A Systematic Review on Industrial 4.0 Readiness for Environmental Sustainability Considering Cultural Influences

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***Abstract*—** This systematic literature review (SLR) investigates the development of sustainability guidelines tailored for Industry 4.0, emphasizing the influence of cultural factors and the multidimensionality of existing sustainability models. Industry 4.0 represents a pivotal shift in industrial operations, integrating advanced technological innovation with a human-centric focus to achieve sustainability goals. Cultural factors, however, play a crucial role in shaping the success of such initiatives. This research examines how the various dimensions of sustainability models are influenced by cultural considerations and provides a comprehensive analysis of their impact on Industry 4.0 readiness. The findings of the SLR underscore that aligning technology with local cultural values, engaging stakeholders across diverse societal levels, and fostering capacity-building through culturally relevant training and education are vital to enhancing the effectiveness of sustainability practices. The proposed guidelines advocate for incorporating cultural analysis during the early planning phases, developing culturally sensitive communication strategies, formulating adaptable and flexible policies, and promoting international collaboration that respects cultural diversity. This study contributes valuable insights into the dynamic interplay between cultural influences and sustainability within the Industry 4.0 framework, emphasizing the importance of culturally responsive strategies for achieving enduring sustainable outcomes.

Keywords: *Cultural Value, Environmental Sustainability, Industry 4.0, Society 5.0.*

I. INTRODUCTION

The concept of Industry 4.0 has become a widely discussed topic in recent times. It involves the convergence of technological advancements, automation, and digitization within various industries, leading to the transformation of processes to better meet the evolving needs of society. Industry 4.0 is characterized by the increasing integration of digital technologies into products, processes, and services across all sectors. This rapid digital interconnectedness of devices, machines, people, and industries generates a significant amount of data within physical products and industrial activities. The digitization of industries is expected to bring about economic growth, create new job opportunities, and generate additional income streams across various sectors.

As industry 4.0 initiatives develop exponentially, there is interest across industries and business sectors to understand the implications concerning sustainability [1]. There is scant literature that addresses how Industry 4.0 might have implications for emerging themes of social, economic, and environmental sustainability in socio-technical systems. Socio-Technical Systems Approach is a relevant theory-focused framework to define, analyze, and reflect on emerging issues of sustainability and system transformation in the context of Industry 4.0 so that focus can be placed on bridging the social and technical aspects of production systems [2].

The emergence of Society 5.0 intends to address such an issue where the coexistence of humanity with machines with emphasis on blending technology with social systems with a more significant interest in the social aspect than in the industrial one. Nonetheless, to meet the needs of Society 5.0, the impact of cultural and social values on environmental sustainability in Industry 4.0 needs an understanding of the evolving Industry 5.0 by determining how smart technologies inclusively maintain cultural systems and values [3].

A more nuanced understanding is achieved by incorporating Hofstede's cultural dimensions into evaluating Industry 4.0 readiness for environmental sustainability. This approach emphasizes the importance of aligning

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technological advancements with cultural values to promote sustainable practices effectively. It acknowledges that strategies for mitigating environmental impact and fostering sustainable development must consider the cultural contexts in which they are applied. However, a limitation of this approach is the complexity of uniformly applying these dimensions across diverse organizational contexts, where interpretations of cultural values can differ widely [4].

Additionally, while Hofstede's framework offers a structured way to understand cultural influences, it may oversimplify the dynamic nature of cultural interactions with technological advancements in Industry 4.0, potentially overlooking critical cultural factors [5]. The reliance on Hofstede's dimensions may not fully capture emerging cultural trends or changes influenced by global connectivity and evolving societal norms, limiting its applicability in dynamic industrial environments [6]. Thus, while Hofstede's cultural dimensions provide a foundational framework, their application in evaluating environmental sustainability in Industry 4.0 readiness requires careful consideration of inherent limitations and the need for complementary approaches [7].

This paper examines the innovative approach of integrating Hofstede's cultural value dimensions into the assessment of Industry 4.0 readiness for environmental sustainability. By doing so, it aims to enhance existing frameworks and methodologies, offering a comprehensive evaluation that considers both technological capabilities and cultural nuances. Ultimately, this integration seeks to promote a more sustainable and culturally aligned deployment of Industry 4.0 technologies, ensuring that progress toward environmental sustainability is achieved in a manner that respects and aligns with diverse cultural values globally.

