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HUMAN FACTOR AS CENTRAL APRAOCH IN A SUSTANABLE BUSINESS MODEL FOR INDUSTRY 5.0

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Abstract The emergence of Industry 5.0 marks a shift from the automation-driven focus of Industry 4.0 toward a more human-centric, sustainable, and resilient industrial paradigm. This study explores the pivotal role of the human factor in shaping this transition, emphasizing the need for policies and business models that balance technological innovation with human well-being, economic stability, and environmental responsibility. A Society 5.0 policy framework is proposed, structured around six key pillars, to ensure that advancements in Artificial General Intelligence, automation, and digital transformation align with societal values. This framework safeguards labor markets, supports local economies, and mitigates the risks of excessive technological dominance over human decision-making. Complementing this, a Sustainable Business Model for Industry 5.0 is introduced, integrating circular economy principles, market-specific regulatory mechanisms, and a balanced economic structure that fosters collaboration between small and medium-sized enterprises, large corporations, and global markets. This paper also provides ten main reasons and explanations why human factors have a very important role in the sustainable business model of Industry 5.0. The findings of this research highlight the urgent need for strategic policies that sustain economic competitiveness while preserving human control over technology. The study provides actionable recommendations for business leaders, policymakers, and researchers, offering a blueprint for transitioning toward an industrial ecosystem where technological progress enhances human and environmental prosperity rather than undermining it.

Keywords: Industry 5.0; human factor; ergonomics; Society 5.0; sustainable business model; human-centric approach; policy framework.

1. INTRODUCTION

The Human Factor, also referred to as Human Factors and Ergonomics (HFE), is a multidisciplinary field concerned with the study of human behavior and interactions within various systems. Its primary objective is to optimize performance, well-being, and safety by integrating knowledge from engineering, design, management, occupational health, psychology, and sociology [1]. The International Ergonomics Association (IEA) and the Federation of European Ergonomics Societies (FEES) define ergonomics as the scientific discipline that seeks to understand human interactions with system elements and applies theory, principles, and data to design, ensuring optimal human well-being and system performance [2,3].

A new definition of ergonomics that in the center of this science position work (In Greek Ergon is work

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and Nomos is law) was provided by Zunjic. This definition, which is very usable for understanding the role of Ergonomics in Industry 5.0, states [4]: "Ergonomics is a multidisciplinary science whose goal is to examine the impact of means of work, conditions of work, processes of work, and products as results of work on humans from the psychological, physiological, anatomical, biomechanical, sociological, organizational and physics aspect by applying the quantitative and qualitative research methods, as well as to adapt the design of the aforementioned elements to humans, with the aim of improving comfort, safety, efficiency and satisfaction, which are considered during their interaction with humans".

Closely linked to the field of Human Factors is the emerging paradigm of Industry 5.0. This concept represents an evolution beyond Industry 4.0, aiming for a symbiotic relationship between human intelligence and machine capabilities within digital and cyber-physical systems. This model emphasizes production efficiency, personalization, and sustainability without diminishing human value or deepening divisions between technology and society [5]. It acknowledges human well-being as a key driver of industrial transformation, placing human-centricity, sustainability, and resilience at the core of economic and technological progress [6].

Unlike Industry 4.0, where advancement is mostly about the coordination of humans with machines, this Industry is about how technology can continue to advance while meeting social and environmental needs and positive economic contributions. This transformation is consistent with the European Union's policy on sustainable industrial development and incorporates various elements of the report Industry 5.0 – Towards a sustainable, human-centric and resilient European industry [5].

The well-being of humans and sustainability are two cornerstones of Industry 5.0. The concept of human well-being describes physical, psychological and social health. It is characterized by work that adds meaning and meaning that comes from work. Moving towards Industry 5.0 favors workplaces that do not compromise human dignity, creativity and work-life balance [6].

Simultaneously, sustainability (encompassing economic progress, social equity, and environmental protection) remains a crucial pillar of Industry 5.0. The Stockholm Resilience Centre's 'wedding cake' model of sustainable development [7], underscores the interdependence between economic systems, societal fairness, and environmental sustainability. This model suggests that economic growth cannot be sustained without social inclusivity, and both depend on the preservation of ecological balance.

On the other hand, the rapid evolution of Artificial Intelligence (AI) and the potential rise of Artificial General Intelligence (AGI) introduced complex risks for economic stability and social cohesion. AGI, capable of performing tasks at human intelligence levels, poses challenges such as economic disruptions, as widespread automation could lead to mass unemployment and threaten the middle class [8]; power concentration, where technological control becomes centralized within a few large corporations or governments, potentially undermining democracy [9]; and psychosocial crises, where humans struggle with a diminished sense of purpose and societal integration in an AI-dominated workforce [10].

To mitigate these risks, Industry 5.0 must establish policy frameworks that ensure human control over technology at all levels. Such policies should maintain human involvement in decision-making processes [11]; foster environments where individuals find meaning and purpose in their work [12]; implement AI

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taxation and incentive structures to ensure equitable economic distribution [8]; and encourage SME support to prevent economic monopolization by large corporations [13].

Figure 1. The wedding cake sustainable development model [7].

At the same time, the Human-Centricity concept must be balanced with corporate competitiveness. A core objective of Industry 5.0 is to preserve human control while ensuring economic competitiveness. Achieving this balance requires incentivizing human-centric business practices through regulatory frameworks and market-driven policies [5]; introducing tax policies for AI and robotics to level the playing field between human labor and automation [14]; preventing market monopolization, ensuring that global corporations drive innovation while supporting SMEs as the backbone of economic diversity and democracy [15]; and promoting ethical and sustainable consumption, encouraging domestic and green products with high human labor input [16].

Through these measures, Industry 5.0 not only ensures economic viability but also fosters a resilient and inclusive society, where technological progress aligns with human dignity, social justice, and ecological responsibility.

The remainder of this paper is structured as follows: Section 2 establishes the policy framework for Society 5.0, outlining key strategies for balancing technological advancements with human-centric and sustainability goals. Section 3 introduces a sustainable business model for Industry 5.0, detailing how businesses can integrate these principles into their operational and market strategies. Finally, Section 4 elaborates on the main findings of this research, examining their practical and theoretical implications, their impact on policy development and business practices, while also outlining future research directions.

