

Supplementary Table S1. Part A: supplementary studies and cross-cutting thematic mapping; Part B: references cited but not counted in the evidence base

The supplementary update added 19 studies to the initial database-derived corpus. Because this update deliberately targeted recent and cross-cutting evidence, these studies were mapped using multi-label thematic tags rather than forced into the mutually exclusive primary-domain counts used for the 64-study database-derived corpus.

Part A. Supplementary studies (n = 19)

Ref.	Study	Analytical domain(s) / thematic tag(s)	Cross-cutting relevance
[21]	Salunkhe O.; Quadrini W.; Wang H.; Stahre J.; Romero D.; Fumagalli L.; Lämkuull D. Review of Current Status and Future Directions for Collaborative and Semi-Automated Automotive Wire Harnesses Assembly. <i>Procedia CIRP</i> 2023, 120, 696–701. DOI: 10.1016/j.procir.2023.09.061.	HRC / collaborative robotics	Harness-specific automation; ergonomics; semi-automated assembly
[22]	Wang H.; Salunkhe O.; Quadrini W.; et al. A systematic literature review of computer vision applications in robotized wire harness assembly. <i>Advanced Engineering Informatics</i> 2024, 62, 102596. DOI: 10.1016/j.aei.2024.102596.	AI perception & inspection	Harness-specific vision; secondary relevance to DLO/manipulation
[23]	Hernandez-Mejia M.; Romero D.; Ruppert T.; et al. A review of robotic manipulation solutions for deformable linear objects: The case of wire harnesses (Co-)assembly by robots. <i>Robotics and Autonomous Systems</i> 2026, 199, 105375. DOI: 10.1016/j.robot.2026.105375.	DLO manipulation + HRC	Secondary AI/perception relevance; wire-harness co-assembly
[24]	Chen M.; Zhao X.; Wang Y.; et al. From artificial intelligence to augmented intelligence: A review of intelligent forward design of wire harnesses. <i>Journal of Manufacturing Systems</i> 2026, 86, 1229–1255. DOI: 10.1016/j.jmsy.2026.04.036.	AI	Secondary DT, DLO and HRC relevance
[25]	Caporali A.; Cuiral-Zueco I.; López-Nicolás G.; Palli G. Robotic perception and manipulation of deformable linear objects: A survey. <i>The International Journal of Robotics Research</i> 2026, Early Access, 1–44. DOI: 10.1177/02783649261432253.	DLO manipulation + AI perception	Cross-cutting perception/manipulation synthesis
[26]	Nie Q.; Chen J.; Liu C.; Zhao Z.; Xu H. Digital Twin-Enabled Human–Robot Collaborative Assembly: A Review of Technical Systems, Application Evolution, and Future Outlook. <i>Machines</i> 2026, 14(3), 255. DOI: 10.3390/machines14030255.	Digital Twin + HRC + AI	Cross-domain integration; task allocation; safety; human factors
[28]	Olbrich S.; Lackinger J. Design for automatic Assembly – A systematic literature review to assess the fitness of sub-components for automation. <i>Procedia CIRP</i> 2023, 120, 667–672. DOI: 10.1016/j.procir.2023.09.056.	Cross-cutting design-for-automation	Supports connector/interface design and robotic assembly integration
[37]	Salunkhe O.; Stahre J.; Romero D.; et al. Specifying task allocation in automotive wire harness assembly stations for Human-Robot Collaboration. <i>Computers & Industrial Engineering</i> 2023, 184, 109572. DOI: 10.1016/j.cie.2023.109572.	HRC + task allocation/planning	Harness-specific workstation and allocation logic
[38]	Navas-Reascos G.E.; Romero D.; Guedea F.; et al. Simulation tests of wire harness assembly tasks supported by collaborative robots for different types of wire harnesses. <i>International Journal of Computer Integrated Manufacturing</i> 2026, published online 27 January 2026, 1–27. DOI: 10.1080/0951192X.2026.2619775.	HRC	Secondary simulation/system-validation relevance
[39]	Wang H.; Salunkhe O.; Hartmann A.; Ekered S.; Bründl P.; Franke J.; Stahre J.; Johansson B. Vision-based human–robot collaboration for wire harness assembly in automotive manufacturing. <i>Robotics and Computer-Integrated Manufacturing</i> 2027, 103, 103390. DOI: 10.1016/j.rcim.2026.103390.	HRC + AI perception	Ergonomics / human factors; harness-specific experimental evidence
[46]	Wang Y.; Guo Q.; Zheng L.; et al. LLM based autonomous agent of human-robot collaboration for aerospace wire harnessing assembly. <i>Robotics and Computer-Integrated Manufacturing</i> 2026, 97, 103120. DOI: 10.1016/j.rcim.2025.103120.	AI/planning + HRC	Analogous wire-harness assembly; agent-based task support
[47]	Kernbach A.; Bargmann D.; Yaman A.; et al. Automotive Wire Harness Connector Installation Using Skill-Based Robotic Programming. In: <i>Advances in Automotive Production Technology (SCAP 2024)</i> . Springer, 2025. DOI: 10.1007/978-3-031-89471-8_26.	Robotic/HRC automation	Connector mating; skill-based programming
[62]	Chen Y.; Wu X.; Zong Y.; et al. DEFT: Differentiable Branched Discrete Elastic Rods for Modeling Furcated Deformable Linear Objects in Real-Time. Preprint, arXiv, 2025. arXiv:2502.15037.	DLO modelling	Branched/furcated DLO representation; treated as preliminary evidence

