fpsyg.2018.02365.

Ghofrani, J. and D. Reichelt. (2019). "Using voice assistants as HMI for robots in smart production systems". In: vol. 2339. 62–65. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064107460%5C&partnerID=40%5C&md5=7647ef0fa7858358802ff51175afd8ba.

Giakoumis, D., S. Segkouli, K. Votis, I. Paliokas, E. Altsitsiadis, and D. Tzovaras. (2019). "Smart, personalized and adaptive ICT solutions for active, healthy and productive ageing with enhanced workability". In: 442–447. DOI: 10.1145/3316782.3322767.

Gil, M., M. Albert, J. Fons, and V. Pelechano. (2019). "Designing human-in-the-loop autonomous cyber-physical systems". *International journal of human-computer studies*. 130: 21–39.

Giorgio, A. de, M. Romero, M. Onori, and L. H. Wang. (2017). "Human-machine collaboration in virtual reality for adaptive production engineering". In: vol. 11. *Procedia Manufacturing*. 1279–1287. DOI: 10.1016/j.promfg.2017.07.255.

Gofuku, A. (2019). "A Consideration to Display Operator Support Information to Human Operators under High Mental Pressure". *3rd International Conference on Nuclear Energy Technologies and Sciences (Iconets) 2019*. 2180. DOI: Artn02002810.1063/1.5135537.

Gokalp, E., U. Sener, and P. E. Eren. (2017). "Development of an Assessment Model for Industry 4.0: Industry 4.0-MM". In: vol. 770. *Communications in Computer and Information Science*. 128–142. DOI: 10.1007/978-3-319-67383-7_10.

Gomes, M., F. Silva, F. Ferraz, A. Silva, C. Analide, and P. Novais. (2017). "Developing an Ambient Intelligent-Based Decision Support System for Production and Control Planning". In: vol. 557. *Advances in Intelligent Systems and Computing*. 984–994. DOI: 10.1007/978-3-319-53480-0_97.

Gorecky, D., M. Schmitt, M. Loskyll, D. Zuhlke, and Ieee. (2014). "Human-Machine-Interaction in the Industry 4.0 Era". In: *IEEE International Conference on Industrial Informatics INDIN*. 289–294. URL: %3CGo%20to%20ISI%3E://WOS:000349558700043.

Gratz-Kelly, S., A. Meyer, P. Motzki, S. Nalbach, G. Rizzello, and S. Seelecke. (2020). "Force measurement based on dielectric elastomers for an intelligent glove providing worker assessment in the digital production". In: vol. 11375. DOI: 10.1117/12.2558442.

Grochowski, M., H. Simon, D. Bohlender, S. Kowalewski, A. Locklin, T. Muller, N. Jazdi, A. Z. Und, and M. Weyrich. (2020). "Formal methods for reconfigurable cyber-physical systems in production". *At-Automatisierungstechnik*. 68(1): 3–14. DOI: 10.1515/auto-2019-0115.

Gualtieri, L., I. Palomba, F. A. Merati, E. Rauch, and R. Vidoni. (2020). "Design of human-centered collaborative assembly workstations for the improvement of operators' physical ergonomics and production efficiency: A case study". *Sustainability (Switzerland)*. 12(9). DOI: 10.3390/su12093606.

Gualtieri, L., E. Rauch, R. Rojas, R. Vidoni, and D. T. Matt. (2018). "Application of Axiomatic Design for the Design of a Safe Collaborative Human-Robot Assembly Workplace". In: vol. 223. DOI: 10.1051/matecconf/201822301003.

Guerin, C., P. Rauffet, C. Chauvin, and E. Martin. (2019). "Toward production operator 4.0: modelling Human-Machine Cooperation in Industry 4.0 with Cognitive Work Analysis". *Ifac Papersonline*. 52(19): 73–78. DOI: 10.1016/j.ifacol.2019.12.111.

Gürerk, Ö., T. Bohné, and G. Alvarez Alonso. (2019). "Productivity and learning effects of head-mounted AR displays on human-centered work". *Available at SSRN 3264118*.

Gutsche, K. and J. Griffith. (2017). "Automating Motivation: A Workplace Analysis of Service Technicians and the Motivational Impact of Automated Assistance". In: vol. 10371. *Lecture Notes in Computer Science*. 101–108. DOI: 10.1007/978-3-319-61240-9_10.

Hamzeh, R., R. Zhong, X. W. Xu, E. Kajati, and I. Zolotova. (2018). "A technology selection framework for manufacturing companies in the context of industry 4.0". In: 267–276. DOI: 10.1109/DISA.2018.8490606.

Hartley, R. V. L. (1928). "Transmission of information". *Bell System Technical Journal*. 7(3): 535–563. DOI: 10.1002/j.1538-7305.1928.tb01236.x.

Hayes, R. B. and R. Jaikumar. (1988). "Manufacturing's Crisis: New Technologies, Obsolete Organizations". *Harvard Business Review*. 66(5): 9. URL: https://web.b.ebscohost.com/ehost/detail/detail?vid=7%5C&sid=f01feb09-dfe3-4759-9a2f-becf1b025326%5C%40pdc-v-sessmgr02%5C&bdata=JnNpdGU9ZWhvc3QtbGl2ZSZzY29wZT1zaXRl%5C#AN=8800019303%5C&db=bsu.

Heinrich, P. and A. Richter. (2015). "Project Deliverable 1.1 Captured and structured practices of workers and contexts of organizations". 1.

Heinz, M., S. Büttner, and C. Röcker. (2019). "Exploring training modes for industrial augmented reality learning". In: 398–401. DOI: 10.1145/3316782.3322753.

Heinze, F., M. Kloeckner, J. Rossmann, B. Kuhlenkoetter, and J. Deuse. (2015). "Simulating and implementing the integration of service robots into manual work processes". In: 371–376. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-84963543223%5C&partnerID=40%5C&md5=90b054a478d1d9f1c42c452c8cb181cd.

Herkommer, O., T. Kleinbeck, and J. Nitsche. (2017). "Increasing competitiveness and human-centered design - Not a contradiction". *ZWF Zeitschrift fuer Wirtschaftlichen Fabrikbetrieb*. 112(9): 621–625. DOI: 10.3139/104.111796.

Hold, P., S. Erol, G. Reisinger, and W. Sihn. (2017). "Planning and Evaluation of Digital Assistance Systems". In: vol. 9. *Procedia Manufacturing*. 143–150. DOI: 10.1016/j.promfg.2017.04.024.

Hold, P. and W. Sihn. (2016). "Towards a Model to Identify the Need and the Economic Efficiency of Digital Assistance Systems in Cyber-Physical Assembly Systems". *2016 1st International Workshop on Cyber-Physical Production Systems (Cpps)*. URL: %3CGo%20to%20ISI%3E://WOS:000386753300001.

Hollender, M., T. G. Graven, J. Partini, and P. Scharing. (2017). "Process Operation 4.0 Collaborative operations in highly integrated work environments". *Atp Edition*. (5): 52–58. URL: %3CGo%20to%20ISI%3E://WOS:000426881800030.

Holubek, R., R. Ruzarovsky, and D. R. D. Sobrino. (2019). "An Innovative Approach of Industrial Robot Programming Using Virtual Reality for the Design of Production Systems Layout". In: *Lecture Notes in Mechanical Engineering*. 223–235. DOI: 10.1007/978-3-030-18715-6_19.

Hoos, E., P. Hirmer, and B. Mitschang. (2017a). "Context-Aware Decision Information Packages: An Approach to Human-Centric Smart Factories". In: vol. 10509. *Lecture Notes in Computer Science*. 42–56. DOI: 10.1007/978-3-319-66917-5_4.

Hoos, E., M. Wieland, and B. Mitschang. (2017b). "Analysis Method for Conceptual Context Modeling Applied in Production Environments". In: vol. 288. *Lecture Notes in Business Information Processing*. 313–325. DOI: 10.1007/978-3-319-59336-4_22.

Huber, A. and A. Weiss. (2017). "Developing human-robot interaction for an industry 4.0 robot: How industry workers helped to improve remote-hri to physical-hri". In: 137–138. DOI: 10.1145/3029798.3038346.

Hurst, W., N. Shone, D. Tully, and Ieee. (2019). *Investigations into the Development of a Knowledge Transfer Platform for Business Productivity. 5th International Conference on Information Management.* 159–164. URL: %3CGo%20to%20ISI%3E://WOS:000474735200029.

Iber, M., P. Lechner, C. Jandl, M. Mader, and M. Reichmann. (2020). "Auditory augmented process monitoring for cyber physical production systems". *Personal and Ubiquitous Computing*. DOI: 10.1007/s00779-020-01394-3.

Imran, F. and J. Kantola. (2019). "Review of industry 4.0 in the light of sociotechnical system theory and competence-based view: A future research agenda for the evolute approach". In: vol. 783. 118–128. DOI: 10.1007/978-3-319-94709-9_12.

Ito, T., M. Abd Rahman, E. Mohamad, A. Rahman, and M. R. Salleh. (2020). "Internet of things and simulation approach for decision support system in lean manufacturing". *Journal of Advanced Mechanical Design, Systems and Manufacturing*. 14(2). DOI: 10.1299/jamdsm.2020jamdsm0027.

Ituarte, I. F., M. Salmi, R. M. Ballardini, J. Tuomi, and J. Partanen. (2017). "Additive Manufacturing in Finland: Recommendations for a Renewed Innovation Policy". In: vol. 89. *Physics Procedia*. 70–79. DOI: 10.1016/j.phpro.2017.08.002.

Ivaschenko, A., P. Sitnikov, and G. Katirkin. (2019). "Accented visualization in digital industry applications". In: vol. 199. 366–378. DOI: 10.1007/978-3-030-12072-6_30.

Ivorra, E., M. Ortega, M. Alcaniz, and N. Garcia-Aracil. (2018). "Multimodal Computer Vision Framework for Human Assistive Robotics". In: 18–22. DOI: 10.1109/METROI4.2018.8428330.

Jakl, A., L. Schöffer, M. Husinsky, and M. Wagner. (2018). "Augmented reality for industry 4.0: Architecture and user experience". In: vol. 2299. 38–42. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060105744%5C&partnerID=40%5C&md5=f0f6eac464ee30e9c4db1b10e605c524.

Jentsch, D., R. Riedel, A. Jäntsch, and E. Müller. (2013). "Factory audit for industry 4.0 - Strategic approach for capability assessment and gradual introduction of a smart factory". *ZWF Zeitschrift fuer Wirtschaftlichen Fabrikbetrieb*. 108(9): 678–681. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-84886714759%5C&partnerID=40%5C&md5=7a94e9a19c304685b926edd0dff34e62.

Jharko, E. (2017a). "Evaluation of Technical and Economic Indexes and Providing Normal Operation of Nuclear Power Plants". *2017 International Siberian Conference on Control and Communications (Sibcon) Proceedings*. URL: %3CGo%20to%20ISI%3E://WOS:000426785900126.

Jharko, E. (2017b). "Information Operator Support Systems and Information Task of Calculating Technical and Economical Indexes of Nuclear Power Plants". *2017 Tenth International Conference Management of Large-Scale System Development (Mlsd)*. URL: %3CGo%20to%20ISI%3E://WOS:000426530800059.

Jharko, E. (2017c). "Information Operator Support Systems of Nuclear Power Plants and a Flexible Modeling Complex". *2017 International Siberian Conference on Control and Communications (Sibcon) Proceedings*. URL: %3CGo%20to%20ISI%3E://WOS:000426785900127.

Jharko, E. F. (2017d). "Towards the Problem of Creating Information Operator Support Systems for Nuclear Power Plants". *2017 Ieee Ii International Conference on Control in Technical Systems (Cts)*: 356–359. URL: %3CGo%20to%20ISI%3E://WOS:000427398300095.

Johansson, P. E. C., G. Eriksson, P. Johansson, L. Malmskold, A. Fast-Berglund, and L. Moestam. (2017). "ASSESSMENT BASED INFORMATION NEEDS IN MANUAL ASSEMBLY". In: *DEStech Transactions on Engineering and Technology Research*. 366–371. URL: %3CGo%20to%20ISI%3E://WOS:000426981800065.