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2. SOCIETY 5.0 POLICY FRAME

Society 5.0 is a transformative concept of social and economic development initially promoted by Japan Cabinet to balance economic advancement with the resolution of social problems in Japanese society [17]. It was announced at the G7 Summit in 2016 [18], and unlike previous industrial revolutions that primarily focused on economic efficiency and productivity, Society 5.0 emphasizes balancing economic growth with social well-being, inclusivity, and environmental sustainability. By integrating advanced technologies into every facet of life—from healthcare and education to transportation and urban planning—this concept seeks to create a harmonious synergy between humans and technology, enabling smarter, more sustainable solutions to pressing issues such as aging populations, climate change, resource depletion, and social inequalities [19].

It envisions a human-centered society that leverages cutting-edge technologies (such as artificial intelligence, internet of things, robotics, big data, or block chain), to address complex global challenges and enhance the overall quality of life for individuals and communities [20].

It was designed to respond to the formidable economic and social challenges facing Japan and the world, capitalize on Japanese technological sophistication and commercialization abilities, and provide a coordinated, forward-looking strategy that could ensure Japan's leadership in the technological revolution. Society 5.0 is the label attached to a vision of 'whole of government, business and academia' plan to integrate new technological systems across various fields to the benefit of humanity [18].

Unlike previous industrial revolutions that primarily focused on economic efficiency and productivity, Society 5.0 emphasizes balancing economic growth with social well-being, inclusivity, and environmental sustainability [21]. By integrating advanced technologies into every facet of life—from healthcare and education to transportation and urban planning—this concept seeks to create a harmonious synergy between humans and technology, enabling smarter, more sustainable solutions to pressing issues such as aging populations, climate change, and resource scarcity [22]. The ultimate goal of Society 5.0 is to establish a society where innovation and technology empower people to live healthier, more meaningful lives while ensuring no one is left behind in the process of progress [23].

A framework policy integrating the Society 5.0 concept is supported by the following six pillars developed by authors:

1. Maintaining the market economy, circular income flows, and a business ecosystem with diverse economic players.
2. Supporting the development of strong and globally competitive business entities.
3. Limited protection of the EU common market.
4. Keeping human control and AI systems as decentralized as possible.
5. Non-financial reporting on ESG in relation to labor productivity.
6. Supporting and protecting individuals through Universal Basic Income and encouraging participation in civil society, with a focus on promoting proximity-based co-working models aligned with the principles of 15-minute cities.

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2.1. Maintaining the Market Economy, Circular Income Flows, and a Business Ecosystem With Diverse Economic Players

One of the major risks generated by the AI evolution is to disturb the labor market. As automation and advanced technologies replace traditional human occupations, there is growing concern about the socioeconomic implications of this shift [24]. The fear of widespread job displacement has sparked debates about potential remedies to mitigate the economic challenges posed by automation. While it is possible that new job opportunities will emerge in the future, waiting passively for these changes is not a viable strategy, as noted by Tyagi et al. in 2024 [25]. Proactive measures must be taken to safeguard the stability of the labor market and ensure equitable opportunities for all individuals [26].

AI system implementation through human-centered design with ergonomic principles reduces negative market consequences for labor jobs. The development of technologies to strengthen human abilities instead of taking their jobs allows both job preservation and enhanced workplace conditions. Not only does this approach help in retaining jobs, but also in creating an environment of productivity and worker satisfaction towards the course of a sustainable economic transition in the era of automation. Therefore, thanks to proactivity in incorporating ergonomics and human centric design, technological progress can not only become support for the worker but also guarantee the stability of the workforce.

One widely discussed solution is Universal Basic Income (UBI), a social welfare proposal that guarantees all citizens regular, unconditional payment regardless of employment status. The rationale behind UBI is to provide a financial safety net in an economy where traditional employment may no longer be as prevalent [28]. UBI would keep adults out of poverty, but it does not guarantee that they would be able to find work [25].

However, implementing an overly expansive UBI system could have unintended consequences, including the disruption of the Circular Flow of Income. The Circular Flow of Income model illustrates how money, goods, and services circulate between economic agents, maintaining a balance within the economy, and it comprises five sectors: households, firms, government entities, international trade partners ("the rest of the world"), and the financial sector [27].

While UBI can provide a safety net for individuals in a rapidly changing economic environment, implementing an overly extensive UBI system could jeopardize the current Circular Flow of Income by altering the dynamics of income generation and expenditure.

Moreover, although UBI can alleviate poverty and provide economic security, it does not address the root issue of job creation or guarantee that individuals will have access to meaningful employment. Research, including studies by Hoynes and Rothstein (2019) [28], highlights that ongoing UBI pilot programs often fail to resolve critical questions regarding their long-term efficacy and impact on economic structures. Thus, while UBI may serve as a temporary measure, it is not a comprehensive solution to the challenges posed by technology-driven labor market disruptions.

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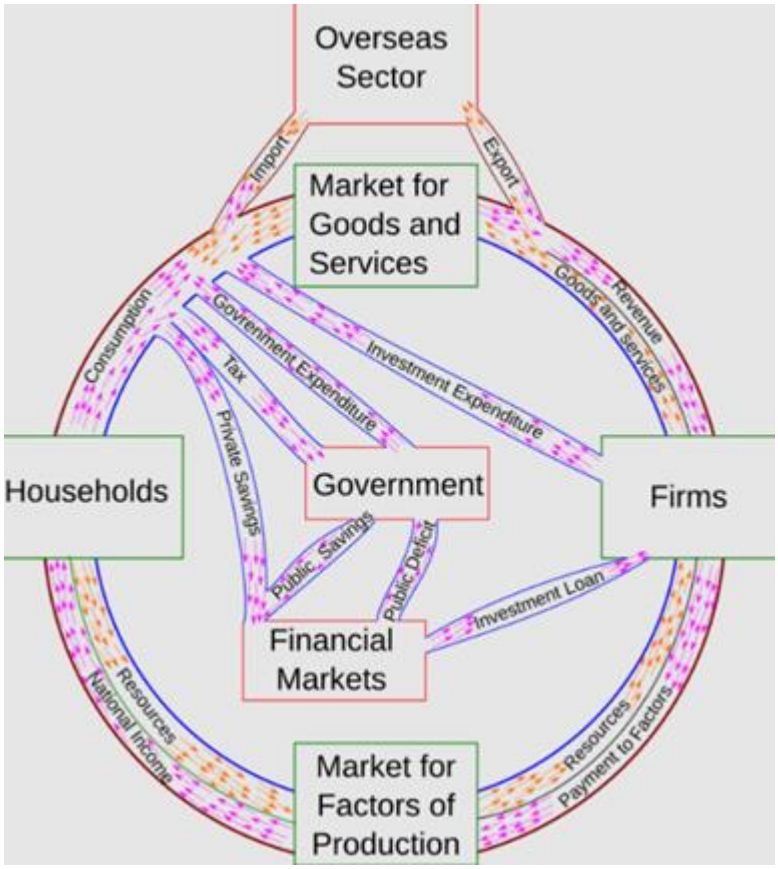