II. THEORETICAL BACKGROUND

Identifying the influence of cultural values on environmental sustainability in the context of Industry 4.0 readiness requires examining how organizational and societal norms shape attitudes and behaviors towards both technology adoption and sustainable practices. Cultural values like collectivism, long-term orientation, and uncertainty avoidance significantly impact an organization's approach to environmental sustainability as it integrates Industry 4.0 technologies.

The increasing emphasis on environmental sustainability in the manufacturing industry has led to the exploration of how Industry 4.0 technologies can contribute to this goal. While previous studies have highlighted the potential of Industry 4.0 to enhance environmental sustainability, the current focus of this industrial revolution has been primarily on increasing production and quality to boost revenues and competitiveness [8]. This suggests that the environmental aspects have not been given sufficient attention, and there is a need to better understand the cultural values that influence the readiness for an environmentally sustainable industry [9].

One key challenge in this regard is the unification of regulations, organizational protocols, and the adoption of a compatible legal framework to support the integration of environmental sustainability into Industry 4.0 [9]. Additionally, the shortage of skilled workers who can navigate the complex interplay between technology and environmental sustainability is another barrier [9].

To address these challenges, top management must be convinced to prioritize investment support and create a system that can facilitate technology convergence to drive supply chain sustainability [10]. Managers must also act on new models of employment and frame plans to continuously improve the system, considering the social aspects of sustainability alongside the economic and environmental dimensions [10].

Research Question 1: How to identify the cultural values that influence environmental sustainability toward Industry 4.0 readiness?

Environmental sustainability in the context of Industry 4.0 readiness is significantly influenced by cultural values that shape how organizations and societies approach both technology and the environment. Key factors include long-term orientation, which encourages investment in sustainable technologies that provide future benefits, aligning with the long-term goals of Industry 4.0 [11]. Collectivism plays a crucial role by fostering a sense of shared responsibility towards the environment, promoting collaborative efforts in adopting green technologies and sustainable practices [12]. High uncertainty avoidance can impact the adoption of innovative, eco-friendly solutions, as cultures with this trait may be more cautious and resistant to change; however, if the environmental and economic benefits of these innovations are clear, this can be overcome [13]. Power distance also matters as organizations with low power distance may empower employees at all levels to contribute to sustainability initiatives, facilitating a more inclusive and innovative approach to environmental challenges [14][15][16]. Finally, a culture that values harmony with nature will likely prioritize the integration of sustainable practices in Industry 4.0, ensuring that technological advancements are balanced with environmental stewardship. These cultural factors are crucial in determining how effectively an organization can align its sustainability goals with the technological advancements of Industry 4.0.

Research Question 2: What are the significant factors of environmental sustainability toward Industry 4.0 readiness based on cultural value influences?

III. REVIEW METHOD

Given that this paper seeks to address specific outcomes through two distinct research questions, a systematic literature review (SLR) was deemed more appropriate than a traditional, broader literature review. To contribute to the existing body of knowledge on Industry 4.0 readiness, the SLR methodology, guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), was employed [17][18][19]. PRISMA is an evidence-based reporting standard recognized for its efficacy in critical appraisal. The SLR methodology is particularly advantageous as it methodically synthesizes existing research to address the research questions. Moreover, the application of inclusion and exclusion criteria, alongside two rounds of article reduction, resulted in a focused selection of articles. In this study, this review technique has been instrumental in identifying various readiness models and subsequently refining the scope to focus exclusively on Industry 4.0 readiness models and dimensions. By definition, a systematic review rigorously examines a clearly defined question using explicit methods for critical appraisal, with or without the

application of statistical procedures [19]. This literature review has been designed with a structured and rigorous approach, ensuring its replicability, which allows for future updates incorporating the latest findings on Industry 4.0 readiness.