Johansson, P., L. Malmskold, A. Fasth Fast-Berglund, and L. Moestam. (2018). "Enhancing Future Assembly Information Systems - Putting Theory into Practice". In: vol. 17. *Procedia Manufacturing*. 491–498. DOI: 10.1016/j.promfg.2018.10.088.

Joppen, R., A. Kuhn, D. Hupach, and R. Dumitrescu. (2019). "Collecting data in the assessment of investments within production". In: vol. 79. *Procedia CIRP*. 466–471. DOI: 10.1016/j.procir.2019.02.126.

Josifovska, K., E. Yigitbas, and G. Engels. (2019). "A Digital Twin-Based Multi-modal UI Adaptation Framework for Assistance Systems in Industry 4.0". In: 398–409. DOI: 10.1007/978-3-030-22636-7_30.

Kaasinen, E., S. Aromaa, A. Vaatanen, V. Makela, J. Hakulinen, T. Keskinen, J. Elo, S. Siltanen, V. Rauhala, I. Aaltonen, J. Hella, P. Honkamaa, M. Leppa, A. Niemela, J. Parviainen, S. Saarinen, M. Turunen, J. Tornqvist, J. Valtonen, and C. Woodward. (2018a). "Mobile Service Technician 4.0 - Knowledge-Sharing Solutions for Industrial Field Maintenance". *Interaction Design and Architectures*. (38): 6–27. URL: %3CGo%20to%20ISI%3E://WOS:000467612700002.

Kaasinen, E., F. Schmalfuß, C. Özturk, S. Aromaa, M. Boubekeur, J. Heilala, P. Heikkilä, T. Kuula, M. Liinasuo, S. Mach, R. Mehta, E. Petäjä, and T. Walter. (2020). "Empowering and engaging industrial workers with Operator 4.0 solutions". *Computers and Industrial Engineering*. 139. DOI: 10.1016/j.cie.2019.01.052.

Kaasinen, E., M. Liinasuo, F. Schmalfuß, H. Koskinen, S. Aromaa, P. Heikkilä, A. Honka, S. Mach, and T. Malm. (2018b). "A Worker-Centric Design and Evaluation Framework for Operator 4.0 Solutions that Support Work Well-Being". In: *Human Work Interaction Design. Designing Engaging Automation*. 263–282.

Kaczmarek, S., N. Straub, and M. Henke. (2017). "HOW SERIOUS GAMES UNFOLD THEIR POTENTIAL IN FURTHER TRAINING IN LOGISTICS. RESULTS OF A MULTIPERSPECTIVE EMPIRICAL REQUIREMENTS ANALYSIS". In: *EDULEARN Proceedings*. 9583–9591. URL: %3CGo%20to%20ISI%3E://WOS:000493048104100.

Kadir, B. A. and O. Broberg. (2020). "Human well-being and system performance in the transition to industry 4.0". *International Journal of Industrial Ergonomics*. 76. DOI: 10.1016/j.ergon.2020.102936.

Kagermann, H., W.-D. Lukas, and W. Wahlster. (2011). "Industrie 4.0: Mit dem Internet der Dinge auf dem Weg zur 4. industriellen Revolution". *VDI nachrichten*. 13(1).

Kazancoglu, Y. and Y. Ozkan-Ozen. (2018). "Analyzing Workforce 4.0 in the Fourth Industrial Revolution and proposing a road map from operations management perspective with fuzzy DEMATEL". *Journal of Enterprise Information Management*. 31(6): 891–907. DOI: 10.1108/JEIM-01-2017-0015.

Kerber, F. and P. Lessel. (2015). "Adaptive and gamified worker assistance in the (semi-) manual Industry 4.0 assembly". In: vol. 1443. 28–35. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-84944311658%5C&partnerID=40%5C&md5=5d605a536fb8ef94db09b41686eb6c7a.

Kerpen, D., M. Lohrer, M. Saggiomo, M. Kemper, J. Lemm, and Y. S. Gloy. (2016). *Effects of Cyber-Physical Production Systems on Human Factors in a Weaving Mill Implementation of Digital Working Environments based on Augmented reality. Proceedings 2016 IEEE International Conference on Industrial Technology*. 2094–2098. URL: %3CGo%20to%20ISI%3E://WOS:000386327700325.

Kinzel, H. (2017). "Industry 4.0 - Where Does This Leave the Human Factor?" *Journal of Urban Culture Research*. 15: 70–83. URL: %3CGo%20to%20ISI%3E://WOS:000424296700008.

Klapper, J., B. Pokorni, and M. Hämmerle. (2020). "A potential analysis of cognitive assistance systems in production areas". In: vol. 1131 AISC. 1069–1073. DOI: 10.1007/978-3-030-39512-4_162.

Kleindorfer, P. R. and F. Y. Partovi. (1990). "Integrating Manufacturing Strategy and Technology Choice". *European Journal of Operational Research*. 47(2): 214–224. DOI: Doi10.1016/0377-2217(90)90280-O.

Klimant, P., C. Kollatsch, M. Schumann, and Asme. (2017). *AUGMENTED REALITY SOLUTIONS IN MECHANICAL ENGINEERING. Proceedings of the Asme 12th International Manufacturing Science and Engineering Conference - 2017, Vol 3*. URL: %3CGo%20to%20ISI%3E://WOS:000412248900067.

Klopper, B., M. Dix, L. Schorer, A. Ampofo, M. Atzmueller, D. Arnu, and R. Klinkenberg. (2016). "Defining Software Architectures for Big Data Enabled Operator Support Systems". *2016 Ieee 14th International Conference on Industrial Informatics (Indin)*: 1288–1292. URL: %3CGo%20to%20ISI%3E://WOS:000393551200204.

Knoch, S., N. Herbig, S. Ponpathirkoottam, F. Kosmalla, P. Staudt, D. Porta, P. Fettke, and P. Loos. (2020). "Sensor-based Human–Process Interaction in Discrete Manufacturing". *Journal on Data Semantics*. 9(1): 21–37. DOI: 10.1007/s13740-019-00109-z.

Knospe, O., M. Drewel, T. Mittag, C. Pierenkemper, and D. Hobscheidt. (2018). "Performance enhancement by industry 4.0 for small and medium-sized enterprises". *ZWF Zeitschrift fuer Wirtschaftlichen Fabrikbetrieb*. 113(1-2): 83–87. DOI: 10.3139/104.111867.

Kochan, T. A. (2017). *Shaping the future of work : a handbook for action and a new social contract*. Boston.

Kohlert, M. and A. König. (2016). "Advanced multi-sensory process data analysis and on-line evaluation by innovative human-machine-based process monitoring and control for yield optimization in polymer film industry". *Technisches Messen*. 83(9): 474–483. DOI: 10.1515/teme-2015-0120.

Kolbeinsson, A., E. Lagerstedt, and J. Lindblom. (2018). "Classification of Collaboration Levels for Human-Robot Cooperation in Manufacturing". In: vol. 8. *Advances in Transdisciplinary Engineering*. 151–156. DOI: 10.3233/978-1-61499-902-7-151.

Kolbeinsson, A., E. Lagerstedt, and J. Lindblom. (2019). "Foundation for a classification of collaboration levels for human-robot cooperation in manufacturing". *Production and Manufacturing Research*. 7(1): 448–471. DOI: 10.1080/21693277.2019.1645628.

Komulainen, T. and A. R. Sannerud. (2018). "Learning transfer through industrial simulator training: Petroleum industry case". *Cogent Education*. 5(1): 1–19. DOI: 10.1080/2331186X.2018.1554790.

Kong, X. T. R., H. Luo, G. Q. Huang, and X. Yang. (2019). "Industrial wearable system: the human-centric empowering technology in Industry 4.0". *Journal of Intelligent Manufacturing*. 30(8): 2853–2869. DOI: 10.1007/s10845-018-1416-9.

Konig, M., M. Stadlmaier, T. Rusch, R. Sochor, L. Merkel, S. Braunreuther, J. Schilp, and Ieee. (2019). "MA(2)RA - Manual Assembly Augmented Reality Assistant". In: *International Conference on Industrial Engineering and Engineering Management IEEM*. 501–505. URL: %3CGo%20to%20ISI%3E://WOS:000541902500100.

Kosch, T., M. Funk, Y. Abdelrahman, A. Schmidt, and Acm. (2017). *One Size does not Fit All - Challenges of Providing Interactive Worker Assistance in Industrial Settings. Proceedings of the 2017 Acm International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2017 Acm International Symposium on Wearable Computers*. 1006–1011. DOI: 10.1145/3123024.3124395.

Kovacs, K., F. Ansari, C. Geisert, E. Uhlmann, R. Glawar, and W. Sihn. (2019). "A Process Model for Enhancing Digital Assistance in Knowledge-Based Maintenance". *Machine Learning for Cyber Physical Systems, Ml4cps 2018*. 9: 87–96. DOI: 10.1007/978-3-662-58485-9_10.

Krason, P., A. Maczewska, and A. Polak-Sopinska. (2019). "Human Factor in Maintenance Management". In: vol. 793. 49–56. DOI: 10.1007/978-3-319-94196-7_5.

Kravcik, M. (2019). "Adaptive Workplace Learning Assistance". In: 33–33. DOI: 10.1145/3345002.3349294.

Kremer, M. (1993). "The O-Ring Theory of Economic Development*". *The Quarterly Journal of Economics*. 108(3): 551–575. DOI: 10.2307/2118400.

Kritzler, M., J. Hodges, D. Yu, K. Garcia, H. Shukla, and F. Michahelles. (2019). "Digital companion for industry artificial meets human intelligence". In: 663–667. DOI: 10.1145/3308560.3316510.

Krugh, M. and L. Mears. (2018). "A complementary Cyber-Human Systems framework for Industry 4.0 Cyber-Physical Systems". *Manufacturing Letters*. 15: 89–92. DOI: 10.1016/j.mfglet.2018.01.003.

Kubenke, J. and A. Kunz. (2019). "Potentials of IT-supported assistive systems: Comparison of two user studies in the manufacturing industry". 52(13): 1866–1871. DOI: 10.1016/j.ifacol.2019.11.474.

Kucek, S. and M. Leitner. (2020). "Training the Human-in-the-Loop in Industrial Cyber Ranges". In: vol. 670 LNEE. 107–118. DOI: 10.1007/978-3-030-48602-0_10.

Kumar, K., D. Zindani, and J. P. Davim. (2019). "Socio-technical Considerations". In: 43–51. DOI: 10.1007/978-981-13-8165-2_5.

Lacueva-Perez, F. J., L. Hannola, J. Nierhoff, S. Damalas, S. Chatterjee, T. Herrmann, and M. Schafler. (2018a). "Comparing Approaches for Evaluating Digital Interventions on the Shop Floor". *Technologies*. 6(4). DOI: 10.3390/technologies6040116.

Lacueva-Perez, F. J., J. Khakurel, P. Brandl, L. Hannola, M. A. Gracia-Bandres, M. Schafler, and Acm. (2018b). *Assessing TRL of HCI Technologies Supporting Shop Floor Workers. 11th Acm International Conference on Pervasive Technologies Related to Assistive Environments*. 311–318. DOI: 10.1145/3197768.3203175.

Ladwig, P., B. Dewitz, H. Preu, and M. Säger. (2019). "Remote guidance for machine maintenance supported by physical LEDs and virtual reality". In: 255–262. DOI: 10.1145/3340764.3340780.

Lall, M., H. Torvatn, and E. A. Seim. (2017). "Towards industry 4.0: Increased need for situational awareness on the shop floor". In: vol. 513. 322–329. DOI: 10.1007/978-3-319-66923-6_38.

Landscheidt, S. and M. Kans. (2016). "Method for assessing the total cost of ownership of industrial robots". In: vol. 57. *Procedia CIRP*. 746–751. DOI: 10.1016/j.procir.2016.11.129.

