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ICASE'25

INTERNATIONAL CONFERENCE ON ALIGNING SDGs & ESG:

Shaping Pathways for a Sustainable and Inclusive Future

8th March 2025

Conference Proceedings & Abstracts

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Editor: Dr. Madan Survase

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International Conference on “Aligning SDGs and ESG: Shaping Pathways for a Sustainable and Inclusive Future"

Conference Proceedings and Abstracts

Editor, Dr. Madan Survase, Associate Professor- Economics

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Acknowledgement

It gives me immense pleasure to present the Proceedings of the International Conference on **"Aligning SDGs and ESG: Shaping Pathways for a Sustainable and Inclusive Future",** held on March 8, 2025.

This volume would not have been possible without the dedication, support, and collaboration of many individuals and institutions. I extend my heartfelt gratitude to our esteemed Keynote Speaker, Mr. Saugata Bhattacharya, Member of the Monetary Policy Committee, RBI, for his insightful address that enriched the conference and inspired meaningful dialogue.

I am especially thankful to Dr. Pramod Kumar, President ISB&M for his continuous guidance, encouragement, and intellectual support throughout the planning and execution of the conference.

My sincere thanks to Dr. Veerendra Rai, Director of ISB&M for his continuous support.

Sincere thanks to all the paper presenters, authors, reviewers, and session chairs whose scholarly contributions from the heart of this publication. Your work adds immense value to the ongoing discourse on sustainable and inclusive development.

I also wish to acknowledge the tireless efforts of the organizing committee, volunteers, and technical team who worked behind the scenes to ensure the smooth conduct of the event and the successful compilation of this volume.

Finally, I am grateful to all participants and attendees for their enthusiastic engagement, thoughtful questions, and commitment to sustainability.

On behalf of the editorial team, I hope this collection serves as a meaningful resource and a step forward in aligning academic thought with practical, sustainable action.

Dr. Madan Survase
Editor
Conference Proceedings
March 8, 2025

Foreword

We are delighted to present the Conference Proceedings of the International Conference on "**Aligning SDGs and ESG: Shaping Pathways for a Sustainable and Inclusive Future**" held on March 8, 2025. This event brought together a vibrant community of scholars, practitioners, policymakers, and students, all committed to advancing conversations around sustainability, governance, and inclusive growth.

The central theme of the conference—aligning the United Nations' Sustainable Development Goals (SDGs) with Environmental, Social, and Governance (ESG) frameworks—reflects the growing recognition that long-term development must be rooted in responsible practices and inclusive approaches. The papers presented here highlight diverse perspectives, research findings, and innovative practices that contribute meaningfully to this global discourse.

We were honored to have Mr. Saugata Bhattacharya, Member of the Monetary Policy Committee, RBI, as our keynote speaker. His thought-provoking address set the tone for the day, encouraging critical reflection on how economic policy, sustainability, and governance intersect in shaping our shared future.

We extend our sincere thanks to Dr. Kumar for his valuable support and guidance throughout the planning and execution of the conference. We also express heartfelt gratitude to the organizing team, contributors, and participants who made this event a success.

This volume is a testament to our collective effort and shared vision for a sustainable and inclusive world. We hope it serves as a valuable resource for future research, dialogue, and action.

Dr. Madan Survase
Editor & Convener

Dr. Manoj Sharma
Co-Editor and Co-convener
International Conference on SDGs and ESG: Shaping Pathways for a Sustainable and Inclusive Future
March 8, 2025

International School of Business & Media

ISB&M, founded in the year 2000 by esteemed Prof. (Dr.) Pramod Kumar (Ph.D. IIT Bombay, Prof., XLRI and ex-Director, SIBM), has established itself as a beacon of wisdom and excellence in over two decades. Through Dr. Kumar's transformative leadership and vision for unmatched quality, ISB&M has risen to become one of the top management schools in India (top 2% media ranking - TOI). ISB&M group also has Engineering & and BBA programmes affiliated to Pune University. ISB&M is unwaveringly committed to its mission of developing dynamic professionals who lead in a changing global business environment. Over 10,000 accomplished alumni working across the globe in leadership roles with the companies like Google, Apple, Goldman Sachs, Microsoft, L'Oréal, and other equally renowned organizations. ISB&M alumni work in 36 countries - large number in US, Canada, UK, Europe, Singapore and Dubai. ISB&M, Pune has garnered significant recognition in the field of education. In the 2023 Times B School Ranking by TOI, it secured the 2nd position among Pune's top private institutes and ranked 3rd in the Top 20 West Zone B Schools category. Furthermore, the institute was honored with the 4th place in the CSR-GHRDC B-Schools Survey for Top B-Schools of Super Excellence. ISB&M has forged strategic partnerships for students and faculty exchange, research collaboration and joint programmes with California State Polytechnic University, Pomona, USA, and with the International Association CTIF in Denmark to enrich its engineering education programs. The institute exhibits a strong commitment to nurturing academic research and facilitating meaningful industry interaction through research conferences, Faculty Development Programs (FDP), and Management Development Programs (MDP).

President, ISB&M

Dr. Pramod Kumar,

President International School of Business & Media.

Ph.D. (Organizational Behavior), IIT Bombay, Formerly with IIM Ahmedabad, Former Chairperson Placement XLRI, Jamshedpur, Ex-Director, Symbiosis Institute of Business Management, Pune; Consultant to over 80 companies worldwide.

Author of over 100 research papers, case and management games. Research quote internationally in textbooks and journal Served on Government of India Committee on Management Education.

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Ph.D., Industrial & Systems Engineering, IIT Kharagpur MS Computer & Info. Science, NJIT USA.

Over 30 years' experience. Worked across many streams in Business Systems & Cybernetics, Business Policy & Business Rules, Program Management, Domain knowledge Structure and Service Systems & IT service management. Has a number of publications & patents. Member of IEEE Systems, Man and Cybernetics (SMC), life member of Systems Dynamics Society. Served on the program committee of numerous conferences including IEEE and edited Elsevier Journal of Electronic Commerce Research & Application (ECRA)

About the Conference

About International Conference on Aligning SDGs and ESG : Shaping Pathways for a Sustainable & Inclusive Future (ICASE)

As global concerns such as climate change, inequality and sustainable economic growth worsen, the need for ethical and inclusive corporate practices becomes more urgent than ever. Environmental, Social and Governance (ESG) frameworks, which are connected with the United Nations' Sustainable Development Goals (SDGs) offer a revolutionary approach to solving these concerns by integrating sustainability into cross sector decision-making processes.

This conference brings together thought leaders, politicians, industry professionals, researchers and activists from many sectors to discuss how ESG measures might help accelerate progress

towards the SDGs. Throughout the event, we will explore the interconnections of environmental sustainability, social well-being and ethical governance as well as propose tangible ways for constructing resilient and equitable communities. International Conference on Synergizing SDGs and ESGs: Pathways to Sustainable and Equitable Futures is being organized by International School of Business and Media (ISB&M). The conference will feature research paper presentations keynote speeches, panel discussions, poster presentations and networking sessions.

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Keynote Speaker

Mr. Saugata Bhattacharya is a member of the Monetary Policy Committee of RBI. He is also Senior Fellow at the Centre for Policy Research, New Delhi. He retired as Executive Vice President and Chief Economist at Axis Bank in 2023. He had previously worked with Infrastructure Development Finance Company Ltd. (IDFC) and Hindustan Unilever Ltd. (HUL). He is a member of several committees on trade and investment and banking and finance at industry associations. He has been part of RBI, Ministry of Finance and Ministry of Housing and Urban Affairs Committees. He was named a Chevening Fellow of the UK Govt in 2017, as an alumnus of King's College, London.

Summary of Keynote Speaker Presentation

"Shaping Pathways for Sustainable and Inclusive Future: Role of Finance in an Age of Global Disruption"

Mr. Saugata Bhattacharya delivered an insightful keynote address that explored the pivotal role of finance in enabling sustainable and inclusive development amidst global disruptions. Drawing on comparative data, he highlighted India's position relative to the world's top 10 economies in terms of GDP and per capita income as of 2022. He projected India's trajectory toward becoming a $7 trillion economy by 2030, underlining the importance of strategic policy interventions.

The presentation emphasized macroeconomic trends, including climate change—2024 being recorded as the hottest year—and the critical need for integrating SDGs and ESG principles into economic frameworks. Mr. Bhattacharya also addressed the transformative impact of generative AI (GenAI) in the financial sector, examining both opportunities and emerging challenges.

The keynote underscored the urgency for innovative, inclusive, and sustainable financial solutions to navigate the uncertainties of a rapidly changing global landscape.

Papers

Developing Harmonized ESG-SDG Key Performance Indicator (KPIs) for Sustainable Corporate Reporting: A Cross-Sector Analysis

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Abstract:

In today's fast-changing business world, integrating Environmental, Social, and Governance (ESG) principles with the United Nations Sustainable Development Goals (SDGs) is essential for long-term corporate sustainability. However, the lack of standardized Key Performance Indicators (KPIs) makes it challenging for organizations to measure progress and ensure meaningful comparisons. Many companies face difficulties with inconsistent reporting frameworks, leading to issues in transparency and accountability. This study explores the need for a unified KPI system that bridges ESG initiatives with SDG objectives. By examining existing reporting practices and analysing real-world case studies across industries like manufacturing, finance, and technology, it highlights key obstacles such as regulatory inconsistencies, data collection challenges, and industry-specific variations. Based on these insights, the research proposes a structured KPI framework to enhance clarity, consistency, and comparability in sustainability reporting.

The findings underscore the importance of measurable, industry-specific KPIs in strengthening corporate accountability, boosting investor confidence, and supporting regulatory compliance. This study offers practical guidance for businesses, policymakers, and stakeholders striving to develop sustainability strategies that drive real, measurable impact toward global development goals.

Key Words: Environmental, Social, and Governance (ESG), Sustainable Development Goals (SDGs), corporate sustainability, Key Performance Indicators (KPIs), sustainability reporting, corporate accountability.