Figure 2. Circular flow of income [29], [30]

To mitigate the risks associated with the rapid technological evolution and its potential disruption of labor markets, policymakers should prioritize preserving the integrity of free markets as a foundational step. This involves safeguarding the fluidity and competitiveness of labor and capital markets while ensuring the continuity of circular income flows [29], [30]. By protecting these dynamics, governments can help balance the disruptive effects of automation and digital transformation, ensuring that technological advancements contribute to inclusive economic progress rather than exacerbating inequalities or destabilizing labor markets [31].

In this context, policies should be strategically designed to:

- Encourage innovation and entrepreneurship across businesses of all sizes: By fostering a culture of innovation, governments can create a dynamic and diverse economic ecosystem where startups, SMEs, and large corporations can thrive. Supporting initiatives like access to venture capital, tax incentives for research and development, and streamlined business registration processes can drive competitiveness and resilience in the face of global challenges [32].
- Promote equitable access to resources and opportunities: Ensuring that individuals and organizations (regardless of their socioeconomic background) can access essential resources such as education, technology, and funding is crucial for enabling them to adapt to technological advancements. This

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includes expanding digital infrastructure, subsidizing technological adoption for smaller enterprises, and creating targeted programs to support underrepresented groups in the workforce [33].

- Implement balanced regulatory frameworks: The adoption of AI and automation must be carefully managed to prevent adverse effects on human labor and small enterprises. Regulatory measures should aim to strike a balance between fostering technological innovation and protecting workers' rights. For instance, implementing safeguards against excessive automation in critical sectors, incentivizing companies to retain human labor, and enforcing ethical AI guidelines can help maintain socio-economic harmony [34].
- Foster collaboration between public and private sectors: Collaborative strategies are essential to address the skills gap and prepare the workforce for the jobs of the future. Governments and private entities should work together to develop upskilling and reskilling programs tailored to emerging industries and roles. Public-private partnerships can facilitate the establishment of training centers, provide financial incentives for employers investing in workforce development, and promote lifelong learning initiatives [35].

The biggest obstacle is to ensure that every part of society is involved in the benefits of technology as it progresses. The welfare of people matters most; so, Universal Basic Income is a better solution than ruthless economic plans focused on making money. Implementing UBI during this type of economic change gives workers an opportunity to earn and have enough money so they do not face the inequality that advanced technologies can cause [36].

There are authors, such as Acemoglu and Johnson, who reject UBI because it does not meet people's needs for work [37]. However, we do not agree with such a standpoint. We believe that UBI strives toward an identical objective as Industry 5.0, in terms of focusing on human well-being. The financial security provided through UBI protects every citizen from economic hardships while simultaneously lowering their stress levels and enhancing their quality of life. With this financial stability, people can pursue more fulfilling and creative work which is quite in tune with the human-centric approach in Industry 5.0. In other words, through UBI recipients maintain independence to seek meaningful employment instead of taking any available job just to survive financially. The implementation of UBI leads to increased workforce motivation and engagement thus benefiting the successful development of Industry 5.0.

Those making policies can use people's needs and abilities to organize UBI to help with career development as the labor market shifts. In other words, UBI helps people gain access to education and entrepreneurship, which improves their lives and the community overall. This way, the development of technology preserves human dignity and does not threaten human well-being.

2.2. Supporting the Development of Strong and Globally Competitive Business Entities

In an increasingly interconnected and competitive global economy, fostering the growth of strong and globally competitive business entities is essential for sustaining economic resilience and innovation. While SMEs play a critical role in job creation and regional development, an economic policy focused solely on sustaining SMEs is insufficient to compete in global markets. Large corporations, with their access to financial resources, innovation capabilities, technological know-how, and marketing capital,

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are indispensable for driving economic growth, maintaining global competitiveness, and securing strategic advantages in key industries [38].

To ensure long-term economic sustainability, policymakers must identify and prioritize strategic markets that are essential for the future and where the EU already possesses significant global strengths. These industries include information technology and communications, artificial general intelligence, quantum computing, semiconductors, energy, biotechnology, nanotechnology, and automotive manufacturing. These sectors are not only critical for technological advancement but also serve as the backbone of economic security and geopolitical influence in the 21st century [39].

For instance, the semiconductor industry is a cornerstone of modern technology, underpinning everything from consumer electronics to defense systems. The EU's reliance on external suppliers for semiconductors has exposed vulnerabilities in its supply chain, highlighting the need for strategic investments to bolster domestic production capabilities. Similarly, the energy sector, particularly renewable energy technologies, is vital for achieving climate goals and ensuring energy independence. By supporting the growth of globally competitive businesses in these areas, the EU can consolidate its position as a leader in innovation and sustainability [15].

Moreover, the symbiotic relationship between large corporations and SMEs is crucial for a thriving economic ecosystem. Large corporations often serve as anchors, generating business opportunities for SMEs through supply chains, partnerships, and innovation clusters. For example, in the automotive industry, major manufacturers rely on a network of SMEs for components, software solutions, and specialized services. This interdependence fosters a dynamic business environment where SMEs can innovate and scale, while large corporations benefit from agility and specialized expertise [38].