Lanzotti, A., F. Carbone, G. Di Gironimo, S. Papa, F. Renno, A. Tarallo, and R. D'Angelo. (2018). "On the usability of augmented reality devices for interactive risk assessment". *International Journal of Safety and Security Engineering*. 8(1): 132–138. DOI: 10.2495/SAFE-V8-N1-132-138.

Larrinaga, F., J. Fernandez, E. Zugasti, I. Garitano, U. Zurutuza, M. Anasagasti, and M. Mondragon. (2018). "Implementation of a Reference Architecture for Cyber Physical Systems to support Condition Based Maintenance". In: *International Conference on Control Decision and Information Technologies*. 773–778. URL: %3CGo%20to%20ISI%3E://WOS:000468641000130.

Larrinaga, F., J. Fernandez-Anakabe, E. Zugasti, I. Garitano, U. Zurutuza, J. Olaizola, M. Anasagasti, and M. Mondragon. (2019). "A Big Data implementation of the MANTIS reference architecture for predictive maintenance". *Journal of Systems and Control Engineering*. 233(10): 1361–1375. DOI: 10.1177/0959651819835362.

Laudante, E. (2017). "Ergonomics and design in industry 4.0". In: 161–166. DOI: 10.1201/9781315198101-34.

Lee, J., I. Cameron, and M. Hassall. (2019). "Improving process safety: What roles for digitalization and industry 4.0?" *Process Safety and Environmental Protection*. 132: 325–339. DOI: 10.1016/j.psep.2019.10.021.

Lemm, J., M. Lohrer, Y. S. Gloy, and T. Gries. (2014). "ADAPTIVE LEARNING SYSTEMS FOR A COMPETENCE-ENHANCING HUMAN-MACHINE INTERACTION". In: *EDULEARN Proceedings*. 848–850. URL: %3CGo%20to%20ISI%3E://WOS:000366837200118.

Lew, R., T. A. Ulrich, and R. L. Boring. (2020). "Beyond COSS: Human Factors for Whole Plant Management". *Advances in Artificial Intelligence, Software and Systems Engineering*. 965: 619–630. DOI: 10.1007/978-3-030-20454-9_61.

Li, D., A. Fast-Berglund, and D. Paulin. (2019a). "Current and future Industry 4.0 capabilities for information and knowledge sharing: Case of two Swedish SMEs". *International Journal of Advanced Manufacturing Technology*. 105(9): 3951–3963. DOI: 10.1007/s00170-019-03942-5.

Li, D., A. Landström, A. Fasth Fast-Berglund, and P. Almström. (2019b). "Human-Centred Dissemination of Data, Information and Knowledge in Industry 4.0". *Procedia CIRP*. 84: 380–386. DOI: 10.1016/j.procir.2019.04.261.

Li, Z., Y. Wang, and K. S. Wang. (2017). "Intelligent predictive maintenance for fault diagnosis and prognosis in machine centers: Industry 4.0 scenario". *Advances in Manufacturing*. 5(4): 377–387. DOI: 10.1007/s40436-017-0203-8.

Liagkou, V., D. Salmas, and C. Stylios. (2019). "Realizing Virtual Reality Learning Environment for Industry 4.0". In: vol. 79. *Procedia CIRP*. 712–717. DOI: 10.1016/j.procir.2019.02.025.

Liagkou, V. and C. Stylios. (2019). "A Case Study of a Virtual Training Environment". In: *Lecture Notes in Mechanical Engineering*. 352–367. DOI: 10.1007/978-3-030-18715-6_30.

Lima, E., E. Gorski, E. F. R. Loures, E. A. P. Santos, and F. Deschamps. (2019a). "Applying machine learning to AHP multicriteria decision making method to assets prioritization in the context of industrial maintenance 4.0". *Ifac Papersonline*. 52(13): 2152–2157. DOI: 10.1016/j.ifacol.2019.11.524.

Lima, F., C. N. de Carvalho, M. B. S. Acardi, E. G. dos Santos, G. B. de Miranda, R. F. Maia, and A. A. Massote. (2019b). "DIGITAL MANUFACTURING TOOLS IN THE SIMULATION OF COLLABORATIVE ROBOTS: TOWARDS INDUSTRY 4.0". *Brazilian Journal of Operations & Production Management*. 16(2): 261–280. DOI: 10.14488/BJOPM.2019.v16.n2.a8.

Lima, Y. O. de and J. M. de Souza. (2019). "Designing LABORe: a Platform for the Collaborative Assessment of Technological Change in the 4th Industrial Revolution". *2019 Ieee International Conference on Systems, Man and Cybernetics (Smc)*: 1775–1781. URL: %3CGo%20to%20ISI%3E://WOS:000521353901133.

Lindblom, J. and W. Wang. (2018). "Towards an Evaluation Framework of Safety, Trust, and Operator Experience in Different Demonstrators of Human-Robot Collaboration". In: vol. 8. *Advances in Transdisciplinary Engineering*. 145–150. DOI: 10.3233/978-1-61499-902-7-145.

Lindholm, J. and K. Johansen. (2020). "Is Design Automation a Feasible Tool for Improving Efficiency in Production Planning and Manufacturing Processes?" In: vol. 25. 194–201. doi: 10.1016/j.promfg.2018.06.074.

Lins, R. G., P. R. M. de Araujo, and M. Corazzim. (2020). "In-process machine vision monitoring of tool wear for Cyber-Physical Production Systems". *Robotics and Computer-Integrated Manufacturing*. 61. doi: ARTN10185910.1016/j.rcim.2019.101859.

Linstone, H. A. (1989). "Multiple perspectives: Concept, applications, and user guidelines". *Systems Practice*. 2(3): 307–331. doi: 10.1007/BF01059977.

Lithoxoidou, E. E., S. Doumpoulakis, A. Tsakiris, S. Krinidis, D. Ioannidis, K. Votis, and D. Tzovaras. (2017). "Improvement of the Workers' Satisfaction and Collaborative Spirit Through Gamification". In: vol. 10673. *Lecture Notes in Computer Science*. 184–191. doi: 10.1007/978-3-319-70284-1_15.

Liu, C.-F. and P.-Y. Chiang. (2018). "Smart glasses based intelligent trainer for factory new recruits". In: 395–399. doi: 10.1145/3236112.3236174.

Liu, Y. R., F. Wang, J. C. Lv, and X. L. Wang. (2020). "A Novel Method for Tool Identification and Wear Condition Assessment Based on Multi-Sensor Data". *Applied Sciences-Basel*. 10(8). doi: ARTN274610.3390/app10082746.

Loch, F., F. Quint, and I. Brishtel. (2016). "Comparing Video and Augmented Reality Assistance in Manual Assembly". In: *International Conference on Intelligent Environments*. 147–150. doi: 10.1109/ie.2016.31.

Lohrer, M., J. Lemm, Y. S. Gloy, and T. Gries. (2015). "ADAPTIVE SUPPORTING SYSTEMS FOR A COMPETENCE-ENHANCING HUMAN-MACHINE INTERACTION IN NEW PRODUCTION PROCESSES". In: *INTED Proceedings*. 3462–3465. url: %3CGo%20to%20ISI%3E://WOS:000398586303074.

Longo, F., L. Nicoletti, and A. Padovano. (2017). "Smart operators in industry 4.0: A human-centered approach to enhance operators' capabilities and competencies within the new smart factory context". *Computers and Industrial Engineering*. 113: 144–159. DOI: 10.1016/j.cie.2017.09.016.

López-Ramos, L. A., G. Cortés-Robles, E. Roldán-Reyes, G. Alor-Hernández, and C. Sánchez-Ramírez. (2019). "The Knowledge-Based Maintenance: An Approach for Reusing Experiences in Industrial Systems". In: Cham. 505–523. DOI: 10.1007/978-3-319-99190-0_23.

Lopik, K. van, M. Sinclair, R. Sharpe, P. Conway, and A. West. (2020). "Developing augmented reality capabilities for industry 4.0 small enterprises: Lessons learnt from a content authoring case study". *Computers in Industry*. 117. DOI: 10.1016/j.compind.2020.103208.

Lotti, G., V. Villani, N. Battilani, and C. Fantuzzi. (2018). "Towards an integrated approach for supporting the workers in Industry 4.0". In: 609–614. DOI: 10.1109/ICPHYS.2018.8390775.

Ludbrook, F., K. F. Michalikova, Z. Musova, and P. Suler. (2019). "Business models for sustainable innovation in industry 4.0: Smart manufacturing processes, digitalization of production systems, and data-driven decision making". *Journal of Self-Governance and Management Economics*. 7(3): 21–26. DOI: 10.22381/JSME7320193.

Luetkehoff, B., V. Stich, M. Schroeter, and F. Steinlein. (2019). "Development of a Methodology for the Analysis and Evaluation of Alternative Actions in Disruption Management in Production". In: vol. 568. 143–150. DOI: 10.1007/978-3-030-28464-0_13.

Mach, S., A. Kastrau, and F. Schmalfuß. (2018). "Information at hand – Using wearable devices to display task information in the context of industry 4.0". In: vol. 850. 93–100. DOI: 10.1007/978-3-319-92270-6_13.

Madonna, M., L. Monica, S. Anastasi, and M. Di Nardo. (2019). "Evolution of cognitive demand in the human–machine interaction integrated with industry 4.0 technologies". In: vol. 189. 13–19. DOI: 10.2495/SAFE190021.

Manghisi, V. M., A. E. Uva, M. Fiorentino, M. Gattullo, A. Boccaccio, and A. Evangelista. (2020). "Automatic ergonomic postural risk monitoring on the factory shopfloor -The Ergosentinel tool". In: vol. 42. 97–103. DOI: 10.1016/j.promfg.2020.02.091.

Mantravadi, S., A. Jansson, and C. Møller. (2020). "User-Friendly MES Interfaces: Recommendations for an AI-Based Chatbot Assistance in Industry 4.0 Shop Floors". In: vol. 12034 LNAI. 189–201. DOI: 10.1007/978-3-030-42058-1_16.

Marcher, C., A. Giusti, C. P. Schimanski, and D. T. Matt. (2019). "Application of Decision Support Systems for Advanced Equipment Selection in Construction". In: vol. 11792 LNCS. 229–235. DOI: 10.1007/978-3-030-30949-7_26.

Marcon, P., J. Arm, T. Benesl, F. Zezulka, C. Diedrich, T. Schröder, A. Belyaev, P. Dohnal, T. Kriz, and Z. Bradac. (2019). "New approaches to implementing the SmartJacket into industry 4.0". *Sensors (Switzerland)*. 19(7). DOI: 10.3390/s19071592.

Mark, B. G., S. Hofmayer, E. Rauch, and D. T. Matt. (2019a). "Inclusion of workers with disabilities in production 4.0: Legal foundations in Europe and potentials through worker assistance systems". *Sustainability (Switzerland)*. 11(21). DOI: 10.3390/su11215978.

Mark, B., L. Gualtieri, E. Rauch, R. Rojas, D. Buakum, and D. Matt. (2019b). "Analysis of User Groups for Assistance Systems in Production 4.0". In: *International Conference on Industrial Engineering and Engineering Management IEEM*. 1260–1264. DOI: 10.1109/IEEM44572.2019.8978907.

Markowitsch, J. and C. Plaimauer. (2009). "Descriptors for competence: Towards an international standard classification for skills and competences". *Journal of European Industrial Training*. 33: 817–837. DOI: 10.1108/03090590910993652.

Martinez-Olvera, C. (2020). "An Entropy-Based Formulation for Assessing the Complexity Level of a Mass Customization Industry 4.0 Environment". *Mathematical Problems in Engineering*. 2020. DOI: Artn637601010.1155/2020/6376010.

Martynov, V., E. Filosova, and A. Zaytseva. (2020). "Information Architecture to Support Technical Education Training for Industry 4.0". In: DOI: 10.1109/Inforino48376.2020.9111792.

Marzano, A., I. Friel, J. A. Erkoyuncu, and S. Court. (2015). "Design of a Virtual Reality framework for maintainability and assemblability test of complex systems". In: vol. 37. *Procedia CIRP*. 242–247. DOI: 10.1016/j.procir.2015.08.067.