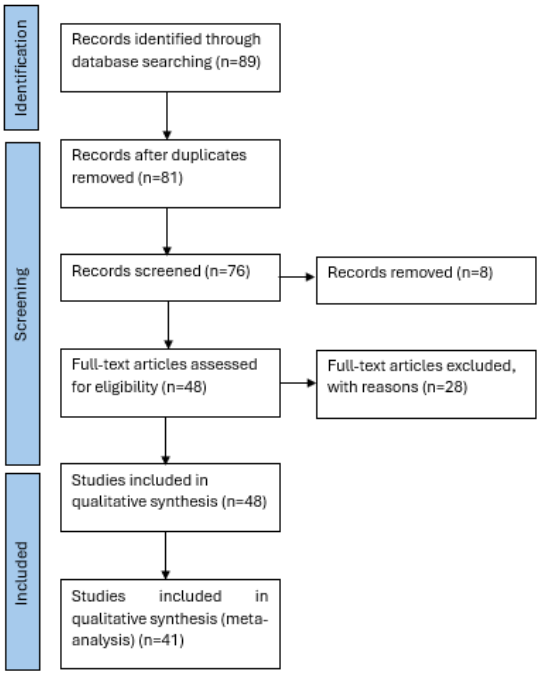


Fig. 1. PRISMA flowchart

In conducting the data analysis, the methodology was augmented by the use of content analysis, a technique frequently favored in social sciences research. Content analysis, a systematic approach, involves the categorization of specific words or codes within a text into defined categories [20]. Similarly, in this review paper, themes were developed by grouping similar contexts and meanings, which informed the findings presented in the subsequent section [21].

A. Framing Research Questions for the Reviews

Framing research questions for literature reviews is a critical step that shapes the direction and scope of the entire review process. A well-framed research question provides clarity and focus, guiding the search for relevant literature and the subsequent analysis. To frame an effective research question, it is important to start with a broad topic of interest and then narrow it down to specific aspects that are both relevant and researchable.

The aim of a literature review on environmental sustainability about Industry 4.0 readiness is to systematically explore and synthesize existing research on how modern technological advancements and digital transformations are impacting environmental sustainability within industrial practices. This type of review seeks to understand the interplay between Industry 4.0 technologies—such as the Internet of Things (IoT), artificial intelligence (AI), big data analytics, and cyber-physical systems—and their potential to enhance or hinder sustainable practices in industrial settings. Our LRS sought to address the following primary research questions (RQ):

a) How to identify the cultural values that influence the environmental sustainability toward Industry 4.0 readiness?
b) What are the significant factors of environmental sustainability toward Industry 4.0 readiness based on cultural value influences?

B. Identifying Relevant Works

Identifying relevant works in a literature review is essential for systematically selecting and evaluating sources pertinent to the research question or topic [22]. This involves conducting a comprehensive search of academic databases, journals, books, and other credible sources using specific keywords and search terms to gather a wide range of literature. Each source is then critically evaluated based on relevance, credibility, and quality, considering factors such as publication date, author and journal reputation, methodologies, and significance of findings [23] [24]. The aim is to filter out irrelevant or low-quality works and focus on those providing valuable insights and evidence. This process helps build a solid foundation of existing knowledge, identifies gaps the current research aims to fill, and ensures the literature review is comprehensive, well-informed, and grounded in credible sources [25]. Ultimately, this enhances the quality, reliability, rigor, and depth of the research project. Conducting a thorough literature review requires systematic planning and execution to ensure a comprehensive and thoughtful evaluation of the existing body of knowledge.

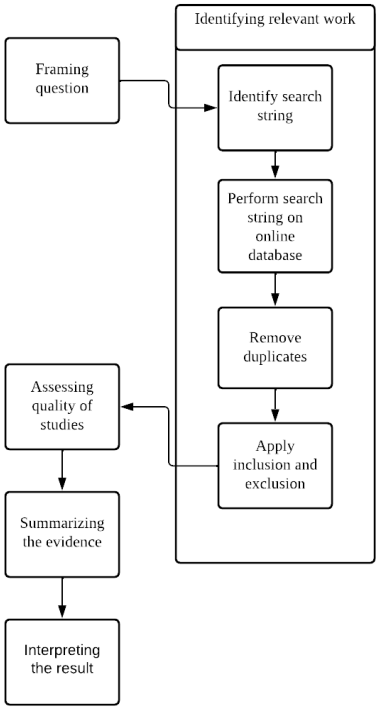


Fig. 2. PICOC Flowchart

Several keywords were devised to establish inclusion and exclusion criteria, as well as to construct database search strings. The formulation of these search strings involved combining synonyms and alternate spellings of the query items using "and" and "or" operators. The most relevant and applicable terms were selected for the study area based on the PICOC (Population, Intervention, Comparison, Outcome, Context) framework. As a result, the search phrases