Introduction:

Background of the study

The increasing focus on corporate sustainability has led businesses to adopt Environmental, Social, and Governance (ESG) frameworks alongside the United Nations' Sustainable Development Goals (SDGs). These frameworks aim to ensure that companies contribute positively to economic, social, and environmental sustainability. However, a major challenge in sustainability reporting is the lack

of standardization, as companies across different sectors use varied indicators and methodologies to report ESG and SDG performance.

The absence of a harmonized reporting system makes it difficult for stakeholders, including investors, regulators, and policymakers, to evaluate and compare corporate sustainability efforts. Developing a unified set of ESG-SDG Key Performance Indicators (KPIs) can bridge this gap, enhancing transparency, accountability, and comparability across industries. This study explores how ESG and SDG reporting can be aligned and standardized through sector-specific and cross-industry analysis.

Research problem statement

Despite the growing importance of sustainability disclosure, there remains no universally accepted framework that fully integrates ESG factors with SDG targets. Companies often adopt different reporting methodologies, making it difficult to assess their actual contribution to sustainable development.

This inconsistency creates challenges for investors and other stakeholders in analysing corporate sustainability performance across different industries. Without a standardized KPI framework, companies may selectively disclose data that favour their image rather than provide a comprehensive view of their sustainability impact. To address this issue, this research seeks to develop a set of harmonized ESG-SDG KPIs that can be applied across various industries, ensuring consistent, reliable, and comparable sustainability reporting.

Objectives of the study

This research aims to:

- Evaluate current ESG and SDG reporting practices across multiple industries.
- Identify similarities and discrepancies in sustainability reporting among different sectors.
- Develop a harmonized ESG-SDG KPI framework to improve corporate sustainability disclosure.
- Assess the effectiveness and applicability of the proposed KPIs across industries.

Significance of the study

The findings of this study will benefit several stakeholders:

- Corporations: A standardized ESG-SDG KPI framework will help companies improve their sustainability reporting, compliance, and transparency.

- Investors: A harmonized reporting system will enable investors to better assess risks and sustainability performance across industries.
- Regulators: This study can support the development of more structured sustainability disclosure policies and guidelines.
- Academics and Researchers: It will contribute to existing literature on ESG-SDG integration and provide a foundation for future research.
- Global Sustainability Efforts: Aligning corporate reporting with SDG targets will enhance businesses role in achieving the United Nations' 2030 Agenda.

Scope and limitations

The study focuses on publicly listed companies across multiple sectors. It examines current ESG and SDG reporting frameworks and their alignment. It proposes a set of harmonized KPIs based on cross-sector analysis.

The research relies on publicly available ESG and SDG disclosure data, which may not fully reflect corporate sustainability efforts. Regulatory differences across regions may impact the applicability of the proposed framework. The adoption of standardized KPIs may face challenges due to industry-specific sustainability priorities.

Literature review

Concept of sustainable development goals (SDGs): The Sustainable Development Goals (SDGs) were introduced by the United Nations in 2015 as part of the 2030 Agenda for Sustainable Development. These 17 goals and 169 targets aim to address global challenges, including poverty, inequality, climate change, and environmental sustainability. While originally designed for national governments, SDGs have increasingly become a benchmark for corporate sustainability, encouraging businesses to align their strategies with broader sustainability objectives.

Corporations play a crucial role in achieving SDGs by integrating sustainability into their business models and reporting practices. SDGs provide a framework for organizations to measure and communicate their economic, social, and environmental impact. However, inconsistencies in corporate reporting make it difficult to assess how effectively businesses are contributing to these goals. The lack of standardized metrics for SDG performance reporting has led to fragmented and incomparable disclosures, highlighting the need for a harmonized ESG-SDG KPI framework.

Corporate sustainability reporting: Corporate sustainability reporting refers to the disclosure of non-financial information related to a company's environmental, social, and governance (ESG) performance. This reporting is essential for enhancing transparency, stakeholder trust, and long-term value creation. Companies use various sustainability reporting frameworks, including:

- Global Reporting Initiative (GRI): Provides comprehensive guidelines for sustainability disclosure.
- Sustainability Accounting Standards Board (SASB): Focuses on industry-specific ESG disclosure standards.
- Task Force on Climate-related Financial Disclosures (TCFD): Recommends climate-related financial risk disclosures.
- Integrated Reporting (IR): Emphasizes value creation by integrating financial and non-financial performance.

While these frameworks offer guidelines for sustainability disclosure, they lack a direct alignment with SDGs, leading to challenges in assessing a company's contribution to global sustainability goals. A harmonized ESG-SDG KPI system would bridge this gap by ensuring that corporate sustainability reports provide consistent and comparable insights across industries.

Relationship between SDG disclosure and ESG performance: ESG performance and SDG disclosure are closely linked, as both measure a company's commitment to sustainability. ESG reporting typically focuses on company-level performance, while SDG reporting aligns business activities with global sustainability priorities. Several studies highlight how companies with strong ESG performance are more likely to engage in comprehensive SDG reporting, as they recognize the value of aligning their business practices with global sustainability trends.

However, there are challenges in integrating ESG and SDG reporting, including:

- Inconsistent metrics: ESG and SDG reporting use different indicators, making comparison difficult.
- Sector-specific priorities: Some industries emphasize certain SDGs more than others, creating variability in reporting approaches.
- Regulatory gaps: A lack of regulatory enforcement results in voluntary and often selective disclosure by companies.

A harmonized ESG-SDG KPI framework would enhance comparability, allowing investors, regulators, and stakeholders to better assess a company's true sustainability impact.

Regulatory frameworks and compliance in sustainability reporting

Governments and regulatory bodies worldwide are increasingly mandating sustainability reporting to improve corporate accountability. Some key regulatory developments include:

- European Union's Corporate Sustainability Reporting Directive (CSRD): Requires large companies to disclose ESG performance using standardized frameworks.
- Securities and Exchange Commission (SEC) Climate Disclosure Rule (USA): Mandates climate-related financial risk disclosures.
- Indonesia's Financial Services Authority (OJK) Regulation 51/2017: Requires companies to publish sustainability reports.

Despite these efforts, variations in regulatory requirements create challenges in ensuring uniform sustainability reporting standards. Many businesses still follow voluntary ESG and SDG disclosure practices, leading to inconsistent reporting across sectors and regions. A standardized ESG-SDG KPI framework could help address this issue by providing clear guidelines for sustainability reporting compliance.

Previous studies on corporate sustainability disclosure

Several researchers have explored the importance, challenges, and effectiveness of sustainability reporting. Key findings from previous studies include:

Author	Finding
Bebbington & Unerman (2018)	Sustainability reporting improves corporate reputation and investor confidence.
Rosati & Faria (2019)	There is a lack of alignment between SDG reporting and ESG performance indicators.
Gunawan et al., 2022	Industries with higher environmental impact, such as mining and energy, tend to have more extensive ESG disclosures.
Opferkuch et al., 2021	Companies often selectively disclose SDG-related information that enhances their public image rather than providing a comprehensive view of their sustainability performance.

These studies highlight the gaps in existing sustainability reporting practices and reinforce the need for a harmonized ESG-SDG KPI framework that enables comparability, transparency, and accountability across industries.

Methodology

Research design: This study employs a descriptive quantitative research design to analyse corporate sustainability reporting by integrating Environmental, Social, and Governance (ESG) factors with Sustainable Development Goals (SDGs). A descriptive approach is used to examine current reporting trends, variations across industries, and key performance indicators (KPIs) for sustainability disclosure. Quantitative methods are utilized to measure and compare ESG-SDG reporting practices, enabling an objective assessment of corporate sustainability performance.

Data collection: The study gathers secondary data from publicly available corporate sustainability reports, financial statements, and regulatory filings of companies across multiple industries. Data sources include:

- Annual sustainability reports published by corporations.
- ESG and SDG disclosures from corporate websites and investor relations sections.
- Databases such as the Global Reporting Initiative (GRI) and the Sustainability Accounting Standards Board (SASB) for industry-specific sustainability data.
- Regulatory filings and government report on mandatory sustainability disclosures.

This approach ensures that data is collected from reliable, publicly available sources, allowing for an in-depth examination of corporate sustainability performance across sectors.

Sampling technique and sample selection: A purposive sampling method is applied to select companies for analysis. The sample consists of publicly listed companies that publish ESG and SDG-related disclosures. The selection criteria include:

- Companies from various industries to allow cross-sector comparison.
- Availability of sustainability reports and ESG disclosures for a minimum of three years.
- Inclusion of companies that adhere to recognized reporting standards such as GRI, SASB, or TCFD.

This sampling approach ensures that the study includes companies with substantial sustainability disclosures, providing meaningful insights into industry-specific and cross-sector sustainability reporting trends.

Data analysis methods: The collected data is analyzed using quantitative statistical methods to assess corporate sustainability reporting patterns. The following techniques are employed:

- Descriptive Statistics: Used to summarize and present ESG-SDG disclosure trends, including mean, standard deviation, and frequency distributions.
- Analysis of Variance (ANOVA): Applied to identify significant differences in ESG-SDG disclosure levels among industries. This helps determine if sustainability reporting varies significantly across sectors.
- Cluster Analysis: Used to group companies based on similar ESG-SDG disclosure patterns. Clusters are formed to categorize companies into different levels of sustainability performance, enabling a clearer understanding of reporting consistency and gaps across industries.

By applying these statistical methods, the study provides a comprehensive evaluation of corporate sustainability disclosure practices, highlighting trends, industry differences, and potential areas for improvement in ESG-SDG reporting.

Results and discussion

General trends in SDG disclosure: The analysis of sustainability reports indicates that corporate SDG disclosure remains relatively low, with an average disclosure rate of approximately 38-39%. While there is a growing trend in sustainability reporting, the inconsistencies across companies and industries highlight the challenges of aligning corporate strategies with SDG targets. The findings reveal that most companies prioritize economic-related SDG indicators over social and environmental aspects, suggesting that businesses focus more on financial sustainability rather than a balanced approach to corporate responsibility.