Masoni, R., F. Ferrise, M. Bordegoni, M. Gattullo, A. E. Uva, M. Fiorentino, E. Carrabba, and M. Di Donato. (2017). "Supporting remote maintenance in industry 4.0 through augmented reality". In: vol. 11. *Procedia Manufacturing*. 1296–1302. DOI: 10.1016/j.promfg.2017.07.257.

Masood, T. and J. Egger. (2019). "Augmented reality in support of Industry 4.0-Implementation challenges and success factors". *Robotics and Computer-Integrated Manufacturing*. 58: 181–195. DOI: 10.1016/j.rcim.2019.02.003.

Masood, T. and J. Egger. (2020). "Adopting augmented reality in the age of industrial digitalisation". *Computers in Industry*. 115. DOI: 10.1016/j.compind.2019.07.002.

Masood, T. and P. Sonntag. (2020). "Industry 4.0: Adoption challenges and benefits for SMEs". *Computers in Industry*. 121: 103261. DOI: 10.1016/j.compind.2020.103261.

Mateus, J. E. C., E. Aghezzaf, D. Claeys, V. Limere, and J. Cottyn. (2018). "Method for transition from manual assembly to Human-Robot collaborative assembly". *Ifac Papersonline*. 51(11): 405–410. DOI: 10.1016/j.ifacol.2018.08.328.

Mathiassen, L. and P. A. Nielsen. (2008). "Engaged Scholarship in IS Research". *Scandinavian Journal of Information Systems*. 20(2): 18. URL: https://aisel.aisnet.org/sjis/vol20/iss2/1.

Matteucci, M., D. Raponi, M. Mengoni, M. Peruzzini, and Asme. (2017). "TANGIBLE AUGMENTED REALITY MODEL TO SUPPORT MANUAL ASSEMBLY". In: *Proceedings of the ASME Design Engineering Technical Conferences*. URL: %3CGo%20to%20ISI%3E://WOS:000423244700038.

Mattsson, S., A. Fast-Berglund, D. Li, and P. Thorvald. (2020). "Forming a cognitive automation strategy for Operator 4.0 in complex assembly". *Computers and Industrial Engineering*. 139. DOI: 10.1016/j.cie.2018.08.011.

Mattsson, S., A. Fast-Berglund, and M. Akerman. (2017). "Assessing Operator Wellbeing through Physiological Measurements in Real-TimeTowards Industrial Application". *Technologies*. 5(4). DOI: 10.3390/technologies5040061.

Mayring, P. (2010). "Qualitative inhaltsanalyse". In: 601–613.

McColl-Kennedy, J. R., M. Zaki, K. N. Lemon, F. Urmetzer, and A. Neely. (2018). "Gaining Customer Experience Insights That Matter". *Journal of Service Research*. 22(1): 8–26. DOI: 10.1177/1094670518812182.

McGill, T. J. and J. E. Klobas. (2009). "A task-technology fit view of learning management system impact". *Computers & Education*. 52(2): 496–508. DOI: 10.1016/j.compedu.2008.10.002.

Mehnert, J., D. Reiß, S. Plesser, and M. Hannen. (2019). "An algorithmic module toolkit to support quality management for building performance". In: vol. 111. DOI: 10.1051/e3sconf/201911105002.

Meissner, J. P. and G. Schuh. (2018). "Adaptive deviation management in production control for small batch production". In: vol. 2017-March. 101–104. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85049002769%5C&partnerID=40%5C&md5=b812d6a0dcc53c16cbcc0c868666c28e.

Meixner, K., R. Rabiser, and S. Biffl. (2020). "Towards Modeling Variability of Products, Processes and Resources in Cyber-Physical Production Systems Engineering". *23rd International Systems and Software Product Line Conference(Splc 2019), Vol B*: 49–56. DOI: 10.1145/3307630.3342411.

Menegozzo, G., D. Dall'Alba, A. Roberti, and P. Fiorini. (2019). "Automatic process modeling with time delay neural network based on low-level data". In: vol. 38. 125–132. DOI: 10.1016/j.promfg.2020.01.017.

Merhar, L., C. Berger, S. Braunreuther, and G. Reinhart. (2019). "Digitization of manufacturing companies: Employee acceptance towards mobile and wearable devices". In: vol. 795. 187–197. DOI: 10.1007/978-3-319-94619-1_18.

Merkel, L., C. Berger, S. Braunreuther, and G. Reinhart. (2019). "Determination of cognitive assistance functions for manual assembly systems". In: vol. 795. 198–207. DOI: 10.1007/978-3-319-94619-1_19.

Minnetti, E., P. Chiariotti, N. Paone, G. Garcia, H. Vicente, L. Violini, and P. Castellini. (2020). "A Smartphone Integrated Hand-Held Gap and Flush Measurement System for in Line Quality Control of Car Body Assembly". *Sensors (Switzerland)*. 20(11): 1–17. DOI: 10.3390/s20113300.

Minow, A. and I. Böckelmann. (2020). "Strain, objective performance and usability in simulated assembly processes with digital work instructions". *Zentralblatt fur Arbeitsmedizin, Arbeitsschutz und Ergonomie*. 70(2): 47–56. DOI: 10.1007/s40664-019-00372-8.

Mittal, S., M. A. Khan, D. Romero, and T. Wuest. (2018a). "A critical review of smart manufacturing & Industry 4.0 maturity models: Implications for small and medium-sized enterprises (SMEs)". *Journal of Manufacturing Systems*. 49: 194–214. DOI: 10.1016/j.jmsy.2018.10.005.

Mittal, S., D. Romero, and T. Wuest. (2018b). "Towards a Smart Manufacturing Maturity Model for SMEs ((SME)-E-3)". In: vol. 536. *IFIP Advances in Information and Communication Technology*. 155–163. DOI: 10.1007/978-3-319-99707-0_20.

Moencks, M., V. De Silva, J. Roche, and A. Kondoz. (2019). "Adaptive Feature Processing for Robust Human Activity Recognition on a Novel Multi-Modal Dataset". *arXiv preprint*.

Moencks, M., E. Roth, and T. Bohné. (2020). "Cyber-Physical Operator Assistance Systems in Industry: Cross-Hierarchical Perspectives on Augmenting Human Abilities". In: 419–423. DOI: 10.1109/IEEM45057.2020.9309734.

Moencks, M., E. Roth, T. Bohné, and P. O. Kristensson. (2022a). "Augmented Workforce: Contextual, Cross-hierarchical Enquiries on Human-Technology Integration in Industry". *Computers & Industrial Engineering*.

Moencks, M., E. Roth, T. Bohné, D. Romero, and J. Stahre. (2022b). "Augmented Workforce Canvas: a Management Tool for Human-centric, Value-driven Human-technology Integration in Industry". *Computers and Industrial Engineering*.

Moencks, M., E. Roth, B. Thomas, M. Basso, and F. Betti. (2022c). "Augmented Workforce: Empowering People, Transforming Manufacturing". URL: https://www.weforum.org/whitepapers/augmented-workforce-empowering-people-transforming-manufacturing.

Molino, M., C. G. Cortese, and C. Ghislieri. (2020). "The promotion of technology acceptance and work engagement in industry 4.0: From personal resources to information and training". *International Journal of Environmental Research and Public Health*. 17(7). DOI: 10.3390/ijerph17072438.

Monteiro, P., M. Carvalho, F. Morais, M. Melo, R. J. Machado, and F. Pereira. (2018). *Adoption of Architecture Reference Models for Industrial Information Management Systems. 2018 9th International Conference on Intelligent Systems*. 763–770. URL: %3CGo%20to%20ISI%3E://WOS:000469337900111.

Morgado-Estevez, A., P. L. Galindo, J. L. Aparicio-Rodriguez, I. Diaz-Cano, C. Rioja-del-Rio, J. A. Soto-Nunez, P. Chavera, and F. J. Abad-Fraga. (2018). "Towards Automated Welding in Big Shipbuilding Assisted by Programed Robotic Arm Using a Measuring Arm". In: vol. 694. *Advances in Intelligent Systems and Computing*. 53–63. DOI: 10.1007/978-3-319-70836-2_5.

Morth, O., C. Emmanouilidis, N. Hafner, and M. Schadler. (2020). "Cyber-physical systems for performance monitoring in production intralogistics". *Computers & Industrial Engineering*. 142. DOI: UNSP10633310.1016/j.cie.2020.106333.

Mourtzis, D., V. Siatras, and J. Angelopoulos. (2020a). "Real-Time Remote Maintenance Support Based on Augmented Reality (AR)". *Applied Sciences-Basel*. 10(5). DOI: 10.3390/app10051855.

Mourtzis, D., V. Zogopoulos, I. Katagis, and P. Lagios. (2018a). "Augmented Reality based Visualization of CAM Instructions towards Industry 4.0 paradigm: a CNC Bending Machine case study". In: vol. 70. *Procedia CIRP*. 368–373. DOI: 10.1016/j.procir.2018.02.045.

Mourtzis, D., V. Zogopoulos, and E. Vlachou. (2018b). "Augmented Reality supported Product Design towards Industry 4.0: a Teaching Factory paradigm". In: vol. 23. *Procedia Manufacturing*. 207–212. DOI: 10.1016/j.promfg.2018.04.018.

Mourtzis, D., V. Zogopoulos, and F. Xanthi. (2019). “Augmented reality application to support the assembly of highly customized products and to adapt to production re-scheduling”. *International Journal of Advanced Manufacturing Technology*. 105(9): 3899–3910. DOI: 10.1007/s00170-019-03941-6.

Mourtzis, D., A. Gargallis, J. Angelopoulos, and N. Panopoulos. (2020b). “An Adaptive Scheduling Method Based on Cloud Technology: A Structural Steelwork Industry Case Study”. In: 1–14. DOI: 10.1007/978-3-030-46212-3_1.

Mueller, R., M. Vette-Steinkamp, L. Hoerauf, C. Speicher, and A. Bashir. (2018). “Intelligent and flexible worker assistance systems assembly assistance platform for planning assisted assembly and rework as well as execution of a worker-centered assistance”. In: vol. 2. 77–85. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047944226%5C&partnerID=40%5C&md5=47ad1165a6528243f54c098f4728e038.

Muller, R., M. Vette-Steinkamp, L. Horauf, C. Speicher, and A. Bashir. (2018). “Worker centered cognitive assistance for dynamically created repairing jobs in rework area”. In: vol. 72. *Procedia CIRP*. 141–146. DOI: 10.1016/j.procir.2018.03.137.

Müller, J. M. (2019). “Assessing the barriers to Industry 4.0 implementation from a workers’ perspective”. 52(13): 2189–2194. DOI: 10.1016/j.ifacol.2019.11.530.

Müller, R., M. Vette, L. Hörauf, C. Speicher, and D. Burkhard. (2017). “Lean Information and Communication Tool to Connect Shop and Top Floor in Small and Medium-sized Enterprises”. *Procedia Manufacturing*. 11: 1043–1052. DOI: 10.1016/j.promfg.2017.07.215.

Munoz, A., X. Mahiques, J. E. Solanes, A. Marti, L. Gracia, and J. Tornero. (2019a). “Mixed reality-based user interface for quality control inspection of car body surfaces”. *Journal of Manufacturing Systems*. 53: 75–92.

Munoz, A., A. Martí Testón, X. Mahiques, L. Gracia, J. Solanes, and J. Tornero. (2020). “Camera 3D positioning mixed reality-based interface to improve worker safety, ergonomics and productivity”. *CIRP Journal of Manufacturing Science and Technology*. 28: 24–37. DOI: 10.1016/j.cirpj.2020.01.004.

Munoz, E., E. García, and L. Puigjaner. (2019b). "Advanced Model Design Based on Intelligent System Characterization And Problem Definition". In: vol. 46. *Computer Aided Chemical Engineering*. 1045–1050. DOI: 10.1016/b978-0-12-818634-3.50175-2.