To support the development of globally competitive business entities, the following policy measures are essential:

- Strategic Investments in Key Industries: Governments and the EU should prioritize funding and incentives for industries with high growth potential and strategic importance. This includes direct investments in research and development, infrastructure, and workforce training to enhance competitiveness in sectors like semiconductors, quantum computing, and biotechnology [34].
- Public-Private Partnerships: Collaborative initiatives between governments, businesses, and academic institutions can accelerate innovation and commercialization. For example, establishing innovation hubs and technology clusters can facilitate knowledge sharing, reduce R&D costs, and attract foreign investment [35].
- Global Market Access and Trade Policies: Ensuring access to international markets is critical for the growth of globally competitive businesses. Trade agreements, export incentives, and diplomatic efforts to reduce trade barriers can help EU-based companies expand their global footprint [40].
- Support for SMEs in Corporate Ecosystems: Policies should encourage large corporations to engage with SMEs as suppliers, partners, and innovators. This can be achieved through tax incentives for corporate-SME collaborations, funding for joint R&D projects, and initiatives to integrate SMEs into global value chains [40].
- Regulatory Frameworks for Innovation: Balancing regulation with innovation is key to fostering competitiveness. Policymakers should create flexible regulatory environments that encourage

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experimentation while ensuring ethical standards and consumer protection, particularly in emerging fields like AGI and biotechnology [38].

2.3. Limited Protection of the EU Common Market

The EU common market is one of the largest and most integrated economic blocs in the world, providing a robust foundation for trade, innovation, and economic growth [41]. However, excessive regulations, particularly those governing labor and business operations, can place EU industries at a competitive disadvantage in the global marketplace. While regulations are essential for ensuring fair competition, consumer protection, and environmental sustainability, an overregulated environment can stifle innovation, increase operational costs, and hinder the ability of EU businesses to compete with players from less regulated markets [42].

The EU market's size and internal cohesion offer significant advantages, as it can sustain many industries if all players adhere to the same rules. However, the challenge lies in competing with external markets where lower regulatory burdens and production costs create unequal playing fields. For instance, industries such as manufacturing, automotive, and technology face intense competition from regions with less stringent labor and environmental regulations, which can lead to market distortions and unfair trade practices [43].

To address these challenges, a balanced approach is needed—one that protects the integrity of the EU common market while ensuring its global competitiveness. A set of targeted economic policies, including strategic trade measures, can help level the playing field and safeguard EU industries. Key measures include:

- Custom Duties and Import Quotas: Implementing custom duties and import quotas for specific industries can protect EU businesses from unfair competition caused by cheaper imports produced under less stringent regulations. These measures should be carefully calibrated to avoid trade wars while ensuring that EU industries remain competitive. For example, tariffs on steel imports have been used to protect the EU steel industry from dumping practices by external players [40].
- Regulatory Harmonization and Simplification: Streamlining regulations across EU member states can reduce administrative burdens and operational costs for businesses. A harmonized regulatory framework ensures that all players within the EU adhere to the same standards, fostering fair competition and reducing inefficiencies [35].
- Strategic Subsidies and State Aid: Targeted subsidies and state aid can support industries that are critical to the EU's economic security and technological sovereignty, such as semiconductors, renewable energy, and biotechnology. These measures should comply with international trade rules to avoid disputes while strengthening the EU's industrial base [15].
- Promoting Fair Trade Practices: The EU should actively engage in international trade negotiations to promote fair trade practices and address regulatory disparities. Bilateral and multilateral agreements can help establish common standards for labor, environmental protection, and competition, ensuring a more level playing field for EU businesses [40].
- Strengthening Anti-Dumping Measures: Robust anti-dumping policies are essential to prevent foreign competitors from flooding the EU market with below-cost products. These measures protect domestic industries from predatory pricing and ensure fair competition [40].

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- Encouraging Innovation and Competitiveness: Policies that incentivize innovation, such as tax breaks for research and development, and funding for green technologies, can enhance the global competitiveness of EU industries. By fostering a culture of innovation, the EU can maintain its leadership in high-value sectors and reduce reliance on external markets [15].

2.4. Keeping Human Control and AI Systems as Decentralized as Possible

The preservation of human control over society and industries is a cornerstone of a sustainable and equitable future [44]. Decentralizing AI systems and ensuring human oversight are essential to maintaining a free market economy, circular income flows, psychosocial well-being, and, most importantly, the sovereignty of humanity over its own destiny. Without such safeguards, the risks of centralized AI systems—ranging from dictatorial control to the erosion of individual freedoms—could become existential threats, as highlighted by thinkers like Yuval Harari in Nexus [9]. To mitigate these risks, regulations must be implemented to prevent the integration of all AGI systems into a single, centralized entity. Such measures are critical to avoiding the concentration of power and ensuring that AI remains a tool for human empowerment rather than a force of domination [45].

One effective regulatory approach is to enforce strict separation between different AI systems and datasets [46], similar to the current separation between medical databases and other types of data. This fragmentation prevents the creation of overly powerful AGI systems that could otherwise consolidate control over vast aspects of human life. For example, keeping AI systems in healthcare, finance, and governance isolated ensures that no single entity can monopolize decision-making or access to sensitive information. This decentralized approach not only safeguards individual privacy and autonomy but also aligns with the principles of a free and democratic society [47].

The philosophical concept of "transcendent censorship", introduced by the Romanian philosopher Lucian Blaga in the mid-20th century, offers a profound metaphor for understanding the need to regulate AGI. In Blaga's philosophical system, transcendent censorship refers to a barrier imposed by the Demiurge (the creator) between humans and the absolute. This barrier ensures that humans can only grasp fragments of the mysteries of existence, preventing them from attaining the full creative and absolute power of the Demiurge. Blaga argues that this limitation is not a hindrance but a safeguard, protecting the mysteries of existence and inspiring humans to pursue creativity and discovery within the boundaries of their limitations [48].