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"environmental sustainability" and "readiness on industry 4.0" were identified. The initial results were used as a pilot to evaluate the inclusion criteria of the review's findings, undergoing multiple iterations before finalizing the query. Since the initial query did not capture all relevant studies, the query string was revised to include additional keywords. The keywords added to the search string are as follows:

- "Cultural value influences" AND "environmental sustainability"
- "Culture value influences" AND "Industry 4.0 readiness"
- "Environmental sustainability" AND "Industry 4.0 readiness"

Finding the source and choosing the studies: To obtain as many pertinent publications as possible, keywords were searched through each publication's title and abstract. The major search procedure involved the utilization often digital databases, namely Scopus. Using the above-mentioned search phrase, a systematic literature search was performed on selected databases: the first search produced 2250 studies. The inclusion and exclusion criteria for all remaining articles were then applied before any duplicate papers were eliminated in the following stage.

TABLE I. INCLUSION AND EXCLUSION PAPER CRITERIA

Inclusion	•	Published between 2018 and 2024
	•	Published in peer-reviewed journals and proceedings
	•	Published in English Language
	•	Articles on Industry 4.0 and Environmental sustainability
Exclusion	•	Published in other language than English
	•	Survey and review papers
	•	Published magazines, websites, and book chapters
	•	Articles related to Layer 1

The final publication had been carefully examined and at the same time, the full texts and abstract of the chosen articles were assessed. A set of standards is used for each chosen article to assess its quality and establish the significance of the findings and conclusion and exclusion criteria and duplicate articles were eliminated. The final publications have been carefully examined based on abstracts and the full texts of the publications.

IV. RESULT

The review method in section 2 is used to generate the search result. A total of 2251 primary studies were synthesized for the final method. Fig. 3 was established after a careful analysis of the papers that were a part of the current study. Interestingly, the authors concentrated on the studies that satisfied the inclusion requirements listed in the Review method.

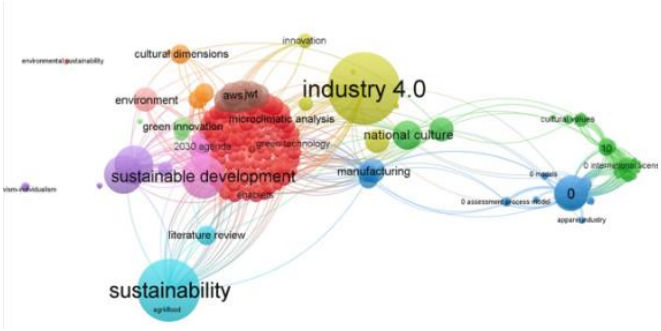


Fig. 3. Paper Cross between Papers

A. *Discussion on Environmental Sustainability and Industry 4.0 Readiness*

After an extensive review and analysis of the literature, including rigorous examination of numerous scholarly articles and journals, the following key insights have been distilled. To enhance accessibility and facilitate translation for broader audiences, the researcher has summarized the critical points derived from all sources consulted.

Research indicates that industries with higher readiness for Industry 4.0 technologies can achieve greater resource optimization, leading to environmental benefits. Companies that have successfully implemented smart sensors and IoT systems can monitor and manage resource usage more effectively. For example, industries with advanced data analytics capabilities can reduce energy and material waste by optimizing production processes and detecting inefficiencies in real-time [26], [27]. This leads to a more sustainable use of resources and a reduction in environmental impact.

Industries that are ready to adopt Industry 4.0 technologies are better positioned to integrate renewable energy sources. Smart grids and energy management systems facilitated by Industry 4.0 can optimize the use of renewable energy and improve energy efficiency, demonstrating that companies with high Industry 4.0 readiness can better manage energy storage and distribution, leading to increased reliance on renewable energy and reduced carbon footprints [28]. Existing literature suggests that the adoption of Industry 4.0 technologies also has a positive impact on supply chain sustainability.

