PROSPECTS 5.0

D1.3 Industry 5.0 Assessment Framework

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Short Description
This deliverable outlines the development and initial structure of the **Industry 5.0 Assessment Framework**, providing main study questions, assessment criteria and KPIs for each Industry 5.0 impact area (human centricity, environmental sustainability and industrial resilience). The Assessment Framework aims to assist companies across various sizes and industrial sectors in evaluating their current maturity level and identifying actionable steps to enhance their adoption of Industry 5.0 practices. For each KPI, the framework defines the necessary data, linked data collection tools, and KPI measurement approach. Additionally, it provides a description of the main variables to be considered for the definition of specific application scenarios, as well as a preliminary analysis of the feasibility risks of the framework itself.

Project Information	
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LIST OF ACRONYMS

AB	Advisory Board
AF	Assessment Framework
AI	Artificial Intelligence
AR / VR	Augmented Reality / Virtual Reality
CAPEX	Capital Expenditure
CSRD	Corporate Sustainability Reporting Directive
DE&I	Diversity, Equity, and Inclusion
EFFRA	European Factories of the Future Research Association
EFQM	European Foundation for Quality Management
eNPS	Employee Net Promoter Score
EPI	Ergonomic Performance Index
ERP	Enterprise Resource Planning
ESG	Environmental, Social and Governance
GHG	Greenhouse Gas
GRI	Global Reporting Initiative
HC	Human Centricity
HR	Human Resources
HRIS	Human Resources Information System
I5.0	Industry 5.0
I5.AF	Industry 5.0 Assessment Framework
IIoT	Industrial IoT
IIP	Investors in People
IoT	Internet of Things
ISO	International Standards' Organization
KPI	Key Performance Indicator
kWh	Kilowatt-hours
LCA	Life Cycle Assessment
LMS	Learning Management Systems
LTIFR	Lost Time Injury Frequency Rate

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LTIs	Lost Time Injuries
MFA	Material Flow Analysis
MJ	Megajoules
ML	Megalitres
NIST	National Institute of Standards and Technology
OPEX	Operational Expenditure
PAF	Preliminary Assessment Framework
PLM	Product Lifecycle Management
R&D	Research and Development
RE	Resilience
SASB	Sustainability Accounting Standards Board
SCM	Supply Chain Management
SDGs	Sustainable Development Goals
SIEM	Security Information and Event Management
SME	Small and Medium-Sized Enterprise
TCIR	Total Case of Incidence Rate of Injuries and Illnesses
TRIR	Total Recordable Incident Rate
UC	Use Case
WP	Work Package
XR	Extended Reality

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1. EXECUTIVE SUMMARY

This deliverable presents the preliminary version of the Industry 5.0 Assessment Framework (I5.AF), a tool designed to facilitate the measurement and promotion of strategic alignment and operational implementation of Industry 5.0 (I5.0) principles. Developed under the PROSPECTS 5.0 project, the I5.AF focuses on three impact pillars: Human-Centricity, Environmental Sustainability, and Industrial Resilience, providing companies with a structured approach to assess their progress towards I5.0 goals. The framework is a key milestone of the project and will undergo further refinement through testing and validation with use cases (UCs) during its implementation phase.

The I5.AF adopts a modular approach, enabling organizations to tailor the framework to their specific contexts while maintaining standardized elements that ensure comparability across applications. The framework integrates two dimensions of assessment: Alignment with I5.0 principles, measured through a set of Core Key Performance Indicators (KPIs), and Level of Implementation of I5.0 practices, evaluated using Scenario-Related KPIs. This dual-layered system provides companies with actionable insights into their strategic priorities and operational maturity. Core KPIs have been carefully selected for their universal relevance across industries and sizes, serving as benchmarks for strategic alignment with I5.0 principles. These KPIs include measures such as technology adoption for worker support, employee well-being and satisfaction, investment in sustainability-focused technologies, regulatory compliance and initiatives beyond, and risk assessment effectiveness. The Scenario-Related KPIs, in contrast, address specific operational and contextual variables, such as company size and sector-specific requirements, offering flexibility and soundness to the assessment process.

The methodology underlying the framework has been informed by an extensive literature review conducted in previous Task 1.2, analysis of existing frameworks, and a series of co-creation workshops with project UCs, Advisory Board (AB) members, and representatives from I5.0-related EU projects. These engagements have shaped both the selection of KPIs and the development of corresponding measurement tools and data requirements, ensuring relevance and practicality.

The modularity and adaptability of the I5.AF make it a valuable tool for companies of varying sizes and sectors, whether at the early stages of I5.0 adoption or already implementing advanced strategies. By focusing on both alignment and implementation, the I5.AF provides organizations with a roadmap for continuous improvement, supporting their transition towards more resilient, sustainable, and human-centric industrial systems. As this is the preliminary version of the framework, it is intended as a foundation for further refinement. The next phase of the project will focus on its testing and validation with UCs, providing critical insights to enhance its applicability and effectiveness.

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2. INTRODUCTION

2.1. Scope of the Industry 5.0 Assessment Framework

The preliminary Assessment Framework (PAF) for I5.0 provides a structured approach to evaluate and advance the adoption of I5.0 principles across diverse organizations. Its scope encompasses the key dimensions of human-centricity, environmental sustainability, and industrial resilience, aligning technological innovation with societal and ecological objectives. The framework is composed of a comprehensive set of assessment criteria for each of these three pillars, which are supported by related research questions to guide the evaluation process. These criteria and questions serve as the foundation for the development of a detailed list of KPIs, which form the core of the Assessment Framework (AF). Designed to be modular and adaptable, the framework can be tailored to varying company sizes, and industrial sectors, according to core and scenario-related KPIs. By offering standardized criteria alongside customizable KPIs, the framework will enable organizations to assess their current practices, identify gaps, and establish actionable goals to drive progress toward a more inclusive, sustainable, and resilient industrial future. This preliminary version lays the groundwork for further refinement through practical application and stakeholder input.

2.2. Relations to Others Work Packages and Deliverables of the Project

The deliverable received inputs from task 1.1 and task 1.2, as defined in Deliverable 1.1: *The Industry 5.0 Community of Interest* and Deliverable 1.2: *Industry 5.0 Community Trends and Status* and as it will be described in detail in the following chapter of the present document. In a similar way, it will provide inputs for all the next work packages (WPs) of the project, constituting the foundation of the project. More specifically, the PAF for I5.0 will provide the necessary information to structure the implementation phase (WP2) and to design the specific implementation plans for the T2.2 activities of data collection in the UCs of the project.

2.3. Structure of the Document

The deliverable is structured to provide a clear and comprehensive overview of the development, characteristics, and application potential of the PAF for I5.0. It begins with an **Executive Summary**, which offers a concise overview of the document, highlighting the main objectives, methodologies, and outcomes of the framework's development. This summary serves as a quick reference for understanding the essence of the work presented in the deliverable.

The **Introduction** follows, defining the scope and purpose of the framework and explaining its alignment with the broader objectives of I5.0. This chapter also outlines the relationships between this deliverable and other WPs and deliverables within the

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project, ensuring a cohesive approach. Finally, the chapter concludes by presenting the structure of the document.

The third chapter focuses on the **methodological approach**, detailing the process through which the framework was developed. This includes an overview of the systematic steps undertaken, such as literature reviews, stakeholder consultations, and the co-creation workshops conducted as part of Task 1.3. Special attention is given to the collaborative process that ensured the inclusivity and relevance of the framework across diverse industrial contexts.

Chapter 4 introduces the **PAF for I5.0**, beginning with an explanation of its three core impact areas: human-centricity, industrial resilience, and environmental sustainability. Each impact area is described in detail, with a focus on how it addresses key I5.0 principles. The chapter then presents the assessment criteria and their associated research questions, which guide the evaluation of these impact areas. The section proceeds to outline the KPIs associated with each impact area. These KPIs are divided into Core KPIs, which are universally applicable across all UCs to measure strategic alignment with I5.0 principles, and Scenario-Related KPIs, which are tailored to specific contexts, primarily influenced by variables such as company size and, in some cases, sector-specific characteristics. For each KPI, the deliverable provides a brief description, scope, target values, formulas for calculation, and a detailed methodological approach for measurement, including required data and tools. Furthermore, the chapter highlights the practical benefits of calculating these KPIs, illustrating their value for industries in implementing I5.0 practices.

Chapter 5 explores the **application scenarios** for the framework, focusing on key variables influencing its implementation, such as company size and industrial sector. This chapter provides examples of potential application scenarios and identifies risks and challenges that may arise during the framework's adoption. It also highlights success factors that can enhance its effective implementation, ensuring its relevance and usability across diverse organizational contexts.

Finally, the deliverable concludes with a **Conclusions** chapter, which synthesizes the key findings and outcomes. This chapter reflects on the contributions of the framework to advancing I5.0 principles and offers insights into the next steps, including validation and further refinement of the framework.

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3. FRAMEWORK DEVELOPMENT METHODOLOGY

3.1. Literature Review and Delphi Survey

The development of the PAF for I5.0 followed a structured and multi-step methodological approach, integrating inputs from literature, stakeholder engagement, and collaborative workshops. This approach ensured the framework's robustness, adaptability, and alignment with the principles of I5.0. Below, the key steps leading to the definition of the preliminary version of the framework are outlined.

The foundation for the framework was established through a **comprehensive literature review** and the results of the **Delphi survey** conducted as part of Task 1.2, as detailed in Deliverable D1.2. The literature review provided a broad understanding of the I5.0 paradigm, its principles, and its focus areas of human-centricity, environmental sustainability, and industrial resilience (Breque et al., 2021). It highlighted gaps in existing approaches and emphasized the need for a tailored AF (Ghobakhloo, 2022; Nahavandi, 2019). The Delphi survey, involving industrial partners of the PROSPECTS 5.0 project, gathered expert opinions on key aspects of I5.0 implementation (Iqbal et al., 2022). It identified priority areas, potential barriers, and enabling factors, offering practical perspectives to complement the theoretical findings. According to the main findings of the Delphi study, the future of I5.0 is defined by a dual emphasis on technological advancement and human-centric innovation, essential for adoption and positive perception. Long-term success hinges on resilient business models that prioritize continuous talent development to maintain competitiveness in a rapidly evolving industrial landscape (Nonaka & Takeuchi, 2021).

Sustainability emerges as a cornerstone, with the adoption of renewable energy, waste optimization, energy-efficient technologies, and circular economy principles playing pivotal roles (European Commission, 2019). The integration of these practices is tied to workforce readiness, emphasizing digital skill development and upskilling to capitalize on technological advances (Doyle Kent & Kopacek, 2021). A redefinition of the human role in I5.0, focusing on creativity and problem-solving, is critical for driving innovation, supported by robust partnerships between industry and education to diversify skills (Acemoglu & Johnson, 2023).

Key enabling technologies, such as Artificial Intelligence (AI), robotics, IoT, and additive manufacturing, are recognized as drivers of efficiency, operational transparency, and customization (Ghobakhloo et al., 2023). Autonomous systems are identified as critical for ensuring business continuity in dynamic markets, while advanced data analytics accelerates innovation (Welfare et al., 2019). Collaboration between industry, academia, and government, alongside supportive regulatory frameworks, is essential for fostering innovation and enabling the widespread adoption of I5.0 technologies (Breque et al., 2021).

The conclusions of Deliverable 1.2 provide a foundational basis for the development of the PAF for I5.0, emphasizing the integration of an industry perspective into the conceptualization and operationalization of I5.0 principles. By identifying the core

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components of triggers, strategic objectives, and enablers, the deliverable bridges the gap between theoretical discourse and practical implementation. It highlights the pivotal role of ethical, social, and economic principles in guiding I5.0 toward achieving its goals of sustainability, human-centricity, and ethical responsibility (Reiman et al., 2021).

Key triggers, such as technological advancements, global competition, and digital transformation, are recognized as essential catalysts for I5.0 adoption, while strategic objectives focus on enhancing resilience, upskilling the workforce, and embedding sustainability as a core priority (Frey & Osborne, 2017). Enablers, including cutting-edge technologies, interdisciplinary collaboration, and robust regulatory frameworks, provide critical pathways for achieving these objectives (Totterdill et al., 2023).

From an industry perspective, the key drivers for I5.0 adoption include upskilling the workforce to align with technological advancements, fostering skill diversification to adapt to dynamic industrial demands, and embedding sustainability as a core priority (Eurofound & Cedefop, 2020). I5.0 strengthens the human role in innovation, positioning individuals as key decision-makers and drivers of continuous improvement. Efforts to promote diversity and inclusivity in leadership further support equitable industrial environments. The integration of autonomous systems is also critical, enhancing efficiency, minimizing human error, and boosting productivity (Nahavandi, 2019).

To achieve these objectives, several enablers are identified, including embedding I5.0 principles into corporate strategies, enhancing workforce skills, promoting interdisciplinary collaboration, and adopting advanced technologies. Supportive regulatory frameworks, additive manufacturing for production flexibility, IoT for interconnected systems and real-time data exchange, and advanced data analytics for innovation are essential. AI is highlighted as pivotal in automation, predictive maintenance, and enhancing human-machine collaboration, strengthening global competitiveness and driving the transition to I5.0 (Vogel & Güttel, 2012).

Building on these conclusions, the PAF incorporates these elements into its structure by aligning its assessment criteria and KPIs with the triggers, objectives, and enablers identified in Deliverable 1.2. The framework is designed to assess and enhance organizational progress across human-centricity, environmental sustainability, and resilience, ensuring alignment with I5.0's broader societal goals. It extends these insights by operationalizing them through measurable indicators and adaptable methodologies, laying the groundwork for further validation and refinement through stakeholder engagement and practical application

3.2. Overview of Existing Evaluation Frameworks

Building on these inputs, a further overview of existing frameworks was conducted as part of Task 1.3. This analysis focused on well-established environmental, social and governance (ESG) frameworks, (Sustainable Development Goals (SDGs)) SDG-oriented frameworks, and industry-specific frameworks relevant to different sectors such as

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automotive, transport and logistics, energy and utilities, aerospace and manufacturing. By examining these frameworks, the analysis provided insights into industry benchmarks, sustainability reporting practices, and resilience evaluation approaches. These findings enriched the framework by refining its assessment criteria and informing the selection of KPIs to ensure their applicability across diverse industrial contexts.

3.2.1. ESG Evaluation Frameworks

ESG frameworks for companies aim to measure and report on various aspects of their operations that impact the environment, society, and how they are governed. Common KPIs within these frameworks help stakeholders understand a company's performance in these critical areas. ESG ratings predominantly use sector-specific methodologies and risk assessments, rather than one single methodology that is applied to all entities that are the subject of these ratings. At present, various standards have been established in the market to provide this information. Nonetheless, the specific variables and criteria used in ESG scoring may differ across various ESG rating agencies. To identify which ESG issues are most significant for a specific company and stakeholders, the first step is usually to conduct a materiality assessment, as indicated by Sustainability Accounting Standards Board (SASB) Standards organization, one of the main ESG rating providers[1]. However, a common regulatory framework is being promoted by the European Commission. On February 14, 2024, a provisional agreement was reached on the regulation proposal made by the Commission regarding ESG rating activities. This initiative is expected to pave the way for greater transparency, consistency, and standardization in ESG rating practices across the EU, potentially influencing global ESG standards and fostering further alignment in the future. Based on the literature review conducted in Task 1.2 and the combined analysis of these frameworks, a list of the common KPIs used across the ESG dimensions and relevant for the I5.AF has been defined, as presented in the table reported in ANNEX 1 to the present document.

3.2.2. SDG Evaluation Frameworks

I5.0's principles support the broader vision of the SDGs by fostering an inclusive, sustainable, and resilient future for industries and promoting innovation, environmental care, and human well-being in the production processes. More concretely, I5.0 principles align with several of the United Nations SDGs. In the table presented in ANNEX 2 the relevant SDGs related with I5.0 and their respective main KPIs are described. Those KPIs help track the progress of integrating I5.0 principles with the objectives of sustainable development. They focus on enhancing efficiency, fostering innovation, ensuring sustainable practices, and reducing environmental impact within the industrial sector.

[1] Exploring materiality - SASB

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3.2.3. Sector-specific and EU Projects' Existing Evaluation Frameworks

As part of the existing framework review conducted within the project, a diverse range of documents, including public deliverables from EU-funded projects, industry reports, and academic studies, were analysed. These documents provided valuable insights into the principles, methodologies, and indicators already in use across various industrial sectors and impact areas. The analysis aimed to identify frameworks and approaches relevant to the I5.0 paradigm, focusing on the three core pillars: human-centricity, sustainability, and resilience. The table presented in ANNEX 3 of the present document summarizes the analysed documents, providing a brief description of each, along with the industrial sectors and impact areas for which they are most applicable.

The findings of the existing frameworks overview provided critical insights that informed the development of a first draft list of KPIs aligned with the principles of I5.0. By integrating perspectives from literature, existing frameworks, and stakeholder inputs through the Delphi survey, the initial draft list of KPIs served as a foundational tool to guide discussions and refinements during the subsequent co-creation process.

3.3. I5.0 AF Design Process

3.3.1. Stakeholder Engagement

An interactive workshop held in Brussels in May 2024, as part of Task 1.1, engaged some of the most significative EU-level stakeholders in this field, including industry representatives, policymakers, and researchers. Representatives of EFFRA (European Factories of the Future Research Association), EIT Manufacturing and the European Commission were also present. This event was a critical validation step for the framework's initial design. During the interactive session, stakeholders provided feedback on the draft assessment criteria and KPIs, helping to identify gaps, validate assumptions, and align the framework with practical needs and expectations. The feedback from this workshop was incorporated into the framework, enhancing its applicability and modularity for diverse organizational contexts.

The framework was further refined through a series of seventeen co-creation workshops conducted with UC leaders, AB members, and representatives from other I5.0-related EU projects. These workshops offered an iterative platform for validating the AF, tailoring it to specific UCs and contexts. Discussions with industry and academic stakeholders enriched the KPIs, ensuring they addressed real-world challenges across sectors. The co-creation process emphasized adaptability, enabling the framework to cater to varying company sizes and industrial sectors.

The identification of KPIs was a central aspect of this co-creation process. Initially informed by the Delphi survey and existing frameworks, the KPIs were aligned with the three pillars of I5.0: human-centricity, environmental sustainability, and industrial resilience. Through the Brussels stakeholder workshop and subsequent co-creation

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sessions, the KPIs were discussed and validated, including measurement tools and data requirements, aiming at defining their practical application across diverse contexts.

3.3.2. Co-creation and Validation Workshops

Workshops with UCs: UNIMORE coordinated fourteen workshops with all UCs participating in the project during the period from July to October 2024. The workshops were conducted in various formats, including in-person, online, and hybrid modes, to accommodate diverse needs. A significant number of these workshops were conducted on-site at the UC premises, providing highly valuable insights grounded in the companies' everyday operations and enabling a deeper understanding of real-world challenges and opportunities for implementing the I5.0 framework.

The organization of these workshops was carefully planned and executed to ensure consistency and effectiveness across all UCs. The Task leader, UNIMORE, was responsible for designing the workshop structure, preparing comprehensive guidelines, and providing all necessary materials, including a reporting tool and a consent form for data processing. The consent form, developed in collaboration with AETHON (the partner responsible for data management) and the Ethics Committee, ensured compliance with ethical and legal standards, guaranteeing the anonymization of participant data. To prepare facilitators for their role, UNIMORE held an informative meeting on July 15, 2024. During this meeting, facilitators from each UC were instructed on how to conduct the workshops. They were provided with detailed guidelines, a clear presentation of the workshops' objectives, an agenda template, and relevant ethical documentation, including the consent form. Facilitators then conducted the workshops with their respective UC providers, tailoring the approach to the needs of each company.

To facilitate participation, the language of the workshops was agreed upon between the facilitators and the UC providers. In most cases, the workshops were conducted in the local language, ensuring clarity and fostering a more engaging discussion. Each workshop was facilitated by the designated representative of the UC, who acted as the primary point of contact and organizer within their respective company. The participating companies were responsible for identifying workshop participants based on their areas of expertise, ensuring that the discussions were informed by relevant insights and perspectives. This collaborative approach ensured that the workshops were tailored to the specific contexts of each UC while maintaining a consistent methodological framework across the project. This flexibility and adaptability of the workshops' main elements were highly valued by the UC companies, as it allowed for tailored implementation that addressed their specific operational contexts, needs, and priorities.

The following table presents a sum-up of the relevant information about the implemented workshops.

Table 1 Implemented Workshops with UCs

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COUNTRY	UC FACILITATOR	UC PROVIDER	WORKSHOP DATE
Italy	UNIMORE	BBRAUN	17th July 2024
Portugal	INEGI	AMF	24th July 2024
Belgium	Flanders Make	OCTAVE	13th August 2024
Germany	FIR	S-GARD	14th August 2024
Romania	Flanders Make	SMARALD	21st August 2024
Czech Republic	UWB	GTW	21st August 2024
Greece	AETHON	TRYGONS	4th September 2024
Austria	I2M	STIRTEC	4th September 2024
Türkiye	INTRACT	TEKNOROT	5th September 2024
Spain	TECNALIA	ZEUKO	9th September 2024
France	EURECAT	EFESTO	12th September 2024
Norway	SINTEF	KNOWIT	12th September 2024
Latvia	LTC	ELMI	20th September 2024
Poland	TPF	CAMELEO	1st October 2024

The workshops with UCs brought together a diverse group of 77 participants, comprising 29 women (38%) and 48 men (62%). As these industries are traditionally male dominated, it is worth highlighting that the Consortium successfully achieved significant involvement of women, reflecting a strong commitment to promoting gender diversity and inclusivity throughout the workshops.

The participants represented a wide range of roles within their respective organizations. The detailed composition of the participants is presented in the following figure.

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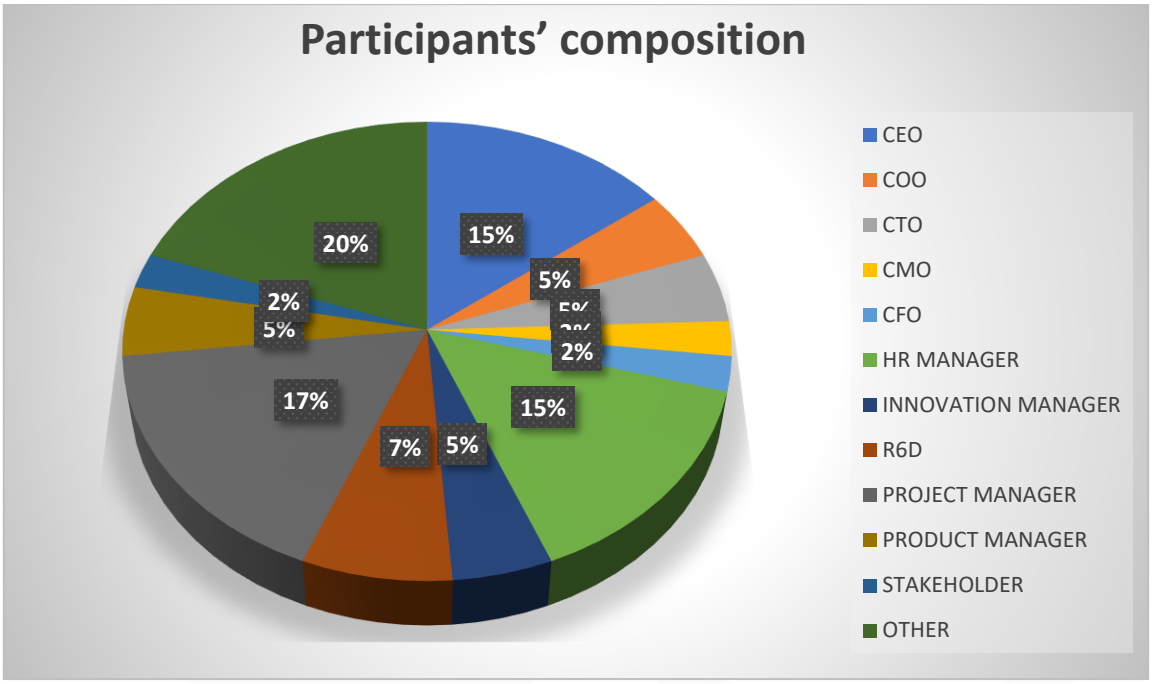

Figure 1 Validation workshops' participants' composition, in percentage

As it can be appreciated, the most represented roles among the participants have been CEOs, project managers, and human resources (HR) managers, reflecting the strategic and operational focus of the discussions. This composition ensured a comprehensive perspective on the implementation and feasibility of the framework, incorporating both leadership insights and practical expertise.

Workshops with AB members and representatives from other I5.0-related EU projects: Between October and November 2024, three workshops were organized to present, discuss, and validate the preliminary structure of the I5.AF with key stakeholders and experts, fostering collaborative refinement of the framework. These workshops, conducted in collaboration with the leader of Task 1.1, brought together representatives from the AB, relevant EU projects, and other I5.0 experts to ensure comprehensive insights and perspectives.

30 October 2024. Workshop with representatives of AIREDGIO 5.0 project

Guest participants:

- Sergio Gusmeroli, Marta Pinzone, Francesco Marzollo (POLIMI)

The first workshop, held on 30 October 2024, focused on collaboration with the AIREDGIO 5.0 project. Esteemed participants included Sergio Gusmeroli, Marta Pinzone, and Francesco Marzollo from Politecnico of Milan (POLIMI), who contributed with their expertise on transitioning from Industry 4.0 to 5.0 to the definition of the scope and the advancing of the preliminary framework.

7 November 2024: Workshop with Advisory Board members.

Guest participants:

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- Matthias Duerr – SIEMENS
- Annamaria Cucinotta – UNIPR / SMILE EDIH
- Wolfgang Zorn – FRAUNHOFER
- Sahar Tahvili - ERICSSON
- Xavier Baillard – EIT Manufacturing
- Pieter Huyskens – DAMEN
- Eleonora Di Maria - UNIPD

The second workshop took place on 7 November 2024 and was dedicated to engaging with AB members. This session featured prominent industry and academic representatives, including Matthias Duerr (SIEMENS), Annamaria Cucinotta (UNIPR / SMILE EDIH), Wolfgang Zorn (FRAUNHOFER), Sahar Tahvili (ERICSSON), Xavier Baillard (EIT Manufacturing), Pieter Huyskens (DAMEN), and Eleonora Di Maria (UNIPD). Their input was invaluable in shaping the framework with insights from diverse industrial contexts, providing valuable insights also on possible barriers to implementation scalability and the I5.AF necessary value proposition.

19 November 2024: Workshop with other EU projects on I5.0

Guest participants:

- Jason Pridmore (SEISMEC project)
- Steven Dhondt (BRIDGES 5.0 project)
- Peter Totterdill (BRIDGES 5.0 project)
- Marta Pinzone (AIREDGIO 5.0 project)
- Francesco Marzollo (AIREDGIO 5.0 project)

The third workshop, organized on 19 November 2024, convened representatives from multiple EU projects focused on I5.0, including the SEISMEC project (Jason Pridmore), the BRIDGES 5.0 project (Steven Dhondt and Peter Totterdill), and the AIREDGIO 5.0 project (Marta Pinzone and Francesco Marzollo). This gathering emphasized cross-project collaboration and the exchange of best practices, further enhancing the framework's relevance and applicability.

These workshops underscored the importance of multi-stakeholder engagement in refining the I5.AF and aligned it with broader EU objectives, ensuring it addresses practical and strategic needs across various industries and research contexts.

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4. I5.0 ASSESSMENT FRAMEWORK

4.1. Impact Areas

The I5.AF is designed to guide the adoption of principles that balance technological advancement with human well-being, environmental responsibility, and system resilience. I5.0 builds upon the foundations of Industry 4.0 by integrating human-cantered values, sustainable practices, and resilient systems, marking a shift toward a paradigm that aligns industrial progress with broader societal and environmental goals. The framework identifies three core impact areas: Human-Centricity, Environmental Sustainability, and Industrial Resilience, which are essential for assessing and advancing I5.0 maturity across diverse sectors and organizational scales. These three impact areas form the foundation of the I5.0 paradigm, allowing organizations to assess and enhance their human-centric, sustainable, and resilient practices. Through the AF, companies can track progress across these dimensions, setting measurable goals for advancing their I5.0 maturity level while aligning technological innovation with the overarching goals of societal and environmental sustainability.

4.1.1. Human-centricity

Human-centricity places the well-being, development, and creativity of employees at the core of industrial systems. Unlike earlier models that prioritized technological efficiency, this approach emphasizes the importance of designing production environments that enhance job satisfaction, foster autonomy, and support personal growth. A human-centric approach promotes the integration of advanced technologies—such as collaborative robots, extended reality (XR), and AI—that amplify human capabilities rather than replacing them (Nonaka & Takeuchi, 2021; Kumar et al., 2021). Policymakers and researchers have increasingly recognized the risks of neglecting the human dimension in industrial progress, including the displacement of jobs and erosion of workplace satisfaction (Frey & Osborne, 2017). The European Commission has called for I5.0 to address these concerns by ensuring that technology serves people, placing employee well-being at the center of production processes (Breque et al., 2021). This involves creating safe and empowering work environments that respect human rights and prioritize skill development (Doyle Kent & Kopacek, 2021). In addition to individual empowerment, human-centricity also acknowledges the social dynamics of the workplace. Organizations are social entities, and their success depends on the interactions among employees, managers, and stakeholders. This socio-centric perspective encourages collaboration, inclusivity, and a shared sense of purpose, which are essential for thriving in an era of rapid technological change (Guest et al., 2022). By fostering inclusive and employee-focused workplaces, I5.0 aims to enhance work-life balance, encourage adaptable job roles, and establish a culture of respect for privacy and dignity (Howaldt et al., 2017). These efforts contribute to long-term workforce engagement, satisfaction, and sustainability (Reiman et al., 2021).

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4.1.2. Environmental Sustainability

Environmental sustainability is one of the cornerstones of I5.0, reflecting the urgent need to address the global climate crisis and operate within ecological limits. I5.0 emphasizes the importance of minimizing environmental impact, conserving resources, and adopting circular economy principles that promote recycling, reuse, and waste minimization (European Commission, 2019). The European Green Deal underscores the role of industry in achieving carbon neutrality, advocating for substantial reductions in energy consumption and resource use (Breque et al., 2021). I5.0 aligns with these goals by leveraging advanced digital technologies—such as IoT, AI, and big data analytics—to optimize resource efficiency, reduce greenhouse gas (GHG) emissions, and drive environmentally friendly practices (Kumar et al., 2021). These innovations enable industries to produce more sustainably, integrating life-cycle perspectives that prioritize doing more with less (Nonaka & Takeuchi, 2021). As highlighted in PROSPECTS Deliverable 1.2, I5.0 supports long-term environmental stewardship by encouraging practices that extend product lifecycles, reduce reliance on non-renewable resources, and enhance energy efficiency (Totterdill et al., 2023). This alignment with global sustainability targets ensures that industrial practices contribute to a healthier planet while maintaining economic viability. Through sustainable innovation, I5.0 enables industries to meet societal expectations for environmental responsibility, ensuring their operations align with the broader goals of resource conservation and ecological balance (European Commission, 2019).

4.1.3. Industrial Resilience

Industrial resilience is critical in a world increasingly shaped by unpredictable disruptions, such as economic crises, pandemics, and geopolitical conflicts. I5.0 emphasizes the development of flexible, adaptive systems that can withstand and recover from these challenges while maintaining operational stability (Teece et al., 1997). The COVID-19 pandemic and subsequent global supply chain disruptions revealed the vulnerabilities of traditional industrial systems (Dwyer et al., 2023). In response, I5.0 promotes decentralized production models, diversified supply chains, and robust cybersecurity measures to ensure continuity under varying conditions (Breque et al., 2021). These strategies are supported by dynamic capabilities, such as strategic management and anticipatory risk analysis, which enable organizations to navigate uncertainty effectively (Vogel & Güttel, 2012). Resilience in I5.0 is not solely about surviving disruptions; it also involves thriving in a rapidly changing world. By fostering innovation and adaptability, resilient systems can respond to evolving market demands and technological advancements (Nonaka & Takeuchi, 2021). The results of the literature analysis and the Delphi survey with industrial partners of the project, as well as other project deliverables such as D1.1 of the Bridges 5.0 project, highlight the importance of high-reliability organizations that anticipate, respond to, and recover from disruptive events, ensuring long-term industrial health (Dwyer et al., 2023). Through the implementation of resilient frameworks, organizations can safeguard their

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operations, enhance value chain stability, and contribute to societal resilience (Breque et al., 2021). This focus on adaptability ensures that industries remain robust and reliable, even in the face of significant challenges (Teece et al., 1997).

4.2. Assessment Criteria and Study Questions

4.2.1. Human-centricity

As described in the methodology section, the results of the literature and existing framework overview, together with the findings from the Delphi survey and the three streams of co-creation workshops implemented within Task 1.3, supported the identification of the following assessment criteria for the Human-centric approach. In the following boxes, these criteria are presented alongside their related study questions, providing a comprehensive perspective to guide their assessment and practical application.