Applying Blaga's concept to the regulation of AGI, we can envision "technological transcendent censorship", a framework that imposes deliberate limits on the capabilities of AGI systems to prevent them from surpassing human control. Just as the Demiurge's censorship protects the mysteries of existence, technological transcendent censorship would protect humanity's sovereignty by ensuring that AGI systems remain subordinate to human decision-making. This approach emphasizes the importance of maintaining a dual-control mechanism, where critical decisions in business management, governance, and other vital areas require human approval alongside AI recommendations. For example, in "An overview of research on human-centered design in the development of artificial general intelligence," the authors emphasize the necessity of aligning AGI development with human values and interests, and advocate for a human-centered design approach to ensure that AGI systems operate ethically and remain under human oversight [49]. In the same way, Floridi (2023) [50] discusses the ethical implications of

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AI development and stresses the need for human oversight in AI systems. He argues that AI should be designed to augment human decision-making rather than replace it, ensuring that humans retain sovereignty over critical decisions. This supports the concept of ensuring AGI systems remain subordinate to human control, and that AI serves as a tool for enhancing human capabilities rather than replacing human judgment [51].

To operationalize this vision, the following measures seem essential:

- Decentralized AI Architectures: AI systems should be designed and deployed in a decentralized manner, with no single entity or system having overarching control. This can be achieved through distributed computing, blockchain technology, and open-source frameworks that promote transparency and accountability [52].
- Strict Data Separation: Regulations should mandate the separation of AI systems and datasets across different domains (e.g., healthcare, finance, education) to prevent the consolidation of power and ensure that no single AGI system can access or control all aspects of human life [53].
- Dual-Control Mechanisms: Critical decisions involving AI systems should require human oversight and approval. For example, in business management, AI recommendations should be subject to human review to ensure alignment with ethical, social, and economic goals [54].
- Ethical AI Frameworks: Governments and international organizations should establish ethical guidelines for AI development and deployment, emphasizing human-centric values, transparency, and accountability. These frameworks should be enforced through regulatory bodies and independent audits [55].
- Public Awareness and Education: Empowering individuals with knowledge about AI's capabilities and limitations is crucial for fostering informed decision-making and public trust. Educational initiatives should focus on digital literacy, ethical AI use, and the importance of human oversight [9].

2.5. Non-Financial Reporting on ESG in Relation to Labor Productivity

Non-financial reporting on ESG criteria has become a critical tool for assessing the sustainability and ethical impact of organizations. This form of disclosure provides stakeholders with comprehensive insights into a company's performance beyond traditional financial metrics, encompassing areas such as environmental stewardship, social responsibility, and governance practices [56].

Currently, ESG reporting is mandatory for large and medium-sized enterprises in various jurisdictions. For instance, the European Union's Corporate Sustainability Reporting Directive (CSRD), adopted in January 2023, requires both EU and non-EU companies with activities in the EU to file annual sustainability reports alongside their financial statements. These reports must adhere to the European Sustainability Reporting Standards (ESRS). The potential benefits in terms of sustainability, ethical impact, and stakeholder trust make a compelling case and its scope should be expanded to include all organizations in the future.

A key addition to ESG frameworks should be the inclusion of standardized metrics that evaluate the relationship between humans and AGI in the workplace. As AGI and automation technologies continue to reshape labor productivity and employment dynamics, such metrics are essential for evaluating their broader impact on the workforce. A study published in Springer Nature highlights that AI and machines

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enhance labor productivity by automating routine tasks, thereby expanding employee skills and increasing the value of work [57].

Traditionally, labor productivity has been measured as turnover per employee, with the goal of maximizing efficiency and output. However, in a future where AGI and automation could displace human workers, the focus should shift toward minimizing turnover per employee to maximize the number of jobs and ensure equitable employment opportunities. This "reverse labor productivity" indicator would align with the broader societal goals of reducing unemployment, promoting social stability, and ensuring that the benefits of technological advancements are distributed fairly [58].

A Classification System for Jobs Involving AGI

To implement this system effectively, a classification framework for jobs involving AGI and automation is essential. A model similar to the SAE J3016 Standard for autonomous vehicles could be adapted for this purpose. The SAE standard defines six levels of driving automation, ranging from no automation (Level 0) to full automation (Level 5). A similar classification system could be applied to jobs, with different tax and incentive structures for each level:

- Level 0: No Automation – Human workers perform all tasks without assistance from AGI or automation. Organizations at this level should receive significant tax reductions and public incentives to encourage job creation.
- Level 1: Assisted Work – AGI systems assist human workers in specific tasks but do not replace them. Moderate tax benefits and incentives should apply.
- Level 2: Partial Automation – AGI systems handle certain tasks independently, but human oversight is required. Tax benefits should be reduced at this level.
- Level 3: Conditional Automation – AGI systems perform most tasks autonomously but require human intervention in complex situations. Organizations at this level should face higher taxes.
- Level 4: High Automation – AGI systems operate independently in most scenarios, with minimal human involvement. Significant taxes and no public incentives should apply.

This classification system would provide a clear framework for aligning labor productivity goals with societal values, ensuring that technological advancements do not come at the expense of human employment.

Guidelines for Ethical AGI Implementation

The integration of AGI, cobots, and other automation technologies into the workplace must be guided by ethical principles to ensure that human workers remain central to organizational processes. A set of guidelines prepared by the Federation of European Ergonomics Societies (FEES) aand presented by Prof. Aleksandar Zunjic for the 2024 ErgoWork International Conference in Bucharest provides a valuable framework for this purpose. The guidelines propose four key principles:

- Human-Centric Design: AGI and automation systems should be designed with human operators in mind, considering their capacities and limitations. This ensures that technology complements human

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skills rather than replacing them. This principle is in line with, for example, the European Commission (2019) [51].

- Leveraging Workplace Expertise: Organizations should recognize and utilize the expertise developed by human workers before implementing AGI systems. This respects the value of human experience and knowledge. As for example, concluded by Yue and Shyu (2023) [49].
- Inclusive Design Processes: Teams of workers should be actively involved in the design and implementation of AGI systems. This fosters collaboration and ensures that technological solutions meet the needs of all stakeholders [59].
- Acknowledging Technological Limits: Technology cannot solve all problems, and overreliance on AGI may lead to unintended consequences. Organizations must recognize the limitations of automation and prioritize human judgment where necessary [60].

