



I3-MYDAS

Newsletter I I

Competence Shift & Ethical AI: Two Pillars for the Next-Gen Remanufacturing



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The competence shift for the industry of the future

The manufacturing transition toward Industry 4.0 and 5.0 has expanded the scope of required workforce competencies beyond traditional technical expertise [1][2]. These skills are broadly classified into distinct but interrelated domains:

- **Technical and operational:** These cover the fundamental knowledge, techniques, and capabilities required to execute production tasks. They include mastery of manufacturing processes, equipment operation, and the ability to address production anomalies [3].
- **Digital:** As factories become software-intense businesses, proficiency in cloud computing, Internet of Things (IoT), artificial intelligence (AI), big data, and cyber-physical systems is essential [2]. This domain involves understanding the integration of intelligent resources and digital process management [1][5].
- **Interpersonal and managerial:** Often categorized as soft skills, these include communication, emotional intelligence, leadership, and people management. These are critical for managing human-machine collaboration and empowering employees [6][4].
- **Sustainability and ethical:** Industry 5.0 emphasizes human-centricity and ecological resilience. Competencies here focus on circular economy principles, social responsibility, and sustainable production practices [1][7].

These domains are further supported by cognitive and behavioral dimensions, such as critical thinking, adaptability, and resilience, which enable workers to handle decision-making under uncertainty. In this evolving competence landscape, a central theme that emerged across the literature is the transformation of the factory worker into a "knowledge worker": as machines and robots increasingly perform routine and hard labor, human value shifts toward tasks requiring intuition, creativity, and complex problem-solving.

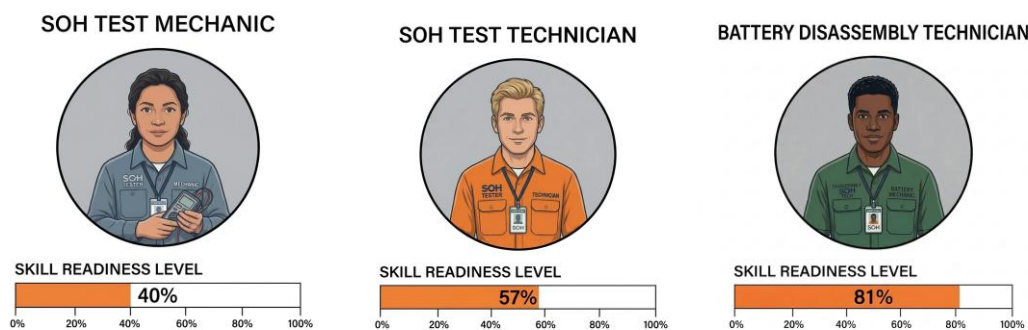
Focusing on Industry 5.0, it emerges the need to re-emphasize the human role in cyber-physical systems, requiring engineers to possess skills that prioritize resilience and ecological sustainability [1]. Managers and employees must demonstrate the ability to adapt to rapid changes in technology and market conditions [6], and there is also a recognized need to integrate technical expertise with soft skills to ensure innovation and sustainable growth [4].

To operationalize this theoretical transition in real-world circular manufacturing setups, systematically mapping how specific job profiles and daily tasks evolve from current baselines to future states becomes essential.

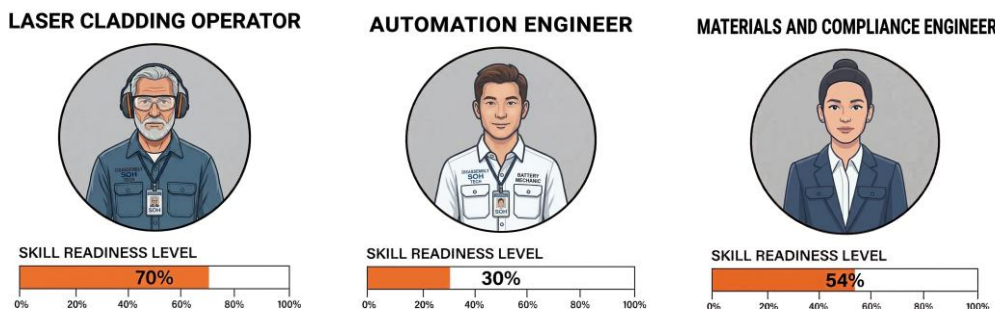
Analysing skills and work profile for the future re-manufacturing industry

Within the R3-MYDAS project, a comparative analysis was conducted between the current workforce skill set (**AS-IS state**) and the future competencies required by the project (**TO-BE state**). This comparison highlights how job profiles and skills will evolve with the introduction of the new technologies developed in the project. The main outputs of this analysis include a set of personas, scenarios, and skill transformation maps that show the change. The following images display the key profiles identified, along with their skill readiness scores to face the innovations introduced by R3-MYDAS, in the three different Demo Cases of the project.

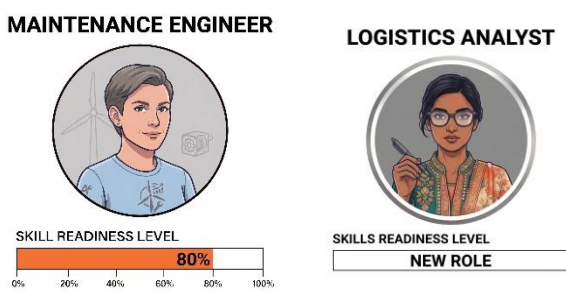
Battery remanufacturing



Crankshafts remanufacturing



Heolic remanufacturing



The skills analysis was conducted using the ESCO database¹, allowing the mapping of required skills based on a set of skills validated at the European level. Looking at the data collected regarding the skill categories that each domain will need most over the next 10 years, common trends emerge:

- **Dominance of Information skills:** They represent the primary and most requested category across all sectors, accounting for over a quarter up to nearly half of the total future requirement (peaking at 47.2% in the battery sector).
- **Relevance of Communication, Collaboration and Creativity skills:** They consistently rank as the second most important macro-area in every domain, with a share ranging between 14.6% and 24.3% (which, combined with *Information skills*, exceeds 60% of total requirements).
- **Steady presence of Management skills:** They maintain a central and cross-cutting role across all analyzed fields, consistently accounting for between 10% and 16%.