Munro, H. and H. Noori. (1988). "Measuring Commitment to New Manufacturing Technology - Integrating Technological Push and Marketing Pull Concepts". *Ieee Transactions on Engineering Management*. 35(2): 63–70. DOI: Doi10.1109/17.6006.

Murauer, N. (2018). *Design Thinking: Using Photo Prototyping for a user-centered Interface Design for Pick-by-Vision Systems. 11th Acm International Conference on Pervasive Technologies Related to Assistive Environments*. 126–132. DOI: 10.1145/3197768.3201532.

Murauer, N., F. Muller, S. Gunther, D. Schon, N. Pflanz, M. Funk, and Acm. (2018). *An Analysis of Language Impact on Augmented Reality Order Picking Training. 11th Acm International Conference on Pervasive Technologies Related to Assistive Environments*. 351–357. DOI: 10.1145/3197768.3201570.

Murauer, N. and N. Pflanz. (2018). "A full shift field study to evaluate user-and process-oriented aspects of smart glasses in automotive order picking processes". *Interaction Design and Architectures*. (38): 64–82. URL: %3CGo%20to%20ISI%3E://WOS:000467612700005.

Naderpour, M., S. Nazir, and J. Lu. (2015). "The role of situation awareness in accidents of large-scale technological systems". *Process Safety and Environmental Protection*. 97: 13–24. DOI: 10.1016/j.psep.2015.06.002.

Naumann, V. and A. Pflaum. (2018). "Lebenszykluskosten und das Internet of Things". *CARF Luzern 2018*: 75.

Neely, A., M. Gregory, and K. Platts. (1995). "Performance measurement system design: A literature review and research agenda". *International Journal of Operations & Production Management*. 25: 1228–1263. DOI: 10.1108/01443570510633639.

Neghina, M., C. B. Zamfirescu, and K. Pierce. (2020). "Early-stage analysis of cyber-physical production systems through collaborative modelling". *Software and Systems Modeling*. 19(3): 581–600. DOI: 10.1007/s10270-019-00753-w.

Nelles, J., S. Kuz, A. Mertens, C. M. Schlick, and Ieee. (2016). *Human-centered design of assistance systems for production planning and control. Proceedings 2016 Ieee International Conference on Industrial Technology*. 2099–2104. URL: %3CGo%20to%20ISI%3E://WOS:000386327700326.

Nesterov, A., I. Kholodilin, A. Shishkov, and P. Vanin. (2017). "Augmented reality in engineering education: Opportunities and advantages". *Communications - Scientific Letters of the University of Zilina*. 19(4): 117–121. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85037684232%5C&partnerID=40%5C&md5=377bb4e57d259b43a9a32c00e44cf35a.

Nia, M. B. and M. A. Kazemi. (2019). *Personalized Virtual Employee Assistant using IOT Recommender System and Cognitive Computing. Proceedings of the European Conference on the Impact of Artificial Intelligence and Robotics*. 413–422. DOI: 10.34190/eciair.19.101.

Nickel, P., P. Bärenz, S. Radandt, M. Wichtl, U. Kaufmann, L. Monica, H. J. Bischoff, and M. Nellutla. (2020). "Human-system interaction design requirements to improve machinery and systems safety". In: vol. 969. 3–13. DOI: 10.1007/978-3-030-20497-6_1.

Nikolenko, A., P. Sehr, S. Hinrichsen, and S. Bendzioch. (2020). "Digital assembly assistance systems – A case study". In: vol. 959. 24–33. DOI: 10.1007/978-3-030-20040-4_3.

Nygaard, J., M. Colli, and B. V. Wæhrens. (2020). "A self-assessment framework for supporting continuous improvement through IoT integration". In: vol. 42. 344–350. DOI: 10.1016/j.promfg.2020.02.079.

Oborski, P. (2018). "Integration of machine operators with shop floor control system for industry 4.0". *Management and Production Engineering Review*. 9(4): 48–55. DOI: 10.24425/119545.

Okoli, C. and K. Schabram. (2010). "A guide to conducting a systematic literature review of information systems research". *Sprouts: Working Papers on Information Systems*. 10(26): 16. URL: http://sprouts.aisnet.org/10-26.

Oliveira, M., A. Bettoni, E. Coscia, and H. Torvatn. (2019). "Applying Co-creation Principles to Requirement Elicitation in Manufacturing". In: vol. 11786 LNCS. 54–61. DOI: 10.1007/978-3-030-30033-3_5.

Ottogalli, K., D. Rosquete, A. Amundarain, I. Aguinaga, and D. Borro. (2019). "Flexible Framework to Model Industry 4.0 Processes for Virtual Simulators". *Applied Sciences-Basel*. 9(23). DOI: 10.3390/app9234983.

Oyekan, J., A. Fischer, W. Hutabarat, C. Turner, and A. Tiwari. (2019). "Utilising low cost RGB-D cameras to track the real time progress of a manual assembly sequence". *Assembly Automation*. DOI: 10.1108/AA-06-2018-078.

Pacaux-Lemoine, M. P. and D. Trentesaux. (2019). "ETHICAL RISKS OF HUMAN-MACHINE SYMBIOSIS IN INDUSTRY 4.0: INSIGHTS FROM THE HUMAN-MACHINE COOPERATION APPROACH". *Ifac Papersonline*. 52(19): 19–24. DOI: 10.1016/j.ifacol.2019.12.077.

Pacaux-Lemoine, M. P., D. Trentesaux, G. Zambrano Rey, and P. Millot. (2017). "Designing intelligent manufacturing systems through Human-Machine Cooperation principles: A human-centered approach". *Computers and Industrial Engineering*. 111: 581–595. DOI: 10.1016/j.cie.2017.05.014.

Pacaux-Lemoine, M.-P. and F. Flemisch. (2021). "Human-Cyber-Physical System Integration (HSI) in Industry 4.0: design and evaluation methods".

Paelke, V. (2014). *Augmented Reality in the Smart Factory Supporting Workers in an Industry 4.0. Environment. 2014 IEEE Emerging Technology and Factory Automation*. URL: %3CGo%20to%20ISI%3E://WOS:000360999100203.

Paelke, V. and C. Röcker. (2015). "User interfaces for cyber-physical systems: Challenges and possible approaches". In: vol. 9186. 75–85. DOI: 10.1007/978-3-319-20886-2_8.

Page, M. J., J. E. McKenzie, P. M. Bossuyt, I. Boutron, T. C. Hoffmann, C. D. Mulrow, L. Shamseer, J. M. Tetzlaff, E. A. Akl, S. E. Brennan, *et al.* (2021). "The PRISMA 2020 statement: an updated guideline for reporting systematic reviews". *Bmj*. 372.

Papcun, P., J. Cabadaj, E. Kajati, D. Romero, L. Landryova, J. Vascak, and I. Zolotova. (2019). "Augmented Reality for Humans-Robots Interaction in Dynamic Slotting "Chaotic Storage" Smart Warehouses". In: *IFIP Advances in Information and Communication Technology*. 633–641. DOI: 10.1007/978-3-030-30000-5_77.

Parasuraman, R., T. Sheridan, and C. Wickens. (2000). "A model for types and levels of human interaction with automation." *IEEE transactions on systems, man, and cybernetics*. 30: 286–97. DOI: 10.1109/3468.844354.

Pardi, T. (2019). "Fourth industrial revolution concepts in the automotive sector: performativity, work and employment". *Journal of Industrial and Business Economics*. 46(3): 379–389. DOI: 10.1007/s40812-019-00119-9.

Park, K. T., J. Lee, H. J. Kim, and S. Noh. (2020). "Digital twin-based cyber physical production system architectural framework for personalized production". *International Journal of Advanced Manufacturing Technology*. 106(5-6): 1787–1810. DOI: 10.1007/s00170-019-04653-7.

Parmar, C. M., P. Gupta, K. S. Bharadwaj, and S. S. Belur. (2018). *Smart Work-Assisting Gear. 2018 IEEE 4th World Forum on Internet of Things*. 724–728. URL: %3CGo%20to%20ISI%3E://WOS:000492762400128.

Patalas-Maliszewska, J. and N. Schlueter. (2019). "Model of a Knowledge Management for System Integrator(s) of Cyber-Physical Production Systems (CPPS)". In: *Lecture Notes in Mechanical Engineering*. 92–103. DOI: 10.1007/978-3-030-18715-6_8.

Pazienza, A., N. Macchiarulo, F. Vitulano, A. Fiorentini, M. Cammisa, L. Rigutini, E. Di Iorio, A. Globo, and A. Trevisi. (2019). "A novel integrated industrial approach with cobots in the age of industry 4.0 through conversational interaction and computer vision". In: vol. 2481. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85074856076%5C&partnerID=40%5C&md5=3169e3d67d121d3d345d6bce38a99d1c.

Peissner, M., C. Hipp, D. Spath, A. Weisbecker, and S. F. Iao. (2013). *Potenziale der Mensch-Technik-Interaktion für die effiziente und vernetzte Produktion von morgen*. URL: http://publica.fraunhofer.de/documents/N-256460.html.

Penesis, I., R. Katersky Barnes, S. Kilpatrick, M. Symes, and B. Leon de la Barra. (2017). "Reskilling the manufacturing workforce and developing capabilities for the future". *Australasian Journal of Engineering Education*. 22: 1–9. DOI: 10.1080/22054952.2017.1338228.

Pérez-Lara, M., J. A. Saucedo-Martínez, J. A. Marmolejo-Saucedo, T. E. Salais-Fierro, and P. Vasant. (2018). "Vertical and horizontal integration systems in Industry 4.0". *Wireless Networks*. DOI: 10.1007/s11276-018-1873-2.

Perini, S., D. Arena, D. Kiritsis, and M. Taisch. (2017). "An ontology-based model for training evaluation and skill classification in an industry 4.0 environment". In: vol. 513. 314–321. DOI: 10.1007/978-3-319-66923-6_37.

Periša, M., T. M. Kuljanić, I. Cvitić, and P. Kolarovszki. (2019). "Conceptual model for informing user with innovative smart wearable device in industry 4.0". *Wireless Networks*. DOI: 10.1007/s11276-019-02057-9.

Peruzzini, M., F. Grandi, and M. Pellicciari. (2020). "Exploring the potential of Operator 4.0 interface and monitoring". *Computers and Industrial Engineering*. 139. DOI: 10.1016/j.cie.2018.12.047.

Peruzzini, M. and M. Pellicciari. (2017). "A framework to design a human-centred adaptive manufacturing system for aging workers". *Advanced Engineering Informatics*. 33: 330–349. DOI: 10.1016/j.aei.2017.02.003.

Peruzzini, M., M. Pellicciari, F. Grandi, and A. O. Andrisano. (2019). "A MULTIMODAL VIRTUAL REALITY SET-UP FOR HUMAN-CENTERED DESIGN OF INDUSTRIAL WORKSTATIONS". *Dyna*. 94(2). DOI: 10.6036/8889.

Pfeiffer, S. (2016). "Robots, Industry 4.0 and Humans, or Why Assembly Work Is More than Routine Work". *Societies*. 6(16). DOI: 10.3390/soc6020016.

Pierdicca, R., E. Frontoni, R. Pollini, M. Trani, and L. Verdini. (2017). "The Use of Augmented Reality Glasses for the Application in Industry 4.0". In: vol. 10324. *Lecture Notes in Computer Science*. 389–401. DOI: 10.1007/978-3-319-60922-5_30.

Pilati, F., M. Faccio, M. Gamberi, and A. Regattieri. (2020). "Learning manual assembly through real-time motion capture for operator training with augmented reality". In: vol. 45. 189–195. DOI: 10.1016/j.promfg.2020.04.093.

Pinzone, M., F. Albè, D. Orlandelli, I. Barletta, C. Berlin, B. Johansson, and M. Taisch. (2020). "A framework for operative and social sustainability functionalities in Human-Centric Cyber-Physical Production Systems". *Computers and Industrial Engineering*. 139. DOI: 10.1016/j.cie.2018.03.028.