Moreover, the study identifies a gradual increase in SDG reporting over the years, indicating that businesses are becoming more aware of sustainability requirements. However, the increase is not significant, implying that the adoption of SDG reporting is still in its early stages. Many companies selectively disclose SDG-related information, often focusing on aspects that enhance their corporate image rather than providing a comprehensive sustainability performance assessment.

Industry-wise comparison of sustainability performance: The study finds significant variations in SDG disclosure across different industries. The mining sector exhibits the highest level of SDG reporting, particularly in environmental and economic aspects. This is likely due to regulatory pressure and stakeholder expectations, as mining operations have a direct environmental and social impact.

Conversely, the agriculture sector reports the lowest level of SDG disclosure, possibly due to limited regulatory enforcement and a lack of sustainability integration in business models. Other industries, such as consumer goods and infrastructure, demonstrate moderate levels of SDG reporting, primarily focusing on economic and social aspects rather than environmental concerns.

A statistical analysis using NOVA confirms significant differences in economic disclosure between industries, while social and environmental disclosures remain relatively uniform across sectors. These findings indicate that companies in industries with higher environmental risks tend to disclose more sustainability-related information, whereas sectors with lower direct environmental impact may not prioritize SDG reporting.

Economic, social, and environmental disclosure levels: When analyzing sustainability reporting across the three key dimensions (economic, social, and environmental), the study finds that:

- Economic disclosures are the most reported, with companies focusing on SDG-related financial aspects such as job creation, industry innovation, and poverty reduction. This is largely driven by investor expectations and financial performance considerations.
- Social disclosures rank second, with companies reporting on aspects such as *education, health, and social justice. However, these disclosures often lack depth and are mostly qualitative rather than quantitative.
- Environmental disclosures are the least reported, indicating that businesses still struggle with transparent environmental impact reporting. SDGs related to climate action, biodiversity conservation, and responsible production receive minimal attention, despite their growing importance in global sustainability discussions.

These findings suggest that while businesses acknowledge sustainability, there is a stronger emphasis on financial aspects rather than a holistic approach to ESG and SDG integration.

Clustering of companies based on disclosure practices: A cluster analysis is performed to categorize companies based on their ESG-SDG disclosure patterns. The results identify five distinct clusters:

- High SDG disclosure leaders: Companies with comprehensive sustainability reporting, balanced across economic, social, and environmental aspects.
- Economically focused disclosers: Businesses prioritizing financial and operational sustainability but with limited environmental reporting.
- Basic-level reporters: Companies with moderate economic and social disclosures, but weak environmental transparency.
- Minimal reporters: Organizations that disclose only limited SDG-related information, often due to low regulatory pressure.
- Non-reporters: Businesses with no or very minimal sustainability disclosures, indicating a lack of integration of SDGs into corporate strategy.

The findings suggest that only 15% of companies fall into the high SDG disclosure category, while a significant 24% still have no or minimal sustainability disclosures. This reinforces the need for stronger regulations and industry-wide sustainability frameworks to ensure that companies move towards comprehensive ESG-SDG alignment.

Factors influencing SDG disclosure: Several factors influence the level of SDG disclosure in corporate reports:

- Industry type: Companies in sectors with high environmental and social risks (e.g., mining, energy) tend to disclose more sustainability information due to regulatory and stakeholder pressures.
- Regulatory environment: Mandatory disclosure regulations in some regions drive higher sustainability reporting, whereas voluntary frameworks lead to inconsistent disclosures.
- Company size and financial performance: Larger firms and financially stable companies are more likely to engage in comprehensive SDG reporting, as they have the resources to implement sustainability initiatives.
- Stakeholder expectations: Investors, consumers, and regulators play a critical role in pushing companies toward better sustainability disclosures. Companies in consumer-facing industries are more likely to highlight social and environmental aspects to maintain brand reputation and customer trust.

These findings suggest that external pressures and business priorities significantly shape corporate sustainability disclosure practices.

Implications for stakeholders and policy makers: The findings have important implications for different stakeholders:

- For corporations: The study emphasizes the need for a more balanced approach to sustainability reporting. Companies should focus on enhancing environmental and social disclosures alongside financial sustainability.
- For investors: The results highlight the importance of standardized ESG-SDG KPIs for investment decisions. Investors should seek transparent, comparable, and comprehensive sustainability reports before making financial commitments.
- For regulators: The significant variability in sustainability reporting underscores the need for stronger regulatory frameworks to ensure uniform and reliable SDG disclosures across industries. Governments and international bodies should push for mandatory sustainability disclosure policies.
- For researchers and academics: This study contributes to the ongoing discussion on ESG-SDG integration, providing a basis for further research on industry-specific sustainability challenges and best practices.

By enhancing transparency, standardizing reporting metrics, and strengthening regulatory oversight, businesses can improve their sustainability performance, contributing more effectively to the achievement of the United Nations' 2030 Agenda.

Conclusion and recommendations

This study examined the alignment of ESG (Environmental, Social, and Governance) reporting with SDG (Sustainable Development Goals) disclosure across different industries, aiming to develop a harmonized ESG-SDG Key Performance Indicator (KPI) framework. The findings indicate that corporate SDG disclosure remains relatively low, averaging around 38-39%, with a strong emphasis on economic sustainability over environmental and social aspects.

There are significant differences in SDG disclosure across industries, with mining and consumer goods sectors leading in reporting, while agriculture and basic industries lag behind. Economic disclosures dominate sustainability reports, while environmental and social disclosures remain secondary concerns. Companies can be classified into five distinct clusters based on their disclosure practices, with only 15% demonstrating strong ESG-SDG integration, while 24% exhibit minimal or no sustainability reporting. Factors influencing SDG disclosure include industry type, regulatory frameworks, company size, and stakeholder pressures. Regulatory

inconsistencies contribute to variability in reporting standards, making cross-sector comparisons difficult. These results highlight the need for a standardized ESG-SDG KPI framework to ensure transparent, comparable, and comprehensive sustainability reporting across industries.

This research contributes to both academic literature and corporate practice. The study expands the existing literature on ESG and SDG integration by highlighting industry-specific sustainability reporting trends. It provides empirical evidence on the relationship between ESG disclosure and SDG alignment, addressing the gap in standard sustainability reporting. The study also develops a conceptual framework for harmonized ESG-SDG KPIs, offering a foundation for future research in corporate sustainability assessment.

The study helps corporations understand gaps in their SDG disclosures and guides them toward more holistic sustainability reporting. It provides investors with a clearer framework for assessing corporate sustainability performance. This study assists policymakers and regulators in designing more effective sustainability disclosure regulations that promote consistency and comparability. By bridging the gap between ESG and SDG reporting, this study enhances corporate transparency and accountability, supporting the achievement of the United Nations' 2030 Agenda.

Recommendations for companies: Companies should enhance social and environmental disclosures alongside financial sustainability to create a comprehensive ESG-SDG alignment. They should also adopt standardized reporting frameworks: Firms should integrate GRI, SASB, TCFD, and other global standards to improve reporting comparability. Companies need to improve stakeholder engagement: Transparency in ESG-SDG reporting can help companies build investor confidence and meet consumer expectations. They should use digital tools and AI for better reporting: Leveraging technology can enhance data collection, analysis, and reporting accuracy.

Recommendations for regulators: Regulators need to mandate ESG-SDG disclosures. Governments should enforce mandatory sustainability reporting requirements to ensure consistency across industries. Development of standardized ESG-SDG KPIs need to be prioritized. Regulatory bodies should work towards harmonizing global sustainability disclosure metrics. Regulators can incentivize sustainability reporting. Governments can offer tax benefits, investment incentives, or certifications to encourage better sustainability practices. Enhanced monitoring and enforcement would address the current concerns. Strengthening compliance mechanisms will ensure that companies adhere to ESG-SDG disclosure regulation.

Limitations of the study: While this research provides valuable insights, it has certain limitations. Data constraints the scope of the study. The study relies on publicly available corporate reports, which may not fully reflect internal sustainability efforts. Further, the study does not account for industry-specific variations. Some industries have different sustainability priorities, making universal KPI standardization challenging. Regulatory differences across regions can also impact the study. ESG-SDG disclosure practices vary based on local regulations and corporate governance structures, affecting global applicability. The study examines sustainability disclosures over a specific period, which may not capture long-term trends in ESG-SDG integration. Addressing these limitations in future research could provide a more comprehensive understanding of sustainability disclosure practice.

Directions for future research: To build upon the findings of this study, future research can explore a deeper analysis of ESG-SDG alignment in specific industries, such as renewable energy, healthcare, and technology. The role of emerging technologies (AI, blockchain) in enhancing ESG-SDG reporting transparency and efficiency further offers avenues for research. Conducting longitudinal studies to examine the impact of new regulations on corporate sustainability disclosures over time can improve our understanding on the subject. Future research can also explore cross-country comparisons to evaluate how regulatory frameworks influence sustainability reporting on a global scale. Stakeholder perspectives on ESG-SDG reporting, including insights from investors, consumers, and policymakers. By addressing these areas, future research can further refine ESG-SDG KPI frameworks and contribute to the development of more effective corporate sustainability strategies.

References

- Global Reporting Initiative (GRI). (2018). Sustainability Reporting Standards. GRI. Retrieved from www.globalreporting.org
- United Nations (UN). (2015). Transforming Our World: The 2030 Agenda for Sustainable Development. United Nations. Retrieved from www.un.org/sustainabledevelopment
- World Economic Forum (WEF). (2020). Measuring Stakeholder Capitalism: Towards Common Metrics and Consistent Reporting of Sustainable Value Creation. WEF. Retrieved from www.weforum.org
- Adams, C. A. (2017). The Sustainable Development Goals, integrated thinking and the integrated report. International Integrated Reporting Council Journal, 3(1), 5-15.