B. *Challenges in Achieving Readiness for Environmental Sustainability*

One of the major challenges faced by industries in achieving readiness for Industry 4.0 is the significant investment required in technology and infrastructure. A study reveals that the initial costs of implementing Industry 4.0 technologies can be a barrier, particularly for small and medium-sized enterprises (SMEs) [29], [30]. These costs include not only the purchase of advanced technologies but also the necessary upgrades to existing infrastructure. This financial challenge can delay the adoption of sustainable practices that Industry 4.0 technologies can facilitate. Additionally, the lack of a clear strategic vision and roadmap for Industry 4.0 adoption has been identified as a key barrier. Organizations need to have a well-defined digital strategy that aligns with their overall business objectives and guides the implementation of Industry 4.0 technologies [31].

Another critical challenge is the skills and knowledge gap within the workforce. The successful implementation of

Industry 4.0 technologies requires specialized skills in data analytics, AI, and cybersecurity. Many industries face difficulties in finding and retaining personnel with the necessary expertise [32]. This skills gap can hinder the effective use of Industry 4.0 technologies for environmental sustainability, as industries may struggle to fully leverage the potential of these technologies. To address this challenge, educational institutions need to adapt their programs to equip students with the requisite skills for the Industry 4.0 era. Universities play a crucial role in bridging the skills gap and preparing a future-ready workforce.

C. Policies and Frameworks to Support Readiness

Government policies and frameworks play a crucial role in supporting industries' readiness for Industry 4.0 and their environmental sustainability goals. Policies that provide financial incentives, tax breaks, or subsidies for the adoption of Industry 4.0 technologies can help mitigate the investment barrier [33]. Additionally, policies that promote research and development in sustainable technologies can accelerate the transition to more environmentally friendly practices. The vision of Industry 4.0 is to bring about improvements in various industrial processes, including supply chain management, to achieve greater sustainability.

The establishment of industry standards and best practices is also essential in guiding industries towards effective implementation of Industry 4.0 technologies. Research emphasizes the importance of developing standards that address both technological and environmental aspects. These standards can help ensure that Industry 4.0 technologies are implemented in a way that maximizes their environmental benefits and minimizes potential negative impacts.

D. Case Studies and Practical Insights

Several case studies illustrate successful implementations of Industry 4.0 technologies that have led to improved environmental sustainability. For example, showcases a manufacturing company that integrated IoT sensors and AI to optimize its production processes, resulting in a significant reduction in energy consumption and waste [34]. Such case studies provide practical insights and best practices that other industries can follow to enhance their readiness and sustainability. From these case studies, valuable lessons can be learned about the factors that contribute to successful Industry 4.0 adoption and its environmental benefits. Key factors include a clear strategic vision, strong leadership commitment, and ongoing investment in technology and workforce development. Addressing these factors can help industries overcome challenges and achieve their sustainability goals.

The readiness of industries to adopt Industry 4.0 technologies is closely linked to their ability to achieve environmental sustainability. While advancements in resource optimization and renewable energy integration highlight the benefits of Industry 4.0, challenges such as investment costs and skills gaps must be addressed. Supportive policies, industry standards, and practical case studies can guide industries in overcoming these challenges and leveraging Industry 4.0 technologies to enhance environmental sustainability. Ongoing research and collaborative efforts will be essential in shaping a sustainable future for industrial operations.

V. Discussion

A. Research Question 1. How to identify the cultural values influences on the environmental sustainability toward Industry 4.0 readiness?

As the global industrial landscape shifts toward Industry 4.0, the interplay between cultural values and environmental sustainability becomes increasingly significant. Cultural values, deeply rooted in societal norms, beliefs, and practices, play a crucial role in shaping attitudes and behaviors toward sustainability initiatives [35]. Understanding how these cultural factors influence the adoption and implementation of Industry 4.0 technologies is essential for fostering environmentally sustainable practices within this new industrial paradigm [36][37].

One of the most effective approaches to identifying the influence of cultural values on environmental sustainability in the context of Industry 4.0 is through cross-cultural analysis. Comparative studies that examine different cultural contexts can reveal how various societies prioritize and integrate sustainability within their industrial strategies. By comparing regions or countries with differing cultural backgrounds, researchers can identify patterns and correlations between cultural values and the readiness to adopt environmentally sustainable Industry 4.0 practices [38].