Ref.	Study	Analytical domain(s) / thematic tag(s)	Cross-cutting relevance
[63]	Luo J.; Xu C.; Geng X.; et al. Multistage Cable Routing Through Hierarchical Imitation Learning. <i>IEEE Transactions on Robotics</i> 2024, 40, 1476–1491. DOI: 10.1109/TRO.2024.3353075.	DLO + AI	Cable routing; imitation learning
[64]	Li M.; Yu H.; Choi C. Routing Manipulation of Deformable Linear Object Using Reinforcement Learning and Diffusion Policy. In: 2025 IEEE International Conference on Robotics and Automation (ICRA), 2025. DOI: 10.1109/ICRA55743.2025.11127451.	DLO + AI/RL	Routing manipulation; learning-based control
[65]	Caporali A.; Palli G. Robotic Manipulation of Deformable Linear Objects via Multiview Model-Based Visual Tracking. <i>IEEE/ASME Transactions on Mechatronics</i> 2025, 30(5), 3966–3977. DOI: 10.1109/TMECH.2025.3562295.	DLO + AI perception	Multiview tracking during manipulation
[76]	Langås E.F.; Zafar M.H.; Sanfilippo F. Exploring the synergy of human–robot teaming, digital twins, and machine learning in Industry 5.0: a step towards sustainable manufacturing. <i>Journal of Intelligent Manufacturing</i> 2026, 37(3), 999–1022. DOI: 10.1007/s10845-025-02580-x.	HRC + Digital Twin + AI	Industry 5.0 cross-domain integration
[77]	Benazzouz T.; Iman A.O.; Saloua M.; et al. Digital twin-driven, human-centric ergonomic risk forecasting in automotive and industrial assembly: a collective case study. <i>Ergonomics</i> 2026, 1–12. DOI: 10.1080/00140139.2026.2617969.	Digital Twin / Human Digital Twin	Ergonomics; human-centric risk forecasting
[81]	Malvido Fresnillo P.; Vasudevan S.; Mohammed W.; et al. A dual-arm robotic system for automated multi-branch wire harness assembly in the automotive industry. <i>Journal of Manufacturing Systems</i> 2025, 83, 577–596. DOI: 10.1016/j.jmsy.2025.10.008.	DLO / robotic manipulation	System integration; multi-branch automotive harness assembly

Note. The thematic counts reported in the main manuscript refer only to the 64 studies retained from the initial database-driven screening, for which each study was assigned once according to its dominant technical contribution. The 19 supplementary studies listed here may support more than one analytical domain. Normative standards and contextual references are cited separately and are not counted in the 83-study evidence base; they are listed in Part B.