- Bebbington, J., & Unerman, J. (2018). Achieving the United Nations Sustainable Development Goals: An enabling role for accounting research. Accounting, Auditing & Accountability Journal, 31(1), 2-24.
- Christensen, H. B., Hail, L., & Leuz, C. (2021). Mandatory CSR and sustainability reporting: Economic analysis and literature review. Review of Accounting Studies, 26(3), 1176-1248.

Green Bond Markets and their Role in Financing SDG-Aligned Projects

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Abstract

Green bond markets have emerged as a critical financial mechanism for mobilizing capital toward environmentally sustainable projects, aligning with the United Nations Sustainable Development Goals (SDGs). These debt instruments provide a pathway for governments, corporations, and financial institutions to raise funds specifically for projects that mitigate climate change, enhance energy efficiency, promote sustainable infrastructure, and support social well-being. This paper explores the structure, growth, and impact of green bond markets, analizing their effectiveness in channel investments toward SDG-aligned initiatives. Additionally, it examines regulatory frameworks, investor perceptions, and the challenges hindering market expansion, such as greenwashing risks and limited standardization. By assessing global case studies and emerging trends, this study highlights the role of green bonds in fostering a sustainable financial ecosystem and provides policy recommendations to enhance their accessibility and impact.

Key Words: Green Bonds, Sustainable Finance, Climate Mitigation, ESG (Environmental, Social, and Governance), SDG (Sustainable Development Goal), Greenwashing, Regulatory Frameworks.

Introduction:

In Recent years, the green bond market has attracted significant attention as a key financial instrument for mobilizing capital for environmentally sustainable projects. As the world grapples with the impacts of climate change, resource depletion, and environmental degradation, the need for a dedicated financing mechanism has become more urgent. Green bonds, a type of fixed-income instrument, allow governments, corporations, and financial institutions to invest solely in climate mitigation, renewable energy expansion, energy efficiency, sustainable infrastructure, and they provide a structured way to raise funds for projects that contribute to biodiversity conservation. These bonds act as a bridge between capital markets and sustainability initiatives, ensuring investors a stable financial return while also ensuring long-term environmental sustainability and enabling support for projects that generate social benefits. Aligned with the United Nations Sustainable Development Goals (SDGs), green bonds support clean energy, smart cities and they help direct investment in key areas such as sustainable transport, promoting the transition towards a low-carbon economy.

The growing demand for sustainable finance has fuelled the rapid growth of the green bond market, which has attracted institutional funds, pension funds and it has attracted a diverse range of investors, including socially responsible investors. Many investors are now integrating environmental, social and governance (ESG) criteria into their decision-making processes, further increasing the credibility and appeal of green bonds. As the regulatory framework evolves, financial institutions are being encouraged to channel more resources into climate-friendly projects, Strengthens the role of green bonds in achieving net-zero emissions and long-term environmental sustainability. However, despite their potential, several challenges hinder the full-scale adoption of green bonds. Greenwashing, regulatory fragmentation, high issuance costs, and the lack of widely accepted standards create significant obstacles to market credibility and efficiency. Greenwashing, in particular, has raised concerns, because some issues falsely claim that their bonds support sustainability efforts without meeting strict environmental criteria. In addition, the lack of global standardization makes it difficult for investors to assess whether they actually contribute to environmental goals, this create a discrepancy between market transparency and investor confidence.

Scope of study

This study explores the role of the green bond market in financing Sustainable Development Goal (SDG) – aligned projects, focusing on its growth, impact, challenges, and future prospects. The study will analyse the development of green bonds, highlighting key drivers such as climate policies, investor demand and financial innovations that have fueled their expansion. It will assess how green bonds support SDGs by financing projects in renewable energy efficiency, smart cities, and biodiversity conservation, contributing to a low-carbon economy. The research will further examine global and regional regulations governing green bonds, the role of organizations like ICMA and CBI, and challenges posed by the lack of universal standards. Further, the study proposes to explore how institutional investors, pension funds, and ESG-focused investors are driving the green bond market, integrating sustainability into their financial strategies. The study also proposes to identify key obstacles such as greenwashing, high issuance costs, regulatory inconsistencies, and transparency issues that will be discussed, highlighting their impact on investor confidence. Finally, the study will present strategies to enhance market credibility, improve standardization, and strengthen regulatory oversight to ensure green bonds effectively support sustainability goals.

Significance of the study:

This study is significant as it highlights the crucial role of green bonds in financing environmentally sustainable projects and achieving the United Nations Sustainable Development Goals (SDGs). By examining their impact on renewable energy, sustainable infrastructure, and climate mitigation, the research underscores how green bonds contribute to a low-carbon economy.

Additionally, the study provides insights into the evolving regulatory landscape, helping policymakers and investors understand the challenges of standardization, transparency, and greenwashing. It also emphasizes the growing influence of Environmental, Social, and Governance (ESG) factors in investment decisions, making it relevant for financial institutions, governments, and sustainability advocates.

Table 1

Year	Key developments in the green bond market	Impact on SDG-aligned projects
2007	First green bond issued by the European Investment Bank (EIB).	Initial funding for climate-focused projects (SDG 13: Climate Action).
2010	World Bank issues its first green bond.	Financing for renewable energy and sustainable transport (SDG 7 & SDG 11)
2013	First corporate green bond issued by Vasakronan (Swedish real estate company).	Support for sustainable infrastructure (SDG 9 & SDG 11).
2014	Green Bond Principles (GBP) introduced by ICMA to standardize the market.	Increased transparency and investor confidence in sustainable investments.
2015	The Paris Agreement emphasizes green finance; record issuance of green bonds.	Strengthening global climate commitments and funding large-scale projects (SDG 13).
2017	Climate Bonds Initiative (CBI) certifies $100 billion in green bonds.	Expansion of climate adaptation projects, including flood resilience (SDG 13 & SDG 15)

2020	COVID-19 pandemic accelerates sustainability-focused investments.	Green bonds used to finance health-related infrastructure and clean energy transitions (SDG3 & SDG 7).
2021-2023	Growth of sovereign green bonds; EU issues largest green bond (12B euro)	Increased government participation in green finance, supporting climate resilience and carbon neutrality goals (SDG 13).

Research problems:

The increasing urgency of climate change and environmental degradation has intensified the need for sustainable financial mechanisms. Green bonds have emerged as a key tool to finance projects that align with the United Nations Sustainable Development Goals (SDGs) by directing capital toward renewable energy, energy efficiency, sustainable infrastructure, and climate adaptation initiatives. However, despite their rapid market growth, several challenges hinder their full potential in financing sustainability projects effectively.

One of the primary issues is the lack of standardized regulations and certification processes across different markets. The absence of a globally accepted green bond framework makes it difficult for investors to assess the credibility of green bond issuances, leading to concerns about greenwashing—where bonds are falsely marketed as environmentally friendly without meeting strict sustainability criteria. This undermines investor confidence and market transparency, limiting the growth and impact of green bonds.

Another critical problem is the high issuance and compliance costs associated with green bonds. Compared to conventional bonds, green bonds require third-party verification, impact assessments, and regulatory approvals, which can be costly and time-consuming. As a result, many small and medium-sized enterprises (SMEs) and organizations in developing economies face significant barriers to issuing green bonds, restricting market inclusivity.

Additionally, while green bonds are intended to support climate mitigation and adaptation efforts, measuring and verifying their actual impact remains a challenge. Many issuers lack standardized impact reporting mechanisms, making it difficult for investors and regulators to track whether green bond-funded projects truly contribute to SDG-aligned objectives. The inconsistency in data reporting and impact assessments reduces transparency and raises concerns about the effectiveness of green bonds in addressing environmental challenges.

This research seeks to address these issues by analysing primary data from investors, issuers, and regulatory bodies to evaluate the challenges and opportunities in the green bond market. The study aims to explore investor perceptions, regulatory inconsistencies, issuance challenges, and impact measurement gaps to provide insights into improving the role of green bonds in financing SDG-aligned projects effectively.

Literature review:

Green bonds have risen as a crucial money related instrument for mobilizing capital toward naturally maintainable ventures. As the request for climate-conscious ventures increments, analysts and monetary investigators have inspected the development, challenges, and affect of green bonds on accomplishing the Feasible Improvement Objectives (SDGs). This writing survey investigates existing considers on the advancement of the green bond advertise, its administrative systems, financial specialist points of view, and its adequacy in financing maintainability projects.

Advancement of the green bond market: The green bond advertisement was to begin with presented in 2007 by the European Venture Bank (EIB) and the World Bank, pointing to coordinate reserves toward ventures that contribute to climate strength and natural supportability (Climate Bonds Activity, 2023). Over a long time, green bond issuances have extended from multilateral organizations to autonomous governments, organizations, and districts (Tang & Zhang, 2022).

According to OECD (2021), the worldwide green bond advertise has experienced exponential development, outperforming $2 trillion in total issuances. Thinks about demonstrate that this surge is driven by:

- Investor request for ESG-compliant resources (Dough puncher et al., 2018).
- Regulatory activities advancing green fund (Nguyen & Phan, 2020).
- Commitments to carbon non-partisanship by governments and organizations (UNEP, 2022).

Despite this development, territorial aberrations stay. Investigate by Wang et al. (2021) highlights that Europe and North America overwhelm the green bond showcase, whereas creating economies confront boundaries such as restricted speculator mindfulness and administrative fragmentation.

Administrative systems and standardization challenges: The need of a bound together worldwide standard for green bonds has been a repeating issue in writing. The Green Bond Standards (GBP) presented by the Worldwide Capital Showcase Affiliation (ICMA) have been broadly received, however analysts contend that shifting national arrangements make irregularities (Cui et al., 2021).