Surveys targeting key stakeholders—such as industry leaders, policymakers, and employees—can provide valuable insights into the perceived importance of environmental sustainability and its alignment with cultural values [39]. These surveys can be designed to assess attitudes toward specific Industry 4.0 technologies, their environmental impact, and how these attitudes are influenced by cultural norms. Empirical data collected through such surveys can help quantify the relationship between cultural values and environmental sustainability, offering a clearer understanding of how cultural factors drive or hinder sustainable practices [40].

Case studies of organizations that have successfully integrated environmental sustainability into their Industry 4.0 strategies can shed light on the role of cultural values in this process ([38] [35]. Ethnographic research, which involves in-depth observation and analysis of specific organizational cultures, can uncover the underlying cultural drivers that support or obstruct sustainable practices. By examining the cultural dynamics within these organizations, researchers can identify key cultural traits that facilitate or challenge the adoption of environmentally sustainable technologies and practices [41].

Frameworks such as Hofstede's Cultural Dimensions or Schwartz's Value Theory can be applied to assess the impact of specific cultural dimensions—such as individualism vs. collectivism, power distance, or long-term orientation—on environmental sustainability efforts [41]. These frameworks allow researchers to systematically analyze how particular cultural characteristics influence attitudes toward sustainability and the readiness to embrace Industry 4.0 technologies. For example, cultures with a strong long-term orientation may be more inclined to invest in sustainable Industry 4.0 solutions that promise long-term environmental benefits.

The influence of cultural values on environmental sustainability can also be observed through the analysis of national policies and regulations that promote Industry 4.0

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readiness [42]. Countries with strong cultural values that emphasize environmental stewardship are more likely to implement policies that encourage the adoption of sustainable technologies [43][44]. By examining the alignment between cultural values and regulatory frameworks, researchers can assess how cultural factors shape the policy landscape and, in turn, influence the readiness of industries to adopt environmentally sustainable practices.

Given the complex nature of the relationship between cultural values and environmental sustainability in the context of Industry 4.0, interdisciplinary approaches that combine insights from cultural studies, environmental science, industrial engineering, and economics are crucial [45]. Such approaches can provide a holistic understanding of how cultural values influence the various dimensions of Industry 4.0 readiness, from technological adoption to policy formulation and organizational change.

Identifying the influence of cultural values on environmental sustainability toward Industry 4.0 readiness requires a multifaceted approach that combines cross-cultural analysis, empirical research, case studies, and theoretical frameworks. By understanding the cultural underpinnings of sustainability practices, stakeholders can develop strategies that are culturally sensitive and more likely to succeed in promoting sustainable Industry 4.0 initiatives. Ultimately, acknowledging and integrating cultural values into the discourse on Industry 4.0 readiness will be key to achieving long-term environmental sustainability in the industrial sector.

B. Research Question 2. What are the significant factors of environmental sustainability toward industry 4.0 readiness based on cultural value influences?

The transition toward Industry 4.0, characterized by advanced automation, data exchange, and the integration of cyber-physical systems, necessitates a thorough examination of environmental sustainability, which is increasingly recognized as a critical component of industrial modernization. Significant factors influencing this sustainability include technological innovation, resource efficiency, regulatory frameworks, and stakeholder engagement, all of which are deeply embedded within and influenced by the cultural values prevalent in specific industrial contexts [46][47]. Cultural values shape organizational behavior, decision-making processes, and the prioritization of sustainability goals, thereby affecting how companies perceive and implement Industry 4.0 technologies in an environmentally responsible manner. For instance, in cultures with a high degree of uncertainty avoidance, there may be resistance to adopting new technologies, which could hinder the pursuit of sustainability through Industry 4.0 innovations. Conversely, cultures that emphasize long-term orientation and collective well-being may be more proactive in integrating sustainable practices into their Industry 4.0 strategies. Additionally, the role of cultural dimensions, such as power distance and individualism versus collectivism, cannot be overlooked, as they influence the hierarchical structures and collaborative efforts necessary for successful sustainability initiatives. Therefore, understanding the cultural underpinnings that guide industrial practices is essential for enhancing Industry 4.0 readiness in a way that aligns with global sustainability goals. The interplay between cultural values and technological readiness underscores the need for culturally tailored approaches to Industry 4.0, ensuring that the adoption of cutting-edge technologies contributes positively to environmental sustainability. This cultural sensitivity is crucial in addressing the diverse challenges and opportunities that arise in different industrial settings, highlighting the importance of a holistic approach that integrates cultural, technological, and environmental considerations for a sustainable future in the era of Industry 4.0 [48][49].