Pinzone, M., I. Barletta, C. Berlin, F. Albè, D. Orlandelli, B. Johansson, and M. Taisch. (2018). "A framework for operative and social sustainability functionalities in Human-Centric Cyber-Physical Production Systems". *Computers & Industrial Engineering*. DOI: 10.1016/j.cie.2018.03.028.

Ploder, C., T. Dilger, and R. Bernsteiner. (2020). "A framework to combine corporate budgeting with agile project management". In: vol. 2581. 19–23. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85082952810%5C&partnerID=40%5C&md5=9fd4323ac62ddb48fe4921ecc90fbb51.

Pretorius, M. W. and G. de Wet. (2000). "A model for the assessment of new technology for the manufacturing enterprise". *Technovation*. 20(1): 3–10. DOI: Doi10.1016/S0166-4972(99)00092-9.

Prinz, C., D. Kreimeier, and B. Kuhlenkotter. (2017). "Implementation of a learning environment for an Industrie 4.0 assistance system to improve the overall equipment effectiveness". In: vol. 9. *Procedia Manufacturing*. 159–166. DOI: 10.1016/j.promfg.2017.04.004.

Pusch, A. and F. Noël. (2019). "Augmented Reality for Operator Training on Industrial Workplaces – Comparing the Microsoft HoloLens vs. Small and Big Screen Tactile Devices". In: vol. 565 IFIP. 3–13. DOI: 10.1007/978-3-030-42250-9_1.

Qasem, Z., J. Bons, C. Borgmann, S. Eimler, M. Jansen, and Ieee. (2018). "Dynamic, Adaptive, and Mobile System for Context-Based and Intelligent Support of Employees in Heavy Industry". In: *International Conference on Enterprise Systems (ES)*. 90–95. DOI: 10.1109/es.2018.00021.

Qu, Y. J., X. G. Ming, S. Q. Qiu, Z. W. Liu, X. Y. Zhang, and Z. T. Hou. (2018). *A FRAMEWORK FOR SMART MANUFACTURING SYSTEMS BASED ON THE STAKEHOLDERS' VALUE. Proceedings of the 2018 IEEE International Conference on Advanced Manufacturing*. 239–242. URL: %3CGo%20to%20ISI%3E://WOS:000458433300068.

Rabelo, R. J., D. Romero, and S. P. Zambiasi. (2018). "Softbots Supporting the Operator 4.0 at Smart Factory Environments". In: vol. 536. *IFIP Advances in Information and Communication Technology*. 456–464. DOI: 10.1007/978-3-319-99707-0_57.

Rabelo, R. J., S. P. Zambiasi, and D. Romero. (2019). "Collaborative Softbots: Enhancing Operational Excellence in Systems of Cyber-Physical Systems". In: vol. 568. 55–68. DOI: 10.1007/978-3-030-28464-0_6.

Rahardja, U., Q. Aini, Y. I. Graha, and M. R. Tangkaw. (2020). "Gamification Framework Design of Management Education and Development in Industrial Revolution 4.0". In: vol. 1364. DOI: 10.1088/1742-6596/1364/1/012035.

Raisamo, R., I. Rakkolainen, P. Majaranta, K. Salminen, J. Rantala, and A. Farooq. (2019). "Human augmentation: Past, present and future". *International Journal of Human-Computer Studies*. DOI: 10.1016/j.ijhcs.2019.05.008.

Raisch, S. and S. Krakowski. (2020). "Artificial Intelligence and Management: The Automation-Augmentation Paradox". *Academy of Management Review*. DOI: 10.5465/2018.0072.

Ras, E., F. Wild, C. Stahl, and A. Baudet. (2017). "Bridging the skills gap of workers in industry 4.0 by human performance augmentation tools - Challenges and roadmap". In: vol. Part F128530. 428–432. DOI: 10.1145/3056540.3076192.

Rasmussen, J. (1983). "Skills, rules, and knowledge; signals, signs, and symbols, and other distinctions in human performance models". *IEEE Transactions on Systems, Man, and Cybernetics*. SMC-13(3): 257–266. DOI: 10.1109/TSMC.1983.6313160.

Rauch, E., P. Dallasega, and M. Unterhofer. (2019). "Requirements and Barriers for Introducing Smart Manufacturing in Small and Medium-Sized Enterprises". *IEEE Engineering Management Review*. 47(3): 87–94. DOI: 10.1109/EMR.2019.2931564.

Rauch, E., M. Unterhofer, R. A. Rojas, L. Gualtieri, M. Woschank, and D. T. Matt. (2020a). "A maturity level-based assessment tool to enhance the implementation of industry 4.0 in small and medium-sized enterprises". *Sustainability (Switzerland)*. 12(9). DOI: 10.3390/SU12093559.

Rauch, E., A. Vickery, M. Garcia, R. Rojas, and D. T. Matt. (2018). "Axiomatic Design based Design of a Software Prototype for Smart Shopfloor Management". In: vol. 223. DOI: 10.1051/matecconf/201822301012.

Rauch, E., A. R. Vickery, C. A. Brown, and D. T. Matt. (2020b). "SME requirements and guidelines for the design of smart and highly adaptable manufacturing systems". In: 39–72. DOI: 10.1007/978-3-030-25425-4_2.

Raworth, K. (2017). *Doughnut economics : seven ways to think like a 21st-century economist / Kate Raworth*.

Reidt, A., S. Schuhback, and H. Krcmar. (2018). *Comprehensive View on Architectural Requirements for Maintenance Information Systems. Proceedings of the 13th International Conference on Evaluation of Novel Approaches to Software Engineering*. 249–257. DOI: 10.5220/0006698602490257.

Reisinger, G., T. Komenda, P. Hold, and W. Sihn. (2018). "A Concept towards Automated Data-Driven Reconfiguration of Digital Assistance Systems". In: vol. 23. *Procedia Manufacturing*. 99–104. DOI: 10.1016/j.promfg.2018.03.168.

Richert, A., M. Shehadeh, S. Muller, S. Schroder, and S. Jeschke. (2016). "Robotic Workmates: Hybrid Human-Robot-Teams in the Industry 4.0". In: *Proceedings of the International Conference on e-Learning*. 127–131. URL: %3CGo%20to%20ISI%3E://WOS:000391678700019.

Ridley, D. (2012). *The Literature Review A Step-by-Step Guide for Students*. 2nd ed. London. URL: https://studysites.sagepub.com/ridley/main.htm.

Rivera, M. M., A. P. Diaz, J. C. Reich, J. C. P. Gallegos, and A. O. Zezzatti. (2019). "Augmented Reality Labels for Security Signs based on Color Segmentation with PSO for Assisting Colorblind People". *International Journal of Combinatorial Optimization Problems and Informatics*. 10(3): 7–20. URL: %3CGo%20to%20ISI%3E://WOS:000461440500002.

Roda-Sanchez, L., C. Garrido-Hidalgo, D. Hortelano, T. Olivares, and M. C. Ruiz. (2018). "OperaBLE: An IoT-Based Wearable to Improve Efficiency and Smart Worker Care Services in Industry 4.0". *Journal of Sensors*. 2018. DOI: 10.1155/2018/6272793.

Romer, T. and R. Bruder. (2015). "User centered design of a cyber-physical support solution for assembly processes". In: vol. 3. *Procedia Manufacturing*. 456–463. DOI: 10.1016/j.promfg.2015.07.208.

Romero, D., S. Mattsson, A. Fast-Berglund, T. Wuest, D. Gorecky, and J. Stahre. (2018). "Digitalizing Occupational Health, Safety and Productivity for the Operator 4.0". In: vol. 536. *IFIP Advances in Information and Communication Technology*. 473–481. DOI: 10.1007/978-3-319-99707-0_59.

Romero, D., J. Stahre, and M. Taisch. (2020). "The Operator 4.0: Towards socially sustainable factories of the future". *Computers and Industrial Engineering*. 139. DOI: 10.1016/j.cie.2019.106128.

Romero, D., J. Stahre, T. Wuest, O. Noran, P. Bernus, A. Fast-Berglund, and D. Gorecky. (2022). "Towards an operator 4.0 typology: A human-centric perspective on the fourth industrial revolution technologies". In: URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85013852895%5C&partnerID=40%5C&md5=60458c9a89e1710f0588a5e11c711c0d.

Roth, E. and M. Moencks. (2021). "Technology-mediated Learning in Industry: Solution Space, Implementation, Evaluation". In: 1480–1484. DOI: 10.1109/IEEM50564.2021.9672851.

Roth, E., M. Moencks, and T. Bohné. (2022). "The Augmented Workforce: A Systematic Review of Operator Assistance Systems". In: vol. 1. *IEEE Press Series on Human-Machine Systems*. Chap. 23.

Roth, E., M. Möncks, T. Bohné, and L. Pumplun. (2020). "Context-Aware Cyber-Physical Worker Assistance in Industrial Systems: A Human Activity Recognition Approach". In: Online Conference.

Roveda, L., J. Maskani, P. Franceschi, A. Abdi, F. Braghin, L. Molinari Tosatti, and N. Pedrocchi. (2020). "Model-Based Reinforcement Learning Variable Impedance Control for Human-Robot Collaboration". *Journal of Intelligent and Robotic Systems: Theory and Applications*. DOI: 10.1007/s10846-020-01183-3.

Rubart, J., B. Lietzau, and P. Sohlke. (2020). "Analyzing Manufacturing Data in a Digital Control Room Making Use of Semantic Annotations". In: 434–438. DOI: 10.1109/ICSC.2020.00084.

Ruhela, S. and S. Riaz. (2019). "An Intelligent Combination: Assessing the Impact of harmonized Emotional and Artificial Intelligence for the Success of Industry 4.0". *2019 10th International Conference on Computing, Communication and Networking Technologies (Icccnt)*. URL: %3CGo%20to%20ISI%3E://WOS:000525828100214.

Sabuj, B., M. J. Islam, and M. A. Rahaman. (2019). "Human robot interaction using sensor based hand gestures for assisting disable people". In: DOI: 10.1109/STI47673.2019.9068087.

Sadeghi-Niaraki, A. (2020). "Industry 4.0 Development Multi-Criteria Assessment: An Integrated Fuzzy DEMATEL, ANP and VIKOR Methodology". *Ieee Access*. 8: 23689–23704. DOI: 10.1109/Access.2020.2965979.

Saggiomo, M., M. Loehrer, D. Kerpen, J. Lemm, and Y. S. Gloy. (2016). "Human- and Task-Centered Assistance Systems in Production Processes of the Textile Industry: Determination of Operator-Critical Weaving Machine Components for AR-Prototype Development". In: *Proceedings of the Annual Hawaii International Conference on System Sciences*. 560–568. DOI: 10.1109/hicss.2016.76.

Sainsbury, D. (2020). *Windows of Opportunity: How Nations Create Wealth*.

Salama, S. and A. B. Eltawil. (2018). "A Decision Support System Architecture Based on Simulation Optimization for Cyber-Physical Systems". In: vol. 26. 1147–1158. DOI: 10.1016/j.promfg.2018.07.151.

Salomon, C., R. Ramler, A. Mayrhofer, and G. Sperrer. (2017). "Towards Information Management Support in Test and Piloting of Complex Mechatronic Systems: An Industry Case Study". In: vol. 285. *Lecture Notes in Business Information Processing*. 69–76. DOI: 10.1007/978-3-319-58801-8_6.

Salvadore, G., E. Rota, E. Corsi, and G. Colombina. (2020). "Industrial Wearable Robots: A HUMANufacturing Approach". In: vol. 76. 1729–1733. DOI: 10.1007/978-3-030-31635-8_210.

Sarkheyli-Hagele, A. and D. Soffker. (2018). "Learning and representation of event-discrete situations for individualized situation recognition using fuzzy Situation-Operator Modeling". *Engineering Applications of Artificial Intelligence*. 72: 357–367. DOI: 10.1016/j.engappai.2018.04.004.

Sattinger, V., M. Papa, K. Stuja, and W. Kubinger. (2019). "Development methodology for safe collaborative production systems in the context of Industry 4.0". *Elektrotechnik und Informationstechnik*. 136(7): 318–325. DOI: 10.1007/s00502-019-00744-1.