Part B. References cited but not counted in the 83-study evidence base

These sources are cited in the manuscript but are not used as evidence for domain counts or maturity ratings. They comprise three contextual references [18,72,80]—an institutional document framing Industry 5.0 and two studies used only to illustrate transferable robotic-cell configuration and layout principles—and eight normative, regulatory, and industrial data-exchange sources [84–89,93,94]. Reference accounting in the revised manuscript: 94 references = 83 evidence studies (64 database-derived + 19 supplementary) + 3 contextual references + 8 normative, regulatory, and data-exchange sources. In the originally submitted version, the corresponding accounting was 89 = 83 + 3 contextual references [18,72,80] + 3 standards [84–86]. All other self-authored references remain in the evidence base according to their methodological role (e.g., [34], an empirical HRI study).

Ref.	Reference	Category	Use in the manuscript
[18]	Breque M, De Nul L, Petridis A. Industry 5.0: Towards a sustainable, human-centric and resilient European industry. European Commission, Directorate-General for Research and Innovation; 2021. https://doi.org/10.2777/308407 .	Contextual reference (institutional document)	Industry 5.0 framing (Sections 1.1, 3.1, 6.2)
[72]	Mocan B, Fulea M, Murar M, Chereches IA, Marian S. Robotic Cell Customization Using Augmented Reality. <i>Acta Technica Napocensis, Series: Applied Mathematics, Mechanics and Engineering</i> 2021;64(4s):725–732. Available online: https://atna-mam.utcluj.ro/index.php/Acta/article/view/1703 (accessed on 3 September 2026).	Contextual reference	Illustrates AR-supported configuration of robotic cells (Section 6.1)
[80]	Mocan B, Buna D, Fulea M, Brad S. Increasing the Efficiency of Robotic Manufacturing Systems by Layout Optimization. <i>Applied Mechanics and Materials</i> 2015;762:283–290. https://doi.org/10.4028/www.scientific.net/AMM.762.283 .	Contextual reference	Illustrates layout optimisation as an efficiency variable (Section 6.3)
[84]	International Organization for Standardization. ISO 10218-1:2025 Robotics—Safety requirements—Part 1: Industrial robots. Geneva: ISO; 2025. Available online: https://www.iso.org/standard/73933.html (accessed on 3 September 2026).	Normative standard	Safety framework (Sections 7, 9.6)
[85]	International Organization for Standardization. ISO 10218-2:2025 Robotics—Safety requirements—Part 2: Industrial robot applications and robot cells. Geneva: ISO; 2025. Available online: https://www.iso.org/standard/73934.html (accessed on 3 September 2026).	Normative standard	Safety framework (Sections 7, 9.6)
[86]	International Organization for Standardization. ISO/TS 15066:2016 Robots and robotic devices—Collaborative robots. Geneva: ISO; 2016. Available online: https://www.iso.org/standard/62996.html (accessed on 3 September 2026).	Normative technical specification	Collaborative operation and biomechanical limits (Section 7)

Ref.	Reference	Category	Use in the manuscript
[87]	International Organization for Standardization. ISO 13849-1:2023 Safety of machinery—Safety-related parts of control systems—Part 1: General principles for design. Geneva: ISO; 2023.	Normative standard	Validation of safety functions (Section 7)
[88]	International Organization for Standardization; International Electrotechnical Commission. ISO/IEC TR 5469:2024 Artificial intelligence—Functional safety and AI systems. Geneva: ISO/IEC; 2024.	Technical report	Boundary of AI in safety-related functions (Section 7)
[89]	Regulation (EU) 2023/1230 of the European Parliament and of the Council of 14 June 2023 on machinery and repealing Directive 2006/42/EC of the European Parliament and of the Council and Council Directive 73/361/EEC. Official Journal of the European Union, L 165, 29 June 2023. Available online: http://data.europa.eu/eli/reg/2023/1230/oj (accessed on 24 September 2026).	Regulation	Conformity assessment for safety functions with self-evolving behaviour (Section 7)
[93]	Verband der Automobilindustrie (VDA). VDA 4968 Vehicle Electric Container (VEC), 03/2020 (prostep ivip Recommendation PSI 21). Berlin: VDA; 2020. Available online: https://ecad-wiki.prostep.org/specifications/vec/ (accessed on 24 September 2026).	Industry data-exchange specification	Harness product-data model (Section 9.7)
[94]	OPC Foundation. OPC 40570: OPC UA for Wire Harness Manufacturing, Release 1.00. 2025. Available online: https://reference.opcfoundation.org/specs/OPC-40570 (accessed on 24 September 2026).	Industry communication specification	Machine–MES communication in wire processing (Section 9.7)