However, the readiness to integrate these technologies effectively into sustainable practices is profoundly impacted by cultural values [50]. For instance, in cultures that prioritize long-term orientation and collective well-being, such as those in Scandinavia, there is often a stronger alignment between sustainability goals and the adoption of Industry 4.0 technologies. These cultures are likely to embrace innovative practices that support environmental stewardship, viewing sustainability as a shared responsibility. Conversely, in cultures with high uncertainty avoidance or low long-term orientation, there may be resistance to adopting new technologies, driven by concerns over potential risks and disruptions [51][52]. Additionally, cultural dimensions such as power distance and individualism versus collectivism influence how organizations perceive and implement sustainability measures; high power distance cultures may experience top-down pressure to adopt sustainable practices, whereas low power distance and more collectivist cultures might see more collaborative efforts toward integrating sustainability [53][54]. Regulatory frameworks, technological innovation, and stakeholder engagement are significant factors in this context, but their impact is modulated by the cultural values that drive organizational behavior and decision-making. Understanding these cultural nuances is essential for tailoring Industry 4.0 strategies that are both technologically advanced and culturally sensitive, ensuring that sustainability goals are achieved in a manner that aligns with the values of diverse organizational environments.

VI. CONCLUSION

In conclusion, the integration of environmental sustainability within the framework of Industry 4.0 is profoundly influenced by cultural value preferences, which shape both the adoption and implementation of advanced technologies. As organizations transition to Industry 4.0, they encounter diverse cultural landscapes that impact their approach to sustainability. Cultures that emphasize long-term orientation and collective well-being, such as those prevalent in many East Asian countries, often exhibit a proactive stance toward sustainable practices, readily embracing technologies that enhance resource efficiency and reduce environmental impact. Conversely, cultures with high levels of uncertainty avoidance or a strong focus on short-term results may exhibit resistance to rapid technological adoption or sustainability measures, affecting their readiness for Industry 4.0 initiatives. Regulatory frameworks and stakeholder engagement strategies are also mediated by cultural values, which influence the effectiveness of sustainability policies and practices. For example, in cultures with high trust in institutions and strong community values, there is often greater alignment between technological advancements and sustainability goals. Therefore, understanding and integrating cultural preferences is essential for developing effective

strategies that promote environmental sustainability within Industry 4.0. Businesses and policymakers must tailor their approaches to align with cultural values to achieve successful and sustainable technological integration. Future research should continue to explore how different cultural contexts impact the interaction between Industry 4.0 readiness and environmental sustainability, providing insights for more culturally adaptive and effective sustainability strategies.

In conducting a systematic literature review, several limitations must be acknowledged to ensure a comprehensive understanding of the research findings. Firstly, the review is constrained by the availability and accessibility of relevant literature, which may lead to publication bias. Studies that are not published or are inaccessible due to subscription barriers can be overlooked, potentially skewing the results. Additionally, the scope of the review is limited by the selection criteria and search terms used, which may inadvertently exclude relevant studies or restrict the review to certain geographical or temporal contexts. Another limitation is the variability in study quality and methodology; differences in research designs, data collection methods, and analytical approaches can affect the comparability of findings and introduce heterogeneity in the results. Furthermore, the reliance on English-language publications may result in language bias, excluding valuable insights from studies published in other languages. The synthesis of findings is also influenced by the subjective interpretation of the literature, which can introduce researcher bias. Lastly, the dynamic nature of the field means that new research findings may emerge after the review is completed, potentially affecting the relevance and comprehensiveness of the conclusions drawn. Addressing these limitations requires ongoing updates to the review, careful consideration of inclusion criteria, and transparency in the review process to enhance the validity and reliability of the findings.

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