Scheuermann, C., B. Bruegge, J. Folmer, and S. Verclas. (2015). "Incident Localization and Assistance System: A case study of a Cyber-Physical Human System". In: 57–61. DOI: 10.1109/ICCChinaW.2015.7961580.

Scheuermann, C., F. Meissgeier, B. Bruegge, and S. Verclas. (2016). "Mobile Augmented Reality Based Annotation System: A Cyber-Physical Human System". In: vol. 9768. *Lecture Notes in Computer Science*. 267–280. DOI: 10.1007/978-3-319-40621-3_20.

Schiffer, M., H. H. Wiendahl, and B. Saretz. (2019). "Self-assessment of Industry 4.0 Technologies in Intralogistics for SME's". *Advances in Production Management Systems: Towards Smart Production Management Systems, Apms 2019, Pt Ii*: 339–346. DOI: 10.1007/978-3-030-29996-5_39.

Schlagowski, R., L. Merkel, C. Meitinger, and Ieee. (2017). "Design of an Assistant System for Industrial Maintenance Tasks and Implementation of a Prototype Using Augmented Reality". In: *International Conference on Industrial Engineering and Engineering Management IEEM*. 294–298. URL: %3CGo%20to%20ISI%3E://WOS:000428267800061.

Schlick, J., P. Stephan, M. Loskyll, and D. Lappe. (2014). "Industrie 4.0 in der praktischen Anwendung". In: Wiesbaden. 57–84. DOI: 10.1007/978-3-658-04682-8_3.

Schmidbauer, C., T. Komenda, and S. Schlund. (2020). "Teaching Cobots in Learning Factories – User and Usability-Driven Implications". *Procedia Manufacturing*. 45: 398–404. DOI: 10.1016/j.promfg.2020.04.043.

Schmiedinger, T., M. Petke, L. Czettritz, B. Wohlschläger, and M. Adam. (2020). "Augmented Reality as a tool for providing informational content in different production domains". *Procedia Manufacturing*. 45: 423–428. DOI: 10.1016/j.promfg.2020.04.047.

Scholz, A., C. Hildebrandt, A. Fay, and Ieee. (2017). "Functional Modelling in Production Engineering Workflows". In: *IEEE International Conference on Automation Science and Engineering*. 695–700. URL: %3CGo%20to%20ISI%3E://WOS:000428014600118.

Schonfuss, B. (2020). "Cataloguing and prioritising digital solutions for manufacturing SMEs". *Unpublished Work*.

Schönfuss, B., D. McFarlane, N. Athanassopoulou, L. Salter, L. De Silva, and S. Ratchev. (2019). "Prioritising low cost digital solutions required by manufacturing SMEs: A shoestring approach". In: Springer. 290–300.

Schönig, S., S. Jablonski, A. Ermer, and A. Aires. (2018). "Digital Connected Production: Wearable Manufacturing Information Systems". In: 56–65. DOI: 10.1007/978-3-319-73805-5_6.

Schroeder, H., A. Friedewald, C. Kahlefendt, and H. Lödding. (2017). "Virtual reality for the training of operators in industry 4.0". In: vol. 513. 330–337. DOI: 10.1007/978-3-319-66923-6_39.

Schuh, G., R. Anderl, R. Dumitrescu, A. Krüger, and M. t. Hompel. (2020). "Industrie 4.0 Maturity Index Managing the Digital Transformation of Companies". *Report*.

Schuldt, J. and S. Friedemann. (2017). "The Challenges of Gamification in the Age of Industry 4.0 Focusing on man in future machine-driven working environments". In: *IEEE Global Engineering Education Conference*. 1622–1630. URL: %3CGo%20to%20ISI%3E://WOS:000405192300246.

Seeliger, A., T. Netland, and S. Feuerriegel. (2022). "Augmented Reality for Machine Setups: Task Performance and Usability Evaluation in a Field Test". *Procedia CIRP*. 107: 570–575.

Segura, A., H. V. Diez, I. Barandiaran, A. Arbelaiz, H. Alvarez, B. Simoes, J. Posada, A. Garcia-Alonso, and R. Ugarte. (2020). "Visual computing technologies to support the Operator 4.0". *Computers and Industrial Engineering*. 139. DOI: 10.1016/j.cie.2018.11.060.

Sellen, A. and D. A. Norman. (1986). *Reviewed Work(s): New Technology and Human Error by Jens Rasmussen, Keith Duncan and Jacques Leplat*. Chichester.

Senderek, R. and K. Geisler. (2019). "Assistance systems for learning support in Industry 4.0". In: vol. 1443. 36–46. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-84944328695%5C&partnerID=40%5C&md5=769161af74d518386b1908ffa19b84ee.

Serras, M., L. García-Sardiña, B. Simões, H. Álvarez, and J. Arambarri. (2020). "Dialogue enhanced extended reality: Interactive system for the operator 4.0". *Applied Sciences (Switzerland)*. 10(11). DOI: 10.3390/app10113960.

Sevinç, A., S. Gür, and T. Eren. (2018). "Analysis of the difficulties of SMEs in industry 4.0 applications by analytical hierarchy process and analytical network process". *Processes*. 6(12). DOI: 10.3390/pr6120264.

Sgarbossa, F., E. H. Grosse, W. P. Neumann, D. Battini, and C. H. Glock. (2020). "Human factors in production and logistics systems of the future". *Annual Reviews in Control*. DOI: 10.1016/j.arcontrol.2020.04.007.

Shneiderman, B. (1996). *The eyes have it: A task by data type taxonomy for information visualizations. Ieee Symposium on Visual Languages, Proceedings*. Los Alamitos. 336–343. DOI: 10.1109/vl.1996.545307.

Shneiderman, B. (1988). "Information processing and human-machine interaction: An approach to cognitive engineering". *Information Processing & Management*. 24(1): 103. DOI: https://doi.org/10.1016/0306-4573(88)90080-5.

Shneiderman, B., C. Plaisant, M. Cohen, S. M. Jacobs, and N. Elmqvist. (2017). *Designing the user interface : strategies for effective human-computer interaction*. 6. edition, global ed. Harlow, Essex.

Silva, J., J. C. Ferreira, and F. Gonçalves. (2020). "The "aftermath" of Industry 4.0 in Small and Medium Enterprises". In: vol. 11930 LNCS. 26–33. DOI: 10.1007/978-3-030-46540-7_3.

Simões, B., R. De Amicis, I. Barandiaran, and J. Posada. (2019). "Cross reality to enhance worker cognition in industrial assembly operations". *International Journal of Advanced Manufacturing Technology*. 105(9): 3965–3978. DOI: 10.1007/s00170-019-03939-0.

Sipsas, K., K. Alexopoulos, V. Xanthakis, and G. Chryssolouris. (2016). "Collaborative maintenance in flow-line manufacturing environments: An Industry 4.0 approach". In: vol. 55. *Procedia CIRP*. 236–241. DOI: 10.1016/j.procir.2016.09.013.

Smids, J., S. Nyholm, and H. Berkers. (2020). "Robots in the Workplace: a Threat to—or Opportunity for—Meaningful Work?" *Philosophy & Technology*. 33(3): 503–522. DOI: 10.1007/s13347-019-00377-4.

Smirnov, A. and A. Kashevnik. (2018). "Semantic Interoperability for Coalition Creation by Mobile Robots and Humans: an Approach and Case Study". *IFAC-PapersOnLine*. 51(11): 1409–1414. DOI: 10.1016/j.ifacol.2018.08.319.

Sorko, S. R., C. Trattner, and J. Komar. (2020). "Implementing AR/MR - Learning factories as protected learning space to rise the acceptance for mixed and augmented reality devices in production". In: vol. 45. 367–372. DOI: 10.1016/j.promfg.2020.04.037.

Stadnicka, D. and D. Antonelli. (2019). "Human-robot collaborative work cell implementation through lean thinking". *International Journal of Computer Integrated Manufacturing*. 32(6): 580–595. DOI: 10.1080/0951192X.2019.1599437.

Stocker, A., P. Brandl, R. Michalczuk, and M. Rosenberger. (2014). "Human-centred ICT tools for smart factories". *Elektrotechnik und Informationstechnik*. 131(7): 207–211. DOI: 10.1007/s00502-014-0215-z.

Stockinger, C., T. Steinebach, D. Petrat, R. Bruns, and I. Zöller. (2020). "The effect of pick-by-light-systems on situation awareness in order picking activities". In: vol. 45. 96–101. DOI: 10.1016/j.promfg.2020.04.078.

Stremousova, E. and O. Buchinskaia. (2019). "SOME APPROACHES TO EVALUATION MACROECONOMIC EFFICIENCY OF DIGITALISATION". *Business Management and Education*. 17(2): 232–247. DOI: 10.3846/bme.2019.11326.

Su, Y. H., C. Y. Chen, S. L. Cheng, C. H. Ko, K. Y. Young, and Ieee. (2018). "Development of a 3D AR-Based Interface for Industrial Robot Manipulators". In: *IEEE International Conference on Systems Man and Cybernetics Conference Proceedings*. 1809–1814. DOI: 10.1109/smc.2018.00313.

Sun, S. J., X. C. Zheng, B. Gong, J. G. Paredes, and J. Ordieres-Mere. (2020). "Healthy Operator 4.0: A Human Cyber-Physical System Architecture for Smart Workplaces". *Sensors*. 20(7). DOI: 10.3390/s20072011.

Suryono, T. J. and A. Gofuku. (2016). "The Desirable Features of Computer Based Emergency Operating Procedure for Nuclear Power Operation". *Ifac Papersonline*. 49(19): 403–407. DOI: 10.1016/j.ifacol.2016.10.599.

Taborri, J., M. Bordignon, F. Marcolin, M. Donati, and S. Rossi. (2019). "Automatic identification and counting of repetitive actions related to an industrial worker". In: 394–399. DOI: 10.1109/METROI4.2019.8792887.

Takehara, Y., Y. Murata, and T. Yoshikawa. (2018). *Picking Assistance System with MS-KINECT and Projection Mapping. Achi 2018: The Eleventh International Conference on Advances in Computer-Human Interactions*. 218–223. URL: %3CGo%20to%20ISI%3E://WOS:000471849600036.

Tan, Q. M., Y. F. Tong, S. F. Wu, and D. B. Li. (2020). "Towards a next-generation production system for industrial robots: A CPS-based hybrid architecture for smart assembly shop floors with closed-loop dynamic cyber physical interactions". *Frontiers of Mechanical Engineering*. 15(1): 1–11. DOI: 10.1007/s11465-019-0563-9.

Tandi, M. and E. M. Jakobs. (2019). "Two Heads Are Better than One: Co-Creation as a Resource for User Interface Design of CAx Systems". In: *IEEE International Professional Communication Conference (IPCC)*. 71–78. DOI: 10.1109/ProComm.2019.00019.

Tannous, M., M. Miraglia, F. Inglese, L. Giorgini, F. Ricciardi, R. Pelliccia, M. Milazzo, and C. Stefanini. (2020). "Haptic-based touch detection for collaborative robots in welding applications". *Robotics and Computer-Integrated Manufacturing*. 64. DOI: 10.1016/j.rcim.2020.101952.

Tavola, G., A. Caielli, and M. Taisch. (2020). "An "additive" architecture for industry 4.0 transition of existing production systems". In: vol. 853. 258–269. DOI: 10.1007/978-3-030-27477-1_20.

Thirunavukarasu, G., S. Chandrasekaran, V. S. Betageri, and J. Long. (2020). "Assessing Learners' Perceptions of Graduate Employability". *Sustainability*. 12(2). DOI: ARTN46010.3390/su12020460.

Tinz, P., J. Tinz, and S. Zander. (2019). "Knowledge management models for the smart factory: A comparative analysis of current approaches". In: vol. 3. 398–404. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85074143215%5C&partnerID=40%5C&md5=1318fe43e25ffb937d01c129331ba73d.

Tortorella, G., R. Miorando, R. Caiado, D. Nascimento, and A. Portioli Staudacher. (2018). "The mediating effect of employees' involvement on the relationship between Industry 4.0 and operational performance improvement". *Total Quality Management and Business Excellence*. DOI: 10.1080/14783363.2018.1532789.