HUMAN EMPOWERMENT
Evaluates the organization's efforts to empower employees through skill development, decision-making participation, and opportunities for role customization.
STUDY QUESTIONS - To what extent are employees involved in formulating improvement initiatives? - How accessible and effective are training and re-skilling programs?

SAFETY AND WELL-BEING
Assesses workplace conditions and programs that prioritize employee health, safety, and overall well-being.
STUDY QUESTIONS - How comprehensive and effective are health and wellness programs? - What is the frequency of workplace accidents and incidents?

TECHNOLOGY ADOPTION FOR WORKER SUPPORT
Evaluates the adoption of advanced technologies to enhance worker productivity, safety, and engagement.
STUDY QUESTIONS - How extensively are smart technologies, such as XR or collaborative robots, used to assist workers?

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- Do these technologies have a positive impact on workers' productivity, safety and engagement? - How integrated are employee-centered initiatives within the digital transformation strategies? - To what extent does the company provide training and resources for employee adaptation to new technologies?

INCLUSIVITY AND DIVERSITY
Measures the effectiveness of initiatives promoting workforce DE&I.
STUDY QUESTIONS - How diverse is the workforce across key demographics? - What is the effectiveness of inclusivity programs in fostering a supportive workplace?

4.2.2. Environmental Sustainability

As for the previous impact area, the identification of assessment criteria for the Environmental Sustainability pillar has been informed by a comprehensive review of literature and existing frameworks, the insights gathered from the Delphi survey, and the outcomes of co-creation workshops conducted as part of Task 1.3. These combined efforts have provided a robust foundation for defining the key dimensions of environmental sustainability within the I5.0 paradigm. The following boxes present these criteria along with their associated study questions, offering a detailed view to guide their assessment and implementation.

INNOVATION IN SUSTAINABLE TECHNOLOGIES
Evaluates the level of investment and development in technologies aimed at improving sustainability.
- What proportion of the organization's Research and Development (R&D) investment focuses on sustainable technologies? - How frequently are new sustainability-focused technologies or initiatives developed or adopted?

REGULATORY COMPLIANCE
Measures compliance with environmental regulations and the implementation of initiatives that exceed compliance standards.
- How effectively does the organization comply with environmental regulations?

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- How many voluntary sustainability initiatives are implemented annually?

CARBON FOOTPRINT AND GHG EMISSIONS INTENSITY
Assesses the organization's efforts to measure and reduce GHG emissions across operations.
- What are the organization's total GHG emissions, and how are they normalized to production or revenue? - How effectively does the organization implement carbon reduction initiatives?

ENERGY AND WATER USAGE EFFICIENCY
Measures the efficiency of energy and water consumption in relation to production or operational output.
- How efficiently is energy consumed per unit of production output? - How effectively is water usage optimized in production processes?

CIRCULARITY AND PRODUCT TRACEABILITY
Tracks the organization's progress in implementing circular economy practices and product traceability features.
- What percentage of products are designed for modularity, repair, or repurposing? - How effectively are traceability features implemented in the product lifecycle?

4.2.3. Industrial Resilience

As detailed in the methodology section, the assessment criteria for the Industrial Resilience impact area have been developed leveraging the systematic analysis of literature and existing frameworks, together with insights from the Delphi survey, and the collaborative outcomes of co-creation workshops conducted in Task 1.3. This multi-faceted approach has enabled the identification of critical dimensions that define resilience within the I5.0 paradigm. The following boxes present these criteria along with their associated study questions, ensuring relevance across diverse industrial contexts and challenges while providing clear guidance for assessment and implementation.

RISK MANAGEMENT
Assesses the organization's ability to identify, evaluate, and mitigate risks to maintain stability and resilience.
- How thorough and accurate are the risk assessment processes?

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- How frequently and effectively are risk mitigation strategies implemented?

SUPPLY CHAIN ALTERNATIVES
Measures the flexibility and resilience of the supply chain through the availability of alternative sourcing options.
- How diverse is the supplier base for critical components? - What percentage of sourcing is local or regionally diversified?

BUSINESS CONTINUITY PLANNING EFFECTIVENESS
Evaluates the organization's ability to plan for and recover from operational disruptions.
- How quickly can the organization recover from disruptions? - How effective are the business continuity plans in mitigating downtime?

INNOVATION AND CONTINUOUS IMPROVEMENT
Tracks the organization's ability to introduce new products, services, or patents, demonstrating adaptability and innovation
- How effectively does the organization innovate in response to market demands or disruptions? - How frequently are new products, services, or patents introduced?

CYBERSECURITY
Measures the organization's efforts to safeguard operations against cyber threats and ensure digital resilience.
- How robust are the cybersecurity measures in protecting against threats? - How frequently are cybersecurity audits or risk assessments conducted?

4.3. Key Performance Indicators

4.3.1. KPI Categorization

The categorization of KPIs in the PAF emerged from a comprehensive, multi-step process involving the integration of literature insights, analysis of existing frameworks, and collaborative stakeholder engagement, as described in the methodology chapter. The categorization process relied on the following steps:

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- **Literature review and framework analysis**: The initial categorization of KPIs leveraged insights from existing frameworks and academic literature to identify metrics relevant to I5.0's core pillars.
- **Practical validation**: Feedback from workshops and stakeholders helped validate the relevance of the KPIs to specific UCs, ensuring alignment with organizational priorities and operational realities.
- **Structured differentiation**: By assessing each KPI's focus—whether on strategic alignment or operational outcomes—the division into policy and outcome levels emerged, with further categorization into specific and generic KPIs based on scope and universality.

The resulting classification separates KPIs into **Company Policy Level KPIs** and **Company Outcome Level KPIs**, reflecting both strategic intent and tangible results.

The **Company Policy Level KPIs** evaluate the alignment of organizational strategies with I5.0 principles and are divided into **specific** and **generic** categories:

- **Specific Policy KPIs** were derived by identifying metrics tied directly to the three core pillars of I5.0: human-centricity, environmental sustainability, and industrial resilience. These KPIs were selected based on their capacity to measure company policies that drive outcomes in specific impact areas.
- **Generic Policy KPIs** were identified as metrics that, while relevant to I5.0, are also widely present in other established frameworks, such as ESG or other non-I5.0-specific methodologies. These KPIs provide a universal baseline for assessment and allow comparability across organizations, even beyond the specific scope of I5.0.

The **Outcome Level KPIs** were designed to measure the effectiveness and real-world impact of company policies and actions. This categorization reflects outcomes such as operational performance, employee engagement, or environmental impact. These KPIs were identified by analysing operational data and measurable results directly linked to I5.0 objectives.

This categorization provides a clear and structured approach to assess both strategic alignment and operational performance, enabling organizations to identify gaps and prioritize improvements effectively. By distinguishing between policy-level and outcome-level KPIs, companies can first evaluate their alignment with I5.0 principles through Core KPIs. These core metrics serve as a foundation, ensuring consistency in assessing strategic alignment across diverse organizations.

To enhance depth and specificity, the inclusion of Scenario-Related KPIs provides organizations with the flexibility to expand their assessment scope based on contextual variables, such as company size, sector, or operational focus. This dual-level categorization—Core KPIs for universal application and Scenario-Related KPIs for tailored assessment—ensures that the framework is robust yet adaptable, meeting the needs of varied organizational profiles and operational realities.

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The I5.0 PAF is designed with inherent modularity, striking a careful balance between standardization and flexibility. This modular structure makes it adaptable across a wide array of industrial sectors and company sizes. Recognizing the unique needs of each organization, the framework provides standardized assessment criteria to ensure consistency while offering flexible, customizable elements that align with specific organizational contexts and requirements.

This modular structure enables organizations to measure and benchmark their progress toward I5.0 effectively, while addressing sector-specific or operational nuances during the assessment phase. To support this modularity, the framework identifies Core KPIs for each impact area, which are universally applicable, and Scenario-Related KPIs, which allow for tailored assessment in specific contexts. By integrating this dual approach, the framework supports comprehensive and actionable insights that drive both strategic alignment and operational maturity.

Core KPIs

Core KPIs represent the minimum set of metrics that must be measured universally across all UCs and companies. These KPIs capture essential aspects that are critical to I5.0 principles. They provide a standardized baseline for assessing organizational maturity and progress, enabling benchmarking and consistency. These KPIs can be slightly tailored to specific organizational contexts while retaining their standardized core structure.

Scenario-Related KPIs

Scenario-Related KPIs are selectively applied depending on specific application scenarios. These scenarios are defined by variables such as company size, industrial sector, or even geographic specific characteristics. These KPIs enable deeper insights into areas critical to certain organizations or sectors.

The distinction between Core and Scenario-Related KPIs in the PAF reflects a deliberate approach to balance accessibility with comprehensiveness, enabling gradual adoption across companies of varying sizes, and sectors. This categorization, as explained before, was shaped by insights gathered through the co-creation process, incorporating the perspectives of UCs, AB members, EU stakeholders, and representatives from other I5.0-related projects.

KPIs were primarily identified during workshops with UC participants, where companies provided direct feedback on the relevance and feasibility of proposed KPIs. Through a ranking process, participants highlighted the most critical indicators for aligning with I5.0 principles.

The categorization of policy and outcome-level KPIs was further refined during workshops with AB members, EU stakeholders, and other project representatives.

Core KPIs are primarily drawn from the **policy-specific** and **generic policy-level KPIs**, with the exception of the KPI on **employee satisfaction**, which was deemed essential

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due to its foundational role in the human-centricity pillar. Policy-level KPIs focus on assessing an organization's alignment with I5.0 principles, providing a baseline for strategic intent in areas such as training opportunities, representation in decision-making, and regulatory compliance. Their inclusion as Core KPIs ensures that organizations can demonstrate alignment with I5.0 goals at an early stage, regardless of their size or sector.

Scenario-Related KPIs, on the other hand, are predominantly **outcome-focused** or more generic in nature, reflecting specific operational impacts or broader metrics that vary based on organizational context. Feedback from UC workshops highlighted the importance of these KPIs in capturing tangible results but also noted their variability depending on company size or industrial sector. This feedback informed their categorization as Scenario-Related KPIs, which allow organizations to expand their assessment scope once they establish policy alignment.

This flexible approach ensures accessibility and scalability within the framework. Companies can begin by adopting Core KPIs to evaluate their strategic alignment and policy intent and, as they mature, incorporate Scenario-Related KPIs to assess real-world outcomes and operational performance. This approach supports gradual adoption, allowing organizations to start with strategic alignment and progressively include operational performance measures, fostering continuous improvement toward I5.0 maturity.

Chapter 5 of the deliverable further illustrates the framework's modularity and adaptability, outlining specific application scenarios. These scenarios demonstrate how the framework can be customized based on variables such as company size and sector-specific requirements. By combining Core KPIs, which ensure universal applicability, with Scenario-Related KPIs, which allow for tailored precision, the AF achieves a robust balance. This approach empowers organizations to effectively measure their alignment with I5.0 principles while addressing their unique operational contexts and strategic goals.

In the following figures, according to the study questions for each assessment criteria the identified KPIs are listed.

The core KPIs for Human Centricity (HC) are:

KPI_HC1: Technology adoption for human-machine collaboration.
KPI_HC2: Training and re-skilling opportunities.
KPI_HC3: Comprehensive employee well-being and satisfaction Index.
KPI_HC4: Representation in decision-making roles.

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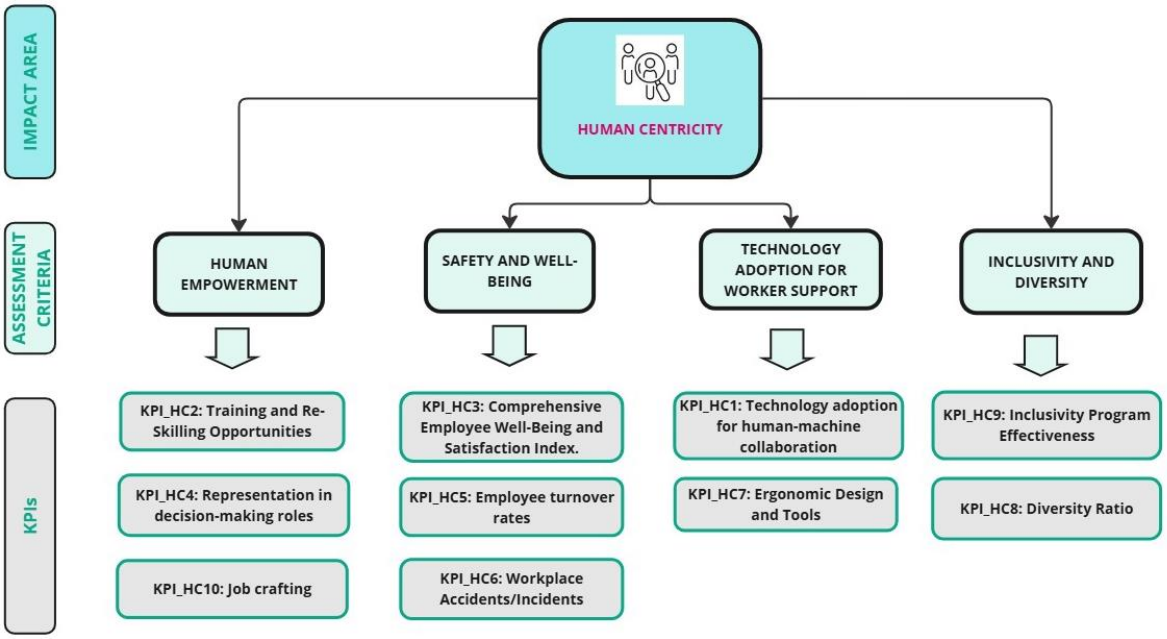

Figure 2 Assessment criteria and related KPIs for HC

The core KPIs for Environmental Sustainability are:

KPI_SU1: Investment in and development of new technologies for sustainability.

KPI_SU2: Regulatory compliance rate and number of initiatives beyond compliance.

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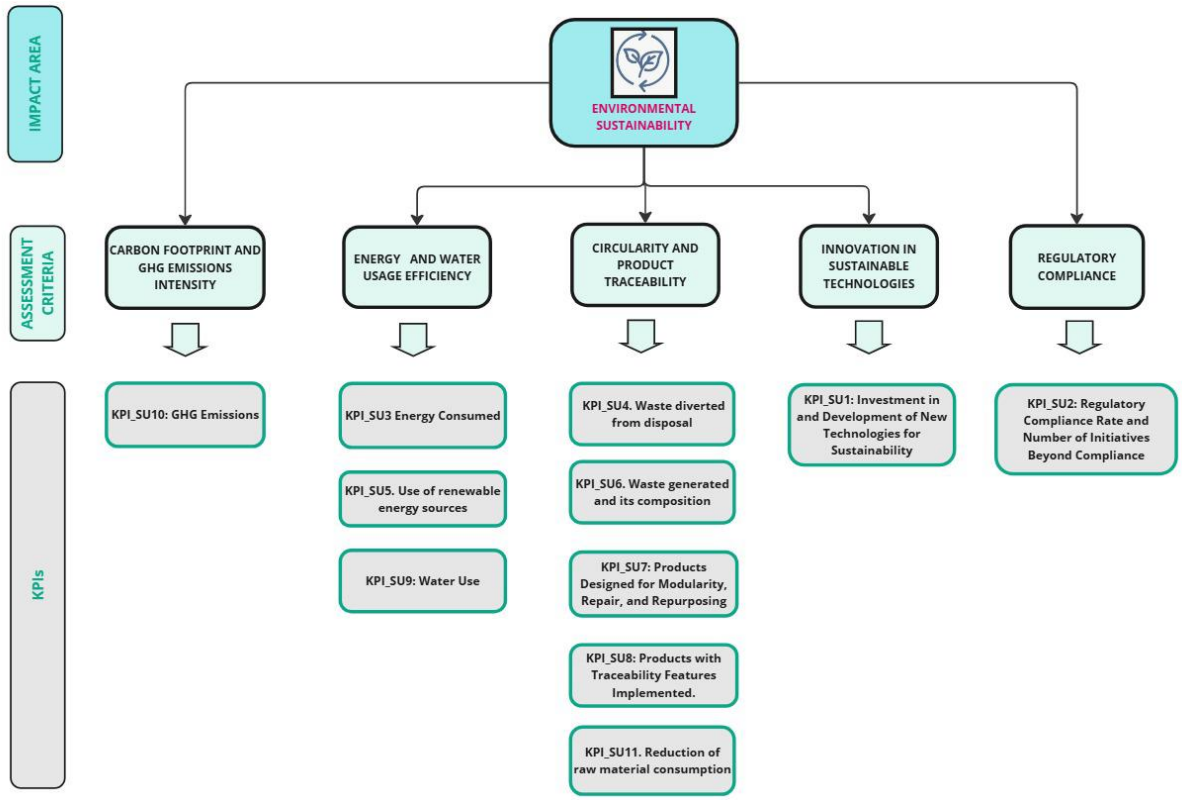

Figure 3 Assessment criteria and related KPIs for Environmental Sustainability

The core KPIs for Industrial Resilience are:

KPI_RE1: Risk assessment effectiveness.
KPI_RE4: Alternative sourcing options.

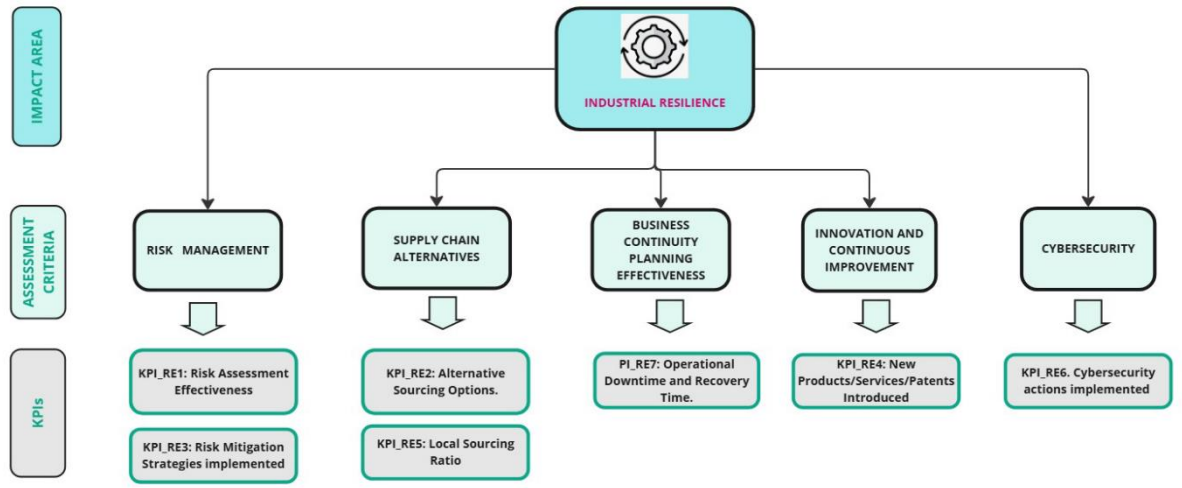

Figure 4 Assessment criteria and related KPIs for Industrial Resilience

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4.3.2. Human Centricity: Key Performance Indicators

Table 2 categorizes the KPIs relevant to the Human-Centricity pillar of I5.0, reflecting the emphasis on placing employee well-being, inclusivity, and development at the center of organizational strategies. The KPIs are divided into policy-specific, generic, and outcome levels to comprehensively assess an organization's commitment to fostering a human-centered workplace.

Table 2 HC KPIs categorization

POLICY LEVEL	HUMAN-CENTRICITY SPECIFIC: **KPI_HC1.** Technology adoption for human-machine collaboration **KPI_HC7.** Ergonomic design and tools **KPI_HC4.** Representation in decision-making roles
	GENERIC: **KPI_HC2.** Training and re-skilling opportunities **KPI_HC8.** Diversity ratio **KPI_HC9.** Inclusivity programs effectiveness **KPI_HC10.** Job crafting
OUTCOME LEVEL	**KPI_HC5.** Employee turnover rates **KPI_HC3.** Comprehensive employee well-being and satisfaction index **KPI_HC6.** Number of workplace accidents / incidents

This categorization highlights the multidimensional aspects of human-centricity. The policy-specific KPIs address targeted initiatives such as technology adoption for collaboration and ergonomic designs, directly aligned with I5.0 principles. Generic KPIs, like diversity ratio and inclusivity program effectiveness, draw from broader frameworks such as ESG standards, ensuring universality and comparability across sectors. Outcome-level KPIs measure tangible impacts like employee turnover and workplace accidents, providing actionable insights into operational effectiveness. By encompassing strategic policies and measurable outcomes, this categorization enables organizations to holistically evaluate their human-centric efforts.

Core KPIs

KPI_HC1. Technology adoption for human-machine collaboration

The concept emerged organically during discussions and observations in the workshops with UCs, even if the KPI was not initially included in the first draft of KPIs. Participants emphasized the increasing relevance of technologies like AI, IoT, XR, and

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collaborative robots (COBOTs) in enhancing worker productivity and well-being. These insights highlighted the critical role of human-machine collaboration in advancing I5.0 principles. Subsequent design-thinking workshops with industry experts, AB members, and stakeholders reinforced this need, recognizing that tracking the adoption of such technologies aligns closely with the human-centric dimension of I5.0. This KPI was thus identified as essential for assessing the integration of worker-supportive technologies, ensuring its inclusion as a Core KPI.

KPI_HC1	**Technology adoption for human-machine collaboration**
Description	Measures the extent of Technology 4.0 tool adoption (e.g., AI, IoT, Augmented Reality / Virtual Reality (AR/VR), collaborative robots) for worker support, reflecting human-machine collaboration progress.
Study questions	○ What percentage of employees actively use collaborative tools such as XR, AI, IoT or COBOTs? ○ What percentage of employees have received training to effectively use human-machine collaboration tools? ○ How do employees perceive the benefits and usability of these technologies? How does the adoption of these technologies support the organization's readiness for future innovation?
Objective	To evaluate and track the extent of advanced technology adoption that supports worker collaboration with machines, ultimately enabling a more efficient, productive, and human-centered workplace.
Scope	Applicable to operations with significant human involvement where advanced technologies are used to support workers; relevant across sectors particularly in industries with high automation potential, including manufacturing, logistics, automotive, aerospace, energy and utilities.
Formula	*Technology Adoption Score= (Number of Technologies Implemented / Total Identified Collaboration Tools) ×0.33 +(Percentage of Employees Trained / 100) ×0.33 + (Employee Usability and Benefit Score (out of 5) ×0.33* *Technologies included: AI systems, collaborative robots, XR tools, IoT devices, and predictive analytics software. Study questions emphasize all three dimensions (adoption, training, and usability) as essential for understanding how well

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	technologies are integrated. Equal weights will ensure that no aspect is undervalued, providing a comprehensive assessment. Number of Technologies Implemented / Total Identified Collaboration Tools (33%) Percentage of Employees Trained (33%) Employee Usability and Benefit Score (33%)
Target and values	Target: it should align with organizational goals Values: **High Performance (Optimal): 70–100%** - Extensive deployment of technologies, >70% of employees trained, and employee perception scores consistently above 4 (out of 5). **Moderate Performance: 40–69%** - Partial deployment of technologies, 40–70% of employees trained, and employee perception scores in the range of 3–4. **Low Performance (Concerning): <40%** - Limited deployment of technologies, <40% of employees trained, and employee perception scores below 3.
Benefits / Value proposition	Increases operational efficiency by optimizing human-machine collaboration, improving the satisfaction and engagement of the workers.

Data collection and analysis approaches and methodologies

This KPI reflects the integration of advanced technologies to support human roles, aligning with workplace innovation principles. Data sources include technology utilization reports, employee feedback surveys, and adoption rates of tools such as XR, collaborative robots, and IoT systems. Organizations use **technology adoption frameworks** like the **Digital Maturity Index** to evaluate progress. Smaller firms may focus on qualitative feedback, while larger enterprises track real-time usage analytics through **digital transformation platforms**.

Measurement Tool	Data Requirements
Technology Deployment Surveys	Employee and manager responses regarding adoption rates, usability, and perceived benefits of new technologies.
Technology Usage Logs	Records tracking frequency, duration, and extent of technology use across operations, such as machine interaction and collaborative tool engagement.

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Budget Allocation Reports	Financial data on investments made toward purchasing, maintaining, and integrating Industry 4.0 tools, normalized against total operational budget.
Employee Training and Technology Integration Reports	Documentation of training sessions, number of employees trained, training hours completed, and feedback on training effectiveness.
Impact Assessments	Data reflecting productivity improvements, error reductions, and enhanced safety metrics attributed to technology adoption, including pre- and post-implementation comparisons.

KPI_HC2. Training and re-skilling opportunities

This KPI is critical to the successful adoption of I5.0 principles, particularly within the human-centricity pillar. It evaluates the organization's ability to equip its workforce with the skills needed for current and future roles. By measuring participation rates, diversity of training offerings, and alignment with industry trends, organizations can identify gaps and opportunities to strengthen their workforce capabilities, fostering resilience and innovation. During the workshops with the UCs providers, KPI_HC4 consistently demonstrated its significance, achieving an average relevance score of 3.83 on a 1-to-5 Likert scale. Furthermore, 42.8% of the participating companies ranked this KPI among their top three priorities, underscoring its critical role in preparing the workforce for current and future demands. Additionally, KPI_HC4 aligns with existing frameworks like ESG and workforce sustainability metrics, reinforcing its broad applicability across sectors and company sizes. The KPI has been identified as a Core KPI due to its universal relevance in assessing and improving workforce capabilities, making it a fundamental element for organizations striving to adopt I5.0 principles.

KPI_HC2	**Training and re-skilling opportunities**
Description	Evaluates the availability and effectiveness of training and career development programs offered to employees.
Study questions	○ What percentage of employees have access to training and career development programs tailored to their roles and future needs? ○ How effectively do these programs bridge skill gaps and prepare employees for technological advancements? ○ To what extent do employees perceive these opportunities as supporting their career growth and job satisfaction? ○ How does the availability of training programs contribute to fostering innovation and improving organizational efficiency?

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Objective	The objectives of training and re-skilling opportunities in companies are essential for fostering employee growth, adapting to technological advancements, and enhancing organizational efficiency.
Scope	This KPI applies across all organizational levels and departments, focusing on the availability, accessibility, and effectiveness of training and re-skilling programs. It is particularly relevant in industries undergoing rapid technological transformation or workforce restructuring. Suitable for organizations of all sizes aiming to align employee skills with emerging industry demands.
Formula	*Training Accessibility Score = (Employees with access to relevant training programs / Total Employees) × 100* Relevant training programs are structured educational or developmental initiatives specifically designed to meet the needs of employees and align with organizational goals. These programs focus on equipping employees with skills, knowledge, and competencies that are directly applicable to their current roles, future career growth, or organizational objectives such as technological advancements, innovation, and operational efficiency.
Target and values	- **Low Performance**: <50% of employees participate in training or re-skilling programs annually, indicating significant gaps in workforce development. - **Moderate Performance**: 50-75% of employees participate in relevant programs annually, reflecting progress but room for improvement. - **High Performance**: >75% of employees participate in training or re-skilling programs annually, demonstrating a strong commitment to workforce development and adaptability. Targets can be tailored to align with the company's strategic goals and sector-specific requirements.
Benefits – value proposition	Address skill gaps and prepare employees for technological and operational advancements. Enhance workforce satisfaction and retention through professional growth opportunities. Drive innovation by fostering a well-trained, adaptive, and resilient workforce. Align workforce capabilities with industry trends, regulatory requirements, and strategic objectives.

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Data collection and Analysis Approaches and Methodologies

Aligned with **Global Reporting Initiative (GRI) 404: Training and Education**, this KPI evaluates participation in employee development programs. Data is gathered from HR systems, training attendance logs, and budgets allocated for skill development. Metrics include training hours per employee, participation rates, and post-training performance improvements. Smaller firms may rely on qualitative methods, while larger organizations employ **learning management systems (LMS)** to monitor training effectiveness and align with organizational goals.

Measurement Tool	Data Requirements
Survey on Training Opportunities	Responses from employees about access to and satisfaction with training programs.
Average Hours of Training per Employee	Total training hours delivered during a specific period, divided by the total number of employees.
Budget Allocation Report	Percentage of the annual budget allocated to training and development activities.
HR Reports	Number of employees trained, types of training programs attended, and participation rates.
Programs for Upgrading Employee Skills	Details of skill development programs implemented, including transition assistance initiatives.
Performance and Career Reviews	Percentage of employees receiving regular performance evaluations and career development discussions.
Training Impact Assessments	Data on the effectiveness of training programs, such as increased productivity, employee satisfaction, or skill enhancements.

KPI_HC3. Comprehensive employee well-being and satisfaction index

This KPI was identified as a Core KPI due to its centrality in assessing human-centricity, a foundational pillar of I5.0. The *Comprehensive Employee Well-Being and Satisfaction Index* captures a holistic view of employee experiences, integrating metrics on workplace satisfaction, work-life balance, social connection, and overall well-being. By consolidating originally separate KPIs into this aggregated measure, the framework ensures a streamlined yet comprehensive approach to evaluating workforce satisfaction and engagement. The importance of this KPI was strongly validated during the workshops with UCs. It achieved an average relevance score exceeding 4 on a 1-to-5 Likert scale, underscoring its universal applicability and significance across different company sizes and sectors. Furthermore, 71.5% of the participating companies ranked this KPI among their top three priorities, reflecting the critical role of employee well-being in fostering innovation, retention, and productivity. This KPI's designation as a Core KPI reflects its universal relevance and the actionable insights it offers. By monitoring

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employee satisfaction and well-being, organizations can identify gaps, address challenges proactively, and align their workforce strategies with I5.0's human-centric principles. Moreover, its adoption supports companies in creating inclusive and empowering work environments, which are essential for achieving long-term industrial success and societal impact.

KPI_HC3	**Comprehensive employee well-being and satisfaction index**
Description	Assesses overall employee satisfaction through surveys, reflecting morale and engagement within the workplace. Measures employee satisfaction with their ability to balance work responsibilities and personal life, including flexibility, work time reduction, and family conciliation options
Study questions	How do employees rate their overall well-being, work-life balance, and job satisfaction? What specific areas of workplace satisfaction need the most improvement?
Objective	The key objectives of creating and tracking this index include: i) enhancing employee engagement and retention; ii) improving productivity and performance; iii) reducing absenteeism and burnout; iv) identifying areas for development; v) strengthening organizational culture; vi) enhancing reputation and attracting talent. Overall, this index provides actionable insights that help create a workplace where employees can thrive, contributing to both organizational success and individual fulfillment in a social perspective.
Scope	Applicable to all levels of the organization and across departments. Relevant for companies of all sizes seeking to prioritize human-centric values in the workplace.

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Formula	*Employee well-being and satisfaction index = (physical well-being + mental well-being + work environment + job satisfaction + work-life balance + career growth opportunities) /N* Explanation of terms: **Physical Well-Being:** Refers to the physical health and safety of employees in the workplace. This includes access to ergonomically designed workspaces, wellness programs, and preventive health measures to reduce risks of injury or illness. **Mental Well-Being:** Encompasses emotional and psychological health, including stress management, mental health support programs, and creating an inclusive culture that fosters a sense of belonging and purpose. **Work Environment:** Pertains to the overall conditions under which employees work, such as physical settings, resources available, organizational culture, and management practices that contribute to a productive and supportive atmosphere. **Job Satisfaction:** Measures how content employees are with their roles, responsibilities, compensation, and opportunities for recognition. High job satisfaction indicates alignment between employee expectations and organizational delivery. **Work-Life Balance:** Assesses the equilibrium between work responsibilities and personal life, including flexible work arrangements, reasonable work hours, and support for family or personal commitments. **Career Growth Opportunities:** Refers to the availability of training, upskilling, promotions, and mentorship programs that enable employees to advance their careers and achieve long-term professional goals. ***N*** *is the number of factors that are calculated (from 1 to 6)*
Target and values	- **Low satisfaction**: <60% index score indicates significant areas for improvement. - **Moderate satisfaction**: 60-80% indicates acceptable levels with room for growth. - **High satisfaction**: >80% reflects a highly engaged and satisfied workforce.

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Benefits / value proposition	Enhances productivity by fostering a motivated, satisfied workforce. Builds a strong employer brand, aiding talent acquisition and retention

Data collection and analysis approaches and methodologies

This KPI aligns with frameworks like **ISO 45003: Psychological Health and Safety at Work** and **GRI 403: Occupational Health and Safety**. Data collection combines survey responses on employee satisfaction, work-life balance, and wellness program participation with absenteeism rates and productivity metrics. Smaller companies may use simple employee surveys, while larger organizations employ **employee experience platforms** for comprehensive tracking. Metrics such as the Employee Net Promoter Score (eNPS) and work-life balance indices provide actionable insights into workforce well-being.