European Union (EU) Green Bond Standard (2022), presented an obligatory detailing necessities to decrease greenwashing dangers (ECB, 2023). Later China's Green Bond Rules (2021): More adaptable in venture qualification, permitting clean coal ventures, which vary from Western definitions of "green" (Zhou & Li, 2022). The U.S. Showcase stipulated intentional adherence to ICMA standards, but needs a federal-level administrative system (Fatica & Panzica, 2020).
This administrative fracture has driven to challenges in cross-border speculations, with considers proposing that harmonization endeavors are required to improve showcase straightforwardness and speculator certainty (Taghizadeh-Hesary & Yoshino, 2019).

Several studies have examined investor behavior with respect to green bonds, shedding light on the growing integration of Environmental, Social, and Governance (ESG) criteria into investment decisions. Flammer (2021) noted that institutional investors are increasingly incorporating ESG factors in their decision-making processes. However, despite the rising interest in green bonds, investors continue to express concerns regarding key issues. One major concern is the risk of greenwashing, where some issuers mislabel regular bonds as "green" without sufficient proof of their environmental impact (Shishlov et al., 2018). Additionally, green bonds often face liquidity challenges, as they typically have lower liquidity compared to conventional bonds, making secondary market trading more difficult (Ehlers & Packer, 2017). Another issue that investors frequently highlight is yield performance, as some analysts argue that green bonds exhibit a "greenium"—a green premium—meaning they tend to offer slightly lower yields than standard bonds due to high demand and limited supply (Bachelet et al., 2019). However, some studies suggest that green bonds may reduce portfolio risks in the long term, especially as governments enforce stricter environmental regulations, which could lead to greater stability for green bond investors (Tang & Zhang, 2022).

In terms of their contribution to the Sustainable Development Goals (SDGs), green bonds play a critical role in financing projects that align with various SDGs. According to UNEP (2022), green bonds are pivotal in funding initiatives related to renewable energy, sustainable infrastructure, and climate action. Studies show that more than 40% of green bond proceeds globally are allocated to renewable energy projects such as solar, wind, and hydropower (IEA, 2023), directly contributing to SDG 7, which focuses on affordable and clean energy. In the context of SDG 9, which aims for sustainable infrastructure, green bonds fund investments in energy-efficient buildings, smart grids, and public transportation systems, all of which help reduce urban carbon footprints (Gianfrate & Peri, 2020). Additionally, green bonds have supported climate action projects, including flood protection systems and reforestation efforts, contributing to SDG 13 (Buchner et al., 2021). However, studies also highlight that measuring the true impact of green bond-funded projects

remains a challenge due to varying reporting standards among issuers, which can make it difficult to assess the actual environmental and social outcomes of these investments (Pereira da Silva, 2022).

Challenges and future outlook: Despite their potential, the green bond showcase faces a few challenges. There are concerns regarding the issue of greenwashing. Ponders caution that without legitimate third-party confirmation, a few bonds may erroneously claim to bolster maintainability activities (Shishlov et al., 2018). Banga (2019) inquire about proposes that the taking a toll of certification, detailing, and compliance disheartens littler guarantors from entering the advertisement). Wang et. al., (2021) shows that whereas Europe and the U.S. lead the advertisement, creating economies require more grounded monetary motivations to embrace green bonds. Looking forward, Taghizadeh-Hesary & Yoshino (2023) propose that governments should:

- Introduce charge motivating forces and appropriations for green bond issuers.
- Strengthen affect evaluation systems to progress accountability.
- Encourage more cooperation from retail speculators through open venture platforms.

With progressing administrative advancements and developing speculators intrigued, analysts anticipate that the green bond showcase will proceed to extend, playing a basic part in worldwide decarbonisation endeavours and SDG financing.

The existing writing highlights the fast development and expanding centrality of the green bond showcase in financing SDG-aligned ventures. Whereas green bonds are successful in mobilizing climate funds, challenges such as administrative fracture, greenwashing dangers, and tall issuance costs stay at the boundaries to full-scale selection. Harmonizing worldwide green bond measures, improving straightforwardness, and growing financial specialist interest will be basic in guaranteeing that green bonds fulfil their expecting part in economic advancement and climate action.

Future inquiry ought to centre on progressing green bond affect appraisal techniques and investigating inventive money related components that upgrade availability and reasonableness, especially in rising economies.

Data analysis

Green bonds have developed as an essential budgetary instrument, channeling capital toward ventures that bolster natural maintainability and adjust with the Joined Together Countries Feasible Advancement Objectives (SDGs). This investigation digs into the current state of the green bond

showcase, its development direction, and its adequacy in financing SDG-aligned activities, based on information sourced from trustworthy monetary and natural organizations.

Development and development of the green bond market

The green bond showcase has experienced exceptional development over the past decade. Once considered a specialty portion, it has presently extended into a considerable showcase, reflecting the expanding worldwide accentuation on feasible advancement and climate action. As of 2024, the green bond showcase has developed into a $2.5 trillion division, underscoring its noteworthy part in financing the move to a low-carbon economy. In the to begin with quarter of 2024, green bond issuances come to $195.9 billion, bookkeeping for 72% of the add up to economical obligation issued amid this period. This speaks to a 25% increment compared to the same quarter in 2023.

Regional contributions: The European Union (EU) has been a noteworthy donor to the green bond advertisement. In October 2021, the EU issued around $14 billion in green bonds, stamping one of the biggest bargains at that time. Emerging markets are too recognizing the potential of green bonds. Nations like Brazil and Turkey have started renewable vitality ventures and green ventures, individually, with bolster from worldwide budgetary education.

Arrangement with economical improvement objectives (SDGs): Green bonds are instrumental in financing ventures that straightforwardly contribute to a few SDGs, especially those centred on natural sustainability.

Key SDGs supported:

- **SDG 6: Clean water and sanitation**

  Investments in water framework ventures guarantee clean water and improved sanitation facilities.

- **SDG 7: Reasonable and clean energy**

  A critical parcel of green bond continues is apportioned to renewable vitality ventures, advancing clean and reasonable vitality solutions.

- **SDG 9: Industry, development, and infrastructure**

  Funding bolsters the improvement of maintainable foundation, cultivating development and versatile mechanical practices.

- **SDG 11: Feasible cities and communities**

Projects pointed at making economical urban situations get financing, contributing to more decent cities.

- **SDG 13: Climate action**

  Green bonds fund activities that address climate alter moderation and adjustment strategies.

- **SDG 15: Life on land**

  Conservation and maintainability utilize ventures advantage from green bond financing, protecting earthbound ecosystems.

These arrangements highlight the key part of green bonds in progressing worldwide supportability destinations.

Challenges and criticisms: Despite the positive direction, the green bond showcase faces a few challenges that may hinder its adequacy in financing SDG-aligned projects.

Greenwashing concerns: There are occasions where the natural benefits of ventures financed by green bonds are flawed. A review showed that as it were 2% of green bond stores are designated to ventures with really imaginative environmental benefits, with the lion's share utilized for renegotiating existing obligations or progressing ventures.

Investment shortages in developing markets: Emerging markets, pivotal for worldwide net-zero outflow endeavours, confront noteworthy venture holes. For example, India's renewable vitality segment requires $68 billion every year to meet its objectives but pulled in as it were $13 billion in the final year. Challenges such as extended delays, arrival securing issues, and administrative obstacles ruin the stream of green ventures in these locales.

Regulatory and standardization issues: The nonattendance of all around acknowledged measures for what qualifies as a green bond leads to irregularities and potential abuse of stores. Endeavours are continuous to build up clearer rules and avoid deceiving homes.

The green bond advertisement has advanced into a considerable monetary instrument, channeling trillions of dollars into ventures that back natural supportability and the SDGs. Be that as it may, to maximize its potential, tending to challenges such as greenwashing, speculation incongruities in rising markets, and the requirement for standardized controls is basic. Improving straightforwardness and setting up strong systems will be significant in guaranteeing that green bonds successfully contribute to worldwide supportability goals.

Methodology:

This study adopts a primary data-driven research methodology to examine the role of green bonds in financing Sustainable Development Goal (SDG)-aligned projects. By collecting firsthand information from key stakeholders—such as investors, financial institutions, regulators, and project implementers—this research aims to provide an original and data-backed assessment of green bond issuance, investment behavior, market challenges, and their real-world impact on sustainability initiatives. The study will employ both quantitative and qualitative research methods to ensure a well-rounded analysis. Surveys and structured interviews will provide measurable insights, while direct observations and case studies will offer in-depth understanding of green bond-funded projects.

Research design

This study adopts a mixed-methods approach, combining both quantitative and qualitative data collection techniques to provide a comprehensive analysis of the green bond market. The research will focus on several key stakeholder groups to ensure a holistic perspective. Institutional investors and financial institutions will offer insights into investment motivations, risk perceptions, and market confidence in green bonds. Their perspectives will help assess how these investors approach the green bond market and the factors influencing their decisions. Corporate and government bond issuers will contribute to understanding the key drivers behind issuing green bonds, including the regulatory challenges they face and their strategies for implementing projects funded by green bonds. This group will provide a deeper understanding of the process of issuing green bonds and the obstacles they encounter. Regulatory authorities will provide valuable perspectives on the effectiveness of green bond policies, certification standards, and market oversight, helping to evaluate how well the current regulatory environment supports green bond issuance and prevents issues like greenwashing. Finally, green bond-funded project managers will offer insights into how green bond funds are used to finance SDG-aligned initiatives and the impact these projects have on sustainability goals. By integrating perspectives from both investors and project implementers, this research aims to provide a well-rounded understanding of the green bond market, highlighting the roles of different stakeholders in promoting sustainable finance.