2.6. Supporting and Protecting Individuals Through Universal Basic Income and Encouraging Participation in Civil Society, With a Focus on Promoting Proximity-Based Co-Working Models Aligned With the Principles of 15-Minute Cities

Universal Basic Income (UBI), as conceptualized in this context, should serve as a strategic policy tool within the EU to mitigate the socio-economic impact of significant labor market disruptions. Its implementation should be geographically targeted based on unemployment rates, ensuring a responsive and adaptive framework. While specific thresholds, such as a 15% unemployment rate, are not universally established as benchmarks for initiating UBI, the concept of introducing UBI in response to significant labor market disruptions has been explored, providing financial stability to affected individuals and communities [61].

In parallel, proactive measures should be established to support SMEs and civil society organizations in regions at risk of substantial unemployment increases. One such measure is the development of proximity-based co-working spaces, which align with the principles of 15-minute cities—urban planning models that prioritize accessibility and local economic ecosystems [62], [63].

Co-working spaces have emerged as dynamic hubs fostering economic activity, social cohesion, and civic engagement. Their implementation can be effectively structured through a three-tiered approach:

- Private Sector-Led Initiatives: Encouraging private entrepreneurs and businesses to independently establish and operate co-working spaces can stimulate organic economic growth. These privately managed spaces often serve as innovation hubs, supporting entrepreneurship and talent development within their local environments [58].
- Public-Private Partnerships: When private initiatives are insufficient, public authorities can collaborate with private entities by providing infrastructure, such as underutilized spaces, while private partners manage operations. PPPs can be catalysts for significant change, attracting investment and utilizing groundbreaking technologies to enhance community engagement in co-working spaces [59].
- Public Sector-Led Solutions: If both private initiatives and PPPs are inadequate, the public sector can assume responsibility for both infrastructure and operational management to ensure accessibility and

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sustainability. Direct provision of public premises and workspaces managed by the public sector can play a crucial role in delivering social infrastructure [60].

- These proximity-based co-working spaces can function as innovation hubs by uniting local talent, entrepreneurs, and community-driven projects, thereby fostering economic resilience and social cohesion. These spaces support various initiatives that contribute to the vitality of local communities:
- Interconnected Business Development: By providing affordable and flexible workspaces, co-working environments enable small businesses and startups to thrive. This accessibility encourages collaboration among local entrepreneurs, leading to partnerships that bolster the local economy [61].
- Civic and Ecological Projects: Co-working spaces often host events and provide resources that facilitate collaboration between NGOs and grassroots initiatives. These collaborations can lead to community-driven ecological projects, enhancing environmental sustainability and civic engagement [59].
- Cultural, Artistic, and Recreational Activities: Many co-working spaces are designed to be inclusive environments that attract individuals from diverse backgrounds and industries. They often offer accessibility features and host a variety of activities, including cultural and artistic events, which promote diversity and inclusion within the community [64].
- Skill-Sharing and Educational Programs: The collaborative nature of co-working spaces fosters mutual learning and knowledge sharing among users. By bringing together professionals from various fields, these spaces create opportunities for skill-sharing and educational programs, enhancing workforce adaptability in a rapidly changing labor market [65].

3. A SUSTAINABLE BUSINESS MODEL FOR INDUSTRY 5.0.

A sustainable business model for Industry 5.0 should be grounded in the overarching framework of Society 5.0, emphasizing a balanced integration of technological advancements with socio-economic sustainability. Unlike Industry 4.0, which focused primarily on efficiency through automation and digitalization, Industry 5.0 reintroduces the human factor as a central element, ensuring that technological progress aligns with ethical, social, and environmental priorities [6]. This paradigm requires a symbiotic relationship between large-scale multinational enterprises, SMEs, and local businesses, fostering a market economy that prioritizes both economic competitiveness and social well-being.

In the context of a sustainable economic structure, a key challenge is managing the potential disruption caused by AGI and advanced automation. These technologies have the potential to reshape labor markets, wealth distribution, and even the stability of democratic institutions if left unchecked [8]. To mitigate these risks, a regulatory framework tailored to specific markets and industries is necessary. Such a framework should include:

- Sector-Specific Taxation and Incentives: Implementing differentiated tax policies to encourage investment in sustainable and high-human-value industries, while ensuring fair redistribution of wealth in markets affected by AGI-driven automation [14].
- Domestic and Foreign Market Quotas: Establishing market participation rules to balance local and global competition while protecting strategic industries essential for economic sovereignty and resilience [66].

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- Support for Local Businesses and Civil Society: Strengthening circular economy principles and short supply chains to enhance local economic resilience, reduce environmental impact, and promote social cohesion [67].
- Non-Financial ESG Reporting: Requiring rigorous ESG disclosures to ensure corporate accountability, transparency, and alignment with long-term sustainability goals [55].

A proposed business and market structure is detailed in Table 1, which categorizes markets according to the Circular Flow of Income Model [68]. The classification is based on three primary market types:

- Consumer Markets: Driven by household consumption patterns, structured around fundamental human needs, following Maslow's hierarchy [69].
- Industrial (Production) Markets: Comprising businesses involved in manufacturing, technology, and supply chain operations, requiring a balance of automation and skilled human labor.
- Government Markets: Involving public-sector procurement and policy-driven initiatives, which influence industrial strategies and local economic support mechanisms.

Within each of these markets, three subcategories should be supported:

- Strategic Markets: Industries where global competitiveness is critical, requiring strong financial incentives, protectionist policies, and a regulatory environment that fosters innovation and technological leadership [70]. This includes high-tech industries, automotive, aviation, and naval sectors, areas where European global champions already operate and must be reinforced.
- Fragmented Markets: Sectors that are best sustained by numerous SMEs, where policies should focus on decentralization, business-friendly tax regimes, and support for innovation-driven entrepreneurship [13]. Encouraging localized industries helps reduce dependency on global supply chains while increasing economic adaptability, and these markets have an active role to replace a part of jobs missed in the future by AGI.
- Regular Markets: Industries operating under standard free-market conditions, where minimal intervention is needed, apart from general sustainability and ethical consumption incentives [71].

To enhance domestic economic resilience and sustainability, consumer and government markets should promote marketing strategies that prioritize local, green, and ethically produced goods. These strategies should emphasize products that have a high degree of human contribution in their production, reinforcing human-centric economic models and preventing the over-domination of fully automated supply chains. Policies such as green labeling, local product incentives, and ethical sourcing requirements can further encourage sustainable consumption patterns [5].