Measurement Tool	Data Requirements
Employee Satisfaction & Engagement Survey	Annual survey incorporating key elements such as job satisfaction, work-life balance, and social connection.
eNPS	Quarterly tracking of employee sentiment, with a focus on likelihood to recommend the workplace.
Work-Life Balance Program Utilization Reports	Data on participation in flexible work options, family support programs, and reduced working hours.
Health and Wellness Program Effectiveness Reports	Metrics on participation in health programs, satisfaction with wellness initiatives, and reductions in absenteeism.
Exit Interviews or Surveys	Feedback from departing employees on job satisfaction, work-life balance, and engagement.
Focus Groups or 360-Degree Feedback	Qualitative data on team dynamics, workplace wellness, and perceptions of support for well-being.
Wearable Devices & IoT Sensors	Physical health data (e.g., activity levels, heart rate) for organizations using advanced health monitoring tools.
HR Records	Data on absenteeism, participation in training programs, demographic information, and use of well-being initiatives.

KPI_HC4. Representation in decision-making roles.

This KPI assesses the participation and representation of employees in decision-making roles and improvement initiatives, reflecting the inclusivity and democratization of decision-making processes within the organization. The inclusion of this KPI as a Core

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KPI reflects its alignment with I5.0's commitment to fostering inclusive and human-centric workplaces. While the relevance score of 3.18 on a 1-to-5 Likert scale during UC validation workshops was moderate, the pivotal feedback from AB members and other EU stakeholders emphasized its strategic importance. Their input highlighted the critical role of participatory decision-making in promoting innovation, enhancing organizational culture, and ensuring diverse perspectives in leadership roles. This KPI's relevance extends beyond operational metrics, addressing broader societal and ethical imperatives such as equity and inclusivity in the workplace. Its status as a Core KPI underscores the framework's commitment to integrating these principles, helping organizations align their policies with I5.0 objectives. By measuring employee involvement in decision-making, this KPI provides actionable insights to enhance leadership inclusivity and improve organizational performance through collective and diverse input.

KPI_HC4	**Representation in decision-making roles**
Description	Assesses the participation and representation of employees in decision-making roles and/or improvement initiatives.
Study questions	What proportion of employees from underrepresented groups hold decision-making roles? How effectively do employees contribute to improvement initiatives?
Objective	To evaluate and promote inclusivity, diversity, and equitable participation in leadership and decision-making processes. It aims to ensure that employees from various backgrounds and levels have a voice in organizational strategy and improvement initiatives, fostering innovation, engagement, and a balanced organizational culture.
Scope	Applies across all organizational levels and is relevant for companies of any size or sector aiming to promote inclusive decision-making and diverse representation in leadership. It is particularly applicable in industries prioritizing equity, innovation, and employee engagement as part of their organizational culture and strategic objectives
Formula	***Representation Rate*** *(%)* = *(Number of Employees Actively Participating in Decision-Making Roles or Activities /Total Number of Employees) ×100*
Target and values	Baseline: Assess current participation levels in decision-making activities using initial data from HR records, decision-making reports, and employee surveys.

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	Short-term Target: Increase the representation rate of employees involved in decision-making roles or improvement initiatives by 10-15% within 2 years, focusing on underrepresented groups (e.g., gender, age, or other demographics). Long-term Target: Aim for representation rates that reflect organizational diversity benchmarks or exceed 50% participation across all demographic groups within 5-7 years. **Values**: **High (>70%)**: Excellent representation with widespread employee involvement in decision-making. **Medium (40-69%)**: Moderate representation with opportunities for improvement in inclusivity. **Low (<40%)**: Limited representation requiring focused efforts to improve participation and inclusivity.
Benefits / Value proposition	Actively engaging employees in decision-making encourages creativity and the implementation of new ideas, driving continuous improvement. Involving employees in decision-making fosters a sense of ownership, motivation, and commitment to organizational goals. Enhances strategic decision-making with diverse input and perspectives.

Data collection and analysis approaches and methodologies

This KPI assesses employee participation in strategic decisions, drawing from workplace innovation frameworks. Data sources include meeting attendance records, leadership demographics, and idea submission platforms. Organizations use **decision-making analytics tools** to track representation metrics. Smaller firms may focus on qualitative insights, while larger organizations implement tools for real-time monitoring of leadership diversity and involvement rates.

Measurement Tool	Data Requirements
Decision-Making Activities Reports	Records of employee participation in decision-making and improvement initiatives.
Surveys	Responses evaluating leadership support, culture of innovation, and employee involvement in innovation activities.
HR Data	Data on employees in decision-making roles, including demographics and role descriptions.
Suggestion Programs and Implementation Rates	Metrics on employee-generated ideas and their implementation in organizational practices.

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Scenario related KPIs

The Scenario-Related KPIs for Human-Centricity have been designated as such due to their variable applicability, which depends on factors like company size and industrial sector. Unlike Core KPIs, these indicators offer deeper insights into specific operational impacts or broader metrics that vary in relevance and feasibility across diverse organizational contexts. The feedback from UC workshops reinforced this categorization, as participants highlighted the practical challenges of implementing these KPIs universally. For example, smaller companies may lack the resources or structural requirements to adopt certain indicators, such as *Ergonomic design and tools* or *Job crafting*. Conversely, larger organizations can benefit from these KPIs, which provide actionable insights into specific areas critical for refining their human-centric policies and outcomes.

These KPIs complement the Core KPIs by allowing organizations to expand their assessment scope once policy alignment has been established. Their designation as Scenario-Related reflects their adaptability to specific organizational contexts, ensuring the framework's applicability across diverse UCs. Each of these Scenario-Related KPIs serves as a flexible tool for organizations to customize their assessment based on their unique context, such as size, sector, or other specific characteristics. While the **policy level KPIs** focus on organizational alignment with broader human-centric goals, the **outcome level KPIs** capture tangible impacts of these policies, enabling deeper insights into operational effectiveness. This dual categorization ensures that the PAF remains adaptable, offering companies the flexibility to assess areas most relevant to their strategic priorities. This categorization, grounded in feedback from workshops and refined through the dual structure of the PAF, ensures that the framework remains both comprehensive and adaptable, aligning with the specific needs and goals of diverse industrial landscapes.

KPI_HC5: Employee turnover rates

This KPI monitors employee turnover rates, measuring the percentage of employees leaving the organization within a specified period. It provides insights into workforce stability, employee satisfaction, and organizational health. Turnover rates are especially relevant for sectors with high competition for talent or significant workforce mobility, such as technology, healthcare, or retail. Smaller organizations may rely on manual tracking or simple HR analytics, while larger companies often use advanced HR management systems for more precise data collection and analysis. Its designation as a Scenario-Related KPI reflects its applicability based on sectoral dynamics, company size, and the criticality of workforce retention to organizational success

KPI_HC5	Employee turnover rates

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Description	Measures the percentage of employees who leave the organization within a specific period, indicating employee retention levels.
Study questions	What are the main factors driving employee turnover in your organization? How does turnover rate compare to industry benchmarks and historical trends?
Objective	The objective of turnover rate is to understand the rate at which employees leave an organization within a specific timeframe. This insight serves multiple functions: i) identify causes of employee departure; ii) improve retention strategies; iii) enhance recruitment and hiring practices; iv) benchmark against industry standards; v) improve employee engagement and satisfaction; vi) reducing cost management.
Scope	This KPI applies to all departments and employee levels within an organization, regardless of size or sector. It tracks the rate at which employees leave the organization, providing insights into workforce stability and areas needing improvement. Turnover rates can be categorized into voluntary, involuntary, and total turnover to better understand the underlying causes and trends.
Formula	*Employee turnover {Employees who left in a year / [(Beginning number of employees + Ending number of employees) / 2]} x 100 = Annual employee turnover rate*
Target and values	-**Low turnover (optimal)**: <10% annually, indicating a stable and satisfied workforce with minimal disruption to operations. - **Moderate turnover**: 10-20% annually, reflecting an acceptable level of employee movement, depending on industry standards. - **High turnover (concerning)**: >20% annually, signaling potential issues with employee engagement, satisfaction, or organizational culture. Targets should align with industry benchmarks and organizational strategic goals.
Benefits / value proposition	Reduces costs associated with recruitment and training by identifying retention strategies. Improves organizational stability and employee morale.

Data collection and analysis approaches and methodologies

This KPI is aligned with HR best practices and frameworks like the **ISO 30414: Human Capital Reporting** standards, ensuring standardized and actionable insights into employee retention trends. Data is sourced primarily from HR reports and HR analytics software, which track workforce movements and classify turnover as voluntary

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(resignations, retirements) or involuntary (terminations, layoffs). Smaller organizations may rely on manual HR tracking systems, while larger firms benefit from more advanced HR analytics platforms that automate data collection and segmentation.

Measurement tools	Data Requirements
HR reports	Total number of employees who left the organization during the reporting period. Categorization of turnover (e.g., voluntary: resignations, retirements; involuntary: terminations, layoffs).
HR Analytics Software	Average number of employees during the reporting period. Real-time tracking of employee exits segmented by department, role, and demographic factors.
Employee Exit Surveys	Qualitative data on reasons for voluntary turnover. Suggestions for improving retention based on departing employee feedback.

KPI_HC6. Number of workplace accidents / incidents

This KPI monitors workplace safety by tracking accidents and incidents, with a focus on physical well-being. It is especially relevant for industries like manufacturing and logistics, where safety risks are higher. Smaller firms may prioritize qualitative assessments or manual tracking, while larger organizations often use advanced incident management systems. Its designation as a Scenario-Related KPI reflects its variability in relevance and applicability based on sectoral and organizational risks.

KPI_HC6	Number of workplace accidents/incidents
Description	Tracks the frequency of accidents and incidents in the workplace, indicating safety and compliance with health regulations
Study questions	What are the most common causes of workplace accidents in the organization? How does the frequency of incidents compare to industry safety standards? Is your company reactive (after the incidents) or proactive (anticipate)?
Objective	The objective of measuring the number of workplace accidents or incidents is to understand, monitor, and improve workplace safety. Tracking incidents provides valuable insights for management and helps establish safer working environments by identifying risks and areas requiring intervention.

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Scope	This KPI applies to all operational areas and employee roles, tracking workplace accidents and incidents that impact employee safety and well-being. It is relevant across all industries, particularly those with higher physical risks, such as manufacturing, construction, and logistics. Suitable for organizations of all sizes aiming to prioritize workplace safety and compliance with regulatory standards.
Formula	For this KPI, different formulas are currently used by the industry. Each of the following formulas helps companies track and understand workplace safety by standardizing incident data for meaningful analysis and comparison. Companies should select the one they are already using. **1. *Total Case of Incidence rate of injuries and illnesses (TCIR)*** = *(Number of Recordable Cases / Total Hours Worked)×200,000* Explanation of Terms ○ **Number of Recordable Cases:** The total count of workplace injuries and illnesses that meet the recordable criteria as defined by regulatory standards ○ **Total Hours Worked:** The total hours worked by all employees during the reporting period. ○ **200,000:** A constant representing the hours worked by 100 full-time employees in a year, assuming 40 hours per week for 50 weeks. **2. *Lost Time Injury Frequency Rate (LTIFR)*** = *(Number of lost time injuries in the reporting period / Total hours worked in the reporting period). x 1,000,000)* Explanation of Terms ○ **Lost Time Injuries (LTIs):** The total number of workplace injuries or illnesses that result in employees being unable to work for a minimum of one full workday or shift. ○ **Total Hours Worked:** The total number of hours worked by all employees during the reporting period. ○ **1,000,000:** A multiplier to normalize the rate to "per million hours worked," a standard benchmark for comparability across industries and organizations. **3. Total Recordable Incident Rate (TRIR)** calculates all recordable incidents per 200,000 working hours ***TRIR*** *= (Number of Incidents / total number of hours worked in the reporting period) x 200,000* **4. *Severity Rate*** = *(Number of lost workdays / Total number of hours worked) x 1,000.* Explanation of Terms

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	○ **Total Lost Workdays:** The cumulative number of workdays employees were unable to work due to injuries or illnesses during the reporting period. ○ **Total Hours Worked:** The total hours worked by all employees during the same reporting period. ○ **1,000:** A constant used to standardize the rate for easier comparison across organizations.
Target and values	- **Low Performance (Concerning)**: >10 workplace accidents/incidents per 100 employees annually, indicating a need for significant improvements in safety measures. - **Moderate Performance**: 3-10 workplace accidents/incidents per 100 employees annually, reflecting progress but room for improvement. - **High Performance (Optimal)**: <3 workplace accidents/incidents per 100 employees annually, demonstrating strong adherence to safety protocols and an effective safety culture. Targets may vary depending on industry norms and risk levels.
Benefits / value proposition	Enhance safety, reduce risks, lower costs associated with injuries, and improve employee morale. It demonstrates a commitment to a safe work environment, supports compliance with regulations, and strengthens overall operational efficiency. Reduces financial and reputational risks associated with workplace injuries. Promotes a culture of safety, enhancing employee trust and satisfaction.

Data collection and analysis approaches and methodologies

This KPI follows **ISO 45001** guidelines, tracking workplace safety incidents and their resolution. Data sources include safety reports, incident logs, and insurance claims. Organizations use **incident management systems** to document and analyse accidents, identifying root causes and preventive measures. Smaller companies may use manual tracking, while larger firms employ automated systems to detect patterns and improve workplace safety proactively.

Measurement Tool	Data Requirements
Incident Reports	Number and type of workplace accidents/incidents, including injuries, near misses, and incidents involving human-robot interactions.
Employee Reports	Records of incidents reported directly by employees, with a focus on human-robot interactions or unsafe conditions.
Safety Inspection Reports	Findings from routine safety inspections and audits, including identified hazards and compliance gaps.

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Automated Logs	Data from IoT devices, robotics, and automated systems tracking incidents and anomalies in operations

KPI_HC7. Ergonomic design and tools

This KPI tracks the implementation and effectiveness of ergonomic designs and tools in the workplace. By identifying areas for improvement and monitoring progress, organizations can enhance employee comfort, reduce workplace injuries, and improve overall productivity. Regular assessments and feedback from employees ensure that ergonomic standards are consistently maintained and adapted to evolving needs. It is especially relevant for sectors like manufacturing and logistics, where physical labor and workstation design are crucial. However, its implementation varies widely depending on organizational size and maturity. Smaller companies may focus on basic ergonomic solutions, while larger firms may leverage advanced assessments and ergonomic technologies. Its status as a Scenario-Related KPI ensures that its application is context-dependent, addressing specific operational needs.

KPI_HC7	**Ergonomic design and tools**
Description	Assesses the design of the workplace environment to ensure it supports employee health, comfort, and productivity and the availability and utilization of ergonomic tools and equipment.
Study questions	What percentage of workstations meet ergonomic standards? How do employees rate their physical comfort and ergonomic tools provided?
Objective	The objective of ergonomic design and tools is to optimize the interaction between employees and their work environments to enhance comfort, safety, and efficiency. Key goals include reducing the risk of injuries, supporting physical and cognitive well-being, increasing productivity, and promoting adaptability and job satisfaction. By creating safer and more user-friendly workplaces, ergonomic solutions contribute to both employee satisfaction and organizational performance.
Scope	This KPI applies to all physical workplaces and job roles that require interaction with equipment, tools, or environments affecting employee comfort, safety, and productivity. It is particularly relevant in industries such as manufacturing, logistics, healthcare, and office-based work environments. Suitable for organizations of all sizes aiming to improve workplace ergonomics and reduce risks associated with poor

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	ergonomic design. Smaller organizations may focus only on the compliance rate, while larger ones might integrate all components.
Formula	***Ergonomic Performance Index (EPI)*** *= (Ergonomic Compliance Rate + Ergonomic Satisfaction Score + Ergonomic Tool Utilization Rate) / 3* ***Ergonomic Compliance Rate*** *= (Number of Ergonomically Assessed and Adapted Workstations or Tools / Total Number of Workstations or Tools)×100* ***Ergonomic Satisfaction Score*** *= Sum of Employee Ergonomic Satisfaction Scores / Total Number of Respondents* ***Ergonomic Tool Utilization Rate*** *= (Number of Ergonomic Tools Actively Used by Employees / Total Distributed Ergonomic Tools)×100*
Target and values	Low Performance (Concerning): EPI <50% Moderate Performance: EPI 50-80% High Performance (Optimal): EPI >80%
Benefits / Value proposition	Reduces absenteeism and injuries due to musculoskeletal issues. Enhances employee productivity and satisfaction.

Data collection and analysis approaches and methodologies

Aligned with **ISO 6385: Ergonomic Principles in the Workplace**, this KPI assesses the design and availability of ergonomic tools. Data sources include workplace surveys on ergonomic satisfaction, equipment utilization reports, and absenteeism records linked to musculoskeletal injuries. Organizations use **ergonomic assessment tools** and health monitoring systems to track progress. Smaller companies may focus on employee feedback, while larger firms leverage IoT-enabled sensors to optimize ergonomic design.

Measurement Tool	Data Requirements
Workplace Ergonomics Assessment Survey	Feedback on employee comfort, satisfaction, and specific ergonomic concerns before and after the implementation of ergonomic tools or designs.
Pulse Surveys on Health and Comfort	Regular employee feedback on the overall ergonomic and design quality of the workplace.
Ergonomic Tools Utilization Report	Data on the availability, distribution, and active usage rates of ergonomic tools such as chairs, desks, or computer accessories provided to employees.

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Physical Health and Absenteeism Records	Instances of musculoskeletal complaints, injuries related to poor ergonomics, and general absenteeism rates linked to workplace discomfort or health issues.
Ergonomic Evaluation and Reporting	Detailed inventory of ergonomic tools, their locations, and specific utilization rates. Reports on ergonomic assessments and their outcomes across workplace setups.

KPI_HC8. Diversity ratio

This KPI measures the representation of diverse demographic groups within the workforce, such as gender, ethnicity, age, and disability. It is generic and broadly relevant across all sectors, aligning with universal inclusivity goals. However, its impact and feasibility can vary significantly based on sectoral context (e.g., historically less diverse sectors like aerospace) and the organization's size. Smaller firms may face challenges in systematically tracking diversity metrics compared to larger companies with established HR infrastructures.

KPI_HC8	**Diversity ratio**
Description	Measures the representation of different demographic groups within the workforce, according to variables such as gender, ethnicity, age, and disability.
Study questions	How does the diversity ratio compare across different organizational levels? What progress has been made toward improving representation over time?
Objective	The objectives of a diversity ratio (or diversity metrics) are to measure and improve the representation of different groups within an organization, institution, or community, aiming to foster a more inclusive, equitable, and productive environment.
Scope	This KPI applies to all levels of the organization, tracking the representation of diverse groups, such as gender, ethnicity, age, and disability, within the workforce and decision-making roles. It is relevant across industries and company sizes, particularly for organizations aiming to foster an inclusive culture and align with DE&I goals.
Formula	***Employee Diversity Ratio*** *= (Number of Employees in a Specific Group / Total Number of Employees) x 100* Explanation of terms:

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	○ **Specific Group**: Refers to a demographic category of employees based on shared characteristics. **Gender**: Male, female, or non-binary employees. **Age**: Specific age ranges (e.g., 18–24, 25–34, 35-50, 50-65). **Ethnicity**: Employees self-identifying as part of specific racial or ethnic groups. **Disability**: Employees disclosing physical or cognitive disabilities. ○ **Number of Employees in a Specific Group**: The total count of employees within the organization belonging to the selected group. ○ **Total Number of Employees**: The total workforce across all groups within the organization. The diversity ratio is calculated separately for each demographic group, providing distinct metrics for gender diversity, age diversity, and so on. This allows for targeted analysis and action plans. ***Diversity Ratio*** *= Percentage of Group in Organization / Percentage of Group in Benchmark Population* Explanation of terms: ○ **Percentage of Group in Organization**: This is the percentage of a particular demographic group (e.g., women, a specific ethnic group) within the organization. ○ **Percentage of Group in Benchmark Population**: This is the percentage of the same demographic group in the larger population that serves as a benchmark (e.g., the industry average or national population statistics). ***Diversity Ratio in Decision-Making Roles (%)*** *= (Number of Employees in a Specific Group in Decision-Making Roles / Total Number of Employees in Decision-Making Roles) ×100*
Target and values	- **Low Performance (Concerning)**: <20% representation of diverse groups in the workforce or decision-making roles, indicating significant gaps in diversity and inclusivity. - **Moderate Performance**: 20-40% representation, reflecting progress but with room for improvement. - **High Performance (Optimal)**: >40% representation, demonstrating strong commitment to DE&I and a balanced, inclusive workforce. Targets may vary depending on industry benchmarks and regional demographics.

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Benefits / Value proposition	Drives innovation through diverse perspectives and inclusivity. Enhances company reputation and aligns with societal expectations.

Data collection and analysis approaches and methodologies

This KPI aligns with **GRI 405: Diversity and Equal Opportunity** and focuses on measuring workforce diversity across gender, age, ethnicity, and other demographics. Data is collected from HR databases, employee surveys, and recruitment records. Metrics include diversity percentages by department and leadership roles. Smaller firms may conduct annual diversity audits, while larger organizations integrate diversity analytics into their **HR information systems (HRIS)** to track and report progress.

Measurement tools	**Data Requirements**
HRIS	Total number of employees; workforce demographic information (age, gender, ethnicity, disability, job level).
Employee Surveys	Self-reported demographic data to validate and enhance HRIS records.
Recruitment Records	Demographic breakdown of new hires and promotions.
Diversity Audits	Periodic reviews of overall workforce and departmental diversity metrics.

KPI_HC9. Inclusivity programs effectiveness

This KPI tracks the availability and impact of programs aimed at fostering inclusivity and equity. Its application as a Scenario-Related KPI reflects its varied relevance based on organizational maturity and industry. For example, larger organizations may run formalized inclusivity initiatives, while smaller firms might focus on informal or grassroots efforts to create inclusive environments.

KPI_HC9	**Inclusivity programs effectiveness**
Description	Tracks the number and effectiveness of programs aimed at promoting DE&I within the organization.
Study questions	What is the participation rate in inclusivity programs across the organization?

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	How do employees perceive the impact of these programs on workplace culture?
Objective	The objective of this KPI is to evaluate the implementation, participation, and impact of inclusivity programs on fostering a diverse, equitable, and inclusive workplace. It aims to measure how well these programs address workforce diversity gaps, improve employee perceptions of inclusivity, and enhance organizational culture.
Scope	This KPI applies to all organizational levels and departments, measuring the reach, impact, and effectiveness of programs aimed at promoting DE&I. It is relevant for organizations of all sizes and sectors striving to foster an inclusive and equitable workplace.
Formula	***Inclusivity Program Effectiveness*** *(%) =* *(Number of Participants in Inclusivity Programs / Total Number of Employees) ×100* ***Program Impact Score*** *= Total Survey Scores from Participants / Number of Survey Responses*
Target and values	- **Low Performance (Concerning)**: <50% of inclusivity program goals achieved or <50% employee participation, indicating significant gaps in program reach or impact. - **Moderate Performance**: 50-75% of program goals achieved or participation rates, reflecting progress with room for improvement. - **High Performance (Optimal)**: >75% of program goals achieved or participation, demonstrating strong engagement and effective program implementation. Targets should align with the organization's strategic DE&I goals.
Benefits / Value proposition	Builds an equitable workplace that attracts and retains top talent. Fosters collaboration and innovation through inclusivity.

Data collection and analysis approaches and methodologies

This KPI evaluates the reach and impact of inclusivity initiatives, using frameworks like **ISO 30415: Diversity and Inclusion**. Data is collected from program participation rates, employee feedback, and performance reviews. Organizations may use **engagement surveys** and qualitative focus groups to assess effectiveness. Smaller firms rely on direct feedback, while larger enterprises integrate inclusivity metrics into organizational culture assessments using digital engagement tools.

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Measurement Tools	Data Requirements
HRIS	Workforce demographic information (age, gender, ethnicity, disability, job level); total number of employees
Inclusivity Program Tracking Reports	Number of inclusivity programs implemented; participation rates in diversity training, mentorships, or affinity groups
Employee Surveys	Feedback on perceived fairness, program effectiveness, and inclusivity of the work environment
Program Records and Suggestion Boxes	Detailed records of program activities, participation, and employee suggestions for improvement

KPI_HC10. Job crafting

This KPI assesses the organization's ability to offer flexibility in job roles to align with employees' skills and aspirations. It has generic applicability but is especially impactful in sectors requiring creative problem-solving or cross-disciplinary collaboration, like energy and utilities. Smaller organizations may implement this KPI informally, while larger ones might adopt structured systems to support job crafting.

KPI_HC10	Job crafting
Description	Measures the extent to which employees actively shape and customize their job roles to better align with their skills, interests, and strengths.
Study questions	What percentage of employees have customized their roles to better suit their skills and interests? How do employees perceive the flexibility to craft their job roles?
Objective	Enhance employees' engagement, satisfaction, and performance.
Scope	This KPI applies to all industries and organizations that aim to enhance employee engagement and productivity by empowering workers to tailor their roles. It is particularly relevant in knowledge-intensive sectors and creative industries, where job flexibility and innovation are critical. For smaller firms, this KPI may focus on informal role modifications, while larger organizations can track structured job-crafting initiatives.
Formula	***Job Crafting Participation Rate (%)*** *= (Number of Employees Engaged in Job Crafting Behaviors / Total Number of Employees) ×100*

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	Explanation of terms**:** **Job Crafting behaviours:** the term includes three components: **Task Crafting**: Changing the scope, nature, or type of tasks performed.: Employees may add, remove, or adjust certain tasks to better match their skills, interests, or goals. For example, a project manager might take on additional tasks related to team building to enhance group cohesion **Relational Crafting**: Modifying the quality or quantity of interactions with others at work. Employees might choose to build stronger connections with certain colleagues, clients, or supervisors to enhance collaboration, gain support, or foster a positive work environment. **Cognitive Crafting**: Changing one's perspective on the role or the tasks involved. This might mean reinterpreting tasks to find more meaning, purpose, or connection to personal values. For instance, a teacher may view grading not as a chore but as an opportunity to provide valuable feedback and mentorship.
Target and values	**High Performance (Optimal):** >70% of employees actively participate in job crafting behaviors, indicating a strong culture of engagement and role ownership. **Moderate Performance:** 40–69% of employees engage in job crafting activities, reflecting growing but uneven adoption across the organization. **Low Performance (Concerning):** <40% of employees participate in job crafting, signaling limited opportunities or support for employee-driven role shaping.
Benefits / Value proposition	Increases engagement by allowing employees to align roles with personal strengths. Encourages innovation and adaptability in the workforce.

Data collection and analysis approaches and methodologies

This KPI evaluates employees' ability to shape their roles for greater satisfaction and productivity, linked to human-cantered job design frameworks. Data is collected from feedback surveys, job description audits, and performance reviews. Organizations use **employee engagement platforms** and real-time feedback tools to measure job-crafting efforts. Smaller firms may conduct annual assessments, while larger companies employ continuous feedback mechanisms integrated into HR systems.

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Measurement Tools	Data Requirements
Surveys on Job Crafting Behaviors	Percentage of employees engaging in job crafting behaviors, frequency of such behaviors, and type (task, relational, or cognitive crafting).
Surveys on Job Crafting Activities	Information on specific activities undertaken by employees to modify tasks, relationships, or perceptions.
Performance Reviews	Data on employee performance improvements linked to job crafting efforts, including task outcomes and goal achievement
Personnel Interviews	Qualitative insights into employees' motivations, challenges, and perceptions of job crafting practices.
Job Description Audits	Comparison of formal job descriptions with actual roles and responsibilities post-crafting
Employee Engagement Platforms	Real-time tracking of job crafting activities and their alignment with organizational goals.

Summary of data collection tools for human-centricity KPIs

To ensure accurate and consistent measurement of Human-Centricity KPIs, organizations leverage various tools designed to capture employee-focused data:

- **Employee surveys and feedback platforms**: comprehensive surveys and pulse feedback tools gather data on job satisfaction, well-being, and engagement, while specific modules assess areas like work-life balance and inclusivity.
- **HRIS**: centralized HR platforms track training hours, participation in upskilling programs, diversity metrics, and representation in decision-making roles.
- **Performance management systems**: these systems provide insights into employee development, career progression, and participation in organizational initiatives.
- **Wellness program tracking tools**: platforms that monitor employee usage of wellness programs, participation rates, and their impact on absenteeism and overall health.
- **Focus groups and 360-degree feedback tools**: qualitative methods for capturing in-depth insights into workplace dynamics, team interactions, and employee perceptions.
- **Wearable and IoT devices**: For organizations that adopt advanced tools, wearable devices and IoT sensors collect data on physical activity, stress levels, and ergonomics to assess workplace health and safety.

Other resources and tools

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- ISO 45001:2018 - Occupational Health and Safety Management Systems – Requirements https://www.iso.org/standard/63787.html
- ISO 45003:2021 - Occupational Health and Safety Management – Psychological Health and Safety at Work – Guidelines for Managing Psychosocial Risks https://www.iso.org/standard/64283.html
- ISO 9001:2015 - Quality Management Systems – Requirements https://www.iso.org/standard/62085.html
- GRI 401: Employment 2016 https://www.globalreporting.org/standards/media/1031/gri-401-employment-2016.pdf
- GRI 403: Occupational Health and Safety 2018 https://www.globalreporting.org/standards/media/1033/gri-403-occupational-health-and-safety-2018.pdf
- GRI 404: Training and Education 2016 https://www.globalreporting.org/standards/media/1034/gri-404-training-and-education-2016.pdf
- GRI 405: Diversity and Equal Opportunity 2016 https://www.globalreporting.org/standards/media/1035/gri-405-diversity-and-equal-opportunity-2016.pdf

- Great Place to Work®: is a global authority on workplace culture, offering certification programs and producing annual lists of the best workplaces. https://www.greatplacetowork.com/
- Investors in People (IIP): is a standard for people management, offering accreditation to organizations that adhere to high standards in leading, supporting, and managing people. https://www.investorsinpeople.com/
- European Foundation for Quality Management (EFQM) Excellence Model: is a framework to help organizations drive improvement and achieve sustainable excellence. https://www.efqm.org/efqm-model/
- Aon Best Employers: is a program that measures and recognizes employer excellence worldwide. https://aon.mediaroom.com/Aon-Hewitt-Launches-Global-Best-Employers-Program-to-Measure-and-Recognize-Employer-Excellence

4.3.3. Sustainability: Key Performance Indicators

Table 3 presents the KPIs for the Environmental Sustainability pillar, focusing on how organizations align their policies and outcomes with sustainability objectives. The categorization follows the same structure as in Table 2, differentiating between policy-specific, generic, and outcome-level KPIs.

Table 3 Sustainability KPIs Categorization

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POLICY LEVEL	SUSTAINABILITY SPECIFIC: **KPI_SU1.** Investment in and development of new technologies for sustainability
	GENERIC: **KPI_SU2.** Regulatory compliance rate and number of initiatives beyond compliance
OUTCOME LEVEL	**KPI_SU3.** Energy consumed **KPI_SU4.** Waste diverted from disposal **KPI_SU5.** Use of renewable energy sources **KPI_SU6.** Waste generated and its composition **KPI_SU7.** Products designed for Modularity, Repair, and Repurposing **KPI_SU8.** Products with traceability features implemented **KPI_SU9.** Water use **KPI_SU10.** GHG emissions **KPI_SU11.** Reduction of raw material consumption

The sustainability KPIs reflect I5.0's emphasis on minimizing environmental impact and promoting resource efficiency. Policy-specific KPIs, such as investments in sustainable technologies, measure strategic alignment with sustainability goals. Generic KPIs, like regulatory compliance rates, ensure organizations meet both legal requirements and exceed them through voluntary initiatives. Outcome-level KPIs, such as waste diversion rates and GHG emissions, quantify environmental impacts, providing clear benchmarks for improvement. This structure underscores the framework's ability to balance global standards with organization-specific needs, ensuring comprehensive sustainability assessments.

Core KPIs

KPI_SU1. Investment in and development of new technologies or initiatives for sustainability.

This KPI evaluates the allocation of financial and HR to sustainability-driven technological advancements, such as energy-efficient machinery, renewable energy technologies, and circular economy solutions. The high average relevance score of 4.27 from workshops highlights its priority status among stakeholders across diverse sectors. The KPI reflects a universal need for innovation, as technological investments form the backbone of sustainable transformation in both small and large organizations. Its designation as a Core KPI stems from its strategic importance in driving

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organizational alignment with I5.0 principles and fostering competitive advantage through environmental stewardship.

In ANNEX 10 a list of possible **sustainability-focused technologies or initiatives** that organizations could invest in or develop to calculate the KPI is provided.

KPI_SU1.	**Investment in and development of new technologies or initiatives for sustainability**
Description	Measures the organization's investment in developing or adopting technologies aimed at enhancing environmental sustainability, including training activities for employees on sustainable practices.
Study questions	What percentage of R&D budget is allocated to sustainability-focused technologies or initiative (e.g. training)? How effective are these investments in achieving sustainability goals?
Objective	To track and promote strategic investments that foster innovation and support the transition to sustainable practices across operations.
Scope	Applicable across all industries where innovation and technology play a role in sustainability efforts. Particularly relevant for larger organizations with dedicated R&D budgets. Smaller companies may adapt this KPI to smaller-scale initiatives.
Formula	*Sustainability Technology Investment Rate = (Investment in Sustainable Technologies or Initiatives / Total R&D Investment) x 100*
Target and Values	- **Low**: <20% of R&D investments in sustainable technologies. - **Moderate**: 20-40% - **High**: >40%.
Benefits / Value proposition	Drives long-term cost savings through energy-efficient and sustainable practices. Enhances competitiveness by aligning with regulatory and market trends.