Data collection methods

A structured survey will be distributed to key stakeholders in the green bond market to collect quantitative data on market trends, investor preferences, and regulatory concerns. The target respondents for the survey will include institutional investors such as asset managers, pension funds, and banks, as well as corporate and government green bond issuers. Retail investors with an interest in sustainable investment will also be included. The survey will consist of multiple-

choice and Likert-scale questions to collect numerical data on investment behavior, market confidence, and sustainability priorities. Additionally, ranking-based questions will be included to assess the perceived benefits and challenges of green bonds, while open-ended responses will provide an opportunity for stakeholders to offer qualitative insights into their experiences and perspectives. The survey will be distributed via online platforms such as Google Forms and Qualtrics, as well as through direct email outreach, ensuring broad and diverse participation from a variety of stakeholders.

In-depth, semi-structured interviews will also be conducted with key market participants to gather qualitative insights into the green bond market. Interview participants will include green bond issuers from both government and corporate sectors to explore the processes, costs, and challenges associated with issuing green bonds. Regulators and policymakers will be interviewed to analyze how policies shape market growth and address issues such as greenwashing. Investment analysts and ESG experts will also be included to assess investor sentiment, long-term trends, and the growing importance of sustainable finance. These interviews will provide a deeper understanding of the motivations, challenges, and trends that influence the green bond market, allowing for richer insights than what can be gathered from the survey alone.

To complement the survey and interview data, the study will incorporate direct observation of green bond-funded projects and a review of real-world case studies. The observation scope will include visits to projects financed by green bonds, such as renewable energy plants, sustainable transportation projects, or climate adaptation initiatives. The research will also involve a review of financial disclosures and impact reports of green bond-funded projects to assess how funds are being utilized and to evaluate their effectiveness. Additionally, the study will observe market behavior and decision-making processes during green bond transactions to understand the dynamics of the market. Case studies will be selected from notable green bond issuances, including sovereign green bonds from countries such as the EU, China, the US, and India, corporate green bonds from the energy and infrastructure sectors, and city-level green bond initiatives focused on smart city development or clean transportation projects. These case studies will provide real-world evidence of how green bonds contribute to sustainable development goals such as clean energy (SDG 7), sustainable infrastructure (SDG 9), and climate action (SDG 13).

3. Data analysis methods:

3.1 Quantitative analysis:

Survey responses will be analyzed using statistical methods to identify trends and correlations in green bond investment behaviour.

Analysis techniques:

- Descriptive Statistics: Mean, median, and percentage distributions of investor preferences and market confidence.
- Correlation Analysis: Examining relationships between investor risk perception and green bond adoption.
- Trend Analysis: Identifying patterns in green bond financing over time.

Data will be processed using SPSS, Excel, or Python-based statistical tools for accuracy.

3.2 Qualitative analysis:

Interview transcripts, open-ended survey responses, and case study findings will be analyzed using:

- Thematic Analysis: Identifying recurring themes in investor concerns, policy impacts, and market challenges.
- Comparative Analysis: Contrasting perspectives from different stakeholder groups (investors vs. regulators vs. issuers).
- Content Analysis: Reviewing financial reports and policy documents to validate primary data insights.

Qualitative findings will be categorized into key market trends, regulatory barriers, and investment motivations to provide a clear narrative of the green bond market's role in financing SDG-aligned projects.

4. Limitations of the study:

While this study offers an original, firsthand analysis of the green bond market, several challenges and limitations need to be considered. Limited access to respondents, particularly institutional investors and policymakers, may impact survey response rates and reduce the diversity of perspectives collected. Additionally, the reliance on self-reported data in surveys and interviews could introduce bias, as responses may reflect subjective opinions rather than objective market conditions. Time and resource constraints may also hinder direct observation of green bond-funded projects, as confidentiality policies or logistical issues might limit access. Furthermore, the variability in green bond certification standards across countries may pose challenges when making cross-market comparisons. To mitigate these challenges, the study will employ multiple

outreach channels to improve survey participation, conduct follow-up interviews for deeper insights, and cross-validate findings with publicly available reports and market data to ensure accuracy and reliability. Through these efforts, the study aims to provide a comprehensive and balanced understanding of the green bond market, despite these inherent limitations.

5. Ethical considerations:

Informed consent will be obtained from all participants, ensuring they are fully aware of the study's purpose before taking part in surveys and interviews. Data confidentiality will be maintained by anonymizing all responses to protect the identities of participants. The study will adhere to principles of transparency and objectivity, ensuring that findings are reported based on empirical evidence and avoiding any biased interpretations. This methodology ensures a rigorous and transparent approach to analyzing the role of green bonds in financing SDG-aligned projects. By relying exclusively on primary data collection methods—such as surveys, interviews, and direct observations of funded projects—the study aims to provide original insights into investor behavior, regulatory challenges, and the real-world impact of green bonds on sustainability initiatives. The combination of quantitative and qualitative research methods will offer a comprehensive analysis, contributing valuable knowledge to policymakers, investors, and financial institutions seeking to expand green finance solutions.

Conclusion:

The green bond market has emerged as a crucial financial tool for funding environmentally sustainable projects that align with the United Nations Sustainable Development Goals (SDGs). Over the years, the market has witnessed significant growth, attracting institutional investors and governments seeking to finance renewable energy, sustainable infrastructure, and climate adaptation initiatives. The increasing emphasis on environmental, social, and governance (ESG) factors has further strengthened investor confidence in green bonds as a reliable asset class.

Despite this progress, challenges remain. Greenwashing, lack of standardized regulations, and high issuance costs continue to hinder the full potential of green bonds. The absence of a globally recognized framework makes it difficult to assess the actual impact of green bond-funded projects, leading to transparency and accountability concerns. Additionally, emerging markets face barriers in accessing green finance due to regulatory complexities and investment risks.

To enhance the effectiveness of green bonds in financing SDG-aligned projects, it is essential to implement stricter regulatory frameworks, improve transparency in impact reporting, and provide financial incentives for issuers and investors. Establishing universal standards for green bond

certification and promoting greater accessibility for developing economies will ensure a more inclusive and efficient market.

In conclusion, while green bonds have demonstrated their potential in supporting sustainable development, addressing existing barriers is critical to ensuring long-term financial stability, investor trust, and meaningful contributions to global environmental goals. Strengthening the green bond market will play a key role in accelerating the transition to a low-carbon and sustainable economy.

References:

- The International Capital Market Associationhttps://www.icmagroup.orgGreen Bond Principles (GBP)

  https://www.google.com/url?q=https://www.icmagroup.org/sustainable-finance/

- Indonesia Financial Services Authority (OJK). (2017). Regulation No. 51/POJK.03/2017 on Sustainable Finance. Retrieved from www.ojk.go.id
- Christensen, H. B., Hail, L., & Leuz, C. (2021). Mandatory CSR and sustainability reporting: Economic analysis and literature review. Review of Accounting Studies, 26(3), 1176-1248.
- Wikipediahttps://en.wikipedia.orgGreen bond

  https://www.google.com/url?q=https://en.wikipedia.org/wiki/Green_bond&sa=U&ved=2ahUKEwiK8vGps-6LAxW8kq8BHTFRAKMQFnoECCEQAQ&usg=AOvVaw3xl0T0DlK8jlM-HLzrqsyf

- Wikipediahttps://en.wikipedia.orgSustainable finance

  https://www.google.com/url?q=https://en.wikipedia.org

- Bebbington, J., & Unerman, J. (2018). Achieving the United Nations Sustainable Development Goals: An enabling role for accounting research. Accounting, Auditing & Accountability Journal, 31(1), 2-24.

Circular Economy Models for Reducing Industrial Waste and Achieving SDGs

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Abstract

The circular economy (CE) presents a sustainable approach to industrial production by emphasizing resource efficiency, waste reduction, and material reuse. Unlike conventional linear models that rely on excessive resource consumption and disposal, the CE focuses on extending product life cycles through recycling, remanufacturing, and sustainable design. This study examines how CE strategies can help industries minimize waste while aligning with the United Nations Sustainable Development Goals (SDGs). It explores practical implementations across different sectors, highlighting the benefits of reduced environmental impact, cost savings, and enhanced sustainability. The research also addresses challenges such as financial barriers, policy limitations, and the need for technological advancements. The findings suggest that adopting circular economy principles can contribute significantly to achieving SDG 9 (Industry, Innovation, and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). The study concludes with recommendations for industries and policymakers to promote a circular economy framework, ensuring long-term environmental and economic sustainability

Key words: circular economy (CE), Sustainable Development Goals (SDGs), resource efficiency, waste reduction, recycling, remanufacturing, and sustainable design, SDG 9, SDG 12, SDG 13, environmental and economic sustainability.

Introduction

Industrial waste has become a significant global concern due to its environmental and economic consequences. Traditional linear economic models, which follow a "take-make-dispose" approach, contribute to excessive resource depletion, pollution, and waste accumulation. In contrast, the circular economy (CE) offers a more sustainable alternative by focusing on resource efficiency, waste minimization, and material reutilization. By designing products for longevity, promoting recycling and remanufacturing, and implementing

sustainable production practices, industries can significantly reduce their environmental footprint.

The CE framework aligns closely with the United Nations Sustainable Development Goals (SDGs), particularly SDG 9 (Industry, Innovation, and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). Through circular economy principles, industries can not only minimize waste but also improve cost efficiency, enhance innovation, and contribute to global sustainability efforts.

This study explores various CE models applied across different industrial sectors, highlighting their benefits and challenges. While circular strategies offer long-term advantages such as reduced resource dependency and lower carbon emissions, industries still face obstacles like financial constraints, policy gaps, and technological limitations.

Addressing these challenges requires a collaborative effort from businesses, policymakers, and researchers to create a supportive framework for CE adoption. By integrating circular principles into industrial operations, businesses can drive sustainable development while fostering economic resilience.

Scope of study

The scope of this study focuses on exploring the application of circular economy (CE) models in reducing industrial waste and contributing to the achievement of Sustainable Development Goals (SDGs). It examines how circular economy principles can be integrated into various industrial sectors to promote resource efficiency, waste minimization, and sustainable production. The study highlights the importance of adopting strategies such as recycling, remanufacturing, and sustainable product design to extend product life cycles and reduce environmental impact.