These findings align with the theoretical framework outlined in the literature on the Industry 4.0 and 5.0 competence shift. The prominent dominance of **Information skills** reflects the ongoing transformation of traditional factory operators into "knowledge workers," where routine hard labor is automated, and human value centers on digital literacy, data processing, and complex decision-making within cyber-physical environments. Simultaneously, the high demand for **Communication, Collaboration and Creativity skills** alongside **Management skills** validates the critical role of soft, interpersonal, and leadership capabilities. As factories become increasingly human-centric and software-intensive, integrating these soft skills with digital fluency is essential to facilitate human-machine collaboration, drive sustainable innovation, and navigate rapid technological evolution across all manufacturing domains.

Ethical AI and EU AI Act compliance for remanufacturing

Together with the impact on skills and competences, R3-Mydas also focused on analysing the potential ethical and liability risks associated with the project solutions design and deployment. In line with the guiding principles of the EU AI Act², AI Trustworthiness underpins the EU's

¹ https://esco.ec.europa.eu/en/classification/skill_main

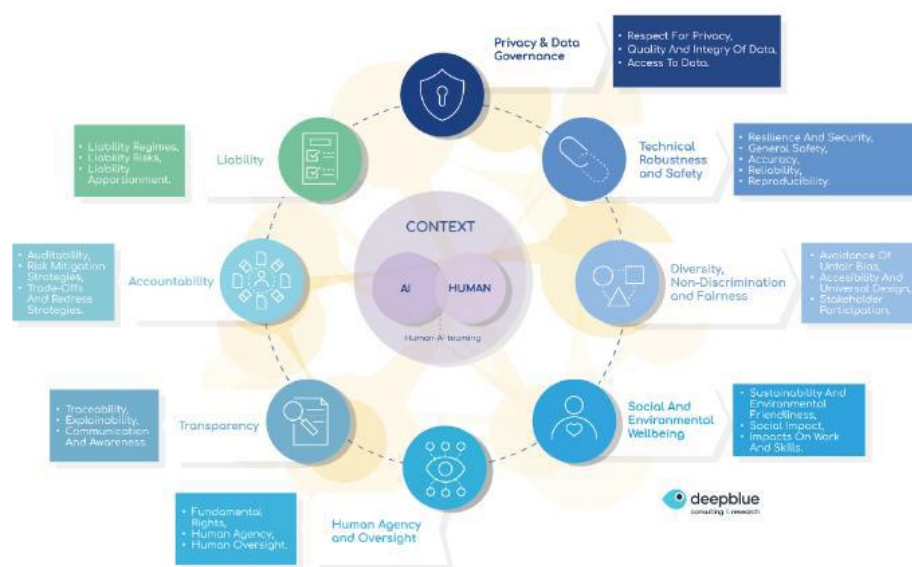
² Regulation (EU) 2024/1689.

human-centric, risk-based regulatory framework, designed to balance the promotion of innovation with the protection of fundamental rights and public safety. It also sets high standards for the development and deployment of high-risk AI systems, where the potential impact on safety and fundamental rights is most significant.

This approach establishes a comprehensive life cycle framework for the development, deployment, and governance of AI systems. It promotes value-aligned design principles and encourages the implementation of ethics and compliance by design from the earliest stages of research and development. By integrating ethical and regulatory requirements directly into the design process, the framework ensures that high-risk AI systems are developed with human safety, data privacy, and ethical standards as essential and non-negotiable components.

This approach to AI Ethics thus calls for the rapid establishment of a dedicated culture, specialized expertise, and tailored methodologies to ensure the effective integration of these aspects into the design, development, and management of AI solutions across various domains. Such integration must also reflect the specific requirements and operational constraints of each sector.

For R3-Mydas, the ethical assessment has been performed adopting the Feat.AI ethical framework designed by Deep Blue to address the unique challenges of AI integration in the safety-critical domain.



The core challenges this framework aims to provide a comprehensive approach to AI ethics assessment that, while drawing from general AI ethics references, is specifically tailored to the

operational and transparency demands of re-manufacturing research and innovation and is designed to be flexibly applicable according to the maturity level of the proposed solutions. The framework has eight main dimensions: Human Agency and Oversight, Technical Robustness and Safety, Privacy and Data Governance, Transparency, Diversity, non-Discrimination and Fairness, Societal and Environmental Well-being, Accountability, and Liability.

Feat.AI framework is designed to evolve alongside the maturity of AI solutions, enabling the iterative assessment and refinement of ethical and legal considerations throughout the entire research and development lifecycle. The depth and scope of the ethics assessment are proportionate to the level of AI automation and the criticality of the application, ensuring evaluations that are both tailored and comprehensive.

For R3-Mydas scope, the Feat.AI framework has been adapted for the remanufacturing sector, considering both the context and the technologies developed. The assessment is still ongoing, following the final stages of the process evaluation to collect data and input for the final stage of the Feat.AI process.

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