Data collection and analysis approaches and methodologies

This KPI aligns with the **GRI Standards (GRI 201: Economic Performance)** and the **Corporate Sustainability Reporting Directive (CSRD)**, which emphasize transparency in investments that promote sustainability and innovation. Data is collected from R&D budgets, financial statements, and project management tools to track investments in sustainability-focused technologies, such as energy-efficient equipment and circular economy initiatives. Metrics include the percentage of total investment directed toward sustainable technologies and initiatives for training on sustainability practices, normalized against company revenue or total Capital Expenditure (CAPEX). Smaller

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firms may document investments manually, while larger companies utilize Integrated Reporting (IR) frameworks or sustainability dashboards to monitor financial and resource allocation.

Measurement Tool	Data Requirements
Financial Records	The total financial investments made by the organization over a specific period, including overall CAPEX and operational expenditure (OPEX)
Investment Portfolios	The amount of financial investments specifically allocated to the development and implementation of new technologies aimed at improving sustainability.
R&D Budgets	Detailed breakdown of R&D expenditures, specifying portions related to sustainable technology innovations and green initiatives.
Project Management Tools	Documentation of project allocations and resource usage for sustainability-focused initiatives, tracked through project planning software or systems.
Sustainability Dashboards	Aggregated data from financial systems and operational tools to provide a real-time view of sustainability-related investments.
Integrated Reporting (IR) Frameworks	Comprehensive financial and non-financial data integration for tracking progress toward sustainability goals, ensuring alignment with CSRD and GRI Standards.

KPI_SU2. Regulatory compliance rate and number of initiatives beyond compliance

This KPI tracks adherence to environmental regulations while recognizing voluntary efforts to exceed compliance. Its average relevance score of 4.00 in workshops with the companies participating in the co-creation process underscores its universal importance as a foundational measure of an organization's sustainability commitments. Identified as a Core KPI, it reflects the dual necessity of meeting baseline legal standards and showcasing leadership through proactive initiatives. This KPI is particularly relevant in sectors with strict regulatory frameworks, such as aerospace and energy, where compliance is a critical operational requirement. The focus on initiatives beyond compliance aligns with I5.0's emphasis on transformative practices that balance innovation, environmental responsibility, and societal benefit, making this KPI a cornerstone for evaluating sustainability-driven policies across organizations of all sizes and sectors.

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In ANNEX 11, a list of possible initiatives beyond compliance is presented.

KPI_SU2.	**Regulatory compliance rate and number of initiatives beyond compliance**
Description	Measures the organization's adherence to environmental regulations and its efforts to implement voluntary initiatives that exceed compliance requirements.
Study questions	What percentage of environmental regulations are met without exemptions? How many sustainability initiatives exceed compliance standards?
Objective	To ensure legal compliance while demonstrating leadership in environmental responsibility through proactive sustainability initiatives.
Scope	Suitable for all industries subject to environmental regulations. Smaller companies in less regulated sectors may focus solely on compliance rather than exceeding requirements.
Formula	*Compliance Rate = (Number of Compliant Processes / Total Regulatory Requirements) x 100* **Number of initiatives beyond compliance:** initiatives that reflect a proactive and leadership-oriented approach to sustainability, demonstrating an organization's commitment to exceeding minimum legal requirements while fostering innovation and competitive advantage. *(see list below)*
Target and Values	- **Low**: <90% compliance. - **Moderate**: 90-99%. - **High**: 100% compliance + at least 3 initiatives beyond compliance annually
Benefits / Value proposition	Avoids penalties and enhances reputation by exceeding compliance expectations. Demonstrates leadership in sustainability, attracting eco-conscious clients.

Data collection and analysis approaches and methodologies

Compliance tracking is rooted in **GRI 307: Environmental Compliance** and incorporates the **CSRD**'s focus on voluntary initiatives that go beyond legal requirements. Data sources include environmental audit records, compliance reports, and records of voluntary projects like carbon neutrality commitments. Organizations benchmark against regional and global regulations, with tools such as compliance tracking software or third-party assurance services. Smaller organizations may rely on periodic audits, while larger firms track compliance and voluntary initiatives in ESG platforms.

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Measurement Tool	Data Requirements
Compliance Audits	Total number of environmental regulations applicable to the organization and records of full compliance with these regulations.
Sustainability Reports	Documentation of voluntary sustainability initiatives and projects, including details on how they exceed mandatory regulatory requirements.
Environmental Audit Records	Specific records verifying compliance with environmental standards, including periodic updates and identified areas of improvement.
ESG Reporting Platforms	Data on compliance metrics and voluntary sustainability projects, aligned with regional, national, and international standards for benchmarking and reporting.
Periodic Reviews	Internal or external evaluations to track adherence to regulations and identify new opportunities for voluntary sustainability initiatives.

Scenario related KPIs

The Scenario-Related KPIs under the Sustainability pillar reflect the diverse needs of organizations across industries and their varying capacities to address environmental challenges. These KPIs enable companies to tailor their assessment based on their specific features related to their size or industrial sector, ensuring relevance and actionable insights. Feedback from workshops with UCs and stakeholders indicated that the feasibility and relevance of these KPIs often depend on industry-specific processes, regulatory pressures, and the organization's stage in sustainability adoption.

KPI_SU3. Energy consumed

This KPI tracks energy efficiency by comparing energy use relative to production output or revenues. It is critical for energy-intensive industries such as manufacturing and automotive, where energy costs significantly impact sustainability and profitability. Smaller firms may rely on simple energy audits, while larger companies utilize sophisticated energy management systems. Its variability in relevance across industries and scales supports its inclusion as a Scenario-Related KPI.

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KPI_SU3.	Energy consumed
Description	Measures the efficiency of energy use by calculating the energy consumed per unit of production output, providing insights into operational energy efficiency.
Study questions	How effectively is energy consumption monitored across different production lines? What percentage of energy consumption is attributed to inefficiencies, and how can these be addressed?
Objective	To optimize energy consumption, reduce operational costs, and minimize the environmental impact associated with production activities.
Scope	Relevant for energy-intensive industries such as manufacturing, logistics, and energy. Smaller businesses may adapt this KPI to measure energy use per employee or per operational hour.
Formula	*Energy Efficiency = Total Energy Consumed / Total Units of Production or Revenue*
Target and Values	- **Low Efficiency**: >15 kWh/unit. - **Moderate Efficiency**: 10-15 kWh/unit. - **High Efficiency**: <10 kWh/unit.
Benefits / Value proposition	Identifies energy inefficiencies, enabling cost savings through optimized usage. Enhances compliance with environmental regulations by reducing energy footprints. Demonstrates commitment to sustainability, improving brand reputation.

Data collection and analysis approaches and methodologies

Energy data collection follows the **GRI 302: Energy** standards, using data from energy meters, utility bills, and IoT-enabled energy management systems. Energy efficiency is calculated by normalizing consumption against production output, as outlined in the **SASB Standards for Manufacturing** and **Automobiles**. Benchmarking against industry averages, often available through ESG platforms, helps organizations assess their energy performance. While smaller firms may use utility records for periodic analysis, larger companies typically deploy automated energy monitoring tools integrated with sustainability platforms like **ISO 50001**.

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Measurement Tools	Data Requirements
Energy Consumption Records	Energy usage data, measured in megajoules (MJ) or kilowatt-hours (kWh), collected from energy meters and utility bills
Production Records	Total production output data, used to normalize energy consumption against units of production.
Sales Reports	Total revenue or sales figures, for benchmarking energy efficiency in service or retail-based organizations.
IoT-Enabled Energy Monitoring	Real-time data from IoT sensors and energy management systems to track and optimize energy usage patterns.
Sustainability Reporting Tools	Benchmarked energy performance data from ESG platforms or compliance with frameworks like ISO 50001.

KPI_SU4. Waste diverted from disposal

This KPI assesses waste management practices by measuring the proportion of waste recycled, reused, or diverted from disposal. Particularly vital for industries adopting circular economy principles, it is applicable across sectors like logistics and manufacturing. Smaller companies may face challenges in tracking waste streams comprehensively, while larger firms implement advanced waste management systems. Its variability in applicability and operational complexity designates it as a Scenario-Related KPI.

KPI_SU4.	**Waste diverted from disposal**
Description	Tracks the proportion of waste diverted from landfills or incineration through recycling, reuse, or composting efforts, reflecting the organization's waste management effectiveness.
Study questions	What processes or systems are in place to divert waste from landfills or incineration? How effectively is waste diversion contributing to overall sustainability goals?
Objective	To minimize waste sent to disposal, align with circular economy principles, and reduce environmental impact.
Scope	Applicable to industries generating significant waste, such as manufacturing and logistics. For smaller businesses with negligible

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	waste, this KPI may focus on specific waste streams, such as packaging or office waste.
Formula	*Waste Diversion Rate = (Diverted Waste / Total Waste Generated) x 100*
Target and Values	- **Low**: <50%. - **Moderate**: 50-80%. - **High**: >80%.
Benefits / Value proposition	Minimizes environmental impact by reducing landfill dependency. Improves resource efficiency, aligning with circular economy principles. Supports compliance with waste management regulations and enhances stakeholder trust.

Data collection and analysis approaches and methodologies

This KPI aligns with **GRI 306: Waste** and **SASB Standards for Renewable Resources**, which stress tracking waste streams and diversion rates. Waste data is collected through vendor records, recycling logs, and on-site waste audits. Metrics include the percentage of waste diverted via recycling or repurposing, calculated against the total waste generated. Organizations may use tools like Life Cycle Assessment (LCA) software or internal waste management systems. Smaller firms may rely on third-party waste handlers, while larger companies leverage circularity modules integrated into enterprise systems.

Measurement Tool	Data Requirements
Waste Management Records	Total weight of waste generated, measured in metric tons, categorized by type (e.g., recyclable, non-recyclable).
Waste Tracking Software	Weight of waste diverted to recovery operations, such as recycling, reuse, or repurposing, measured in metric tons.
Recycling Vendor Records	Documentation of waste handled by third-party vendors, specifying amounts recycled or reused.
On-Site Waste Audits	Data from physical audits of waste streams to validate recovery operations and identify opportunities for diversion.
Sustainability Reporting Tools	Aggregated metrics on waste diversion rates, aligned with GRI 306 standards for waste reporting.

KPI_SU5. Use of renewable energy sources

This KPI evaluates the adoption of renewable energy by measuring its share of total energy use. It holds particular importance in energy-intensive and public-facing

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industries like automotive and energy, where sustainability practices are scrutinized. Smaller firms may adopt renewable energy incrementally, while larger organizations implement comprehensive strategies. Its sectoral relevance and scalability challenges justify its categorization as a Scenario-Related KPI.

KPI_SU5.	**Use of renewable energy sources**
Description	Tracks the share of total energy consumption sourced from renewable energy, reflecting the organization's commitment to reducing reliance on non-renewable energy.
Study questions	What proportion of total energy consumption is sourced from renewable technologies? What steps are being taken to increase the share of renewable energy in operations?
Objective	To support the transition to renewable energy, reduce carbon emissions, and align with global sustainability targets.
Scope	Relevant for energy-intensive industries. Smaller companies in rented facilities may adapt this KPI to track influence over landlords or the use of renewable credits.
Formula	*Renewable Energy Usage = (Energy from Renewable Sources / Total Energy Consumption) x 100*
Target and Values	- **Low**: <20%. - **Moderate**: 20-50%. - **High**: >50%.
Benefits / Value proposition	Reduces dependency on fossil fuels, decreasing GHG emissions. Enhances resilience to energy market volatility and price fluctuations. Aligns with global sustainability goals and improves investor attractiveness.

Data collection and analysis approaches and methodologies

This KPI follows **GRI 302-1: Renewable Energy Consumption** and incorporates guidelines from the **SASB Renewable Energy Standards**. Data sources include utility bills, renewable energy certificates (RECs), and on-site renewable energy production data. Metrics include the share of energy derived from renewables, such as solar or wind, compared to total consumption. Smaller organizations often rely on supplier disclosures, while larger firms integrate IoT-enabled energy tracking tools aligned with frameworks like **ISO 14064** for emissions reduction.

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Measurement Tool	Data Requirements
Energy Consumption Records	Total energy consumption over a specific period, measured in kilowatt-hours (kWh) or megajoules (MJ).
Energy Management Systems	Data on energy usage broken down by source, specifying the amount derived from renewables like solar, wind, or hydro.
Renewable Energy Certificates (RECs)	Documentation of renewable energy purchases to validate the share of energy from renewable sources.
Utility Bills	Breakdown of energy consumption by type (renewable vs. non-renewable), provided by energy suppliers.
On-Site Renewable Energy Logs	Data from on-site renewable energy production (e.g., solar panels, wind turbines), tracking generated and consumed energy.

KPI_SU6. Waste generated and its composition

This KPI tracks waste generation metrics relative to production or workforce size, providing insights into operational efficiency. It is particularly significant for industries producing substantial byproducts, such as logistics and manufacturing. Smaller companies may focus on basic waste tracking, while larger firms employ detailed compositional analysis. Its inclusion as a Scenario-Related KPI reflects its varying relevance and resource demands.

KPI_SU6.	**Waste generated and its composition**
Description	Measures waste generated relative to production output or workforce size, providing insights into waste management efficiency and environmental performance.
Study questions	How is waste generation monitored and tracked across different operations? What strategies are in place to reduce waste generation at its source?
Objective	To reduce waste generation, optimize resource usage, and enhance waste management practices.
Scope	Relevant for industries with significant waste streams. Smaller businesses with negligible waste may adjust this KPI to specific operational activities, such as office waste or packaging.
Formula	*Waste Rate = Total Waste Generated /(Production Output or Number of Employees)*

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Target and values	- **Low**: >0.5 kg/unit or employee. - **Moderate**: 0.2-0.5 kg/unit or employee. - **High**: <0.2 kg/unit or employee.
Benefits / Value proposition	Reduces material wastage, driving cost savings. Encourages adoption of lean manufacturing principles for operational efficiency. Enhances compliance with environmental standards and builds sustainable practices.

Data collection and analysis approaches and methodologies

Aligned with **GRI 306: Waste**, this KPI tracks waste generation through audits, waste management logs, and production data. The waste composition is analyzed using metrics such as hazardous vs. non-hazardous waste, normalized against production levels or employee counts. Tools like material flow analysis (MFA) and waste management systems help capture detailed insights. Larger companies can use blockchain-enabled traceability systems to ensure precise tracking, while smaller firms typically conduct semi-annual waste audits.

Measurement Tool	Data Requirements
Waste Audits	Total weight of waste generated in metric tons, categorized into hazardous and non-hazardous waste.
Production Data	Data on production output (e.g., units produced or service levels), used to normalize waste metrics.
Waste Management Records	Comprehensive logs detailing waste handling, including recycling, disposal, and recovery processes.

KPI_SU7. Products designed for Modularity, Repair, and Repurposing

This KPI measures the adoption of circular economy principles in product design, focusing on modularity and repairability. It is highly relevant for industries like automotive, aerospace, energy and manufacturing, where design plays a crucial role in lifecycle sustainability. Smaller organizations may struggle with design constraints, while larger companies leverage advanced tools to embed circularity. Its applicability to specific industries and company sizes defines its designation as a Scenario-Related KPI.

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KPI_SU7.	**Products Designed for Modularity, Repair, and Repurposing**
Description	Measures the proportion of products designed for modularity, repairability, or repurposing, reflecting alignment with circular economy principles.
Study questions	Reduces material wastage, driving cost savings. Encourages adoption of lean manufacturing principles for operational efficiency. Enhances compliance with environmental standards and builds sustainable practices.
Objective	To extend product lifecycles, reduce waste, and promote resource efficiency by integrating sustainable design practices.
Scope	Relevant for product-based industries such as manufacturing, automotive, and electronics. Service-oriented sectors may adapt this KPI to measure modularity in service delivery models.
Formula	*Modularity Rate = (Number of Products with Modularity, Repair, and Repurposing characteristics / Total Products Designed) x 100*
Target and Values	- **Low**: <30%. - **Moderate**: 30-60%. - **High**: >60%.
Benefits / Value proposition	Prolongs product lifespans, reducing waste and resource consumption. Enhances customer satisfaction through repair-friendly designs. Positions the company as an innovator in sustainable product development.

Data collection and analysis approaches and methodologies

This KPI corresponds to **GRI 301: Materials** and circular economy principles. Data collection involves product design logs, R&D records, and lifecycle assessment (LCA) tools. Metrics include the proportion of products meeting modularity and repairability standards. ESG frameworks like **SASB for Consumer Goods** and **Automotive** provide sector-specific benchmarks. Smaller firms may conduct qualitative assessments, while larger companies leverage **product lifecycle management (PLM)** software to quantify circular design metrics.

Measurement Tool	Data Requirements
Product Design Records	Total number of new products designed or existing products redesigned during the specified reporting period.

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Product Lifecycle Assessment (LCA)	Data on product features, including modularity, ease of repair, and potential for repurposing.
PLM Software	Quantitative tracking of circular design elements throughout product development stages.

KPI_SU8. Products with traceability features implemented

This KPI monitors the integration of traceability mechanisms for enhancing supply chain transparency and accountability. It is particularly relevant for sectors like energy and logistics, where traceability supports compliance and operational integrity. Smaller firms may have limited data collection capabilities, whereas larger organizations implement IoT-based tracking systems. Its sector-specific relevance and technological demands justify its Scenario-Related KPI status.

KPI_SU8.	**Products with traceability features implemented**
Description	Measures the share of products equipped with traceability features, ensuring transparency and accountability throughout the supply chain.
Study questions	What proportion of products has traceability features for sourcing and lifecycle monitoring? How effectively are traceability systems being utilized to ensure supply chain transparency?
Objective	To enhance supply chain visibility, ethical compliance, and stakeholder trust by implementing traceability systems.
Scope	Applicable to industries with complex supply chains such as food production, manufacturing, and textiles. Companies with localized supply chains may adapt this KPI to focus on regional sourcing or certifications.
Formula	*Traceability Rate = (Number of products with traceability features / Total products) x 100*
Target and Values	- **Low**: <30%. - **Moderate**: 30-60%. - **High**: >60%.
Benefits / Value proposition	Improves supply chain accountability and stakeholder trust. Enables compliance with regulatory requirements related to traceability. Reduces risks associated with unethical practices in the supply chain.

Data collection and analysis approaches and methodologies

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Rooted in **GRI 102: Supply Chain** and the traceability focus of **SASB Standards**, this KPI measures the adoption of end-to-end product traceability systems. Data is sourced from supply chain management (SCM) platforms, blockchain technology, and IoT sensors. Metrics include the percentage of products with traceable components or origins. Smaller companies may implement basic QR code systems, while larger organizations use blockchain-enabled SCM solutions to achieve real-time traceability.

Measurement Tool	Data Requirements
Enterprise Resource Planning (ERP) Systems	Total production data, capturing the overall number of products manufactured during the reporting period.
Inventory Management Systems	Records of products tagged with traceability features such as RFID tags, barcodes, or serial numbers.
SCM Systems	Data on product origins, component traceability, and movement throughout the supply chain.
Quality Assurance and Control Systems	Verification data on traceability feature implementation and compliance with traceability standards.

KPI_SU9. Water use

This KPI tracks water efficiency metrics to identify resource optimization opportunities, calculating the water use per unit of production output / or per square meter of facility. Particularly critical for water-intensive industries like energy and manufacturing, it helps monitor sustainability efforts. Smaller firms may rely on manual tracking, while larger organizations use automated monitoring systems. Its designation as a Scenario-Related KPI reflects its variable relevance and resource requirements for companies of different sizes or industrial sectors.

KPI_SU9.	**Water use**
Description	Tracks water consumption relative to production output or square meter of facility, offering insights into operational water efficiency and conservation efforts.
Study questions	How is water consumption tracked and monitored across facilities? What strategies are in place to improve water efficiency in operations?
Objective	To optimize water use, reduce operational costs, and minimize the environmental impact of water-intensive processes.
Scope	Relevant for water-intensive industries such as agriculture, food production, and manufacturing. Non-water-intensive sectors may

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	exclude this KPI or focus on specific water-saving initiatives in office operations.
Formula	*Water Efficiency = Total Water Consumed / Total Production Output or total floor area of facility.*
Target and Values	- **Low Efficiency**: >5 L/unit. - **Moderate Efficiency**: 3-5 L/unit. - **High Efficiency**: <3 L/unit.
Benefits / Value proposition	Reduces water consumption, lowering operational costs. Mitigates risks related to water scarcity in regions of operation. Demonstrates leadership in sustainable resource management.

Data collection and analysis approaches and methodologies

This KPI follows **GRI 303: Water** and uses data from water meters, utility bills, and IoT water management tools. Metrics are normalized against production or facility size, tracking water efficiency improvements over time. Tools like **digital water meters** or **AI-enabled water management platforms** help monitor trends and benchmark against industry averages. Smaller firms rely on utility data for basic analysis, while larger companies use **ISO 14046** frameworks for water footprinting.

Measurement Tool	Data Requirements
Water Usage Reports	Total water consumption over a specific period, measured in megalitres (ML).
Production Data	Total number of production units manufactured during the same reporting period (if applicable).
Sector-Specific Water Use Benchmarks	Industry-standard water usage rates to compare performance and efficiency.
Facility Management Records	Total floor area of the facility where water is used, measured in square meters (if applicable).
IoT Water Management Tools	Real-time monitoring of water usage trends and identification of areas for improvement.

KPI_SU10. GHG emissions

This KPI calculates GHG emissions relative to production, workforce, or revenue, aligning with carbon reduction goals. It is essential for industries with significant emissions, such as energy and automotive, where sustainability practices are under public scrutiny. Smaller organizations may use simplified estimation methods, while larger firms adopt

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advanced carbon accounting frameworks. Its wide applicability but resource-intensive nature makes it a Scenario-Related KPI.

KPI_SU10.	**GHG emissions**
Description	Measures GHG emissions normalized to production output, workforce size, or revenue, reflecting the organization's carbon intensity.
Study questions	How effectively are emissions monitored across different production activities? What strategies are being implemented to reduce GHG emissions?
Objective	To track and reduce carbon emissions, align with climate goals, and demonstrate commitment to environmental sustainability.
Scope	Applicable across all industries, particularly those with significant carbon footprints such as manufacturing, energy, and transportation. Smaller companies may adapt this KPI to simpler proxies, such as energy usage.
Formula	*GHG Intensity = Total GHG Emissions (Scope 1 and 2) /* unit of production, or employee, or unit of revenue.
Target and Values	- **Low Performance**: >20 kg CO2/unit. - **Moderate Performance**: 10-20 kg CO2/unit. - **High Performance**: <10 kg CO2/unit.
Benefits / Value proposition	Reduces carbon footprint, improving compliance with climate goals. Positions the company as a leader in low-carbon technologies. Attracts investors and customers seeking environmentally responsible partners.

Data collection and analysis approaches and methodologies

Aligned with the **GHG Protocol** and **GRI 305: Emissions**, this KPI tracks Scope 1 (direct emissions) and Scope 2 (indirect emissions from energy use) emissions using data from energy consumption logs, transportation records, and supplier disclosures. Metrics are calculated per unit of production, employee, or revenue. Carbon accounting software like **SBTi** (Science-Based Targets initiative) tools or **ISO 14064-compliant platforms** enables precise tracking. Smaller firms may use simplified calculators, while larger organizations employ comprehensive carbon accounting systems.

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Measurement Tool	Data Requirements
Carbon Accounting Software (e.g., SBTi tools, ISO 14064-compliant platforms)	Total GHG emissions produced by the organization over a specific period, measured in metric tons CO2 equivalent.
Energy Consumption Logs	Data on energy usage from electricity, heating, cooling, and transportation activities contributing to emissions.
Production Records	Total production output over the reporting period to normalize emissions against production.
HR Systems	Total number of employees during the reporting period for emissions per employee calculation.
Financial Reports	Total revenue generated by the organization over the reporting period for emissions per revenue calculation.

KPI_SU11. Reduction of raw material consumption

This KPI evaluates efficiency in raw material use, emphasizing reductions relative to production output. It is particularly relevant for sectors like manufacturing, where resource consumption impacts both cost and sustainability. Smaller firms may face challenges in tracking and normalizing data, while larger organizations implement MFA systems. Its sectoral focus and complexity support its inclusion as a Scenario-Related KPI.

KPI_SU11.	**Reduction of raw material consumption**
Description	Measures the reduction in raw material consumption normalized against production levels, reflecting efforts to optimize resource use and reduce environmental impact.
Study questions	What steps are being taken to optimize raw material usage in production? How does raw material reduction align with operational efficiency goals?
Objective	To promote resource efficiency, reduce waste, and align with sustainability goals.
Scope	Relevant for material-intensive industries such as manufacturing, construction, and electronics. Service-based industries may focus on reducing consumables like paper or office supplies.

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Formula	Raw Material Reduction Rate = (Baseline Raw Material Usage - Current Usage) / Baseline Usage
Target and Values	- **Low Reduction**: <10%. - **Moderate Reduction**: 10-25%. - **High Reduction**: >25%.
Benefits / Value proposition	Reduces dependency on non-renewable resources, mitigating supply chain risks. Lowers production costs by optimizing resource usage. Supports circular economy initiatives and enhances environmental sustainability.

Data collection and analysis approaches and methodologies

This KPI reflects **GRI 301: Materials** and emphasizes resource efficiency. Data is collected from procurement logs, production records, and material tracking systems. Metrics track material use reductions relative to production levels. Tools like **material resource planning (MRP)** and LCA software help identify opportunities for efficiency. Smaller firms may focus on manual tracking, while larger companies employ advanced MRP systems integrated with ESG platforms.

Measurement Tool	Data Requirements
MFA Systems	Total raw materials consumed by the organization during the current reporting period, measured in metric tons.
ERP Systems or Inventory Management	Total raw materials consumed during the baseline period, measured in metric tons.
Production Records	Production data for both the current and baseline periods to normalize material usage.
Sustainability Reporting Tools	Benchmarked data for resource consumption trends and sector-specific efficiency metrics.

Summary of data collection tools

Key tools to ensure organizations can effectively monitor and improve their environmental performance, aligning with I5.0's sustainability objectives include:

- **Energy Management Systems (EMS)**: Monitor energy consumption, renewable energy usage, and efficiency improvements across operations.
- **PLM Systems**: Capture data on modularity, repairability, and traceability features of products, aligning with circular economy goals.

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- **Sustainability Reporting Software**: Facilitates data aggregation and reporting on compliance, sustainability initiatives, and progress toward environmental goals.

Other resources and tools

- Corporate Sustainability Reporting Directive –CSRD (2022). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022L2464
- GRI 102: General Disclosures 2016 https://www.globalreporting.org/standards/media/1030/gri-102-general-disclosures-2016.pdf
- GRI 201: Economic Performance 2016 https://www.globalreporting.org/standards/media/1027/gri-201-economic-performance-2016.pdf
- GRI 301: Materials 2016 https://www.globalreporting.org/standards/media/1028/gri-301-materials-2016.pdf
- GRI 302: Energy 2016 https://www.globalreporting.org/standards/media/1029/gri-302-energy-2016.pdf
- GRI 303: Water and Effluents 2018 https://www.globalreporting.org/standards/media/1910/gri-303-water-and-effluents-2018.pdf
- GRI 305: Emissions 2016 https://www.globalreporting.org/standards/media/1032/gri-305-emissions-2016.pdf
- GRI 306: Waste 2020 https://www.globalreporting.org/standards/media/2594/gri-306-waste-2020.pdf
- GRI 307: Environmental Compliance 2016 https://www.globalreporting.org/standards/media/1036/gri-307-environmental-compliance-2016.pdf
- ISO 14001:2015 - Environmental Management Systems – Requirements with Guidance for Use https://www.iso.org/standard/60857.html
- ISO 45001:2018 - Occupational Health and Safety Management Systems – Requirements https://www.iso.org/standard/63787.html
- ISO 50001:2018 - Energy Management Systems – Requirements with Guidance for Use https://www.iso.org/standard/69426.html

4.3.4. Resilience: Key Performance Indicators

Table 4 categorizes KPIs for the Industrial Resilience pillar, aimed at assessing an organization's ability to adapt, recover, and thrive amidst disruptions. The

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categorization into policy-specific, generic, and outcome-level KPIs mirrors the approach used for the other pillars.

Table 4 Industrial resilience KPIs categorization

POLICY LEVEL	RESILIENCE SPECIFIC: **KPI_RE2.** Alternative sourcing options **KPI_RE5.** Local sourcing ratio
	GENERIC: **KPI_RE1.** Risk assessment effectiveness **KPI_RE4.** New products/services/ patents introduced **KPI_RE6.** Cybersecurity actions implemented
OUTCOME LEVEL	**KPI_RE3.** Risk mitigation strategies implemented **KPI_RE7.** Operational downtime and recovery time

The KPIs for industrial resilience capture both strategic preparedness and operational robustness. Policy-specific KPIs, such as the number of alternative sourcing options, directly address resilience strategies tailored to I5.0 challenges. Generic KPIs, like the effectiveness of cybersecurity measures, provide universally applicable benchmarks for organizational stability. Outcome-level KPIs, such as average operational downtime and recovery time, measure the tangible impact of resilience strategies, highlighting areas for improvement. This categorization enables organizations to evaluate resilience comprehensively, ensuring readiness for evolving challenges.

Core KPIs

KPI_RE1. Risk assessment effectiveness

This KPI measures the thoroughness and accuracy of risk assessment processes, thereby promoting a proactive approach to risk mitigation and resilience-building. It ensures that organizations proactively manage operational, financial, and strategic risks, aligning with the broader goal of industrial resilience in I5.0. During the validation workshops, the two KPIs now merged into KPI_RE1 received an average relevance score of 3.7 on a 1-to-5 Likert scale, with 42.8% of companies ranking it in the top three for importance. Feedback from UC and AB workshops emphasized that effective risk assessments form the foundation for robust risk management strategies, making this KPI universally significant across industries and company sizes. The KPI has been identified as a Core KPI due to its pivotal role in assessing policy-level alignment with I5.0 principles. Its relevance spans multiple sectors and organizational contexts, ensuring a standardized measure for understanding and mitigating risks. By

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incorporating this KPI, the framework supports organizations in building resilient systems capable of adapting to disruptions while safeguarding operational continuity.

KPI_RE1.	**Risk assessment effectiveness**
Description	Measures the comprehensiveness and accuracy of the organization's risk assessment processes, including identification, evaluation, and prioritization of risks.
Study questions	How comprehensive and timely are risk assessments conducted across the organization? How does the organization monitor and prioritize risks?
Objective	To ensure thorough and accurate risk assessments that help proactively manage operational, financial, and strategic risks across the organization
Scope	Applicable across all departments involved in risk management, especially in sectors with high levels of operational or supply chain complexity. Relevant for medium to large companies with established risk management processes.
Formula	*Risk Assessment Effectiveness Score = (Number of Identified Risks Addressed / Total Number of Identified Risks) x 100*
Target and Values	- **Low**: <60% of identified risks addressed - **Moderate**: 60-80% of identified risks addressed - **High**: >80% of identified risks addressed. Targets vary based on sector and risk profile.
Benefits / Value proposition	Minimizes potential disruptions by proactively identifying and addressing risks. Enhances stakeholder confidence through transparent risk management.

Data Collection and Analysis Approaches and Methodologies

Aligned with **ISO 31000** and **SASB Standards**, this KPI evaluates the comprehensiveness and accuracy of risk assessments. Data is collected from risk management frameworks, assessment tools, and stakeholder interviews. Metrics include the percentage of risks identified and mitigated within the assessment cycle. Organizations use **risk evaluation dashboards** to prioritize risks based on likelihood and impact. Smaller companies rely on simpler tools like spreadsheets, while larger enterprises deploy advanced **risk analytics platforms** for scenario modelling.

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Measurement Tool	Data Requirements
Risk Management Software	Risk logs documenting identified risks and their associated scores, prioritization, and mitigation strategies.
Incident Tracking Systems	Incident reports detailing risk-related events and their outcomes, including root cause analysis.
Regular Risk Review Documentation	Records of periodic risk assessments, including evaluation criteria, scoring methods, and assessment outcomes.
Risk Registers	Comprehensive list of all identified risks, categorized by severity, likelihood, and potential impact.
Risk Identification Reports	Reports highlighting newly identified risks and their corresponding scores for ongoing evaluation.