By integrating these structured market dynamics within an Industry 5.0 framework, the proposed by authors business model ensures a sustainable, human-centric, and resilience approach that balances technological progress with social and environmental responsibility.

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Table 1. Annex specific to markets.

No.	Consumer Markets					Industrial (Production) Markets					Government Markets
	Category	Type	Incentives	Tax system	Import quotes	Category	Type	Incentives	Tax system	Import quotes	Category
1	Food	fragmented	for local, artizanal cosum	higher for mass products	30%	Agriculture, fishing, forestry, food procesing	fragmented	for local production	higher for largest companies	30%	International organizations, regulatory and support institutions
2	Hygiene – Clothing	regular	for local cosum	higher for mass products	50%	Extractive industries, raw materials, chemical, textile	regular	without	equal	70%	Regulatory, control, and support institutions
3	Private habitat – Housing	fragmented	for local, artizanal cosum	higher for mass products	10%	Industrial equipment and machinery production	strategic	for large compnies	equal	50%	Regulatory, control, and support institutions
4	Collective build enviroment	regular	for local cosum	higher for mass products	50%	Construction, real estate, and housing arrangements	regular	without	equal	70%	Public infrastructure, regulatory institutions
5	Natural collective enviroment	regular	for local cosum	higher for mass tourism	wuthout	Greenery and tourism management	fragmented	for local production	higher for largest companies	without	Public infrastructure, regulatory and support institution, educational, research and development institutions
6	Health	regular	for local cosum	equal	20%	Private medicine	regular	without	equal	70%	Public infrastructure, regulatory and support institution, educational, research and development institutions
						Pharmaceutical industry	strategic	for large compnies	equal	40%	International organizations, regulatory and support institutions
7	Electricity, heat, water, sewage	strategic	for local cosum	equal	30%	Production and distribution of energy, heating, AC, water - sewage facilities	strategic	for large compnies	equal	40%	International organizations, regulatory and support institutions
8	Individual mobility	regular	for local cosum	higher for mass products	30%	Automotive Industry	strategic	for large compnies	equal	30%	Public infrastructure, regulatory institutions
						Motorcycle - velo - cycling industry amd renting services	regular	without	equal	50%	
9	Colective mobility	strategic	for local cosum	equal	30%	Collective and industrial means of transport	strategic	for large compnies	equal	30%	International organizations, regulatory and support institutions
10	Connectivity, internet, information networks in general, household appliancess	strategic	for local cosum	equal	40%	IT&C, robotics, household appliancess industry	strategic	for large compnies	equal	30%	International organizations, regulatory and support institutions

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Table 1. Annex specific to markets (continuation).

No.	Consumer Markets					Industrial (Production) Markets					Government Markets
	Category	Type	Incentives	Tax system	Import quotes	Category	Type	Incentives	Tax system	Import quotes	Category
11	Safety	strategic	equal	equal	20%	Defense industry, private security systems, insurance services	strategic	for large compnies	equal	20%	Defense, public security institutions, regulatory institutions
12	Education and research	regular	equal	equal	20%	Production of didactic material, associative or entrepreneurial education and research services	fragmented	for small compnies	equal	30%	Basic pre-university and university education and research services
13	Facilities for family material support and other forms of association and psycho-social support on a small scale (co-living as example)	fragmented	for local cosum	lower for small entreprises	10%	Associative or entrepreneurial support services for families and small communities (kindergartens, clubs, co-living, etc.)	fragmented	for small compnies	lower for small entreprises	10%	Public infrastructure and support institution
14	Facilities for business, sustainable entrepreneurship	fragmented	for local cosum	lower for small entreprises	40%	Consulting services, production spaces and facilities, logistic, storage, marketing, co-working spaces	fragmented	for SMEs	lower for small entreprises	10%	Co-working spaces and other facilities
15	Facilities for social - cultural - creative entrepreneurship and positive, non-discriminatory religious manifestations	fragmented	for local cosum	lower for small entreprises	10%	Consulting services, marketing, co-working spaces	fragmented	for SMEs	lower for small entreprises	10%	Co-working spaces and other facilities
16	Facilities for preserving the natural, cultural, agricultural heritage	fragmented	for local cosum	lower for small entreprises	10%	Consulting services, production spaces and facilities, logistic, storage, marketing, co-working spaces	fragmented	for SMEs	lower for small entreprises	10%	Co-working spaces and other facilities
17	Sports facilities	fragmented	for local cosum	lower for small entreprises	10%	Private sports associations, private sports spaces and facilities	fragmented	for SMEs	lower for small entreprises	10%	Public sports infrastructure, public institutions
18	Financial - insurance	strategic	equal	equal	40%	Banks, insurance companies, investment funds, stock exchanges, others	strategic	for large compnies	equal	40%	State banks and other public institutions
19	Public administration and governance services	strategic	equal	equal	0	Services and support providers for public administrations	fragmented	for SMEs	lower for SMEs	20%	Central and local public administration, international bodies, justice, regulatory and control institutions

Table 1. Annex specific to markets (continuation).

4. CONCLUSIONS

This section elaborates on the main findings of this research, examining their practical and theoretical implications, their impact on policy development, and business practices, while also outlining future research directions.

4.1. Main Findings

This study highlights the central role of the human factor in shaping a new industrial paradigm, Industry 5.0, which prioritizes three core pillars: human-centricity, sustainability, and resilience. Unlike Industry 4.0, which was primarily driven by digital transformation, automation, and efficiency gains, Industry 5.0

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fosters a synergistic relationship between advanced technologies and human intelligence. This ensures that technological innovation enhances human well-being, creativity, and job quality rather than merely increasing productivity at the expense of human involvement.

The proposed Society 5.0 policy framework, structured around six key pillars, offers a comprehensive approach to maintaining economic and societal stability. It safeguards the labor market by promoting policies that prevent large-scale job displacement due to AGI and other disruptive technologies. Additionally, this framework introduces mechanisms for inclusive innovation, ensuring that digital and cyber-physical systems serve human interests rather than marginalizing workers or deepening socioeconomic inequalities.