This research covers different industrial sectors, including manufacturing, construction, electronics, and packaging, to showcase diverse applications of CE models. It also evaluates the role of technological innovations, such as advanced recycling methods and digital platforms, in enhancing circular practices. Additionally, the study addresses economic, environmental, and social benefits linked to the circular economy, aligning with SDG 9 (Industry, Innovation, and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action).

Furthermore, the study identifies the challenges faced by industries in adopting circular models, including financial constraints, lack of regulatory frameworks, and technological limitations. It provides insights into possible solutions, policy recommendations, and collaborative approaches that can support industries in transitioning towards circular economy practices. The findings aim to contribute to the broader discourse on sustainable development by encouraging industries to adopt more responsible and innovative production methods.

Significance of the study

This study is important as it emphasizes how circular economy (CE) models can help industries reduce waste and operate more sustainably. Unlike the traditional linear approach, which leads to excessive resource consumption and disposal, CE focuses on recycling, remanufacturing, and efficient resource utilization. By adopting these strategies, industries can lower environmental damage while improving cost efficiency and long-term sustainability.

The research also aligns with global sustainability efforts, particularly Sustainable Development Goals (SDGs) such as SDG 9 (Industry, Innovation, and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). Additionally, it highlights practical challenges businesses face, such as financial limitations and policy gaps, while offering solutions to overcome these obstacles. By encouraging industries and policymakers to transition towards circular practices, this study aims to contribute to a more sustainable and resource-efficient future.

Research problems

Despite the potential of circular economy (CE) models in reducing industrial waste and promoting sustainability, several challenges hinder their widespread adoption. One major issue is the financial burden associated with transitioning from traditional linear models to circular practices, as industries often face high initial costs for implementing recycling, remanufacturing, and sustainable design processes.

Another key challenge is the lack of supportive policies and regulatory frameworks, which creates inconsistencies in CE adoption across different regions and industries. Additionally, technological limitations and inadequate infrastructure make it difficult to efficiently manage waste and reuse materials on a large scale.

Moreover, industries often struggle with consumer awareness and market acceptance of circular products, which can impact their profitability and long-term viability. Addressing these issues is crucial for successfully integrating CE models into industrial practices and achieving Sustainable Development Goals (SDGs) such as SDG 9 (Industry, Innovation, and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action).

Literature review

The circular economy concept has gained significant attention in recent years. Previous studies have shown that adopting circular economy practices can drastically reduce resource consumption and waste generation. However, challenges such as high costs, lack of

regulatory frameworks and technological limitations have hindered adoption across industries.

Circular economy models

Implementing circular economy (CE) models is essential for reducing industrial waste and achieving Sustainable Development Goals (SDGs). Various models have been developed to optimize resource use, minimize waste, and promote sustainability in industrial sectors.

Circular economy model	SDG supported	Impact
Recycling	SDG 12 (Responsible Consumption)	Reduces waste and promotes recycling
Industrial symbiosis	SDG 9 (Industry, Innovation, Infrastructure)	Reuses waste from one industry as raw material for another
Product-as-a-Service	SDG 13(Climate Action)	Reduces resources extraction and carbon emissions
Reuse & Repair	SDG 12	Extends product life and reduces landfill waste
Design for all sustainability	SDG 6 (Clean water)	Reduces pollution in water bodies through sustainable products

Methodology

This study follows a systematic approach to analyze how circular economy (CE) models can effectively reduce industrial waste while supporting the achievement of Sustainable Development Goals (SDGs). The methodology consists of multiple stages, including research design, data collection, data analysis, evaluation framework, and recommendations.

1. Research design

A mixed-method approach is used, incorporating both qualitative and quantitative research methods to ensure a comprehensive understanding of CE models and their impact on industrial sustainability. The study focuses on examining different CE models

such as closed-loop recycling, industrial symbiosis, remanufacturing, and product-as-a-service. Further the study evaluates the role of CE strategies in reducing industrial waste across various sectors like manufacturing, electronics, construction, and packaging. Identifying how CE practices align with SDG 9 (Industry, Innovation, and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). To gather reliable insights, both primary and secondary data sources are utilized.

Data analysis

The analysis of circular economy (CE) models for reducing industrial waste and achieving Sustainable Development Goals (SDGs) is based on primary data from surveys, interviews, and case studies, as well as insights from recent global studies.

Adoption of CE models: Around 60-70% of businesses in manufacturing and electronics sectors have started implementing CE models, primarily focusing on closed-loop recycling and remanufacturing.

- Industry-Specific Trends:

Electronics: High adoption of product-as-a-service (PaaS) and remanufacturing.

Manufacturing: Strong emphasis on industrial symbiosis and recycling-based models.

Impact on Waste Reduction The case study insights suggests that companies implementing CE strategies report a 30-40% reduction in industrial waste over three to five years. Businesses that focus on resource efficiency and material reuse achieve up to 50% cost savings on raw materials.

Economic and environmental benefits: On average, industries investing in CE models experience a 20-30% reduction in operational costs due to material recovery. CE adoption contributes to a 15-25% decline in greenhouse gas emissions, aligning with SDG 13 (Climate Action). Differences in global sustainability regulations create barriers for multinational companies.

Alignment with SDGs: SDG 9 (Industry, Innovation, and Infrastructure): Encourages sustainable industrial processes and technological advancements. SDG 12 (Responsible Consumption and Production): Promotes resource efficiency, reducing material waste. SDG 13 (Climate Action): Supports carbon footprint reduction and eco-friendly production.

Conclusion

Circular economy models offer a sustainable approach to reducing industrial waste while contributing to global environmental and economic goals. By integrating strategies such as closed-loop recycling, remanufacturing, and industrial symbiosis, businesses can significantly lower waste generation, conserve natural resources, and improve cost efficiency. These models align with SDG 9 (Industry, Innovation, and Infrastructure), SDG

12 (Responsible Consumption and Production), and SDG 13 (Climate Action), fostering a more sustainable industrial framework.

However, challenges such as high initial investment costs, regulatory inconsistencies, and limited consumer awareness hinder widespread adoption. Overcoming these barriers requires collaborative efforts from industries, policymakers, and consumers. Governments must implement supportive policies, businesses should invest in innovative CE strategies, and consumers need to embrace sustainable products and services.

References

ScienceDirectcomhttps://www.sciencedirect.com The impact of the circular economy on sustainable development

https://www.google.com/url?q=https://www.sciencedirect.com/science/article/pii/S235255 09 22002561&sa=U&ved=2ahUKEwj4v6f57--
LAxVcsFYBHRckEvwQFnoECC8QAQ&usg=AOvVaw3g1ePDSiCMSWWqyx7yx4Tb

ResearchGatehttps://www.researchgate.net(PDF) Circular Economy as a Model of Achieving Sustainable

https://www.google.com/url?q=https://www.researchgate.net/publication/361317967_Ci rcula
r_Economy_as_a_Model_of_Achieving_Sustainable_Development&sa=U&ved=2ahU KEwj 4v6f57--

LAxVcsFYBHRckEvwQFnoECHcQAQ&usg=AOvVaw1_U0fKBcTNvHCM1ERCmY kw

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https://www.google.com/url?q=https://www.linkedin.com/pulse/circular-economy-sustainable-development-achieving-goals-badra&sa=U&ved=2ahUKEwj4v6f57--
LAxVcsFYBHRckEvwQFnoECGgQAQ&usg=AOvVaw3zResrDMhNFVgiU7QuYjJN

National Institutes of Health (NIH) (.gov)https://pmc.ncbi.nlm.nih.govCircular economy approach in solid waste management system to ...

https://www.google.com/url?q=https://pmc.ncbi.nlm.nih.gov/articles/PMC9622352/ &sa=U& ved=2ahUKEwj4v6f57--
LAxVcsFYBHRckEvwQFnoECEQQAQ&usg=AOvVaw0Bo78_Z_609EB8cXl3tTJ N

Impact of the Internet on Human Being

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Abstract

The internet has greatly changed the way people live, making communication, learning, business, and education . It helps people stay connected through emails, video calls, and social media, no matter where they are. Online education has made knowledge easily available, allowing students and professionals to learn new skills anytime. Businesses also use the internet for advertising, online shopping, and remote work, which improves productivity and expands their reach. As a result, the internet plays a major role in economic growth and social interactions.

At the same time, too much internet use can have negative effects. Many people spend hours on social media, reducing real-life conversations and causing loneliness. False information get quickly spread in online mode. Cyber crimes like hacking and identity theft are also growing concerns. Health problems such as eye strain, poor sleep, and lack of physical activity are common due to excessive screen time. Privacy is another issue, as companies collect personal data for advertisements. Despite these problems, people can enjoy the benefits of the internet by using it responsibly. Governments and individuals must work together to make online spaces safer and more secure.

Keywords : Internet, communication, learning, business, social media, false information, privacy, health, online safety.

Introduction

The internet has had a huge impact on human beings in many ways, changing the way we live, work, and interact with each other. With just a few clicks, people can access information from all over the world, connect with others, and even work from home. This global connectivity has made the world feel smaller and has opened up countless opportunities for learning, communication, and business.In addition to its benefits, the internet also brings challenges. People spend more time online, sometimes leading to a lack of face-to-face interaction, which

can affect social skills and relationships. It has also led to concerns about privacy and security, as personal information is shared and stored online.

The internet has also changed the way we work and learn. Online education and remote jobs have become more popular, allowing people to work from almost anywhere. However, it has also raised questions about the effects of too much screen time, including the impact on mental health.While the internet has brought many positive changes, it's important for individuals and society to find a balance. It has transformed the world in many ways, and understanding both its advantages and challenges is key to using it in a healthy and productive way.

The internet has revolutionized communication, making it easier for people to stay in touch with friends and family, regardless of distance. Social media platforms, messaging apps, and video calls have brought people closer together, allowing them to share experiences and ideas in real-time. This has also led to the rise of online communities, where individuals with similar interests can connect and support each other, regardless of geographical location.