KPI_RE2. Alternative sourcing options

This KPI evaluates the availability of alternative suppliers for critical resources, reflecting the organization's supply chain flexibility and resilience. It highlights the capacity to adapt to supply chain disruptions by diversifying sourcing strategies, a key aspect of resilient industrial systems. Validation workshops yielded an average relevance score of 3.92 for this KPI, with 50% of companies ranking it among the top three for importance. UC discussions frequently identified alternative sourcing as a strategic priority, particularly for industries heavily reliant on global supply chains, such as manufacturing, energy, and automotive. The KPI has been designated as a Core KPI because it aligns with policy-level strategies that strengthen resilience, addressing critical vulnerabilities in supply chain management. Its universal relevance across sectors ensures that it serves as a standardized metric for assessing preparedness and adaptability in sourcing practices. This KPI underscores the framework's commitment to fostering robust supply chain ecosystems that are essential for enabling proactive risk management and minimizing dependency on single suppliers.

KPI_RE2.	**Alternative sourcing options**
Description	Measures the number of alternative suppliers available for critical materials or components, reflecting the organization's supply chain flexibility and resilience in mitigating risks associated with supplier dependency and potential disruptions.
Study questions	How diverse is the supplier base, and what proportion offers critical supplies? How effectively are alternative sourcing strategies integrated into supply chain planning?

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Objective	To ensure supply chain resilience by diversifying sourcing options, reducing the risk of production delays, cost volatility, and other disruptions due to supplier constraints.
Scope	Relevant for procurement and supply chain departments, particularly in industries with high reliance on critical components, such as manufacturing, automotive, energy, and logistics. Suitable for medium and large companies where supply chain flexibility is essential for operational continuity.
Formula	*Alternative Sourcing Options Score = (Total Number of Alternative Suppliers for Critical Components / Total Number of Critical Components)*
Target and values	- **Low Resilience**: Less than 2 alternative suppliers per critical component - **Moderate Resilience**: 2-3 alternative suppliers per critical component - **High Resilience**: 4 or more alternative suppliers per critical component. Targets should reflect sectoral norms and criticality of materials.
Benefits / Value proposition	Enhances supply chain resilience, reducing risks of dependency on single suppliers. Increases operational flexibility to adapt to market disruptions. Strengthens relationships with a broader supplier network, fostering competitive pricing and innovation.

Data Collection and Analysis Approaches and Methodologies

This KPI evaluates supply chain flexibility, following guidelines from **SASB Standards on Supply Chain Resilience**. Data sources include supplier databases, SCM systems, and procurement records. Metrics include the number of alternative suppliers available for critical materials. Organizations often employ **supplier risk assessment tools** to evaluate reliability and ensure diversification. Smaller firms may rely on periodic supplier reviews, while larger companies integrate supplier analytics platforms with ERP systems for real-time visibility.

Measurement Tool	Data Requirements
Supplier Databases	List of current and potential suppliers, including key attributes and capabilities.
SCM Software	Data on critical components and supplier dependencies.

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ERP Systems	Procurement records and supplier contracts.
Market Research Records	Insights into alternative suppliers and market trends.
Contingency Plans	Backup supplier lists and documented risk mitigation strategies.

Scenario related KPIs

These KPIs focus on specific aspects of operational and strategic resilience, such as risk mitigation, local sourcing, innovation, and system downtime, which differ in importance based on an organization's unique context. Feedback from UC workshops revealed that smaller companies often prioritize qualitative or manual tracking approaches, while larger organizations leverage advanced systems and technologies to measure these KPIs. Their categorization reflects the need for flexibility in assessment, allowing organizations to tailor their evaluations to specific resilience challenges and opportunities.

KPI_RE3. Risk mitigation strategies implemented

This KPI tracks the implementation and effectiveness of risk mitigation strategies, assessing how well organizations manage identified risks. It is particularly relevant in industries with high operational uncertainties, such as logistics and manufacturing. Smaller companies may focus on basic strategies, while larger organizations often have comprehensive risk management systems. As an outcome-level KPI, it reflects tangible efforts to enhance organizational resilience and is categorized as Scenario-Related due to variability in risk profiles and mitigation capabilities across sectors and sizes.

KPI_RE3.	**Risk mitigation strategies implemented**
Description	Measures the number and effectiveness of risk mitigation strategies put in place to address identified risks, reflecting the organization's commitment to proactive risk management and resilience
Study questions	How many risk mitigation strategies are implemented annually? What percentage of identified risks are successfully mitigated?
Objective	To monitor and improve the implementation of risk mitigation strategies that minimize the impact of operational, financial, and strategic risks.
Scope	Relevant across all departments responsible for risk management, particularly in high-risk sectors like manufacturing, energy, logistics, finance, and healthcare. Suitable for medium to large organizations

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	where structured risk mitigation strategies can be effectively implemented.
Formula	*Risk Mitigation Implementation Rate = (Number of Risk Mitigation Strategies Implemented / Total Number of Identified Risks) x 100*
Target and Values	- **Low**: <50% of identified risks have mitigation strategies implemented - **Moderate**: 50-75% of identified risks have mitigation strategies - **High**: >75% of identified risks have mitigation strategies. Targets should align with organizational goals and risk tolerance.
Benefits / Value proposition	Ensures operational continuity by addressing critical risks effectively. Builds organizational resilience against unforeseen disruptions.

Data collection and analysis approaches and methodologies

Aligned with **ISO 31000** on risk management, this KPI evaluates the implementation of mitigation actions to address identified risks. Data is collected from risk assessment reports, mitigation strategy logs, and incident response records. Organizations use **risk management software** and periodic audits to track the status and effectiveness of mitigation plans. Smaller firms might rely on manual documentation, while larger companies deploy advanced analytics platforms to evaluate the cost-benefit and success rate of implemented strategies.

Measurement Tool	Data Requirements
Risk Management Software	Logs of identified risks, mitigation strategies implemented, and ongoing status tracking.
Internal Audits	Documentation of periodic reviews to verify the implementation and effectiveness of mitigation strategies.
Risk Mitigation Tracking Systems	Detailed reports on mitigation efforts, including timelines, responsible teams, and completion status.

KPI_RE4. New products/services/ patents introduced

This KPI measures innovation output by tracking the development and introduction of new products, services, or intellectual property. It holds universal relevance across sectors but varies in scope depending on organizational size and maturity. Larger firms often have dedicated R&D resources, while smaller companies may innovate at a slower pace. Categorized as a Generic Policy KPI, it highlights an organization's strategic

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emphasis on innovation, making it essential for assessing resilience through adaptability and market responsiveness.

KPI_RE4.	**New products/services/ patents introduced**
Description	Tracks the number of new products, services, or patents introduced by the organization, indicating its innovation capacity and commitment to adapting to market demands and technological advancements.
Study questions	How many new innovations have been successfully launched in the past year? How do these innovations align with market demands and company goals?
Objective	To measure and encourage the organization's efforts in innovation, ensuring it maintains a competitive edge and meets evolving industry standards through the continuous development of new offerings.
Scope	Applicable across all departments involved in product development, R&D, and intellectual property management, particularly in sectors with high innovation demands, such as technology, manufacturing, energy, healthcare, and automotive industries. Suitable for organizations of all sizes committed to fostering innovation.
Formula	*Innovation Introduction Rate = (Number of new products, services, or patents introduced during the period / Total new product/service/patent goals) x 100*
Target and values	- **Low**: <50% of the target number of new products/services/patents introduced - **Moderate**: 50-80% of the target achieved - **High**: >80% of the target achieved. Targets are typically set annually, aligned with organizational R&D and market growth objectives.
Benefits / Value proposition	Drives revenue growth through innovation and market expansion. Strengthens competitive positioning with cutting-edge offerings.

Data collection and analysis approaches and methodologies

Data for this KPI are derived from product development records, R&D project databases, patent filings, and innovation tracking systems. The aim is to quantify the output of new products, services, or patents as a measure of the organization's adaptability and commitment to continuous innovation. Metrics focus on the volume of new patents, products, or services introduced within a defined period. Smaller organizations often

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document innovation manually, while larger firms use tools like innovation management software to track and benchmark progress against industry norms. Integrating innovation KPIs with corporate strategy ensures that they align with broader organizational objectives.

Measurement Tool	Data Requirements
PLM Systems	Records of product development timelines, features, and lifecycle stages.
Patent Databases	Number of patents filed during the specified period.
Innovation Management Software	Progress and completion rates of innovation projects.
R&D Records	Documentation of research outcomes, development milestones, and resources allocated.
Marketing and Sales Records	Data on product launches, revenue generated from new products, and market performance.
Press Releases and Announcements	Official public communications of new product introductions.
Profit Analysis Tools	Profitability analysis of new products and services introduced during the period.

KPI_RE5. Local sourcing ratio

This KPI evaluates the proportion of procurement sourced locally, reflecting supply chain flexibility and resilience. It is especially significant in industries like manufacturing and energy, where supply chain disruptions can have a significant impact. Smaller companies often have localized sourcing by necessity, while larger firms may pursue it strategically to mitigate global supply risks. Its categorization as a Sustainability-Specific Policy KPI highlights its role in promoting both resilience and sustainability through regional sourcing strategies.

KPI_RE5.	**Local sourcing ratio**
Description	Measures the proportion of the organization's total sourcing that comes from local suppliers, reflecting its commitment to supporting the local economy, reducing supply chain complexity, and lowering environmental impact through shorter transport distances.
Study questions	What proportion of sourcing is from local suppliers within the region? How has the local sourcing ratio changed over time?

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Objective	To increase the use of local suppliers where feasible, enhancing supply chain resilience, supporting the local economy, and reducing the environmental footprint associated with long-distance transportation.
Scope	Relevant for procurement and supply chain departments, especially in sectors like manufacturing, food production, and energy where local sourcing can contribute to sustainability and resilience. Applicable across all company sizes seeking to balance cost efficiency with regional supplier engagement.
Formula	*Local Sourcing Ratio = (Total Spend on Local Suppliers / Total Sourcing Spend) x 100*
Target and values	- **Low Local Sourcing**: <30% of total sourcing from local suppliers - **Moderate Local Sourcing**: 30-60% from local suppliers - **High Local Sourcing**: >60% from local suppliers. Targets should be set based on industry standards and strategic goals for local supply chain support.
Benefits / Value proposition	Reduces supply chain risks and supports local economies. Enhances sustainability by minimizing transportation emissions.

Data Collection and Analysis Approaches and Methodologies

Drawing on **SASB Supply Chain Standards** and **GRI 204: Procurement Practices**, this KPI measures the proportion of sourcing from local suppliers. Data is collected from procurement records, supplier databases, and ERP systems. Metrics assess the percentage of total sourcing expenditure directed locally, which supports regional economic development and reduces supply chain vulnerabilities. Smaller firms may conduct supplier reviews annually, while larger companies leverage SCM tools for real-time monitoring.

Measurement Tool	Data Requirements
ERP Systems	Records of procurement activities and supplier locations.
Procurement Software	Data on spending allocated to local suppliers.
SCM Platforms	Geographic distribution of suppliers and supply chain length analysis.
Supplier Database	Details on supplier locations, classifications, and contributions to overall procurement.

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Financial Records	Expenditure breakdown, highlighting costs incurred with local vs. non-local suppliers.

KPI_RE6. Cybersecurity actions implemented

This KPI assesses the breadth and effectiveness of cybersecurity measures adopted to protect against digital threats. With the increasing reliance on connected systems, it is crucial across all sectors but varies in complexity and scope. Smaller firms may implement basic measures, while larger organizations often deploy comprehensive cybersecurity frameworks. Categorized as a Generic Policy KPI, it underscores the universal importance of cybersecurity in maintaining resilience against digital vulnerabilities.

In ANNEX 12 a list of cybersecurity actions is presented.

KPI_RE6	**Cybersecurity actions implemented**
Description	Measures the effectiveness and frequency of actions taken to improve and maintain cybersecurity within the organization. It tracks the number and type of proactive and reactive cybersecurity measures, reflecting the organization's commitment to protecting its digital assets, data, and operational systems from cyber threats.
Study questions	How many cybersecurity measures have been deployed in the past year? How effective are these measures in mitigating cyber threats?
Objective	To monitor and enhance the organization's cybersecurity posture by assessing the implementation of security actions, such as regular updates, vulnerability assessments, and incident response measures.
Scope	Applicable to all areas of the organization that handle digital information or have connected systems, including IT infrastructure, data storage, production systems, and supply chain networks. Relevant across all industries, especially critical for sectors with sensitive data or high connectivity (e.g., finance, healthcare, manufacturing). Applicable to small, medium, and large enterprises, with the flexibility to adjust action frequency and depth based on organizational complexity.
Formula	*Cybersecurity actions compliance rate=* *Number of completed cybersecurity actions / total number of recommended cybersecurity actions ×100*
Target and values	- Low Compliance: Less than 60% of recommended cybersecurity actions completed*.

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	- Moderate Compliance: 60-80% of recommended cybersecurity actions completed. - High Compliance: Over 80% of recommended cybersecurity actions completed. Targets can be customized based on organizational goals, with yearly milestones to ensure continuous improvement in cybersecurity measures.
Benefits / value proposition	Protect sensitive data and maintains business continuity. Build trust with clients and partners by demonstrating robust cybersecurity.

Data Collection and Analysis Approaches and Methodologies

Aligned with **ISO 27001** and the U.S. National Institute of Standards and Technology (NIST) **Cybersecurity Framework**, this KPI tracks the adoption of cybersecurity measures, including incident prevention, detection, and response capabilities. Data sources include cybersecurity incident logs, vulnerability assessments, and IT policy records. Organizations use **cybersecurity management platforms** to document actions like employee training, software updates, and penetration tests. Smaller firms often rely on external audits, while larger enterprises use advanced tools like **security information and event management (SIEM)** systems for continuous monitoring.

Measurement Tool	Data Requirements
Cybersecurity Action Log	Record of all actions taken, including updates, patches, vulnerability assessments, and employee training sessions. Documentation of completed actions with dates and responsible personnel.
IT Management System or Cybersecurity Platform	List of recommended cybersecurity actions (e.g., software updates, firewall configurations, access control checks). Alerts for overdue or pending actions.
Incident Records	Detailed reports on cybersecurity incidents, responses, and remediation steps taken (e.g., log of breach responses).

KPI_RE7. Operational downtime and recovery time

This KPI measures the average duration of downtime and the time required to recover from disruptions, providing insights into operational stability and resilience. It is particularly critical in sectors like logistics and manufacturing, where downtime directly affects productivity. Smaller firms may track this KPI manually, while larger organizations typically rely on automated systems. As an outcome-level KPI, it reflects

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the real-world impact of resilience strategies and is categorized as Scenario-Related due to its sectoral and organizational variability.

KPI_RE7.	**Operational downtime and recovery time**
Description	Measures the average amount of time the organization's operations are disrupted and the time taken to resume normal functioning after an interruption. This KPI reflects the organization's operational resilience and its ability to manage and recover from unexpected downtime effectively.
Study questions	What is the average downtime during operational disruptions? How quickly can the organization recover and resume operations?
Objective	To minimize operational downtime and improve recovery time, ensuring that disruptions have minimal impact on productivity and overall business continuity.
Scope	Applicable to all critical operations and departments where downtime could significantly impact productivity, customer satisfaction, and revenue. Relevant across various industries, including manufacturing, logistics, healthcare, and IT services. Suitable for companies of all sizes aiming to enhance resilience.
Formula	*Average Downtime= (Total Downtime Hours in a Period / Number of Downtime Events)* *Average Recovery Time = (Total Recovery Time in a Period / Number of Recovery Events)*
Target and values	- **Low Resilience**: Average downtime >10 hours per event and recovery time >5 hours. - **Moderate Resilience**: Average downtime 3-10 hours per event and recovery time 2-5 hours. - **High Resilience**: Average downtime <3 hours per event and recovery time <2 hours. Targets depend on industry standards and operational criticality.
Benefits / Value proposition	Reduces revenue losses and maintains customer satisfaction during disruptions. Enhances operational efficiency and resilience.

Data Collection and Analysis Approaches and Methodologies

This KPI measures resilience by assessing the average downtime and time to recovery after disruptions. Data collection aligns with **ISO 22301: Business Continuity Management**, using incident logs, maintenance records, and operational dashboards. Metrics include mean downtime duration and recovery rates, which are normalized against production schedules or critical operation benchmarks. Smaller organizations

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may track manually, while larger firms integrate real-time monitoring through **industrial IoT (IIoT)** and predictive maintenance platforms.

Measurement Tool	Data Requirements
Incident Management Systems	Detailed incident logs, including cause, duration, and resolution of downtime events.
ERP Software	Operational records and downtime reports integrated with production schedules and system availability data.
Maintenance Management Systems	Maintenance logs, including planned maintenance schedules and records of corrective actions.
Business Continuity and Recovery Software	Recovery activities and time tracking for each incident, including response initiation and resolution timestamps.
Risk Management System	Risk assessment data linking potential threats to actual downtime and recovery scenarios.

Summary of Data Collection Tools

To ensure accuracy and consistency, organizations typically use several core tools across these methodologies:

- Risk Management Software: Centralized platforms for documenting and tracking risk assessments, mitigation actions, and incidents.
- ERP and SCM Systems: ERP and SCM systems support data collection on suppliers, downtime, and recovery metrics.
- Innovation and IP Management Tools: R&D tracking software, patent databases, and PLM systems are key for capturing data on new products, services, and intellectual property.
- Incident and Maintenance Management Systems: Tools that document operational downtime, maintenance schedules, and incident reports are essential for calculating average recovery times and identifying areas for improvement.
- IoT-Enabled Tools and AI-Driven Analytics for Real-Time Monitoring and Predictive Insights.

Other resources and tools

- ISO 9001:2015 - Quality Management Systems – Requirements https://www.iso.org/standard/62085.html
- ISO 22300:2021 – Security and Resilience – Vocabulary https://www.iso.org/standard/50066.html
- ISO 28000:2022 - Security and Resilience – Security Management Systems – Requirements

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https://www.iso.org/standard/79612.html
- ISO 31000:2018 - Risk Management – Guidelines https://www.iso.org/standard/65694.html
- ISO 22301:2019 - Security and Resilience – Business Continuity Management Systems – Requirements https://www.iso.org/standard/75106.html
- NIST Cybersecurity Framework 2.0 (2024) https://www.nist.gov/cyberframework
- SASB Standards for Supply Chain Flexibility and Innovation Metrics (2018) https://www.sasb.org/standards/download/

4.4. Summary of the Structure of the Framework

To conclude the chapter, Table 5 summarizes the modular structure of the I5.AF, consolidating the categorization of KPIs across the three pillars. It outlines the dual-layered approach of Core and Scenario-Related KPIs, emphasizing the framework's adaptability to diverse organizational contexts.

Table 5 Summary of the structure of the framework

Impact areas	Core KPIs	Scenario-related KPIs
HC	**KPI_HC1.** Technology adoption for human-machine collaboration **KPI_HC2.** Training and re-skilling opportunities **KPI_HC3.** Comprehensive employee well-being and satisfaction index **KPI_HC4.** Representation in decision-making roles	**KPI_HC5.** Employee turnover rates **KPI_HC6.** **W**orkplace accidents / incidents **KPI_HC7.** Ergonomic design and tools **KPI_HC8.** Diversity ratio **KPI_HC9.** Inclusivity programs effectiveness **KPI_HC10.** Job crafting

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SU	**KPI_SU1.** Investment in and development of new technologies for sustainability **KPI_SU2.** Regulatory compliance rate and number of initiatives beyond compliance	**KPI_SU3.** Energy consumed **KPI_SU4.** Waste diverted from disposal **KPI_SU5.** Use of renewable energy sources **KPI_SU6.** Waste generated and its composition **KPI_SU7.** Products designed for Modularity, Repair, and Repurposing **KPI_SU8.** Products with traceability features implemented **KPI_SU9.** Water use **KPI_SU10.** GHG emissions **KPI_SU11.** Reduction of raw material consumption
RE	**KPI_RE1.** Risk assessment effectiveness **KPI_RE2.** Alternative sourcing options	**KPI_RE3.** Risk mitigation strategies implemented **KPI_RE4.** New products/services/ patents introduced **KPI_RE5.** Local sourcing ratio **KPI_RE6.** Cybersecurity actions implemented **KPI_RE7.** Operational downtime and recovery time

The summary table captures the essence of the framework's design: a balance between standardization and flexibility. Core KPIs provide a universal foundation, ensuring consistency in assessing alignment with I5.0 principles. Scenario-Related KPIs introduce customization based on factors like company size and sectoral requirements, enabling tailored assessments. This structure ensures that the framework remains robust yet adaptable, addressing both strategic and operational dimensions. It serves as a guide for organizations to navigate their I5.0 journey effectively, catering to unique contexts while maintaining alignment with overarching principles.

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5. APPLICATION SCENARIOS AND SCORING MECHANISM

5.1. Variables for the Definition of Application Scenarios

The specific application scenario will be defined based primarily on the variable of **company size**. This core variable will guide the customization of the framework, ensuring that the approach aligns with the resources, technological capacity, and strategic goals of each organization. Additionally, variables related to **industrial sector** and other contextual factors that may emerge will be considered on a case-by-case basis, allowing for flexibility and adaptation to the unique needs and characteristics of each UC. Different sectors, such as manufacturing, energy, automotive, aerospace, and logistics, have unique characteristics, regulatory requirements, and operational challenges, that in some cases could require further adaptation of the AF according to each scenario. For example, in manufacturing, the human-centricity module may emphasize ergonomic improvements and skill-based training, while in healthcare, it might focus on employee well-being and patient-centered innovations. Similarly, the framework allows adaptations based on company size; as an example, large enterprises can apply advanced KPIs for complex supply chain resilience, while smaller companies might prioritize foundational measures to improve basic operational flexibility.

This tailored approach ensures that the implementation plans are relevant, flexible, and capable of maximizing the benefits of I5.0 principles across diverse UCs

Definition of Company Size Categories

In the European Union, companies are categorized by size based on specific criteria, including the number of employees, annual turnover, and balance sheet total. Here's a breakdown of the definitions according to EU standards, with additional distinctions for startups/spin-offs, SMEs, and large companies:

Startups/Spin-Offs

Startups and spin-offs are typically newly created companies focused on bringing innovative products or services to market. Spin-offs are often formed by an existing organization to pursue a new business line or research outcome. Emphasis on innovation, adaptability, and potential for high growth. Startups and spin-offs often seek external funding from venture capital or public funding programs.

Criteria: These companies are often in early-stage development, may have fewer than 10 employees, and have limited revenue compared to more established companies. They are generally unprofitable in the early years, focused on rapid growth and scaling.

SMEs (Small and Medium-sized Enterprises)

SMEs are companies that fall within specific size limits defined by the EU, which include micro, small, and medium-sized businesses. SMEs make up the majority of businesses

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in the EU, known for their flexibility, regional economic impact, and specialization. They often face more resource constraints than large companies but are critical to innovation and job creation in local economies.

Criteria:

- Micro-enterprise: Fewer than 10 employees and annual turnover or balance sheet total not exceeding €2 million.
- Small enterprise: Fewer than 50 employees and annual turnover or balance sheet total not exceeding €10 million.
- Medium-sized enterprise: Fewer than 250 employees and annual turnover not exceeding €50 million, or balance sheet total not exceeding €43 million.

Large companies

Large companies exceed the thresholds set for medium-sized enterprises in terms of number of employees, turnover, or balance sheet total. Large companies have extensive resources, economies of scale, and a significant market presence, often operating across multiple regions or countries. They typically have more structured operations and established processes for research, development, and international expansion.

Criteria: More than 250 employees and/or annual turnover exceeding €50 million or balance sheet total exceeding €43 million.

5.2. Scoring Mechanism for the I5.AF

The preliminary version of the I5.AF suggests a two-tiered scoring mechanism to evaluate companies' alignment with I5.0 principles and their level of implementation of I5.0 practices. This approach ensures a comprehensive understanding of an organization's strategic alignment and operational maturity.

5.2.1. Alignment with I5.0 (Core KPI scoring)

Alignment with I5.0 is measured through the **Core KPIs**, which represent the foundational metrics essential for all companies to assess their adherence to I5.0 principles across the three pillars: Human-Centricity, Environmental Sustainability, and Industrial Resilience. As described in the previous chapter, each Core KPI is assessed based on predefined target values, with performance categorized into three levels: **High** (Optimal), **Moderate**, and **Low** (Concerning). As a reminder, here are some examples:

- ***KPI_HC1 (Technology adoption):*** *High performance reflects extensive deployment of collaborative tools with >70% of employees trained and high employee usability scores, while low performance indicates limited adoption and training.*

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- ***KPI_SU2 (Regulatory compliance):*** *High performance requires 100% regulatory compliance plus at least three initiatives beyond compliance, whereas low performance reflects <90% compliance.*
- ***KPI_RE1 (Risk mitigation):*** *High performance involves mitigating >80% of identified risks.*

The overall alignment is then calculated based on the proportion of Core KPIs achieving high performance:

- **High Alignment:** >70% of Core KPIs achieve high performance.
- **Moderate Alignment:** 40–70% of Core KPIs achieve high performance.
- **Low Alignment:** <40% of Core KPIs achieve high performance.

This alignment score provides a standardized benchmark for assessing whether a company is strategically aligned with the human-centric, sustainable, and resilient principles of I5.0.

5.2.2. Level of Implementation with Respect to I5.0 (Scenario-Related KPI Scoring)

The level of implementation with respect to I5.0 is assessed through the **Scenario-Related KPIs**, which measure specific practices and outcomes tailored to the organization's size, or industrial sector. These KPIs complement the Core KPIs by offering insights into how effectively a company operationalizes I5.0 principles.

Each Scenario-Related KPI is scored based on the target and values defined in section 4 of the present document. The overall implementation level is determined by aggregating the scores of all applicable Scenario-Related KPIs. This score reflects the organization's operational maturity in applying I5.0 principles, classifying it into one of three implementation levels:

- **High Implementation:** >80% of scenario-related KPIs achieve high performance.
- **Moderate Implementation:** 40–80% of scenario-related KPIs achieve high performance.
- **Low Implementation:** <40% of scenario-related KPIs achieve high performance.

The output of the scoring mechanism described should be to provide companies with an assessment on the maturity level they reached regarding I5.0 principles and practices, including actionable insights to:

Identify gaps in strategic alignment and operational maturity.

Prioritize improvements in Core KPIs for alignment and Scenario-Related KPIs for implementation.

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Progress through defined maturity levels, supporting continuous growth toward I5.0 excellence.

This dual-structured scoring system, grounded in clear target values and tailored methodological approaches, ensures that the I5.AF remains adaptable to various industries and organizational contexts, supporting incremental and strategic progress towards I5.0 goals.

5.3. Preliminary Analysis of the Feasibility of I5.AF

The feasibility of the I5.AF is grounded in its ability to address practical barriers to implementation while leveraging identified success factors. The following sections provide a preliminary analysis of these considerations, drawn from workshops with companies, EU stakeholders, and AB members.

5.3.1. List of Potential Barriers to Implementation of I5.AF

During workshops with UCs, several barriers to the effective implementation of I5.AF were highlighted. One of the most common issues raised was time and resource constraints, especially among small and medium-sized enterprises (SMEs). These organizations often lack the dedicated personnel, financial resources, or technological tools necessary to conduct structured data collection processes or implement new evaluation methodologies. For smaller companies, time limitations often prevent a full commitment to the framework, as the perceived costs in terms of effort and resources may outweigh the immediate benefits.

Another significant barrier relates to the perceived irrelevance or subjectivity of some KPIs, depending on company size or sector. Startups and micro-enterprises, for instance, may find it difficult to justify the applicability of certain KPIs, particularly those requiring in-depth assessments like employee turnover or advanced risk management. In these cases, KPI evaluations are often handled informally by management, leading to inconsistencies and subjective interpretations that can undermine the credibility of the framework.

Language barriers also pose challenges, particularly for multinational organizations or companies operating in linguistically diverse regions. Translating KPIs and survey tools into multiple languages is not only resource-intensive but may also introduce discrepancies in interpretation, complicating cross-border comparisons and standardization efforts.

Moreover, the generalization of KPIs across sectors presents difficulties. Industries with unique operational characteristics, such as aerospace or energy, require tailored KPIs to reflect their specific regulatory and operational demands. For example, tightly regulated sectors may struggle to adapt generalized KPIs without additional

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customization, while organizations heavily reliant on subcontractors face challenges in acquiring reliable data from external sources.

Smaller firms frequently expressed concerns about bureaucratic hurdles and the rigidity of structured frameworks. The absence of clear guidance on how data would be utilized, combined with potential survey fatigue, may deter organizations from engaging fully with I5.AF. Furthermore, companies operating in volatile markets, where short-term survival often takes precedence over long-term strategic alignment, may deprioritize framework implementation. Specifically, regarding the sustainability reporting initiatives (e.g. CSRD), a recently published study from KNOWIT underlines that a significant identified barrier for their implementation is the lack of clarity regarding reporting requirements. Companies often face challenges in understanding the specific information needed for compliance, leading to uncertainty and potential delays in implementation. This ambiguity can result in inconsistent reporting practices and hinder the effective adoption of frameworks like I5.AF.

Additionally, the complexity of data collection poses substantial challenges. Data is frequently dispersed across various sources and collected manually, making the process labor-intensive and prone to errors. This complexity can deter companies from fully engaging with comprehensive AFs, as the effort required may outweigh the perceived benefits (KNOWIT 2023).

5.3.2. Potential Success Factors for the Adoption of I5.AF

Despite these barriers, several key factors emerged that could facilitate the adoption and successful implementation of I5.AF. The framework's modularity is one of its greatest strengths. By allowing companies to begin with Core KPIs and eventually incorporate Scenario-Related KPIs, I5.AF offers an adaptable approach that accommodates varying levels of I5.0 maturity, organizational size, and sector-specific needs. This flexibility ensures that companies can adopt the framework at their own pace, making it less daunting for those with limited resources or experience.

The alignment of I5.AF with broader EU policy goals, such as the European Green Deal and digital transition strategies, provides another strong incentive for adoption. Companies that align their practices with these initiatives not only improve their sustainability and technological capabilities but also enhance their competitiveness in increasingly regulated markets. Furthermore, I5.AF's focus on actionable KPIs ensures that companies can track tangible outcomes, enabling them to identify gaps, implement improvements, and demonstrate measurable progress.

Collaboration between industry stakeholders, government entities, and academia was identified as a critical enabler for the success of I5.AF. Workshops emphasized the importance of fostering a supportive ecosystem that provides the guidance, resources, and validation needed for companies to adopt the framework effectively. This collaborative environment also ensures that the framework evolves in response to real-world challenges and opportunities, maintaining its relevance across diverse contexts.

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Scalability is another significant success factor. By starting with a baseline evaluation and expanding the scope of assessment as companies grow in maturity and capability, I5.AF allows organizations to scale their commitment to I5.0 principles over time. This approach minimizes initial implementation burdens while maintaining long-term relevance.

Finally, the value proposition of I5.AF was identified as a critical area of potential. Stakeholders suggested that the framework could evolve into a certification mechanism for I5.0 readiness. Such certification could enhance a company's reputation, attract investment, and provide a competitive edge in global markets. While this idea remains in its early stages, it represents an exciting avenue for further development during the project, showcasing how I5.AF could provide not only strategic insights but also tangible benefits for participating organizations.

In summary, while the implementation of I5.AF faces notable barriers, its flexible and scalable design, alignment with EU policy goals, and potential as a certification tool position it as a valuable asset for companies seeking to align with I5.0 principles. By addressing these challenges and leveraging the identified success factors, the framework can become a transformative tool for driving human-centric, sustainable, and resilient industrial practices.

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6. CONCLUSIONS

The preliminary **I5.AF,** developed within the PROSPECTS 5.0 project, represents a foundational tool for aligning industrial practices with the principles of I5.0. By integrating human-centricity, environmental sustainability, and industrial resilience into its structure, the framework underscores the need for a balanced approach to technological advancement, emphasizing ethical, social, and environmental considerations. Its modular design provides scalability and adaptability, catering to organizations of varying sizes and sectors.

The framework introduces a dual-layered scoring mechanism to assess both strategic alignment and operational maturity. Strategic alignment is measured through **Core KPIs**, which are universally applicable and reflect an organization's commitment to I5.0 principles. Operational implementation is assessed through **Scenario-Related KPIs**, which adapts to company-specific variables such as size and, in some cases, sectoral context.

The Core KPIs have been carefully selected to represent the most critical dimensions of I5.0 principles, ensuring their relevance across all application scenarios. These KPIs include:

1. **Technology adoption for human-machine collaboration (KPI_HC1):** Captures the organization's integration of collaborative technologies and their usability for workers. This KPI demonstrates a commitment to leveraging technology to enhance worker capabilities while prioritizing usability and training.
2. **Training and re-skilling opportunities (KPI_HC2):** Reflects the organization's investment in workforce adaptability through training, a cornerstone of resilience and innovation.
3. **Comprehensive employee well-being and satisfaction index (KPI_HC3):** Measures employee satisfaction and engagement, underscoring the importance of human-centricity in industrial contexts.
4. **Representation in decision-making roles (KPI_HC4):** Highlights inclusivity and empowerment by evaluating employee participation in organizational decision-making.
5. **Investment in and development of new technologies or initiatives for sustainability (KPI_SU1):** Tracks organizational commitment to sustainability through targeted investments in green technologies and practices.
6. **Regulatory compliance and initiatives beyond compliance (KPI_SU2):** Reflects adherence to environmental standards and voluntary efforts to exceed compliance, emphasizing sustainability leadership.
7. **Risk assessment effectiveness (KPI_RE1):** Evaluates the organization's ability to identify and address potential risks, a fundamental aspect of industrial resilience.
8. **Alternative sourcing options (KPI_RE2):** Measures the availability of alternative suppliers to ensure supply chain flexibility and continuity.