Tourish, D. (2019). "The Triumph of Nonsense in Management Studies". *Academy of Management Learning & Education*. 19(1): 99–109. DOI: 10.5465/amle.2019.0255.

Tranfield, D., D. Denyer, and P. Smart. (2003). "Towards a methodology for developing evidence-informed management knowledge by means of systematic review". *British Journal of Management*. 14(3): 207–222. DOI: Doi10.1111/1467-8551.00375.

Traub, T., M. G. Gregorio, and P. Groche. (2018). "A framework illustrating decision-making in operator assistance systems and its application to a roll forming process". *International Journal of Advanced Manufacturing Technology*. 97(9-12): 3701–3710. DOI: 10.1007/s00170-018-2229-x.

Trotha, C. V., M. Azarmipour, and U. Epple. (2018). "Advanced Assistance Systems in the Process Industry: A Classification Attempt". *Iecon 2018 - 44th Annual Conference of the Ieee Industrial Electronics Society*: 3231–3236. URL: %3CGo%20to%20ISI%3E://WOS:000505811103031.

Trstenjak, M., D. Lisjak, T. Opetuk, and D. Pavković. (2019). "Application of multi criteria decision making methods for readiness factor calculation". In: DOI: 10.1109/EUROCON.2019.8861520.

Tsourma, M., S. Zikos, G. Albanis, K. C. Apostolakis, E. E. Lithoxoidou, A. Drosou, D. Zarpalas, P. Daras, and D. Tzovaras. (2019). "Gamification Concepts for Leveraging Knowledge Sharing in Industry 4.0". *International Journal of Serious Games*. 6(2): 75–87. DOI: 10.17083/ijsg.v6i2.273.

Turner, C. J., C. Emmanouilidis, T. Tomiyama, A. Tiwari, and R. Roy. (2019). "Intelligent decision support for maintenance: an overview and future trends". *International Journal of Computer Integrated Manufacturing*. 32(10): 936–959. DOI: 10.1080/0951192X.2019.1667033.

Tvenge, N. and K. Martinsen. (2018). "Integration of digital learning in industry 4.0". In: vol. 23. *Procedia Manufacturing*. 261–266. DOI: 10.1016/j.promfg.2018.04.027.

Unger, H., F. Borner, and E. Muller. (2017). "Context related information provision in Industry 4.0 environments". In: vol. 11. *Procedia Manufacturing*. 796–805. DOI: 10.1016/j.promfg.2017.07.181.

Uva, A. E., M. Gattullo, V. M. Manghisi, D. Spagnulo, G. L. Cascella, and M. Fiorentino. (2018). "Evaluating the effectiveness of spatial augmented reality in smart manufacturing: a solution for manual working stations". *International Journal of Advanced Manufacturing Technology*. 94(1-4): 509–521. DOI: 10.1007/s00170-017-0846-4.

Vafeiadis, T., A. Nizamis, K. Apostolou, V. Charisi, I. N. Metaxa, T. Mastos, D. Ioannidis, A. Papadopoulos, and D. Tzovaras. (2019). "Intelligent Information Management System for Decision Support: Application in a Lift Manufacturer's Shop Floor". In: DOI: 10.1109/INISTA.2019.8778290.

Van Acker, B. B., P. D. Conradie, P. Vlerick, and J. Saldien. (2020). "Employee acceptability of wearable mental workload monitoring: exploring effects of framing the goal and context in corporate communication". *Cognition, Technology and Work*. DOI: 10.1007/s10111-020-00633-0.

Van de Ven, A. H. and P. E. Johnson. (2006). "Knowledge for theory and practice". *Academy of Management Review*. 31(4): 802–821. DOI: 10.5465/Amr.2006.22527385.

Vathoopan, M., M. Johny, A. Zoitl, and A. Knoll. (2018). "Modular Fault Ascription and Corrective Maintenance Using a Digital Twin". *Ifac Papersonline*. 51(11): 1041–1046. DOI: 10.1016/j.ifacol.2018.08.470.

Venables, M. (2017). "Future maintenance: Transitioning from digitalisation to industry 4.0". *Plant Engineer*. 2017-May(May-June): 10–12. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85021757075%5C&partnerID=40%5C&md5=b61378aacc96062c802185103172c3e1.

Vogel-Heuser, B., M. Bohm, F. Brodeck, K. Kugler, S. Maasen, D. Pantforder, M. J. Zou, J. Buchholz, H. Bauer, F. Brandl, and U. Lindemann. (2020). "Interdisciplinary engineering of cyber-physical production systems: highlighting the benefits of a combined interdisciplinary modelling approach on the basis of an industrial case". *Design Science*. 6. DOI: ARTNe510.1017/dsj.2020.2.

Vukicevic, A. M., M. Djapan, P. Todorovic, M. Eric, M. Stefanovic, and I. Macuzic. (2019). "Decision Support System for Dimensional Inspection of Extruded Rubber Profiles". *IEEE Access*. 7: 112605–112616. DOI: 10.1109/access.2019.2934561.

Wächter, M. and A. C. Bullinger. (2016). "Design of utilizable assistance systems for Industry 4.0". In: 165–170. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029459612%5C&partnerID=40%5C&md5=ad2450ef270ee9742ef83c4aecf197a4.

Wagire, A. A., R. Joshi, A. P. S. Rathore, and R. Jain. (2020). "Development of maturity model for assessing the implementation of Industry 4.0: learning from theory and practice". *Production Planning & Control*. DOI: 10.1080/09537287.2020.1744763.

Waltersmann, L., M. Luckert, D. Gorzig, J. Siegert, and T. Bauernhansl. (2019). "Aligning Academic Knowledge and Industrial Needs to Enable Efficient Research Transfer in the Context of Digitization". In: 164–169. DOI: 10.1109/ICEED47294.2019.8994927.

Wang, J., J. Erkoyuncu, and R. Roy. (2018). "A Conceptual Design for Smell Based Augmented Reality: Case Study in Maintenance Diagnosis". In: vol. 78. *Procedia CIRP*. 109–114. DOI: 10.1016/j.procir.2018.09.067.

Wang, L., R. Gao, J. Váncza, J. Krüger, X. V. Wang, S. Makris, and G. Chryssolouris. (2019). "Symbiotic human-robot collaborative assembly". *CIRP annals*. 68(2): 701–726.

Waschull, S., J. A. C. Bokhorst, E. Molleman, and J. C. Wortmann. (2020). "Work design in future industrial production: Transforming towards cyber-physical systems". *Computers & Industrial Engineering*. 139. DOI: UNSP10567910.1016/j.cie.2019.01.053.

Weckenborg, C. and T. S. Spengler. (2019). "Assembly Line Balancing with Collaborative Robots under consideration of Ergonomics: A cost-oriented approach". 52(13): 1860–1865. DOI: 10.1016/j.ifacol.2019.11.473.

Weiss, A., A. Huber, J. Minichberger, and M. Ikeda. (2016). "First Application of Robot Teaching in an Existing Industry 4.0 Environment: Does It Really Work?" *Societies*. 6(3). DOI: 10.3390/soc6030020.

Welford, A. T. (1968). *Fundamentals of skill. Fundamentals of skill.* New York, NY, US.

Wiedemann, M. and D. Wolff. (2013). "Maintenance - Fields of action for the optimization of software technical support in the context of Industry 4.0: Reports from the Inpro Innovation Academy (Part 1)". *ZWF Zeitschrift fuer Wirtschaftlichen Fabrikbetrieb*. 108(11): 805–808. DOI: 10.3139/104.013118.

Wijaya, T., W. Caesarendra, B. K. Pappachan, T. Tjahjowidodo, A. Wee, and M. I. Roslan. (2017). "Robot Control and Decision Making through Real-Time Sensors Monitoring and Analysis for Industry 4.0 Implementation on Aerospace Component Manufacturing". In: *IEEE Pacific Rim Conference on Communications Computers and Signal Processing*. URL: %3CGo%20to%20ISI%3E://WOS:000424781900050.

Wilschut, E. S., G. J. W. Van Rhijn, R. Könemann, T. Bosch, and M. S. Murphy. (2019). "Evaluating learning approaches for product assembly Using chunking of instructions, spatial augmented reality and display based work instructions". In: 376–381. DOI: 10.1145/3316782.3322750.

Wittenberg, C. (2016). "Human-CPS Interaction - requirements and human-machine interaction methods for the Industry 4.0". *IFAC-PapersOnLine*. 49(19): 420–425. DOI: 10.1016/j.ifacol.2016.10.602.

Wobbrock, J. O. and J. A. Kientz. (2016). "Research contributions in human-computer interaction". *Interactions*. 23(3): 38–44. DOI: 10.1145/2907069.

Wolfartsberger, J., F. Obermair, S. Egger, and M. Höller. (2017). "Assembly instruction 4.0: Augmented reality as compensation for the paper based construction manual". *Productivity Management*. 22(2): 58–61. URL: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85017125354%5C&partnerID=40%5C&md5=15aef33faea54880689e7b6e099e2704.

Wolfartsberger, J., J. Zenisek, and N. Wild. (2020). "Supporting teamwork in industrial virtual reality applications". In: vol. 42. 2–7. DOI: 10.1016/j.promfg.2020.02.016.

Wurl, A., A. Falkner, A. Haselboeck, and A. Mazak. (2019). "A conceptual design of a digital companion for failure analysis in rail automation". In: vol. 1. 578–583. DOI: 10.1109/CBI.2019.00073.

Xu, P., H. Mei, L. Ren, and W. Chen. (2017). "ViDX: Visual Diagnostics of Assembly Line Performance in Smart Factories". *IEEE Transactions on Visualization and Computer Graphics*. 23(1): 291–300. DOI: 10.1109/TVCG.2016.2598664.

Yang, J. and J. Kim. (2018). "An accident diagnosis algorithm using long short-term memory". *Nuclear Engineering and Technology*. 50(4): 582–588.

Yilma, B. A., H. Panetto, and Y. Naudet. (2019). "A Meta-Model of Cyber-Physical-Social System: The CPSS Paradigm to Support Human-Machine Collaboration in Industry 4.0". In: vol. 568. 11–20. DOI: 10.1007/978-3-030-28464-0_2.

Yin, S. Y., J. S. Bao, J. Zhang, J. Li, J. L. Wang, and X. D. Huang. (2020). "Real-time task processing for spinning cyber-physical production systems based on edge computing". *Journal of Intelligent Manufacturing*. DOI: 10.1007/s10845-020-01553-6.

Zamora, M., E. Caldwell, J. Garcia-Rodriguez, J. Azorin-Lopez, and M. Cazorla. (2018). "Automatic learning improves human-robot interaction in productive environments: A review". In: 2014–2024. DOI: 10.4018/978-1-5225-5204-8.ch087.

Zeller, A., N. Jazdi, and M. Weyrich. (2019). "Functional verification of distributed automation systems: Assisting production line operators by an automated model composition". *International Journal of Advanced Manufacturing Technology*. 105(9): 3991–4004. DOI: 10.1007/s00170-019-03791-2.

Zhang, C. Y., Z. X. Wang, K. Ding, F. T. S. Chan, and W. X. Ji. (2020). "An energy-aware cyber physical system for energy Big data analysis and recessive production anomalies detection in discrete manufacturing workshops". *International Journal of Production Research*. DOI: 10.1080/00207543.2020.1748904.

Zhang, Y. and T. H. Kwok. (2018). "Design and Interaction Interface using Augmented Reality for Smart Manufacturing". In: vol. 26. 1278–1286. DOI: 10.1016/j.promfg.2018.07.140.

Zubov, D., N. Siniak, and A. Grencikova. (2019). *Impact Of Industry 4.0 Technologies On The Employment Of The People With Eye Problems: A Case Study On The Spatial Cognition Within Industrial Facilities. Vplyv Industry 4.0 Na Tvorbu Pracovnych Miest*. 254–263. URL: %3CGo%20to%20ISI%3E://WOS:000461829500031.