Building upon this foundation, the Sustainable Business Model for Industry 5.0 provides a structured pathway for balancing industrial competitiveness with social and environmental responsibilities. By promoting diverse economic structures, circular income flows, and a harmonized interaction between SMEs, large corporations, and global markets, this model fosters a more resilient, inclusive, and ethically responsible economy. It emphasizes policies such as localized production, circular economy practices, and market-specific regulations, ensuring that businesses operate within a framework that encourages sustainability and social well-being.

Together, the Society 5.0 policy framework and the Sustainable Business Model for Industry 5.0 provide actionable strategies that support long-term sustainability, equitable growth, and the seamless integration of emerging technologies within human-centered economic systems. These findings underscore the necessity of rethinking traditional business and policy structures, ensuring that technological advancements contribute to a more balanced and prosperous society rather than exacerbating economic and social disparities.

It may be concluded that the main 10 reasons why human factors have a very important role in the sustainable business model of Industry 5.0 are:

1. Providing the balance between humans and artificial intelligence
Industrial progress in AI and automation poses the danger of replacing human workers which creates unemployment instability in society. The Industry 5.0 sustainable business model protects human decision-making authority while strengthening their position by apliying ergonomics rather than substituting them with technology.

2. Contribution to the psychosocial well-being of employees
Proper use of ergonomic principles in Industry 5.0 workspaces develops areas where workers experience lower physical along with mental stress which results in better employee satisfaction levels and enhanced team member bonding. Organizations who implement workstations and tools that follow ergonomic principles prove their dedication to employee well-being thus building team trust and increasing employee morale along with a better workplace culture.

3. Preserving of the market economy and circular income flow
Organizations achieve better market positioning and decreased production costs when they implement workplaces designed according to ergonomics because it supports staff productivity growth and higher

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product standards. This support maintains business benefits by reducing expenses from medical treatment and labor absence. The funding of ergonomic solutions creates a sustainable cycle allowing better workforce performance to generate additional revenue which allows more workplace enhancements for continued economic flow between businesses and their workers and the economy.

4. Ensuring workers' safety and health
To lower the chances of injuries, musculoskeletal disorders and stress to employees, workplaces, machines and processes are designed with human safety in mind. This is in direct contribution to safety and worker wellbeing.

5. Enhancing productivity and efficiency
Humans working with machines or processes experience reduced fatigue because of ergonomic design which leads to better productivity results. The system becomes more efficient for resource allocation together with waste reduction when ergonomic design principles apply.

6. Contribution to employee satisfaction
Comfort and satisfaction of employees increase due to ergonomic working conditions, which in turn may reduce the workforce turnover and increase the motivation.

7. Improvement of sustainability and social responsibility
A company shows its social responsibility through ergonomic workplace design which places worker health and safety first. Organizations that implement ergonomic solutions generate multiple positive social effects which help achieve corporate sustainability commitments alongside social accountability requirements.

8. Ensuring adaptability and inclusiveness
Ergonomic design allows employers to put together a workplace that suits all workers, including those with special or different needs.

9. Providing a holistic approach to work
Industry 5.0 is not only about making profit but it is also about sustainable future in the long term through ethical and socially responsible practices. Ergonomics make sure that people are at the core of this system and that human values are coupled with technological advancement.

10. Possibility of participation in the creation of Industry 5.0 directives and regulations
Ergonomic experts and Human factors specialists can participate in multidisciplinary teams for creation of directives and regulates that relates to Industry 5.0.

4.2. Practical Implications

The findings of this study have significant implications for policymakers, businesses, and industry leaders. The proposed sustainable business model offers guidance on structuring markets based on their strategic importance, allowing policymakers to implement targeted tax systems, incentives, and protectionist measures to sustain industry competitiveness. For businesses, Industry 5.0 necessitates the development of ethical and sustainable business strategies that foster collaboration between human

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workers and AI-driven systems. Companies must align their operational goals with sustainability initiatives, such as circular economy principles and ESG reporting, to maintain long-term viability and social responsibility.

Moreover, organizations must proactively address workforce transformations by investing in upskilling programs and fostering work environments where human employees retain meaningful roles. The study also suggests that government policies should encourage ethical consumption by promoting green and socially responsible products through market-driven incentives.

4.3. Theoretical Contributions

This research contributes to the theoretical foundation of Industry 5.0 by advancing the discourse on human-centric and sustainable industrial practices. The study extends existing socio-technical theories by integrating Industry 5.0 concepts with sustainability frameworks, emphasizing the importance of human well-being in economic and technological progress. Furthermore, it enhances the understanding of market segmentation within Industry 5.0 by categorizing markets into strategic, regular, and fragmented domains. This classification provides a new lens for analyzing how different industries should be regulated and supported within a sustainable business framework.

4.4. Policy Development Impact

The study provides valuable insights for policymakers seeking to implement regulatory frameworks that ensure a balanced and sustainable industrial ecosystem. Key policy recommendations include implementing taxation and incentive structures tailored to strategic, regular, and fragmented markets; enforcing ESG reporting standards to promote corporate transparency and social responsibility; developing policies to mitigate risks associated with AGI by maintaining human oversight in decision-making processes; supporting SMEs through financial incentives, innovation grants, and access to technology; and encouraging local and circular economy initiatives to enhance resilience and reduce dependency on global supply chains.

These policy measures aim to create a fair and competitive industrial landscape that aligns economic progress with social and environmental sustainability.

4.5. Future Research Directions

While this research provides a comprehensive framework for integrating human-centric principles, several areas require further investigation:

- AI Governance and Regulation: Future studies should explore governance models that ensure responsible AI development while balancing innovation and human control.
- Economic Impact of Industry 5.0: Additional research is needed to quantify the long-term economic effects of human-centric industrial policies on global markets.
- Workforce Adaptation and Skill Development: Empirical studies should examine effective strategies for reskilling workers and assessing job displacement risks in Industry 5.0 environments.

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- Sustainability Metrics and Performance Evaluation: Further research should develop standardized metrics for measuring the effectiveness of sustainable business models within Industry 5.0.
- By addressing these research gaps, scholars and practitioners can refine Industry 5.0 frameworks and contribute to the development of more resilient, equitable, and sustainable industrial ecosystems.

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