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These Core KPIs provide organizations with a benchmark for assessing their alignment with I5.0 principles, offering a standardized approach to strategic evaluation. Their inclusion reflects feedback from workshops with UCs, which highlighted their universal relevance and feasibility for implementation across diverse organizational contexts.

In contrast, the Scenario-Related KPIs address specific operational aspects that vary based on organizational size and sector. These KPIs allow for deeper insights into areas critical to certain companies, providing a more nuanced assessment. For instance:

- **Human-centricity scenario-related KPIs**: These include metrics like job crafting, ergonomic design, and inclusivity program effectiveness, which vary in relevance based on organizational focus and workforce characteristics.
- **Environmental sustainability scenario-related KPIs**: These encompass measures such as energy efficiency, waste management, and water use, which are highly dependent on the industrial sector and the organization's operational scale.
- **Industrial resilience scenario-related KPIs**: These include cybersecurity measures, local sourcing ratio, operational downtime and recovery times, which vary in importance based on the company's reliance on digital infrastructure and the complexity of its supply chain.

The decision to categorize these KPIs as scenario-related stems from their variability in applicability. Larger organizations with specialized operations may find these KPIs critical, while smaller firms might prioritize simpler metrics. Additionally, sectoral dynamics, such as regulatory requirements and industry-specific risks, further influence the relevance of these KPIs.

The dual approach of Core and Scenario-Related KPIs ensures the framework's flexibility while maintaining its rigor. Companies can start with the Core KPIs to establish their strategic alignment with I5.0 principles and then expand their assessment scope to Scenario-Related KPIs for a detailed evaluation of operational maturity. This modularity allows for incremental implementation, accommodating the unique challenges and opportunities of each organization.

As the framework enters its testing and validation phase within the PROSPECTS 5.0 project, it will be refined based on real-world applications in diverse UCs. This iterative process will play a critical role in enhancing its usability and adaptability, ensuring it remains a practical tool for organizations of various sizes and sectors. The insights gathered during this phase will not only strengthen the framework itself but also directly inform the project's key outputs, such as the policy recommendations, guidelines for I5.0 implementation and the digital platform that aims to digitize the I5.AF. By aligning the framework's structure and KPIs with tangible operational realities, these outputs will be better equipped to support companies in adopting ethical, sustainable, and resilient practices that reflect the evolving demands of I5.0. Ultimately, the framework serves as a cornerstone of the project, facilitating a holistic transition to I5.0 principles while ensuring measurable progress and actionable outcomes for stakeholders.

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8. ANNEXES

- ANNEX 1: ESG and SDG frameworks KPIs relevant for Industry 5.0
- ANNEX 2: Other existing frameworks (industrial sectors and EU projects) analysed
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- ANNEX 4: Agenda UC workshops
- ANNEX 5: Workshops' guidelines
- ANNEX 6: Consent form for data processing
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- ANNEX 9: Survey on employee satisfaction (KPI_HC3)
- ANNEX 10: List of possible technologies or initiatives for sustainability (KPI_SU1)
- ANNEX 11: List of possible initiatives beyond compliance with sustainability regulations (KPI_SU2)
- ANNEX 12: List of possible actions on cybersecurity (KPI_RE6)

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PROSPECTS 5.0

D1.3 Industry 5.0 Assessment Framework
ANNEX 1: ESG and SDG Frameworks KPIs Relevant for Industry 5.0

Date	: 09.12.2024
Topic	: D1.3 – ANNEX 1
Responsible Partner	: UNIMORE
Author	: Giacomo Cantini (UNIMORE)

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COMMON ESG KPIS RELEVANT FOR THE I5.AF

Table 1 Common ESG KPIs relevant for the I5.AF.

ESG dimension	KPIs	KPI DESCRIPTION
ENVIRONMENTAL	**Carbon footprint**	Measures the total greenhouse gas emissions caused directly and indirectly by an organization.
	Energy consumption	Records the amount of energy used, often with distinctions between renewable and non-renewable sources.
	Water usage	Tracks the amount of water used and the efficiency of water use within the company.
	Waste management	Measures the amount of waste generated and the effectiveness of recycling and waste reduction initiatives.
SOCIAL	**Employee turnover rate**	Indicates the rate at which employees leave the company and can highlight the company's workplace environment and culture.
	Diversity and inclusion	Metrics related to the workforce's composition in gender, ethnicity, and other diversity indicators.
	Health and safety	Includes statistics on workplace accidents, injuries, and fatalities.
	Community engagement	Measures the company's involvement and investment in local communities, including philanthropy, volunteering, and community development programs.
GOVERNANCE	**Board diversity**	Looks at the board's composition in gender, ethnicity, age, and background diversity.
	Ethics and compliance	Measures the adherence to laws, regulations, and standards, noting violations or fines.
	Executive compensation	Details the pay disparity between top executives and the average worker, including bonuses and other compensation metrics.
	Transparency and reporting	Assesses the quality and frequency of disclosures related to financial and non-financial performance.

INDUSTRY 5.0 ALIGNMENT WITH SDG GOALS AND RELEVANT KPIS

Table 2 Industry 5.0 alignment with SDG goals and relevant KPIs

SDGs	RELATION WITH I5.0	RELEVANT KPIs
Goal 9: Industry, Innovation, and Infrastructure	Industry 5.0 directly enhances this goal by promoting advanced manufacturing technologies that improve infrastructure and innovation, making industries and infrastructures more sustainable through smart technology.	**Percentage of manufacturing value added in GDP:** Measures the contribution of manufacturing to the economy, emphasizing the importance of high-tech and sustainable manufacturing sectors. **Research and development expenditure as a proportion of GDP:** Indicates the level of innovation and investment in developing new technologies and products.

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		Carbon intensity of manufacturing industries: Tracks the reduction of greenhouse gas emissions in manufacturing, aligning with sustainable production methods.
Goal 8: Decent Work and Economic Growth	The emphasis on human-centric manufacturing in Industry 5.0 supports creating quality jobs and promotes safe and secure working environments, contributing to sustained, inclusive economic growth.	**Employment in industry as a proportion of total employment:** Reflects the job opportunities created by the industrial sector, including advanced manufacturing. **Fatal and non-fatal occupational injury rates:** Important for assessing the safety and health standards in the workplace, which Industry 5.0 aims to enhance through better human-machine collaboration.
Goal 12: Responsible Consumption and Production	Industry 5.0 encourages industries to adopt sustainable practices and increase resource efficiency. It emphasizes the reduction of waste and the better use of resources, aligning with the goal of ensuring sustainable consumption and production patterns.	**Material footprint per capita:** Measures the amount of primary materials required to meet consumption demands, encouraging more efficient use of resources. **Recycling rate, tons of material recycled:** Directly reflects the efficiency and sustainability of resource use in production processes. **Hazardous waste generated and proportion treated:** Assesses the impact of production processes on the environment and the effectiveness of waste management practices.
Goal 13: Climate Action	Industry 5.0's focus on sustainability helps in adapting to climate change impacts, reducing emissions, and promoting environmental management systems in industrial applications.	**Greenhouse gas emissions per unit of value added:** A key metric for understanding how much industrial processes contribute to emissions and the effectiveness of measures to reduce them. **Investment in clean technologies:** Quantifies the financial commitment to developing and deploying technologies that reduce environmental impacts.
Goal 7: Affordable and Clean Energy	By integrating smart technologies in industrial production, Industry 5.0 can enhance energy efficiency and promote the use of renewable energy sources in manufacturing processes.	**Percentage of energy from renewable sources:** The proportion of total energy consumption derived from renewable sources such as solar, wind, and bioenergy. **Energy saving through technology integration:** Amount of energy saved due to the implementation of advanced technologies and process optimizations, often measured in megawatt-hours (MWh) or equivalent.

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D1.3 Industry 5.0 Assessment Framework
ANNEX 2: Overview of Existing Frameworks

Date	: 09.12.2024
Topic	: D1.3 – ANNEX 2
Responsible Partner	: UNIMORE
Author	: Giacomo Cantini (UNIMORE)

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RELEVANT EXISTING FRAMEWORKS OVERVIEW

As part of the existing framework review conducted within the project, a diverse range of documents, including public deliverables from EU-funded projects, industry reports, and academic studies, were analysed. These documents provided valuable insights into the principles, methodologies, and indicators already in use across various industrial sectors and impact areas. The analysis aimed to identify frameworks and approaches relevant to the Industry 5.0 paradigm, focusing on the three core pillars: human-centricity, sustainability, and resilience. The table presented below summarizes the analysed documents, providing a brief description of each, along with the industrial sectors and impact areas for which they are most applicable.

Table 2 Relevant existing frameworks overview

PAPER / PUBLICATION	SHORT DESCRIPTION	INDUSTRIAL SECTOR	IMPACT AREA
Sustainability and Industry 4.0: Definition of a Set of Key Performance Indicators for Manufacturing Companies	Identifies KPIs across environmental, economic, and social areas. Current literature offers a flat set of KPIs lacking sector-specific implementation guidance.	Manufacturing	Sustainability (economic, environmental, social)
SHOP4CF Enhancing worker-centred digitalisation in industrial environments: A KPI evaluation methodology –	The document outlines a KPI evaluation methodology for assessing digitalization processes in industrial environments, incorporating human-centric principles and addressing the transition from Industry 4.0 to Industry 5.0. The Human Centric Digital Industry (HCDI) KPI methodology is a KPI-based framework assessing human-centric digitalization in factories, balancing automation with human involvement.	Manufacturing/ Smart Factory	Human-centricity
An index-based sustainability assessment framework for manufacturing organizations	Proposes a composite sustainability index using the triple bottom line, life-cycle stages, and 6R principles.	Manufacturing	Sustainability, human-centricity
FACTORIES OF THE FUTURE Multi-annual roadmap for the contractual PPP under Horizon 2020	Outlines technologies for sustainable, high-performing EU factories, developed through stakeholder consultations.	Manufacturing	environmental, human, business
Key Performance Indicators and Industry 4.0 – A Socially Responsible Perspective	Highlights the role of KPIs in Industry 4.0, linking them to corporate social responsibility and offering implementation recommendations.	Manufacturing	ALL
FACTORY2FIT	D1.5 describes the initial work well-being framework that integrates user experience, usability, safety, and ethics into Factory2Fit solutions for new work practices.	Manufacturing	Human Centricity

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D1.5 – Design and evaluation framework and measuring tools. D5.3 – Evaluation and assessment of the pilots	D5.3 describes the user evaluation results from Factory2Fit pilots carried out with the industrial pilot partners Continental, UTC and Prima Power.		
The Impact of Industry 4.0 Technologies on Key Performance Indicators for a Resilient Supply Chain 4.0	Industry 4.0 technologies improve KPIs for supply chain resilience.	Manufacturing / Logistics	Resilience
BRIDGES 5.0 D1.1 Conceptual framework of Industry 5.0 to study workforce skills (DRAFT)	Explores workforce skills for Industry 5.0 and impacts on employees, with a conceptual framework for future testing.	Manufacturing / All	Sustainability / Human-centricity / Resilience
HUMAN – Human Manufacturing D7.1 Evaluation Methodology D7.2 Evaluation Analysis	Defines performance indicators for industrial trials using the Simplified ECOGRAI methodology. D7.2 presents the evaluation process templates.	Manufacturing /Aerospace / Furniture	Human-centricity
PROREGIO D3.2: Operational KPI evaluation framework	Introduces five steps for KPI framework development: definition, classification, selection, interaction, and monitoring.	Manufacturing/ Aerospace	Sustainability / Human-centricity
Logistics 5.0 Implementation Model Based on Decision Support Systems	Develops a decision-support model prioritizing green logistics elements based on investment and ROI goals.	Logistics	Sustainability / Human-centricity
FENIX D5.4 Impact Assessment Report	Assesses eleven pilot sites using a "learning by doing" approach to prepare logistics and transport corridor services.	Logistics	Sustainability / Resilience
5G-LOGINNOV D3.4 Evaluation of social, economic, and environmental impacts	Evaluates economic, social, and environmental KPIs to measure project effectiveness.	Logistics	Sustainability / Human-centricity / Resilience
FESTA (Field opErational teSt supporT Action) handbook	Guides field operational test planning, execution, and analysis, emphasizing standardization for cross-comparison.	Transport and Mobility	Sustainability / Human-centricity
SASB Standards – Automobiles Sustainability Accounting Standard	It provides guidance for reporting sustainability factors critical to the automobile industry, including fuel efficiency, emissions, product safety, and supply chain management. It offers metrics to disclose material impacts, aligning sustainability performance with financial	Automotive	Sustainability / Human-centricity / Resilience

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	outcomes to support informed decision-making by investors and stakeholders.		
SASB Standards – Auto Parts Sustainability Accounting Standard	Focuses on auto parts industry metrics like product safety, materials efficiency, and supply chain sustainability.	Automotive	Sustainability / Human-centricity / Resilience
Trilateral Impact Assessment Framework For Automation in Road Transportation -VTT Report	Investigates automation KPIs in road transportation through stakeholder surveys.	CCAM (automotive)	Sustainability / Human-centricity
AUTOPILOT - D.4.1 Methodology for Evaluation	Evaluates IoT's value for cooperative driving using FESTA-based KPIs and research questions.	CCAM (automotive)	
CARTRE - D5.3 Societal impacts of automated driving	Built on the work of the Trilteral ART Working Group: Defines KPIs for societal impact through a collaborative process.	CCAM (automotive)	Sustainability / Human-centricity
C-ROADS PLATFORM Evaluation and assessment plan	Assesses Day 1 C-ITS Services' impacts on user acceptance, safety, traffic efficiency, and socio-economics.	CCAM (automotive)	Sustainability / Human-centricity
LEVITATE - Societal Level Impacts of Connected and Automated Vehicles Final Technical Report	This report explores the societal impacts of connected and automated vehicles (CAVs), emphasizing safety, environmental sustainability, and social equity. Relevant to Industry 5.0, it provides insights into integrating automation with human-centric and sustainable transportation systems. The framework highlights the importance of adaptive policy measures, ethical considerations, and the potential for CAVs to enhance resilience within transportation networks.	CCAM (automotive)	Sustainability / Human-centricity
SASB Standards – Biofuels Sustainability Accounting Standard	This standard outlines key sustainability metrics for biofuel production, focusing on energy efficiency, emissions, and land use. It aligns with Industry 5.0 principles by addressing environmental sustainability through circular resource management and optimizing renewable energy use. The metrics support companies in benchmarking their sustainability performance and integrating biofuels into green industrial practices.	Energy & utilities	Sustainability / Human-centricity / Resilience
SASB Standards – Ful-cells and industrial batteries Sustainability Accounting Standard	This document provides guidance on evaluating the environmental and social impacts of fuel cells and industrial battery production. Relevant for Industry 5.0, it emphasizes waste reduction, lifecycle management, and the circular economy, fostering sustainable manufacturing practices and innovation in energy storage technologies.	Energy & utilities	Sustainability / Human-centricity / Resilience

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SASB Standards – Solar Technology Sustainability Accounting Standard	Focused on the production and deployment of solar technologies, this standard promotes the adoption of renewable energy sources. Key areas include material efficiency, emissions reduction, and the social impact of solar installations. It aligns with Industry 5.0 by integrating sustainable and human-centric energy solutions into industrial operations.	Energy & utilities	Sustainability / Human-centricity / Resilience
SASB Standards – Wind Technology Sustainability Accounting Standard	This standard addresses the sustainability impacts of wind energy technology manufacturing and deployment. It includes metrics for resource use, emissions, and lifecycle management, promoting environmentally friendly practices in the energy sector. The relevance to Industry 5.0 lies in its alignment with sustainable energy goals and fostering resilience in renewable energy supply chains.	Energy & utilities	Sustainability / Human-centricity / Resilience
SPARCS A Comprehensive Methodology for Assessing the Impact of Smart City Interventions: Evidence from Espoo Transformation Process	Proposes a seven-step process to assess smart city interventions with a combined top-down and bottom-up approach.	Energy, Urban mobility, Smart City	Sustainability / Human-centricity
eCharge4Drivers D1.1 Study questions, impact areas, and KPIs	Explains relations between study questions, tasks, and data collection methodologies for project KPIs.	Electric Mobility, Energy	Sustainability / Human-centricity
Do industry 5.0 advantages address the sustainable development challenges of the renewable energy supply chain?	Highlights modularity, human-centered innovation, and hyper-connected networks addressing sustainability challenges.	Renewable energy	Sustainability / Human-centricity / Resilience
A Holistic Digitalization KPI Framework for the Aerospace Industry	Proposes a digitalization KPI framework tailored to resource-constrained aerospace suppliers.	Aerospace	Digitalization / Human-centricity
A Study on The Development Of Key Performance Indicators (KPIs) at an Aerospace Manufacturing Company	Develops KPIs for an aerospace company's lean manufacturing journey using benchmarks and communication improvements.	Aerospace	Sustainability / Human-centricity / Resilience
The Industry 5.0 framework: viability-based integration of the resilience, sustainability, and human-centricity perspectives	Defines I5.0 as a framework for resilient value creation, human well-being, and sustainability, spanning society, networks, and plants	ALL	Sustainability / Human-centricity / Resilience

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PROSPECTS 5.0

TOWARDS THE INDUSTRY 5.0 (I5.0)

A NEED FOR CHANGE:

Theory vs. Practice

BluePoint Brussels
(Bd A. Reyers 80 – 1030 Brussel)

29 May 2024-09:15-16:00

The times in the calendar are set in Central European Time (CET), ie in the (GMT+2) time zone.

The “Industry 5.0” paradigm seems to complement the "Industry 4.0" approach by specifically putting research and innovation at the service of the transition to a **sustainable, human-centric** and **resilient** European industry:

- **Environmental dimension** is aiming at eliminating fossil fuels, promoting energy efficiency, use of nature-based solutions, regeneration of carbon sinks and restoration of biodiversity. **Regenerative features of industrial transformation** are embracing circular economy and facilitate restorative feedback loops as a key pillar of the design of entire value chains;

- **Inherent social dimension** is focusing on workers well-being, social inclusion and the introduction of technologies that complement human skills;

- **Resiliency dimension,** as a response to current disruptions (climate change, COVID-19, geopolitical conflicts), is being built through systemic transformation by improving infrastructure innovation alongside policy innovation and by bringing together the appropriate skills and collective intelligence.

In the morning session, speakers will set the stage by presenting and discussing the current frameworks and methodologies linked to the Industry 5.0 paradigm.

The afternoon session will be dedicated to industry testimonials discussing how the current Industry 4.0 approach is complemented with the three core competencies of the Industry 5.0 approach (sustainability, human-centricity, resilience) and adopted/implemented in practice in different industry sectors.

CONTACT

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29 May 2024-09:15-16:00

The times in the calendar are set in Central European Time (CET), ie in the (GMT+2) time zone.

AGENDA

Registration and Welcome Coffee — 09:15–10:00

Welcome and Introduction — 10:00–10:15

- Agenda introduction and presentation of the event objectives (5 minutes)
- Presentation of the PROSPECTS 5.0 project (10 minutes)

Morning Plenary Session — 10:15–11:30

Presentations of existing frameworks and methodologies linked to the Industry 5.0 (15 minutes per presentation, including Q&A)

- Bridges 5.0 project - Workforce skills for Industry 5.0 conceptual framework (Steven Dhondt, TNO)
- SEISMEC project - Striking the right balance between disruptive technology and human-centricity: the CAPS framework (Jason Pridmore, Erasmus University Rotterdam)
- AI Redgio 5.0 - Experimenting Industry 5.0 in TEchnology and REgulatory SAndboxes (TERESA) and Didactic Factories (Sergio Gusmeroli, Politecnico di Milano)
- SURE 5.0 project (TBC)
- Community of Practice 5.0 - Findings from working groups on Thematic Analysis and Learning and Assessment Tool (DG RTD, Industry 5.0 and AI in Science Unit)

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PROSPECTS 5.0

TOWARDS THE INDUSTRY 5.0 (I5.0)

A NEED FOR CHANGE:

Theory vs. Practice

BluePoint Brussels
(Bd A. Reyers 80 – 1030 Brussel)

29 May 2024-09:15-16:00

The times in the calendar are set in Central European Time (CET), ie in the (GMT+2) time zone.

AGENDA

Panel Discussion — 11:30–12:30

How are Industry 4.0 & Industry 5.0 connected?

Lunch — 12:30–14:00

Break-out Sessions (World Café Style) — 14:00–16:00

3 meeting rooms, each focusing on of the I5.0 pillars: sustainability (SU), resilience (RE), and human-centricity (HC)

10': Introduction and group division according to the interest of participants indicated during registration
70': Each group discusses one of the pillars (HC/SU/RE);
10'x3: Summary of discussions from each group
10': Final wrap-up

TIME	OBJECTIVE	DESCRIPTION
5'	Session introduction	Introducing the World Café format & setting the context
10'	Industry use-case (UC) presentation	Hands-on testimony from a company
20'	Part 1: Awareness level of the participants about I5.0	Questions will be provided in advance
30'	Part 2: How to evaluate and measure HC/SU/RE in the industry	Questions will be provided in advance
5'	Wrap-up	

Networking Cocktail — 16:00–17:00

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PROSPECTS5_0 (X)
PROSPECTS5-0 (YouTube)
PROSPECTS5-0.EU

PROSPECTS 5.0

D1.3 Industry 5.0 Assessment Framework

ANNEX 4: I5.AF Validation Workshop AGENDA

Date	: 03.07.2024
Topic	: D1.3 – ANNEX 4
Responsible Partner	: UNIMORE
Authors	: Giacomo Cantini (giacomo.cantini@unimore.it), Anna Rita Graziani (annarita.graziani@unimore.it)

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AGENDA:

#		Contents	Time
1	Welcome remarks	Brief presentation of PROSPECTS 5.0 project and the objectives and scope of the workshop	5′
2	Participants presentation	Participants briefly introduce themselves, their role, and their interest in the workshop.	10′
3	Overview of proposed KPIs	Present an overview of the proposed KPIs and measurement tools for Industry 5.0 initiatives, categorised by Human-centricity, Environmental Sustainability, and Industrial Resilience.	10′
4	**Interactive session**: KPIs and measurement tools discussion(s)	Provide clear **instructions** on discussion points and expected outcomes of the session. Participants discuss the relevance, feasibility, and potential challenges of the proposed KPIs and measurement tools. Discussion Points: **- Validation of proposed KPIs** **- Identification of additional KPIs** **- Feasibility and implementation challenges** **- Suggestions for improvement** *(There should be a short coffee break, or at least coffee and beverages available, according to participants' needs)* *Only if there are more than one group: each group presents their discussion points, feedback, and suggestions.*	105′/ 135′
5	Wrap-up and conclusions	Summarise the key points discussed, agreed-upon KPIs, and any action items identified. Thank participants, emphasise the importance of the discussed KPIs, and encourage ongoing collaboration and engagement. *(Optional: conclusions by the company's CEO or a Senior Executive)*	20′

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PROSPECTS 5.0

D1.3 Industry 5.0 Assessment Framework
ANNEX 5: I5.AF Validation Workshop Guidelines

Date	: 03.07.2024
Topic	: D1.3 – ANNEX 5
Responsible Partner	: UNIMORE
Authors	: Giacomo Cantini (giacomo.cantini@unimore.it), Anna Rita Graziani (annarita.graziani@unimore.it)

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THE PROJECT

PROGRESS TOWARDS INDUSTRY 5.0: A SMART STUDY ON ANALYSIS AND IDENTIFICATION OF PRACTICES, DRIVERS, SUCCESS FACTORS AND OBSTACLES OF TRANSITIONS TOWARDS INDUSTRY 5.0 (PROSPECTS-5.0), is a project funded by the European Union's Horizon Europe Research and Innovation Programme, under Grant Agreement no. 101135948. The global objective of the PROSPECTS 5.0 project is to facilitate the successful transition to Industry 5.0 by providing practical guidance, tools, and solutions to policy makers and industry stakeholders. As a specific objective, within the Work Package 1 (WP1) "Building the foundation: developing an Assessment Framework for Industry 5.0" the project aims at developing an Industry 5.0 Assessment Framework based on a multi-sectorial and multi-stakeholders' engagement and co-creation processes. **This workshop is part of the validation process of the KPIs and measurement tools that will constitute the basis for the Assessment Framework.**

WORKSHOP'S SCOPE AND TOPICS

The workshop will focus on discussing, refining, and validating the proposed KPIs and related measurement tools relevant to Industry 5.0 initiatives within the companies that provide the Use Cases of the project. It will engage key stakeholders across various departments, including Operations, Production, Human Resources, R&D and Innovation, Energy management and Work Council representatives, to ensure the KPIs are comprehensive, relevant, and practical for implementation. The results of the workshops will support the definition of the preliminary Industry 5.0 Assessment Framework.

WORKSHOPS'S OBJECTIVE

The primary objective of the workshop is to collaboratively **evaluate and validate a set of KPIs and measurement tools** that will effectively monitor and drive Industry 5.0 initiatives in the participating companies. The workshop aims to achieve consensus on the **relevance**, **feasibility**, and **implementation strategies** for these KPIs, ensuring alignment with each organisation's strategic goals and operational realities.

WORKSHOP'S FACILITATORS AND TASKS

The workshop should always be conducted by a team consisting of a moderator and an assistant. The **moderator** facilitates the discussion; the **assistant** takes notes and runs the recording. It is important to register the answers with the

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identified reporting tools, to facilitate the data analysis process. The *moderator* should:

- be able to listen attentively with sensitivity and empathy;
- be able to listen and think at the same time;
- believe that all group participants have something to offer no matter what their education, experience, or background;
- have adequate knowledge of the topic and read in advance the KPIs list and other material that could be provided by Task leader UNIMORE;
- be able to keep personal views and ego out of the setting;
- be able to relate to but also give authority;
- appropriately manage challenging group dynamics.

The *assistant* should:

- run a tape recorder/camera during the session if there is the permission from participants;
- take notes and fill in the reporting tools;
- note/record body language or other subtle but relevant clues;
- Take some pictures of the event;
- allow the moderator to do all the talking during the group.
- After the conclusion of the workshop: provide Task leader UNIMORE with the provided Word reporting tool filled (digitally or by hand), including open observations on the session, and provide Dissemination leader Technology Partners with the provided event report tool filled (pictures and a brief description of the workshop).

PARTICIPANTS

The suggestion is to invite UC company's personnel like CEO, COO, CPO, HR manager, energy manager, innovation manager and work council representatives, from a minimum of 2 to a maximum of 12 participants. It's up to every UC provider and facilitators to decide whether to invite additional local ecosystem's stakeholders or not.

In the case participants are **more than five**, the discussion will be implemented dividing participants into two smaller groups based on their roles or areas of expertise. Therefore, moderators should be two and assistants two as well.

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LENGTH

The workshop will be around 150/180 minutes long, depending on the number of participants.

DATA MANAGEMENT CONSENT FORM

The data management consent form, including the permission to record the workshop, will be sent in advance to be signed before the starting of the session.

CONDUCTING THE WORKSHOP

A)Select the right **venue**, which should:

- Have the appropriate technical infrastructure, such as power sockets, audiovisual equipment, internet access, etc.
- Be easily accessible for the participants.
- Be quiet, have sufficient space, appropriate lighting, air circulation and temperature conditions.
- Have chairs and tables that can be arranged in round tables/coffee tables style.
- Have a setting that provides every participant with the opportunity to see each other and the screens easily, avoiding the creation of a sense of hierarchy among the participants.

B)Consider the **roles** of the different persons:

- The **moderator** is responsible for the direction, guidance and facilitation of all the implemented procedures. The moderator will present the necessary steps for the conduction of the workshop, he/she will coordinate them, and he/she will summarise the obtained outcomes.
- The **assistant** will observe the discussion having as target highlighting the main points of agreement and disagreement, ensuring the filling up of the reporting tool on KPIs and measurement tools, and the correct recording of the session.
- The rest of **participants**, who are requested to participate actively in the discussion through questions, comments, examples, ideas and

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disagreements to benefit the discussion with their accumulated experience in the specific field.

C)Don't forget to bring all the necessary **material** for the interactive sessions:

- List of KPIs (PPT Presentation)
- Reporting tool (Word document)
- *List of KPIs printed (optional)*
- Flipcharts and markers
- Pencils and papers

D)Agree on the **rules of the workshop**, which will help to run and conduct the meeting smoothly.

- Start and end of the workshop on time.
- Equal opportunity to everyone for participation.
- Right to decide to leave the workshop if the participant is feeling uncomfortable.
- Confidentiality regarding the participants' attitudes and statements.
- Turn off mobile telephones.

5)Consider and carefully plan the three different **phases of the workshop**, which consist of the:

Introduction: the period from the arrival of the participants to the beginning of the main presentation and activities.

- Prepare for a registration procedure of the participants.
- Introduce the moderator, the assistant and the participants pinpointing their role.
- Present the objectives and the agenda of the workshop.

Conduction: it involves the main presentation and activities. During the conduction of the workshop the role of the moderator is considered as crucial. Among suggestions to be followed:

- To create a friendly atmosphere and help participants to feel comfortable.

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- To be creative and utilise humour in order to make your activities more entertaining.
- To be enthusiastic, motivating the participants for a more effective involvement.
- To appreciate participants' contributions and statements.
- To encourage any input, feedback and proposals.
- To try not to judge or criticise.
- To respect the right of each member for participation and remember that every opinion counts.
- To keep track of time. Try to avoid unnecessary deviations from the timetable of the agenda.
- To allow adequate time for reflection and discussion.
- To be aware of similarities and differences among the ideas of the participants.

Closure: it includes the summary, the evaluation and the ending.

- To summarise the main findings of the workshop.
- To give the opportunity to the participants to react to the obtained outcomes. This can be achieved either with a formal procedure or through some simple questions.
- To provide the opportunity to the participants to sum up.

TIMESCALE: July- September 2024.

LANGUAGE and REPORTING:

Workshop implementation: local language or English.

UNIMORE team provides a full version of the agenda, KPIs and measurement tools' list, questions for discussion and reporting tool in English. The translation of the questions for discussion is up to every single UC facilitator. The reporting tool will be filled in by the UC facilitator in English and sent to UNIMORE, including open observations on the session, to support qualitative analysis of the workshops.

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AGENDA:

#		Contents	Time
1	Welcome remarks	Brief presentation of PROSPECTS 5.0 project and the objectives and scope of the workshop	5′
2	Participants presentation	Participants briefly introduce themselves, their role, and their interest in the workshop.	10′
3	Overview of proposed KPIs	Present an overview of the proposed KPIs and measurement tools for Industry 5.0 initiatives, categorised by Human-centricity, Environmental Sustainability, and Industrial Resilience.	10′
4	**Interactive session**: KPIs and measurement tools discussion(s)	Provide clear **instructions** on discussion points and expected outcomes of the session. Participants discuss the relevance, feasibility, and potential challenges of the proposed KPIs and measurement tools. Discussion Points: **- Validation of proposed KPIs** **- Identification of additional KPIs** **- Feasibility and implementation challenges** **- Suggestions for improvement** *(There should be a short coffee break, or at least coffee and beverages available, according to participants' needs)* *Only if there are more than one group: each group presents their discussion points, feedback, and suggestions.*	105′/ 135′
5	Wrap-up and conclusions	Summarise the key points discussed, agreed-upon KPIs, and any action items identified. Thank participants, emphasise the importance of the discussed KPIs, and encourage ongoing collaboration and engagement. *(Optional: conclusions by the company's CEO or a Senior Executive)*	20′

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INTERACTIVE SESSION: KPIs and measurement tools discussion

Slides for each KPI and related measurement tools will be displayed. Make participants discuss and reach consensus on every proposed KPI and related measurement tool and data requirements, starting with Human Centricity, then following with Industrial Resilience and Environmental Sustainability. These are the **discussion points:**

A) Validation of proposed KPIs
B) Identification of additional KPIs
C) Feasibility and implementation challenges
D) Suggestions for improvement

Questions for each presented KPI (to be reported in the reporting tool):

- **Does your company calculate this KPI?**
- **How would you rate the relevance of this KPI for your company and/or the specific industrial sector?**
- **Which measurement tool are you using/will you be using for the identified KPI?**
- **Which data are required to calculate the KPI?**

Questions at the end of each pillar (HC, SU, RE)

Once finalised the discussion on the KPIs of each pillar, make participants answer the following questions:

- **Are there any additional KPIs or tools needed?**
- **What potential challenges or barriers exist in implementing these KPIs?**
- **Do you have any suggestions for improvement**
- **How would you rank the discussed KPIs according to their priority level for your company? Identify at least the first 6 KPIs**

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PROSPECTS 5.0

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PROSPECTS 5.0

D1.3 Industry 5.0 Assessment Framework
ANNEX 6: I5.AF Validation Workshop Consent form for data processing

Date	: 08.07.2024
Topic	: D1.3 – ANNEX 6
Responsible Partner	: AETHON
Author	: Giacomo Cantini, Anna Rita Graziani (UNIMORE), Rosanna Babagiannou (AETHON)

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CONSENT FORM FOR DATA PROCESSING

The present consent form is about the collection and processing of the data that will be shared in the workshops to be implemented either in presence or online between July and September 2024 with each of the use case providers of the PROSPECTS-5.0 project. The data will be collected by the respective use case facilitators in an open session where participants will discuss the relevance of the proposed KPIs for their companies and/or sectors, and the related measurement tools and data requirements. All collected data during the workshops will then be send to the related Work Package 1 and Task 1.3 Leader University of Modena and Reggio Emilia (UNIMORE) and processed within the framework of the PROSPECTS-5.0 project for scientific reasons, namely, to validate the preliminary Assessment Framework (AF) for Industry 5.0. The workshops are part of the validation process of the KPIs and measurement tools that will constitute the basis for the AF for Industry 5.0 that will be implemented during the project.

The data collected may include:

- Role of the participant within the company or within the local ecosystem.
- Participant feedback on the assessment framework and specific KPIs and/or measurement tools.
- Potential challenges or barriers to the implementation of the AF.
- Suggestions for improvements.
- Any other relevant information shared during the workshop sessions.

The data collected will be used in anonymous and aggregate form, so as not to be able to trace the data of individual participants. The data collected will be used solely for the purpose of validating and improving the AF and for scientific publications. The information will help the project Consortium to better understand the needs and expectations of companies from different industrial sectors and enhance the effectiveness of the framework.

All the data processing activities within the project will comply with the requirements of the General Data Protection Regulation (GDPR - EU 2016/679 of the European Parliament and of the Council of 27 April 2016). The Consortium partners have jointly determined the purposes and means of processing personal data in accordance with Article 26 of the GDPR. All collected data will be securely stored in the project's repository on Microsoft 365 SharePoint and shared between partners according to the stipulations outlined in the Data Management Plan (D6.13) signed by all PROSPECTS-5.0 partners, maintaining the highest degree of confidentiality.

The Work package 1 Leader (UNIMORE), in collaboration with AETHON will ensure that:

1) We take the security of your personal data seriously and implement a variety of technical and organizational measures to protect it from unauthorized access, use, or disclosure. These measures include:
    - Encryption: We use encryption to protect your data during transmission and storage.
    - Access controls: We limit access to your personal data to authorized personnel who need it to perform their job duties.

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- Regular audits: We conduct regular security audits and assessments to identify and address potential vulnerabilities in our systems.
- Secure data storage: We store your data in secure facilities with strict access controls and monitoring.

2) We will retain your personal data only for as long as necessary to fulfil the purposes for which it was collected, as outlined in this consent form, or as required by law. The criteria we use to determine the retention periods include:
   - Legal requirements: We retain personal data for the period required by applicable law.
   - Project needs: We retain personal data for as long as necessary to provide our services, maintain our project records, and manage our relationship with you.
   - Consent: We will retain your data until you withdraw your consent.

Once the retention period of three years after the project's lifespan expires, we will securely delete or anonymize your personal data to prevent unauthorized access or use.

For any questions or to exercise the rights[1] that derive form the legislation in force about personal data protection, please contact the designated Data Controller:
Rosanna Babagiannou (AETHON),
via email at: rbabagiannou@yahoo.com
or telephone: +30 6982381165.

Second contact person:

[1] Rights of Data Subjects

Under data protection law, GDPR, you have the following rights regarding your personal data:

1. Right to Access: You have the right to request access to the personal data we hold about you. This includes the right to obtain a copy of your data and information about how and why it is being processed.
2. Right to Rectification: If any of the personal data we hold about you is inaccurate or incomplete, you have the right to request that we correct or complete it.
3. Right to Erasure: You have the right to request that we delete your personal data under certain circumstances, such as when it is no longer needed for the purposes for which it was collected or if you withdraw your consent.
4. Right to Restrict Processing: In certain situations, you have the right to request that we restrict the processing of your personal data. This means we can store your data but not use it further.
5. Right to Data Portability: You have the right to request that we transfer your personal data to another organization, or directly to you, in a structured, commonly used, and machine-readable format.
6. Right to Object: You have the right to object to the processing of your personal data for specific purposes, such as direct marketing or processing based on our legitimate interests.
7. Right to Withdraw Consent: If we are processing your personal data based on your consent, you have the right to withdraw your consent at any time. This will not affect the lawfulness of any processing carried out before you withdraw your consent.
8. Right to Lodge a Complaint: If you believe that we have not complied with your data protection rights, you have the right to lodge a complaint with the relevant supervisory authority.

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Zeta Spyropoulou (AETHON),
via email at: z.spyropoulou@aethon.gr
or telephone: +30 6988069150.

Participation in these workshops is entirely voluntary. You may withdraw your consent any time during the workshop or within a week after (without retroactive effect) by contacting the designated contact point. You may exercise the rights deriving from the GDPR anytime.

Consent Statement

☐ I hereby consent to the collection and processing of my data during the AF validation workshops and for three years after the end of the PROSPECTS-5.0 project for scientific analyses. I understand the purpose of the data collection and how it will be used. I acknowledge that my participation is voluntary and that I can withdraw my consent any time during the workshop or within a week after.

☐ I consent to the audio recording of the workshop.

Participant's Name:

Signature:

Date:

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PROSPECTS 5.0

D1.3 Industry 5.0 Assessment Framework
ANNEX 7: I5.AF Validation Workshop Reporting Tool

Date(s)	: --.--.----
Event title	: I5.AF validation workshop with use case provider [---]
Event Type	: T1.3 - Co-creation & validation workshops
Location, venue:	:

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PROSPECTS 5.0

Short Description
This report is intended to provide information about the event organized in the frame of the project by the PROSPECTS 5.0 consortium partner [---]

The completed report to be returned by email to PROSPECTS 5.0 Work Package 1 Leader UNIMORE, contact person: Giacomo Cantini: giacomo.cantini@unimore.it

Timeframe for reporting: within 7 days after the event

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INTRODUCTION

Classification of the Use-Case provider (for moderator/assistant)

- ○ AMF Safety Shoes, Portugal
- ○ SPAB. Braun AVITUM ITALY SPA, Italy
- ○ CAMELEO, Poland
- ○ EFESTO, France
- ○ ELMI SIA, Latvia
- ○ GTW BEARINGS S.R.O, Czechia
- ○ KNOWIT OBJECTNET AS, Norway
- ○ OCTAVE, Belgium
- ○ S-GARD, Germany
- ○ SMARALD, Romania
- ○ STIRTEC GMBH, Austria
- ○ TEKNOROT OTOMOTIV URUNLERI SAN. VE TIC. A.S, Türkiye
- ○ TRYGONS SA, Greece
- ○ ZEUKO SA, Spain
- ○ Other _____

Page Break

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For moderator/assistant:

Indicate the Number of Participants

_____

Indicate the Number of Female Participants

_____

Indicate the Number of Male Participants

_____

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For moderator/assistant: The participants are (please indicate the position of the participants):

- ○ Chief Executive Officer (CEO)
- ○ Chief Operating Officer (COO)
- ○ Chief Technical Officer (CTO)
- ○ Chief Marketing Office (CMO)
- ○ Chief Finance Officer (CFO)
- ○ Chief Information Officer (CIO)
- ○ Chief Security Officer (CSO)
- ○ Chief Risk Officer (CRO)
- ○ Human Resource Manager (HR Manager)
- ○ Energy Manager
- ○ Innovation Manager
- ○ Research & Development Manager (R&D)
- ○ Project Manager
- ○ Plant Manager
- ○ Product Manager
- ○ Work Council Representative
- ○ Stakeholder
- ○ Other (please specify) _____

End of Block: Introduction

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Start Block: HUMAN CENTRICITY

HUMAN CENTRICITY 1 Does your company assess the **TURNOVER RATE**?

○ Yes ○ No

HUMAN CENTRICITY 1 How would you rate the relevance of **TURNOVER RATE** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

---

ONLY FOR MODERATOR/ASSISTANT
If the respondents declare that they do not measure the KPI and it is not important for them please ask if they measured it in the past. If this is not the case jump to the next KPI.
Applicable for each KPI

HUMAN CENTRICITY 1 Which measurement tool are you using/will you be using for the identified KPI?

○ HR reports

○ HR analytics software

○ Other (please specify) _____

HUMAN CENTRICITY 1 Which data are required to calculate the **TURNOVER RATE**?

○ number of employees who left in the last 12 months/average number of employees

○ number of voluntary (resignations, retirements) vs. involuntary turnover (terminated or laid off).

○ Other (please specify) _____

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HUMAN CENTRICITY 1 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

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HUMAN CENTRICITY 1 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT
Observations (relevant information emerged during the discussion)

Page Break

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HUMAN CENTRICITY 2 Does your company assess the **EMPLOYEES' SATISFACTION RATES**?

○ Yes ○ No

HUMAN CENTRICITY 2 How would you rate the relevance of **EMPLOYEES' SATISFACTION RATES** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

HUMAN CENTRICITY 2 Which measurement tool are you using/will you be using for the identified KPI?

- ○ annual employee satisfaction surveys
- ○ employee engagement or commitment surveys
- ○ employee net promoter score
- ○ pulse survey
- ○ exit survey
- ○ other (please specify) _____

HUMAN CENTRICITY 2 Which data are required to calculate the **EMPLOYEES' SATISFACTION RATES**?

- ○ Survey reports
- ○ Other (please specify) _____

HUMAN CENTRICITY 2 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

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HUMAN CENTRICITY 1 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

Page Break

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HUMAN CENTRICITY 3 Does your company offer **TRAINING AND DEVELOPMENT OPPORTUNITIES**?

Yes No

HUMAN CENTRICITY 3 How would you rate the relevance of offering **TRAINING AND DEVELOPMENT OPPORTUNITIES** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

HUMAN CENTRICITY 3 Which measurement tool are you using/will you be using for the identified KPI?

- Survey on training opportunities
- Average hours of training per year per employee
- Number of Programs for upgrading employee skills and transition assistance
- Percentage of employees receiving regular performance and career development reviews
- Budget allocation report
- HR reports
- Training Impact Assessments
- Other (please specify) _____

HUMAN CENTRICITY 3 Which data are required to calculate the efficacy of the **TRAINING AND DEVELOPMENT OPPORTUNITIES?**

- Survey reports
- Data on the effectiveness of training programs
- Number of training programs available for employees within a specific period
- Number of trained employees in the last 12 months
- Percentage of budget allocated for training and development
- Other (please specify) _____

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HUMAN CENTRICITY 3 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

HUMAN CENTRICITY 3 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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HUMAN CENTRICITY 4 Does your company assess the **WORK-LIFE BALANCE SATISFACTION**?

○ Yes ○ No

HUMAN CENTRICITY 4 How would you rate the relevance of measuring **WORK-LIFE BALANCE SATISFACTION** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

HUMAN CENTRICITY 4 Which measurement tool are you using/will you be using for the identified KPI?

- ○ Survey Work-Life Balance scale (WLB).
- ○ Life Satisfaction Survey.
- ○ Average number of hours worked per week.
- ○ Utilization rate/implementation records of work life balance programs (like flexible work options).
- ○ Other (please specify) _____

HUMAN CENTRICITY 4 Which data are required to calculate the efficacy of the **WORK-LIFE BALANCE SATISFACTION?**

- ○ Surveys' responses and data analysis.
- ○ Number of participants.
- ○ Demographic information (age, gender, department, job level).
- ○ Data on the implementation and availability of flexibility options, work time reduction initiatives, and family conciliation programs.
- ○ Other (please specify) _____

HUMAN CENTRICITY 4 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

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HUMAN CENTRICITY4 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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HUMAN CENTRICITY 5 Does your company assess **the NUMBER OF WORKPLACE ACCIDENTS /INCIDENTS?**

○ Yes ○ No

HUMAN CENTRICITY 5 How would you rate the relevance of measuring the **NUMBER OF WORKPLACE ACCIDENTS /INCIDENTS** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

HUMAN CENTRICITY 5 Which measurement tool are you using/will you be using for the identified KPI?

- ○ Incident reports: data from workplace incident reports.
- ○ Automated logs: Data from robots, IoT devices, and other automated systems.
- ○ Safety inspection reports: reports from regular safety inspections and audits.
- ○ Employee reports: incidents reported by employees, especially those involving human-robot interactions.
- ○ Other (please specify)

HUMAN CENTRICITY 5 Which data are required to calculate **the NUMBER OF WORKPLACE ACCIDENTS /INCIDENTS?**

- ○ Number and type of accidents/incidents (resulted in injury) in a specific period of time.
- ○ Number and type of accidents/incidents (all reported incidents, near misses, incidents involving robots, cyber-physical systems, human errors) in a specific period of time.
- ○ Other (please specify) _____

HUMAN CENTRICITY 5 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

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HUMAN CENTRICITY 5 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

Page Break

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HUMAN CENTRICITY 6 Does your company assess the **EMPLOYEE HEALTH AND WELLNESS**?

Yes No

HUMAN CENTRICITY 6 How would you rate the relevance of measuring the **EMPLOYEE HEALTH AND WELLNESS** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

HUMAN CENTRICITY 6 Which measurement tool are you using/will you be using for the identified KPI?

- Regular health screenings reports.
- Wearables and IoT devices to monitoring physical activities.
- Wearables and AI-based tools to monitor stress levels.
- Mental health resources and counseling sessions reports.
- Other (please specify) _____

HUMAN CENTRICITY 6 Which data are required to calculate the **EMPLOYEE HEALTH AND WELLNESS?**

- Data from wearable devices and IoT sensors to gather data on physical activities, heart rate, sleep patterns, etc.
- Data from regular surveys.
- Feedback sessions to assess mental health.
- Other (please specify) _____

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HUMAN CENTRICITY 6 Do you consider this KPI as a (allow multiple answers)**:**

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

Human Centricity 6 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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HUMAN CENTRICITY 7 Does your company assess the **WORKPLACE ERGONOMIC DESIGN**?

○ Yes ○ No

HUMAN CENTRICITY 7 How would you rate the relevance of measuring the **WORKPLACE ERGONOMIC DESIGN** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

HUMAN CENTRICITY 7 Which measurement tool are you using/will you be using for the identified KPI?

○ Periodic ergonomic assessments of workstations, tools, and equipment, using standardized ergonomic evaluation tools or checklists.

○ Survey: employees' feedback regarding comfort, satisfaction, and any ergonomic concerns.

○ Other (please specify) _____

HUMAN CENTRICITY 7 Which data are required to calculate the efficacy of the **WORKPLACE ERGONOMIC DESIGN**?

○ Ergonomic Evaluation reporting data.

○ Survey results and data analysis.

○ Other (please specify) _____

HUMAN CENTRICITY 7 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

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HUMAN CENTRICITY 7 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

Page Break

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HUMAN CENTRICITY 8 Does your company assess the USE OF ERGONOMICS TOOLS?

Yes No

HUMAN CENTRICITY 8 How would you rate the relevance of measuring the **USE OF ERGONOMICS TOOLS** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

HUMAN CENTRICITY 8 Which measurement tool are you using/will you be using for the identified KPI?

- Survey: Employee satisfaction scores related to ergonomic comfort.
- Productivity metrics before and after the implementation of ergonomic tools.
- Other (please specify) _____

HUMAN CENTRICITY 8 Which data are required to calculate the **USE OF ERGONOMICS TOOLS**?

- Inventory of ergonomic tools and utilization records (which tools have been distributed, the number of employees using them, and the specific locations where they are used).
- Employees' satisfaction.
- Other (please specify) _____

HUMAN CENTRICITY 8 Do you consider this KPI as a (allow multiple answers):

Strategic KPI	Tactical KPI	Operational KPI

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HUMAN CENTRICITY 8 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

Page Break

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HUMAN CENTRICITY 9 Does your company assess the **DIVERSITY RATIOS ACROSS WORKFORCE DEMOGRAPHICS** (gender, ethnicity, age, disability)?

○ Yes ○ No

Human Centricity 9 How would you rate the relevance of measuring the DIVERSITY RATIOS ACROSS WORKFORCE DEMOGRAPHICS for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

HUMAN CENTRICITY 9 Which measurement tool are you using/will you be using for the identified KPI?

- ○ Gender ratio.
- ○ Ethnicity ratio.
- ○ Age distribution (the distribution of employees across different age brackets).
- ○ Disability ratio.
- ○ Representation and Comparison with benchmark or specific goals.
- ○ Other (please specify) _____

HUMAN CENTRICITY 9 Which data are required to calculate the **DIVERSITY RATIOS ACROSS WORKFORCE DEMOGRAPHIC**?

- ○ Total number of employees.
- ○ Workforce demographic information (age, gender, ethnicity, disability, job level).
- ○ Other (please specify) _____

HUMAN CENTRICITY 9 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

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HUMAN CENTRICITY 9 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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HUMAN CENTRICITY 10 Does your company assess the efficacy of the **IMPLEMENTATION OF SPECIFIC INCLUSIVITY PROGRAMS?**

○ Yes ○ No

HUMAN CENTRICITY 10 How would you rate the relevance of measuring the **IMPLEMENTATION OF SPECIFIC INCLUSIVITY PROGRAMS** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

HUMAN CENTRICITY 10 Which measurement tool are you using/will you be using for the identified KPI?

- ○ Evaluation of training and inclusion programs: surveys to assess employee perceptions of inclusivity and program effectiveness.
- ○ Evaluation of training and inclusion programs: focus groups to assess employee perceptions of inclusivity and program effectiveness.
- ○ Evaluation of training and inclusion programs: anonymous suggestion boxes to assess employee perceptions of inclusivity and program effectiveness.
- ○ Policy effectiveness: Percentage of employees who are aware of the organization's harassment policies and reporting procedures.
- ○ Other (please specify) _____

HUMAN CENTRICITY 10 Which data are required to calculate the efficacy of the **IMPLEMENTATION OF SPECIFIC INCLUSIVITY PROGRAMS?**

- ○ List of all inclusivity programs implemented.
- ○ Records of the implementation of each inclusivity program, including start dates, duration, participants, and objectives.
- ○ Feedback from participants and assessments of the impact of each inclusivity program.
- ○ Other (Please specify)

  _____

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HUMAN CENTRICITY 10 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

HUMAN CENTRICITY 10 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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HUMAN CENTRICITY 11 Does your company assess the **REPRESENTATION IN DECISION-MAKING ROLES?**

○ Yes ○ No

Human Centricity 11 How would you rate the relevance of measuring the **REPRESENTATION IN DECISION-MAKING ROLES for** your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

---

HUMAN CENTRICITY 11 Which measurement tool are you using/will you be using for the identified KPI?

- ○ Decision making activities reports.
- ○ Survey on Leadership support. Evaluate the level of support and encouragement from organizational leaders towards employee involvement in improvement initiatives.
- ○ Survey on Culture of innovation. Assess the organizational culture to determine if it promotes openness, creativity, and collaboration among employees to generate and implement ideas.
- ○ Employee-generated ideas' implementation rates.
- ○ Other (please specify) _____

HUMAN CENTRICITY 11 Which data are required to calculate the **REPRESENTATION IN DECISION-MAKING ROLES**?

- ○ List of existing activities through which employees can propose and contribute to improvement ideas and participation rates.
- ○ Survey data.
- ○ The number of employee-generated ideas that are implemented or incorporated into organizational practice.
- ○ Other (please specify) _____

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HUMAN CENTRICITY 11 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

HUMAN CENTRICITY 11 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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HUMAN CENTRICITY 12 Does your company assess the **JOB CRAFTING**?

○ Yes ○ No

HUMAN CENTRICITY 12 How would you rate the relevance of measuring the efficacy of **JOB CRAFTING** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

HUMAN CENTRICITY 12 Which measurement tool are you using/will you be using for the identified KPI?

- ○ Surveys on job crafting behaviors
- ○ Surveys on job crafting activities.
- ○ Performance review goals
- ○ Other (please specify) _____

HUMAN CENTRICITY 12 Which data are required to calculate the **JOB CRAFTING**?

- ○ Surveys on the percentage of employees who actively engage in job crafting behaviors (job crafting participation rate).
- ○ Survey on frequency of job crafting behaviors over a defined period.
- ○ Survey on frequency of types of job crafting: task crafting (modifying tasks and responsibilities), relational crafting (changing relationships with colleagues or clients), and cognitive crafting (reinterpreting the meaning of tasks).
- ○ Data on goals achievements.
- ○ Other (please specify) _____

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HUMAN CENTRICITY 12 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

HUMAN CENTRICITY 12 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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HUMAN CENTRICITY 13 Does your company assess the **EMPLOYEES' PERCEPTION OF SOCIAL CONNECTION?**

Yes No

HUMAN CENTRICITY 13 How would you rate the relevance of measuring the **EMPLOYEES' PERCEPTION OF SOCIAL CONNECTION** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

HUMAN CENTRICITY 13 Which measurement tool are you using/will you be using for the identified KPI?

- Identification scale. Employees' feelings of belonging, satisfaction with workplace relationships, and perception of company culture.
- Work climate: measure the atmosphere in the workplace, including perceived support, inclusiveness, and stress levels.
- Social Network Analysis (SNA): map out the relationships and interactions between employees, identifying central figures, isolated individuals, and overall network cohesion.
- Other (Please specify)_____

HUMAN CENTRICITY 13 Which data are required to calculate the **EMPLOYEES' PERCEPTION OF SOCIAL CONNECTION**?

- Surveys' results and data analysis
- Other (please specify) _____

HUMAN CENTRICITY 13 Do you consider this KPI as a (allow multiple answers):

Strategic KPI	Tactical KPI	Operational KPI

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HUMAN CENTRICITY 13 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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HUMAN CENTRICITY Are there any additional KPIs or tools needed?

- ○ no
- ○ do not know
- ○ Yes (please specify)

_____

HUMAN CENTRICITY What potential challenges or barriers exist in implementing these KPIs?

- ○ Implementation barriers. Please specify.

_____

_____

_____

_____

- ○ Risks related with framework implementation's expected results. Please specify.

_____

_____

_____

_____

- ○ Do not know

HUMAN CENTRICITY Do you have any suggestions for improvement?

- ○ No
- ○ Don't know
- ○ Yes. Please specify_____

_____

_____

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HUMAN CENTRICITY: Which KPIs are more important for your company?

Ask participants to rank the six more important KPIs for their company

Human centricity - KPIs	ranking
HC1. Employee turnover rates	
HC2. Employee satisfaction rates	
HC3. Training and development opportunities	
HC4. Work-life balance satisfaction	
HC5. Number of workplace accidents/incidents	
HC6. Employee health and wellness	
HC7. Workplace ergonomic design	
HC8. Use of ergonomics tools	
HC9. Diversity ratios across workforce demographics	
HC10. Implementation of specific inclusivity programs	
HC11. Representation in decision-making roles	
HC12. Job Crafting	
HC13. Employees' perception of social connection	

End of Block: HUMAN CENTRICITY

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Start of Block: RESILIENCE KPI

RESILIENCE KPI 1 Does your company calculate the **NUMBER of KEY RISKS** Number of times key risks (in the supply chain, operations, technology, and personnel area) occurred in the last 5 years (or in a specific period of time)?

○ Yes ○ No

RESILIENCE KPI 1 How would you rate the relevance of the **NUMBER of KEY RISKS** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

RESILIENCE KPI 1 Which measurement tool are you using/will you be using for this KPI?

○ Risk incident reports.

○ Other (please specify) _____

RESILIENCE KPI 1 Which data are required to calculate the **NUMBER of KEY RISKS**?

○ A comprehensive list of key risks relevant to the organization's supply chain, operations, technology, and personnel areas.

○ Detailed records of incidents related to identified key risks.

○ Other (please specify) _____

RESILIENCE KPI 1 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

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RESILIENCE KPI 1 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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RESILIENCE KPI 2 Does your company calculate the **EFFECTIVENESS OF RISK IDENTIFICATION AND ASSESSMENT PROCESSES**?

○ Yes ○ No

RESILIENCE KPI 2 How would you rate the relevance of the **EFFECTIVENESS OF RISK IDENTIFICATION AND ASSESSMENT PROCESSES** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

RESILIENCE KPI 2 Which measurement tool are you using/will you be using for this KPI?

- ○ Risk incident reports.
- ○ Risk registers.
- ○ Effectiveness of Risk Assessment = (Number of thoroughly assessed risks / Total number of identified risks) ×100.
- ○ Other (please specify) _____

RESILIENCE KPI 2 Which data are required to calculate the **EFFECTIVENESS OF RISK IDENTIFICATION AND ASSESSMENT PROCESSES**?

- ○ Total number of risks identified and the number of thoroughly assessed risks within the annual reporting period, categorized by type.
- ○ Documentation of the assessment process for each identified risk, including risk scoring, prioritization, evaluation criteria, and assessment outcomes.
- ○ Other (please specify) _____

RESILIENCE KPI 2 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

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RESILIENCE KPI 2 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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RESILIENCE KPI 3 Does your company calculate the **NUMBER OF NEW RISK MITIGATION STRATEGIES IMPLEMENTED ANNUALLY?**

○ Yes ○ No

RESILIENCE KPI 3 How would you rate the relevance of the **NUMBER OF NEW RISK MITIGATION STRATEGIES** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

RESILIENCE KPI 3 Which measurement tool are you using/will you be using for this KPI?

○ Number of new risk mitigation strategies.

○ Other (please specify) _____

RESILIENCE KPI 3 Which data are required to calculate the **NUMBER OF NEW RISK MITIGATION STRATEGIES**?

○ List of current risk mitigation strategies in place before the reporting period.

○ Records of new risk mitigation strategies or improvements that have been implemented within the reporting period.

○ Other (please specify) _____

RESILIENCE KPI 3 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

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RESILIENCE KPI 3 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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RESILIENCE KPI 4 Does your company calculate the **LOCAL SOURCING RATIO** (the proportion of the company's total sourcing that comes from local suppliers by number of suppliers or by spend)?

○ Yes ○ No

RESILIENCE KPI 4 How would you rate the relevance of the **LOCAL SOURCING RATIO** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

RESILIENCE KPI 4 Which measurement tool are you using/will you be using for this KPI?

○ Supplier database.

○ Financial records.

○ Other (please specify) _____

RESILIENCE KPI 4 Which data are required to calculate the **LOCAL SOURCING RATIO**?

○ Total number of suppliers.

○ Number of local suppliers.

○ Total spend on suppliers.

○ Spend on local suppliers.

○ Other (please specify) _____

RESILIENCE KPI 4 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

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RESILIENCE KPI4 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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RESILIENCE KPI 5 Does your company calculate the **NUMBER OF ALTERNATIVE SOURCING OPTIONS**?

○ Yes ○ No

RESILIENCE KPI 5 How would you rate the relevance of the **NUMBER OF ALTERNATIVE SOURCING OPTIONS** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

RESILIENCE KPI 5 Which measurement tool are you using/will you be using for this KPI?

- ○ Supply chain records.
- ○ Supplier database.
- ○ Financial records.
- ○ Market research reports.
- ○ Contingency plans.
- ○ Other (please specify) _____

RESILIENCE KPI 5 Which data are required to calculate the **NUMBER OF ALTERNATIVE SOURCING OPTIONS**?

- ○ List of critical supplies or essential components.
- ○ List of current primary suppliers for each critical supply or component.
- ○ Alternative suppliers for each critical supply or component.
- ○ Other (please specify) _____

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RESILIENCE KPI 5 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

RESILIENCE KPI 5 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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RESILIENCE KPI 6 Does your company calculate the **AVERAGE OPERATIONAL DOWNTIME AND RECOVERY TIME**?

○ Yes ○ No

RESILIENCE KPI6 How would you rate the relevance of the **AVERAGE OPERATIONAL DOWNTIME AND RECOVERY TIME** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

RESILIENCE KPI 6 Which measurement tool are you using/will you be using for this KPI?

○ Operational records.

○ Risk management systems.

○ Other (please specify) _____

RESILIENCE KPI 6 Which data are required to calculate the **AVERAGE OPERATIONAL DOWNTIME AND RECOVERY TIME**?

○ Records of incidents causing operational downtime, including the start and end times of each downtime event.

○ List of strategic and tactical disruptions experienced whiting a specific period.

○ Records of recovery activities, including the start and end times of recovery efforts and the time taken to fully restore normal operations.

○ Other (please specify) _____

RESILIENCE KPI 6 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

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RESILIENCE KPI 6 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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RESILIENCE KPI 7 Does your company calculate the **AVERAGE CYBERSECURITY INCIDENT RESPONSE TIME**?

○ Yes ○ No

RESILIENCE KPI 7 How would you rate the relevance of the **AVERAGE CYBERSECURITY INCIDENT RESPONSE** TIME for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

RESILIENCE KPI 7 Which measurement tool are you using/will you be using for this KPI?

○ Cybersecurity incident reports.

○ Other (please specify) _____

RESILIENCE KPI 7 Which data are required to calculate the **AVERAGE CYBERSECURITY INCIDENT RESPONSE TIME**?

○ Records of all cybersecurity incidents, including detection time, response start time and resolution time.

○ Other (please specify) _____

RESILIENCE KPI 7 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

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RESILIENCE KPI 7 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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RESILIENCE KPI 8 Does your company calculate the **NUMBER OF NEW PRODUCTS/SERVICES INTRODUCED**?

○ Yes ○ No

RESILIENCE KPI 8 How would you rate the relevance of the **NUMBER OF NEW PRODUCTS/SERVICES INTRODUCED** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

RESILIENCE KPI 8 Which measurement tool are you using/will you be using for this KPI?

○ R&D record.

○ Marketing and sales records.

○ Press releases and announcements.

○ Other (please specify) _____

RESILIENCE KPI 8 Which data are required to calculate **the NUMBER OF NEW PRODUCTS/SERVICES INTRODUCED**?

○ List of all new products and services offered by the organization, introduced within the reporting period.

○ Other (please specify) _____

RESILIENCE KPI 8 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

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RESILIENCE KPI 8 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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RESILIENCE KPI 9 Does your company calculate the **PERSONNEL/STAKEHOLDER SATISFACTION SCORE ON COMMUNICATION DURING AND AFTER DISRUPTIONS**?

○ Yes ○ No

RESILIENCE KPI 9 How would you rate the relevance of the **PERSONNEL /STAKEHOLDER SATISFACTION SCORE ON COMMUNICATION DURING AND AFTER DISRUPTIONS** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

RESILIENCE KPI 9 Which measurement tool are you using/will you be using for this KPI?

- ○ Surveys on communication during and after disruptions.
- ○ Interviews on communication during and after disruptions.
- ○ Focus groups on communication during and after disruptions.
- ○ Feedback forms to capture immediate reactions.
- ○ Feedback forms to capture suggestions for improvement.
- ○ Other (please specify) _____

RESILIENCE KPI 9 Which data are required to calculate the **PERSONNEL /STAKEHOLDER SATISFACTION SCORE ON COMMUNICATION DURING AND AFTER DISRUPTIONS**?

- ○ Responses to surveys designed to assess satisfaction with communication.
- ○ Feedback from focus group designed to assess satisfaction with communication.
- ○ Responses to interviews designed to assess satisfaction (individual satisfaction scores) with communication.
- ○ Number of survey / interview / focus group participants.
- ○ Other (please specify) _____

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RESILIENCE KPI 9 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

RESILIENCE KPI 9 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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RESILIENCE Are there any additional KPIs or tools needed?

- ○ no
- ○ do not know
- ○ Yes (please specify)

_____

RESILIENCE What potential challenges or barriers exist in implementing these KPIs?

- ○ Implementation barriers. Please specify.

_____

_____

_____

_____

- ○ Risks related with framework implementation's expected results. Please specify.

_____

_____

_____

_____

- ○ Do not know

RESILIENCE Do you have any suggestions for improvement?

- ○ No
- ○ Don't know
- ○ Yes. Please specify_____

_____

_____

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RESILIENCE: Which KPIs are more important for your company?

Ask participants to rank the six more important KPIs for their company

Resilience KPIs	ranking
RE1. Number of times key risks occurred in the last 5 years	
RE2. Effectiveness of risk identification and assessment processes	
RE3. Number of new risk mitigation strategies implemented annually	
RE4. Local sourcing ratio	
RE5. Number of alternative sourcing options.	
RE6. Average operational downtime and recovery time	
RE7. Average cybersecurity incident response time	
RE8. Number of new products/services introduced	
RE9. Personnel /Stakeholder satisfaction score on communication during and after disruptions	

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Start of Block: SUSTAINABILITY

SUSTAINABILITY KPI 1 Does your company calculate the GHG EMISSIONS PER UNIT OF PRODUCTION/OUTPUT, PER EMPLOYEE, OR PER UNIT OF REVENUE?

○ Yes ○ No

SUSTAINABILITY KPI 1 How would you rate the relevance of the **GHG EMISSIONS PER UNIT OF PRODUCTION/OUTPUT, PER EMPLOYEE, OR PER UNIT OF REVENUE** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

SUSTAINABILITY KPI 1 Which measurement tool are you using/will you be using for this KPI?

○ Emissions inventory, following the guidance of the GHG Protocol Corporate Standard, normalized by relevant factors (e.g., production units, employee, revenue).

○ Other (please specify) _____

SUSTAINABILITY KPI 1 Which data are required to calculate the **GHG EMISSIONS**?

○ The total amount of GHG emissions produced by the organization over a specific period, in metric tons CO2 equivalent.

○ The total production output over the same period

○ The total number of employees in the organization during the reporting period

○ The total revenue generated by the organization over the same period

○ Other (please specify) _____

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SUSTAINABILITY KPI 1 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

SUSTAINABILITY KPI 1 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

Funded by the European Union

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SUSTAINABILITY KPI 2 Does your company calculate the **ENERGY CONSUMED PER UNIT OF PRODUCTION OUTPUT / PER FUNCTION OR PER SERVICE / PER MONETARY UNIT OF SALES**?

○ Yes ○ No

SUSTAINABILITY KPI 2 How would you rate the relevance of the ENERGY CONSUMED for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

SUSTAINABILITY KPI 2 Which measurement tool are you using/will you be using for this KPI?

- ○ Energy consumption records.
- ○ Production records.
- ○ Services or functions records.
- ○ Sales reports.
- ○ Other (please specify) _____

SUSTAINABILITY KPI 2 Which data are required to calculate the **ENERGY CONSUMED**?

- ○ Energy consumption data, in mega joules (MJ)/ Energy consumption data, in kilowatt-hours (kWh) or multiples.
- ○ Production data / total amount of services offered.
- ○ Total amount of sales.
- ○ Other (please specify) _____

SUSTAINABILITY KPI2 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

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SUSTAINABILITY KPI2 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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SUSTAINABILITY KPI 3 Does your company calculate the **USE OF RENEWABLE ENERGY SOURCES AS A PERCENTAGE OF TOTAL ENERGY CONSUMPTION**?

○ Yes ○ No

SUSTAINABILITY KPI 3 How would you rate the relevance of the **USE OF RENEWABLE ENERGY SOURCES AS A PERCENTAGE OF TOTAL ENERGY CONSUMPTION** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

SUSTAINABILITY KPI 3 Which measurement tool are you using/will you be using for this KPI?

- ○ Energy consumption records.
- ○ Energy management systems.
- ○ Other (please specify) _____

SUSTAINABILITY KPI 3 Which data are required to calculate the **USE OF RENEWABLE ENERGY SOURCES AS A PERCENTAGE OF TOTAL ENERGY CONSUMPTION**?

- ○ The total amount of energy consumed by the organization over a specific period, typically measured in kilowatt-hours (kWh), megajoules (MJ), or other relevant units.
- ○ The amount of energy consumed by the organization that is sourced from renewable energy sources, such as solar, wind, hydroelectric, geothermal, and biomass.
- ○ Other (please specify) _____

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SUSTAINABILITY KPI3 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

SUSTAINABILITY KPI3 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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SUSTAINABILITY KPI 4 Does your company calculate the **WATER USE PER UNIT OF PRODUCTION OUTPUT/OR PER SQUARE METER OF FACILITY**?

○ Yes ○ No

SUSTAINABILITY KPI 4 How would you rate the relevance of the **WATER USE PER UNIT OF PRODUCTION OUTPUT/OR PER SQUARE METER OF FACILITY** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

SUSTAINABILITY KPI 4 Which measurement tool are you using/will you be using for this KPI?

- ○ Water usage reports.
- ○ Production data.
- ○ Sector-specific water use benchmarks.
- ○ Other (please specify) _____

SUSTAINABILITY KPI 4 Which data are required to calculate the **WATER USE PER UNIT OF PRODUCTION OUTPUT/OR PER SQUARE METER OF FACILITY**?

- ○ Total water consumption over a specific period, in megaliters (ML).
- ○ Total number of production units manufactured over the same period (if it applies).
- ○ Total floor area of the facility where water is being used, in square meters (if it applies).
- ○ Other (please specify) _____

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SUSTAINABILITY KPI 4 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

SUSTAINABILITY KPI 4 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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SUSTAINABILITY KPI 5 Does your company calculate the **WASTE GENERATED PER UNIT OF PRODUCTION/OUTPUT OR PER EMPLOYEE, AND ITS COMPOSITION**?

○ Yes ○ No

SUSTAINABILITY KPI 5 How would you rate the relevance of the **WASTE GENERATED PER UNIT OF PRODUCTION/OUTPUT OR PER EMPLOYEE, AND ITS COMPOSITION** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

SUSTAINABILITY KPI 5 Which measurement tool are you using/will you be using for this KPI?

- ○ Waste audits.
- ○ Production data.
- ○ Waste management records.
- ○ Other (please specify) _____

SUSTAINABILITY KPI 5 Which data are required to calculate the **WASTE GENERATED PER UNIT OF PRODUCTION/OUTPUT OR PER EMPLOYEE, AND ITS COMPOSITION**?

- ○ Total weight of waste generated in metric tons.
- ○ A breakdown of this total by composition of the waste.
- ○ Total Production Output.
- ○ Total Number of Employees.
- ○ Other (please specify) _____

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SUSTAINABILITY KPI 5 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

SUSTAINABILITY KPI 5 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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SUSTAINABILITY KPI 6 Does your company calculate the **PERCENTAGE OF WASTE DIVERTED FROM DISPOSAL**?

○ Yes ○ No

SUSTAINABILITY KPI 6 How would you rate the relevance of the **PERCENTAGE OF WASTE DIVERTED FROM DISPOSAL** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

SUSTAINABILITY KPI 6 Which measurement tool are you using/will you be using for this KPI?

○ Waste management records.

○ Waste tracking software.

○ Other (please specify) _____

SUSTAINABILITY KPI 6 Which data are required to calculate **THE PERCENTAGE OF WASTE DIVERTED FROM DISPOSAL**?

○ The total weight of waste generated, in metric tons.

○ The weight of waste that the organization directs to recovery operations (reuse, recycle, others..).

○ Other (please specify) _____

SUSTAINABILITY KPI 6 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

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SUSTAINABILITY KPI 6 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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SUSTAINABILITY KPI 7 Does your company calculate the **REDUCTION OF RAW MATERIAL CONSUMPTION, NORMALIZED AGAINST PRODUCTION LEVELS**?

○ Yes ○ No

SUSTAINABILITY KPI 7 How would you rate the relevance of the **REDUCTION OF RAW MATERIAL CONSUMPTION, NORMALIZED AGAINST PRODUCTION LEVELS** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

SUSTAINABILITY KPI 7 Which measurement tool are you using/will you be using for this KPI?

○ Procurement/supply chain records.

○ Production reports.

○ Other (please specify) _____

SUSTAINABILITY KPI 7 Which data are required to calculate the **REDUCTION OF RAW MATERIAL CONSUMPTION, NORMALIZED AGAINST PRODUCTION LEVELS**?

○ The total amount of raw materials consumed by the organization during the current reporting period, in metric tons.

○ The total amount of raw materials consumed by the organization during the baseline period, in metric tons.

○ Production data (both periods).

○ Other (please specify) _____

SUSTAINABILITY KPI 7 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

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SUSTAINABILITY KPI7 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

Page Break

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SUSTAINABILITY KPI 8 Does your company calculate the **PERCENTAGE OF PRODUCTS DESIGNED FOR MODULARITY, REPAIR, AND REPURPOSING**?

○ Yes ○ No

SUSTAINABILITY KPI 8 How would you rate the relevance of the **PERCENTAGE OF PRODUCTS DESIGNED FOR MODULARITY, REPAIR, AND REPURPOSING** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

SUSTAINABILITY KPI 8 Which measurement tool are you using/will you be using for this KPI?

○ Product design record.

○ Product Lifecycle Assessment (PLA).

○ Other (please specify) _____

SUSTAINABILITY KPI 8 Which data are required to calculate the **PERCENTAGE OF PRODUCTS DESIGNED FOR MODULARITY, REPAIR, AND REPURPOSING**?

○ The total number of new products designed or existing products redesigned during the specified reporting period.

○ The number of products out of the total that include design features facilitating modularity, ease of repair, and potential for repurposing.

○ Other (please specify) _____

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SUSTAINABILITY KPI 8 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

SUSTAINABILITY KPI 8 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

SUSTAINABILITY KPI 9 Does your company calculate the **PERCENTAGE OF PRODUCTS WITH TRACEABILITY FEATURES IMPLEMENTED**?

○ Yes ○ No

SUSTAINABILITY KPI 9 How would you rate the relevance of the **PERCENTAGE OF PRODUCTS WITH TRACEABILITY FEATURES IMPLEMENTED** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

SUSTAINABILITY KPI 9 Which measurement tool are you using/will you be using for this KPI?

- ○ Enterprise Resource Planning (ERP) systems.
- ○ Inventory management systems.
- ○ Supply chain management systems.
- ○ Quality assurance and control systems.
- ○ Other (please specify) _____

SUSTAINABILITY KPI 9 Which data are required to calculate the **PERCENTAGE OF PRODUCTS WITH TRACEABILITY FEATURES IMPLEMENTED**?

- ○ Total production data.
- ○ Number of products out of the total that have traceability features implemented (RFID tags, barcodes, serial numbers, blockchain technology, or detailed documentation).
- ○ Other (please specify) _____

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SUSTAINABILITY KPI 9 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

SUSTAINABILITY KPI 9 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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SUSTAINABILITY KPI10 Does your company calculate the **PERCENTAGE OF INVESTMENT IN AND DEVELOPMENT OF NEW TECHNOLOGIES AIMED AT IMPROVING SUSTAINABILITY ON THE TOTAL AMOUNT OF INVESTMENTS**?

○ Yes ○ No

SUSTAINABILITY KPI10 How would you rate the relevance of the **PERCENTAGE OF INVESTMENT IN AND DEVELOPMENT OF NEW TECHNOLOGIES AIMED AT IMPROVING SUSTAINABILITY ON THE TOTAL AMOUNT OF INVESTMENTS** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

SUSTAINABILITY KPI10 Which measurement tool are you using/will you be using for this KPI?

- ○ Financial records.
- ○ Investment portfolios.
- ○ Other (please specify) _____

SUSTAINABILITY KPI10 Which data are required to calculate the **REGULATORY COMPLIANCE RATE AND NUMBER OF INITIATIVES BEYOND COMPLIANCE**?

- ○ The total financial investments made by the organization over a specific period.
- ○ The amount of financial investments specifically allocated for the development and implementation of new technologies that aim to improve sustainability (investments in renewable energy, energy-efficient equipment, sustainable materials, waste reduction technologies, and other green innovations).
- ○ Other (please specify) _____

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SUSTAINABILITY KPI1 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

SUSTAINABILITY KPI10 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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SUSTAINABILITY KPI11 Does your company calculate the **REGULATORY COMPLIANCE RATE AND NUMBER OF INITIATIVES BEYOND COMPLIANCE**?

○ Yes ○ No

SUSTAINABILITY KPI11 How would you rate the relevance of the **REGULATORY COMPLIANCE RATE AND NUMBER OF INITIATIVES BEYOND COMPLIANCE** for your company and/or the specific industrial sector?

1	2	3	4	5
Not at all important	Slightly important	Moderately important	Very important	Extremely important

SUSTAINABILITY KPI11 Which measurement tool are you using/will you be using for this KPI?

○ Compliance audits.

○ Sustainability reports.

○ Other (please specify) _____

SUSTAINABILITY KPI11 Which data are required to calculate the **REGULATORY COMPLIANCE RATE AND NUMBER OF INITIATIVES BEYOND COMPLIANCE**?

○ The total number of environmental regulations that apply to the organization.

SUSTAINABILITY KPI11 Do you consider this KPI as a (allow multiple answers):

○ Strategic KPI	○ Tactical KPI	○ Operational KPI

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SUSTAINABILITY KPI 11 *ONLY FOR MODERATOR/ASSISTANT*

According to your impression, the discussion on the importance of this KPI was:

1	2	3	4	5
Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy

ONLY FOR MODERATOR/ASSISTANT

Observations (relevant information emerged during the discussion)

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SUSTAINABILITY Are there any additional KPIs or tools needed?

- ○ No
- ○ Do not know
- ○ Yes (please specify)

_____

SUSTAINABILITY What potential challenges or barriers exist in implementing these KPIs?

- ○ Implementation barriers. Please specify.

_____
_____
_____
_____

- ○ Risks related with framework implementation's expected results. Please specify.

_____
_____
_____
_____

- ○ Do not know

SUSTAINABILITY Do you have any suggestions for improvement?

- ○ No
- ○ Don't know
- ○ Yes. Please specify. Yes. Please specify_____

_____

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SUSTAINABILITY Which KPIs are more important for your company?

Ask participants to rank the six more important KPIs for their company

Sustainability KPIs	ranking
SU1. GHG emissions per unit of production/output, per employee, or per unit of revenue.	
SU2. Energy consumed per unit of production output / per function or per service / per monetary unit of sales:	
SU3. Use of renewable energy sources as a percentage of total energy consumption	
SU4. Water use per unit of production output / or per square meter of facility	
SU5. Waste generated per unit of production/output or per employee, and its composition	
SU6. The percentage of waste diverted from disposal	
SU7. Reduction of raw material consumption, normalized against production levels	
SU8. Percentage of products designed for Modularity, Repair, and Repurposing	
SU9. Percentage of products with traceability features implemented	
SU10. Percentage of investment in and development of new technologies aimed at improving sustainability on the total amount of investments	
SU11. Regulatory compliance rate and number of initiatives beyond compliance	

End of Block: SUSTAINABILITY

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PROSPECTS 5.0

PROSPECTS5-0

PROSPECTS5-0

PROSPECTS5_0

PROSPECTS5-0.EU

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AGENDA of the workshops with Advisory Board members and EU projects' stakeholders

PHASES	CONTENTS	FACILITATOR	TIME
WARM UP	**Presentation** of the workshop and participants	Ziga Valic	9.30 – 9.45
ORIENTATION	**Introduction** to the WP1's activities related to the development of the PAF and main insights from the workshops with companies: KPI prioritization, main barriers to implementation, framework modularity	Giacomo Cantini	9.45 – 10.00
WORKING	**Discussion** session on the following issues: -Assessment criteria and KPIs -Implementation scenarios -AF implementation success factors	Giacomo Cantini	10.00 – 10.50
CONCLUSIONS	**Conclusions**	Ziga Valic	10.50 – 11.00

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PROSPECTS 5.0

PROSPECTS 5.0

D1.3 Industry 5.0 Assessment Framework
ANNEX 9: Survey on Employee Satisfaction

Date : 09.12.2024

Deliverable No : D1.3 – ANNEX 9

Responsible Partner : UNIMORE

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Annex 9: Survey on employee satisfaction (KPI_HC3)

A. Job Satisfaction

Job Satisfaction (General Evaluation)

The questions in this section ask how you feel about different aspects of your job.

Job Satisfaction

Q1. Overall, I am ____ with my job.

Not at all satisfied
Not too satisfied
Somewhat satisfied
Very satisfied

Wage Satisfaction

Q2. I am ___ with my wages.

Not at all satisfied
Not too satisfied
Somewhat satisfied
Very satisfied

Benefits Satisfaction

Q3. I am ___ with the benefits provided by my employer.

Not at all satisfied
Not too satisfied
Somewhat satisfied
Very satisfied
Does not apply

Advancement Satisfaction

Q4. I am ___ with my chances for advancement on the job.

Not at all satisfied
Not too satisfied
Somewhat satisfied
Very satisfied

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Calculate the average of the four items (Q1-4)

Job Satisfaction (Job performance)

Job Security

Q5. I feel my job is secure.

Strongly disagree
Somewhat disagree
Somewhat agree
Strongly agree

Job Autonomy

Q6. I am given a lot of freedom to decide how to do my own work.

Strongly disagree
Somewhat disagree
Somewhat agree
Strongly agree

Time Paucity/Work Overload

Q7. I never seem to have enough time to get everything done on my job.

Strongly disagree
Somewhat disagree
Somewhat agree
Strongly agree

Calculate the average of these items (Q5-7)

Job Satisfaction (Meaningful Work)

Q8. The work I do is meaningful to me.

Strongly disagree
Somewhat disagree
Somewhat agree
Strongly agree

Q9. The work I do serves a greater purpose.

Strongly disagree
Somewhat disagree
Somewhat agree
Strongly agree

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Calculate the average of these items (Q8-Q9)

Three Job satisfaction indexes: General Job Satisfaction, Job Performance, Meaningful Work.

The items are taken from NIOSH [2021]. NIOSH worker well-being questionnaire (WellBQ). By Chari R, Chang C-C, Sauter SL, Petrun Sayers EL, Huang W, Fisher GG. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2021-110 (Revised 05/2024), https://doi. org/10.26616/NIOSHPUB2021110revised052024 DHHS (NIOSH) Publication No. 2021-110 (Revised 05/2024) DOI: https://doi.org/10.26616/NIOSHPUB2021110revised052024

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B. Workplace Physical Well Being

The questions in this section ask how you feel about different aspects of your job

Overall Workplace Safety

Q1. Overall, how safe do you think your workplace is?

Very unsafe
Somewhat unsafe
Somewhat safe
Very safe

Workplace Safety Climate

Q2. Please indicate how much you agree or disagree with each of the following statements about safety practices at your workplace.
Calculate the average of the following six items (Q2A-2F):

	Strongly disagree	**Somewhat disagree**	**Somewhat agree**	**Strongly agree**	**Does not apply**
A. Management reacts quickly to solve the problem when told about safety hazards.					
B. Management insists on thorough and regular safety audits and inspections.					
C. Management provides all the equipment needed to do the job safely.					
D. Management invests a lot of time and money in safety training for workers.					
E. Management listens carefully to workers' ideas about improving safety.					

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F. Management gives safety personnel the power they need to do their job.

Physical Work Environment Well-Being

Q3. On my present job, this is how I feel about the following topics:
Calculate the average of the following four items (Q33A-33D):

	Strongly disagree	**Somewhat disagree**	**Somewhat agree**	**Strongly agree**	**Does not apply**
. A. The environmental conditions (heating, lighting, ventilation, etc.)					
. B. The physical surroundings (for example, building infrastructure, work area layout, design)					
C. The pleasantness of the work environment					
D. The accommodations for disabilities and/or special needs (wheelchair ramps, lactation rooms, etc.)					

Three Indexes of Workplace Physical Well Being: Overall Workplace Safety, Workplace Safety Climate, Physical Work Environment Well-Being

The items are taken from NIOSH [2021]. NIOSH worker well-being questionnaire (WellBQ). By Chari R, Chang C-C, Sauter SL, Petrun Sayers EL, Huang W, Fisher GG. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2021-110

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(Revised 05/2024), https://doi. org/10.26616/NIOSHPUB2021110revised052024 DHHS (NIOSH) Publication No. 2021-110 (Revised 05/2024) DOI: https://doi.org/10.26616/NIOSHPUB2021110revised052024

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C. Mental Well Being and Wellness

The questions in this section ask how you feel about different aspects of your job

Work-related Positive Affect and Work-related Negative Affect

(Perception of Personal Work Well-being)

Q1A–Q1N How often do you experience these feelings when you are working?
Calculate a single index by averaging the emotions (BUT before reverse the scores of the negative emotions)

	Never	Rarely	Often	Every time
Work-Related Positive Affect				
A Enthusiastic				
B. Energetic				
C. Content				
D. At ease				
E. Engaged				
F. Identified				
Work-Related Negative Affect				
G. Anxious				
H. Angry				
I. Gloomy				
L. Discouraged				
M. Fatigued				
N. Stressed				

Mental Health and Wellness Culture in Organization

Q1. My organization is committed to employee health and well-being.

Strongly disagree
Somewhat disagree
Somewhat agree
Strongly agree
Does not apply

Q2. My organization is committed to employee mental health.

Strongly disagree
Somewhat disagree

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Somewhat agree
Strongly agree
Does not apply

Q3. My organization encourages me and provides opportunities to engage in healthy behaviors, such as being physically active, eating a healthy diet, living tobacco free.
Strongly disagree
Somewhat disagree
Somewhat agree
Strongly agree
Does not apply

Q4. My organization encourages me and provides opportunities to engage in mental health behaviors, such as program for managing the stress and/or favoring" break culture" (against hustle culture).
Strongly disagree
Somewhat disagree
Somewhat agree
Strongly agree
Does not apply

Two indexes of Mental Well Being and Wellness: Perception of Personal Work Well-being, Mental Health and Wellness Culture in Organization.

The items are taken/adapted from NIOSH [2021]. NIOSH worker well-being questionnaire (WellBQ). By Chari R, Chang C-C, Sauter SL, Petrun Sayers EL, Huang W, Fisher GG. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2021-110 (Revised 05/2024), https://doi. org/10.26616/NIOSHPUB2021110revised052024 DHHS (NIOSH) Publication No. 2021-110 (Revised 05/2024) DOI: https://doi.org/10.26616/NIOSHPUB2021110revised052024

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D. Work Environment
The questions ask how you feel about your organization and the work environment.
Supportive Work Culture
Calculate the average of the following five items (Q1-5): Q1. At my organization, I am treated with respect. 1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree Does not apply
Q2. My organization values my contributions. 1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree Does not apply
Q3. My organization cares about my general satisfaction at work. 1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree Does not apply
Q4. My organization is willing to extend resources in order to help me perform my job to the best of my ability.
1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree Does not apply
Q5. I receive recognition for a job well done. 1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree Does not apply
Perception of Interpersonal Social Support

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Supervisor Support
Q5. I can count on my supervisor for support when I need it. Strongly disagree Somewhat disagree Somewhat agree Strongly agree Does not apply
Coworkers Support
Q6. I can count on my coworkers for support when I need it. Strongly disagree Somewhat disagree Somewhat agree Strongly agree Does not apply
Calculate the average of these items (Q5-6)

Two indexes of Work Environment: Supportive Work Culture, Perception of Interpersonal Social Support at Work.

The items are taken/adapted from NIOSH [2021]. NIOSH worker well-being questionnaire (WellBQ). By Chari R, Chang C-C, Sauter SL, Petrun Sayers EL, Huang W, Fisher GG. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2021-110 (Revised 05/2024), https://doi. org/10.26616/NIOSHPUB2021110revised052024 DHHS (NIOSH) Publication No. 2021-110 (Revised 05/2024) DOI: https://doi.org/10.26616/NIOSHPUB2021110revised052024

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E.Work-Life Balance The questions ask how you feel about your organization and the work environment.
Q1. I currently have a good balance between the time I spend at work and the time I have available for non-work activities. 1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree
Q.2 I have difficulty balancing my work and non-work activities 1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree *Note: The score of the Item 2 must be reversed*
Q.3 I feel that the balance between my work demands, and non-work activities is currently about right. 1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree
Q.4 Overall, I believe that my work and non-work life are balanced. 1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree

One Index of Work-Life Balance

The scale is taken from Paula Brough, Carolyn Timms, Michael P. O'Driscoll, Thomas Kalliath, OiLing Siu, Cindy Sit & Danny Lo (2014) Work–life balance: a longitudinal evaluation of a new measure across Australia and New Zealand workers, *The International Journal of Human Resource Management*, 25:19, 2724-2744, DOI: 10.1080/09585192.2014.899262

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F. Career Growth
Career Goal Progress *Calculate the average of the following four items (Q1-Q4):*
Q1 My present job moves me closer to my career goals. 1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree
Q2 My present job is relevant to my career goals and vocational growth 1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree
Q3 My present job sets the foundation for the realization of my career goals. 1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree
Q4 My present job provides me with good opportunities to realize my career goals. 1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree
Professional Ability Development *Calculate the average of the following four items (Q5-Q8):*
Q5 My present job encourages me to continuously gain new and job-related skills. 1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree
Q6 My present job encourages me to continuously gain new job-related knowledge. 1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree

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4 Strongly agree
Q7 My present job encourages me to accumulate richer work experiences. 1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree
Q8 My present job enables me to continuously improve my professional capabilities. 1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree
Promotion Speed *Calculate the average of the following four items (Q9-Q12)*:
Q9 My promotion speed in the present organization is fast. 1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree
Q10. The probability of being promoted in my present organization is high. 1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree
Q.11. Compared with previous organizations, my position in my present one is ideal. 1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree
Q.12 Compared with my colleagues, I am being promoted faster. 1. Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree
Remuneration Growth *Calculate the average of the following three items (Q13-Q15)*:

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Q.13 My salary is growing quickly in my present organization. 1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree
Q.14 In this organization, the possibility of my current salary being increased is very large. 1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree
Q.15 Compared with my colleagues, my salary has grown more quickly 1 Strongly disagree 2 Somewhat disagree 3 Somewhat agree 4 Strongly agree
It can be calculated a single index (by averaging all the items) or consider 4 indexes

Four Indexes of Career Growth: Career Goal Progress, Professional Ability Development, Promotion Speed, Remuneration Growth.

The scale is taken from Kim, B., Rhee, E., Ha, G., Jung, S. H., Cho, D., Lee, H. K., & Lee, S. M. (2016). Cross-cultural validation of the career growth scale for Korean employees. *Journal of career development*, *43*(1), 26-36. https://doi.org/10.1177/0894845314568310

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Work Status

Is your job full-time or part-time?

Full-time
Part-time

Job Tenure

How long have you worked in your job?

Less than 1 year
1–5 years
6–10 years
10–20 years
More than 20 years

Age

What is your age?

18–29
30–44
45–64
65 and older

Gender

What is your gender?
Male
Female
Refused
Don't know

Education

What is the highest level of school you have completed of the highest degree you have received?

A. Less than high school
B. High school/GED
C. Some college
D. Bachelor's degree or higher

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D1.3 Industry 5.0 Assessment Framework

ANNEX 10: List of Technologies or Initiatives for Sustainability (KPI_SU1)

Date	: 09.12.2024
Topic	: D1.3 – ANNEX 9
Responsible Partner	: UNIMORE
Author	: Giacomo Cantini (UNIMORE)

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LIST OF SUSTAINABILITY-FOCUSED TECHNOLOGIES OR INITIATIVES

Here is a list of possible **sustainability-focused technologies or initiatives** that organizations could invest in or develop to calculate the KPI_SU1.

1. **Energy-efficient equipment**:
    a. High-efficiency HVAC (Heating, Ventilation and Air Conditioning) systems.
    b. LED lighting and smart lighting systems.
    c. Energy-efficient machinery and production lines.
    d. Variable frequency drives (VFDs) for motors and compressors.
2. **Renewable energy systems**:
    a. Solar panels and photovoltaic systems.
    b. Wind turbines for on-site power generation.
    c. Geothermal heating and cooling systems.
    d. Hydroelectric microgeneration systems.
    e. Battery storage systems for renewable energy.
3. **Circular economy initiatives**:
    a. Waste-to-energy technologies.
    b. Material recovery and recycling systems.
    c. Reverse logistics for product lifecycle management.
    d. Design for modularity, repairability, and repurposing.
    e. Bio-based and biodegradable material production.
4. **Water management technologies**:
    a. IoT-enabled water monitoring systems.
    b. Rainwater harvesting systems.
    c. Advanced water treatment and recycling technologies.
    d. Leak detection and repair systems.
5. **Sustainable product innovations**:
    a. Development of low-carbon or carbon-neutral products.
    b. Use of sustainable raw materials and alternative resources.
    c. Eco-friendly packaging solutions, including compostable and recyclable materials.
6. **Digital and IoT-enabled sustainability tools**:
    a. Energy management platforms for real-time monitoring and optimization.
    b. AI-driven tools for predictive maintenance and operational efficiency.
    c. Blockchain systems for supply chain traceability and transparency.
    d. Smart sensors to track emissions, energy use, and waste generation.
7. **Transportation and logistics solutions**:
    a. Electric or hybrid vehicle fleets.

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   b. Hydrogen fuel cell vehicles for logistics.
   c. Route optimization software to reduce fuel consumption.
   d. Automated warehouse systems to minimize energy use.

8. **Carbon reduction technologies**:
   a. Carbon capture, utilization, and storage (CCUS) systems.
   b. Emission reduction technologies for manufacturing processes.
   c. Electrification of industrial processes to replace fossil fuels.
   d. Adoption of green hydrogen as an energy source.
9. **Sustainability certification and standards**:
   a. Compliance with ISO 14001 (Environmental Management Systems).
   b. Investments in achieving LEED or BREEAM certifications for facilities.
   c. Development of in-house sustainability metrics and reporting systems.
10. **Employee and community initiatives**:
   a. Sustainability education and training programs.
   b. Investments in green office spaces and coworking facilities.
   c. Community engagement projects like afforestation and biodiversity conservation.

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D1.3 Industry 5.0 Assessment Framework

ANNEX 11: List of Initiatives Beyond Sustainability Compliance (KPI_SU2)

Date	: 09.12.2024
Topic	: D1.3 – ANNEX 11
Responsible Partner	: UNIMORE
Author	: Giacomo Cantini (UNIMORE)

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LIST OF INITIATIVES BEYOND SUSTAINABILITY COMPLIANCE

Possible initiatives beyond compliance may include:

Energy efficiency and renewable energy initiatives

1. Voluntary renewable energy use:
    a. Achieving 100% renewable energy sourcing ahead of legal mandates.
    b. Installing on-site renewable energy systems (solar, wind, geothermal).
2. Energy efficiency projects:
    a. Implementing energy management systems exceeding regulatory requirements (e.g., ISO 50001).
    b. Retrofitting facilities with high-efficiency insulation and energy recovery systems.
3. Carbon neutrality and Net-Zero goals:
    a. Committing to science-based targets for carbon reduction (e.g., through SBTi) before regulatory deadlines.
    b. Offsetting emissions via certified carbon credits.

Circular economy and waste management initiatives

4. Material recycling programs:
    a. Voluntary collection and recycling of products at the end of their lifecycle.
    b. Developing closed-loop production systems.
5. Zero waste goals:
    a. Setting internal targets for zero landfill contributions, even if not mandated.
    b. Developing partnerships for waste-to-energy conversion projects.
6. Plastic-free or low-plastic operations:
    a. Replacing plastic packaging with biodegradable or reusable alternatives.

Water Conservation and Management

7. Water neutrality initiatives:
    a. Offsetting water use through investments in watershed conservation.
    b. Installing advanced water recycling systems.
8. Voluntary water monitoring and reporting:
    a. Tracking water use and efficiency improvements even where regulations don't require it.

Biodiversity and natural capital conservation

9. Reforestation and afforestation projects:
    a. Initiating reforestation efforts to offset environmental impacts.
    b. Supporting local biodiversity through habitat restoration.
10. Partnerships for ecosystem protection:

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a. Collaborating with NGOs or governments for wetland and wildlife conservation.

Sustainable supply chain initiatives

11. Traceability and transparency:
    a. Implementing blockchain technology to ensure sustainable sourcing practices.
    b. Publishing voluntary reports on Scope 3 emissions or supply chain impacts.
12. Sourcing beyond standards:
    a. Partnering only with suppliers who meet elevated environmental and ethical standards.

Employee and community engagement

13. Employee-led sustainability initiatives:
    a. Encouraging green commuting options like carpooling and cycling.
    b. Offering incentives for employee-driven sustainability projects.
14. Community development programs:
    a. Sponsoring clean energy access projects in underserved areas.
    b. Investing in educational programs on sustainability.

Innovation and R&D investments

15. R&D for green technologies:
    a. Funding research into new methods for reducing emissions or enhancing energy efficiency.
    b. Developing carbon-negative products or processes.
16. Green building certifications:
    a. Upgrading facilities to exceed LEED or BREEAM certification requirements.

Voluntary reporting and certifications

17. Exceeding reporting standards:
    a. Publishing sustainability reports aligned with GRI or CDP frameworks, even when not required.
    b. Meeting higher certification thresholds (e.g., ISO 14064 for carbon accounting).
18. Engagement in voluntary agreements:
    a. Participating in sector-wide voluntary pacts to reduce emissions or enhance sustainability.

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D1.3 Industry 5.0 Assessment Framework

ANNEX 12: List of Cybersecurity Actions (KPI_RE6)

Date	: 09.12.2024
Topic	: D1.3 – ANNEX 12
Responsible Partner	: UNIMORE
Author	: Giacomo Cantini (UNIMORE)

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LIST OF CYBERSECURITY ACTIONS

*Examples of actions include:

- Regular software updates and patches.
- Routine vulnerability assessments and penetration testing.
- Implementation of multi-factor authentication (MFA).
- Employee cybersecurity training and phishing awareness.
- Incident response drills and post-incident reviews.
- Data encryption and backup verification.

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