Moreover, the internet has dramatically changed the way we access and consume information. News, entertainment, and educational resources are now readily available at our fingertips. People can watch videos, read articles, or even take online courses to expand their knowledge, all from the comfort of their homes. This has democratized education and opened up learning opportunities for people who may not have had access to traditional resources.

However, with these benefits come some risks. The internet can sometimes be a place where misinformation spreads quickly, leading to confusion or fear. Additionally, the constant connection to the online world can be overwhelming, leading to stress, anxiety, or addiction in some cases. It's crucial for people to be mindful of how much time they spend online and how it affects their overall well-being.

Research problem

The research problem looks at how too much internet use affects mental health, social life, and brain development. It can cause issues like anxiety, depression, and loneliness, especially in different age groups. The study also explores how the internet has changed the way we communicate and build relationships, both positively and negatively. Understanding these effects can help us use the internet in a healthier and more balanced way.

Objective

- To evaluate its influence on mental health and well-being.
- To explore its impact on economic opportunities and job markets, IT has facilitated businesses growth through e-commerce, remote work, and digital marketing.
- To identify the challenges and risks associated with internet usage.
- To provide insights into the future implications of internet dependence.
- To make communication easier, the internet provides instant messaging, emails, and video calls.
- To improve education and knowledge accessibility has been enhanced through online courses, e-books, and virtual classrooms have made learning more accessible.
- To provide entertainment, streaming services, online games, and social media offer endless content.

Scope and importance

The internet spans across countries, connecting people, businesses, and governments worldwide.

The impact of the internet is spread across various sectors like education, healthcare, entertainment, business, and social life. The Internet is a significant driver of innovation. It continually reshapes industries, fostering new technologies, startups, and services. It has further significance in the evolution of the workforce. The internet has resulted in changes in job roles, work structures (remote work, freelancing), and industries. Furthermore, it influences access to opportunities, with challenges in digital literacy and internet availability. Along with these, the internet has important social and cultural influences. It impacts cultural exchange, societal norms, and public opinion.

Importance of the internet:

The Internet plays a crucial role in modern life, touching nearly every aspect of society. It is essential for education and self-learning, enabling global knowledge exchange and access to vast resources. Economically, it drives innovation, fuels entrepreneurship, and supports the global economy by creating new opportunities and markets. In terms of communication, the Internet has revolutionized how individuals and organizations interact, allowing for real-time collaboration regardless of location. It also enhances convenience and efficiency by streamlining everyday tasks such as shopping, banking, and accessing services, ultimately

saving time and effort. Socially, the Internet connects people across distances, strengthening relationships among families, communities, and cultures. Additionally, it contributes to health and well-being by advancing medical research, providing telemedicine services, and promoting health awareness worldwide.

Limitations of the study

The study explores how personality types influence conflict resolution strategies within multinational companies like IBM, emphasizing the importance of personality in shaping workplace dynamics. However, several limitations must be considered when interpreting the findings. The sample size and scope are confined to specific regions or companies, which may not accurately reflect global trends. Data accuracy may be compromised by biases in self-reported information or inaccuracies in secondary sources. Additionally, the rapid pace of technological change can render findings obsolete quickly. Cultural variations across different regions may affect the study's relevance and applicability, as societal norms significantly influence behavior. Limited access to comprehensive and up-to-date data due to resource constraints can also hinder the depth of analysis. Furthermore, ethical concerns surrounding privacy, consent, and confidentiality in data collection may impact the validity and reliability of the results.

Literature review

The body of research on internet use and its impact on social and psychological well-being offers a multifaceted view of the digital age. Barge and McKenzie (2004) emphasize the social benefits of the internet, such as authentic self-expression and the formation of meaningful connections, though they overlook negative consequences like addiction and isolation. Kimberly Young (1998) presents foundational work on internet addiction, including symptoms and treatments, but her study lacks a cross-cultural perspective and fails to address evolving digital trends. Kraut et al. (1998) highlight the internet's paradoxical role in diminishing face-to-face interaction and psychological well-being, yet they do not consider how future social media developments might alter this impact. Similarly, Kraut and Kiesler (2002) examine the internet's connection to loneliness, noting both increased access to social networks and potential for reduced offline engagement, though their analysis does not reflect more modern digital environments. Ellis, Davidson, and Shaw (2019) address problematic internet use, identifying outcomes like stress and sleep deprivation, but their study does not differentiate the effects of specific online activities. Greenfield (2009) focuses on children's

cognitive development, citing improved multitasking but reduced attention spans, while giving limited attention to emotional and social growth. Finally, Montgomery (2017) provides a broad review of the internet's mental health implications, recognizing both its therapeutic potential and its dangers, though she omits in-depth discussion of vulnerable populations. Together, these studies underscore the need for more nuanced, updated, and inclusive research to fully grasp the internet's complex influence on human development and social life.

Research methodology

I have collected secondary data on the impact of the internet on human beings from a wide range of credible sources, including peer-reviewed academic journals, government reports, reputable books, and industry research publications. These sources provide comprehensive information on how the internet has influenced various aspects of human life. For example, studies from scholarly articles cover the cognitive effects of internet use, including its influence on memory, attention span, and decision-making processes. Additionally, government reports offer data on internet penetration, digital access across different regions, and its role in economic development and social inclusion.

Further, I've gathered data from case studies that highlight the impact of the internet in various sectors, such as education, healthcare, and work environments. These case studies explore how the internet has facilitated online learning, telemedicine, and remote work, and how it has transformed traditional industries and practices. On the other hand, reports on internet addiction, social media use, and online privacy concerns provide insight into the potential negative effects, including social isolation, mental health challenges, and security risks.

The data also includes surveys and statistical reports, which offer quantitative insights into how individuals of different age groups, socio-economic backgrounds, and geographical locations interact with the internet. This includes information on usage frequency, preferred platforms, and the types of content accessed. These quantitative findings help identify patterns in internet behaviors and offer a broader understanding of internet use globally.

By synthesizing these diverse data sources, I aim to gain a holistic view of the internet's role in shaping human interactions, behaviors, and societal norms. This approach allows me to analyze not only the opportunities and benefits that internet access provides but also the challenges and risks associated with its widespread usage.

Case study

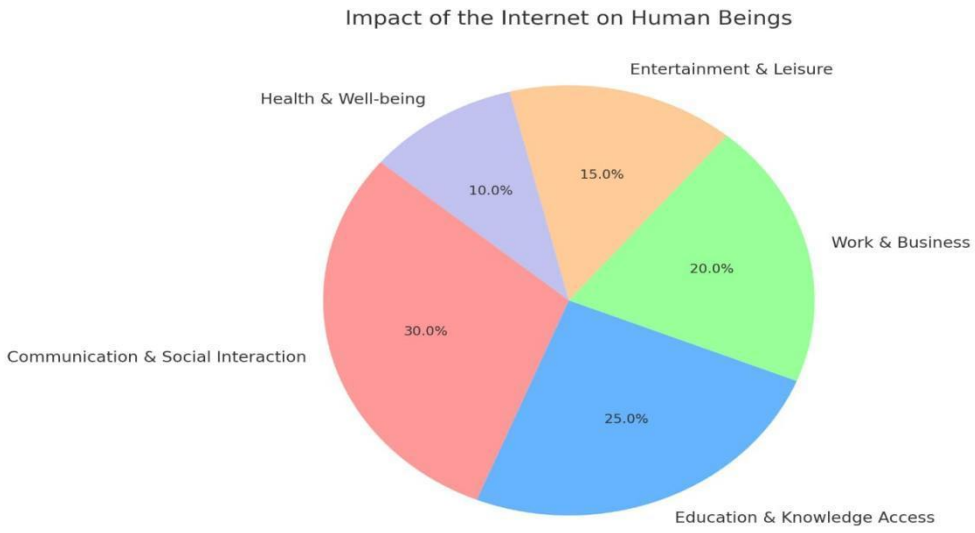
Education: online learning revolution (Coursera & Khan Academy)

The internet has radically transformed education by making learning more accessible to students around the globe. Platforms like Khan Academy and Coursera have played pivotal roles in offering both free and paid courses across various disciplines. For example, during the COVID-19 pandemic, millions of students continued their education through these platforms, effectively reducing the learning gap caused by school closures. The key benefits of online learning include global access to high-quality education, flexible learning schedules, and cost-effective courses compared to traditional education models, making learning more inclusive and adaptable to individual needs.

Healthcare: Telemedicine in rural areas (Apollo Telehealth & Practo)

The internet has also revolutionized healthcare, particularly in rural areas where medical professionals are often scarce. Telemedicine services such as Apollo Telehealth and Practo have made it possible for patients to consult with doctors through video calls, improving access to healthcare in underserved regions. For instance, Apollo Telehealth provided consultations to over 10 million patients in rural areas of India, alleviating the pressure on hospitals and improving access to specialists. The key benefits of telemedicine include reduced travel time and costs for patients, faster diagnoses and treatments, and enhanced healthcare accessibility for those in remote areas.

Data analysis and interpretation



The internet has profoundly impacted various aspects of modern life, with communication and social interaction accounting for 30% of its influence. It has revolutionized how people connect through instant messaging, video calls, and social networking platforms, fostering global connectivity while also raising concerns about social media addiction. In the realm of education and knowledge access (25%), the internet has enhanced learning opportunities through online courses and research availability, although issues like misinformation and increased screen time persist. Work and business (20%) have also been transformed, with remote work, e-commerce, and digital marketing boosting productivity and innovation, albeit accompanied by challenges such as job automation and cybersecurity threats. Entertainment and leisure (15%) have expanded through streaming services, gaming, and digital content, offering diverse options for enjoyment but also contributing to digital addiction and a decline in physical activity. Lastly, the internet's role in health and well-being (10%) is evident in the rise of telemedicine, fitness apps, and mental health resources, though concerns remain over cyberbullying and the mental health impacts of prolonged screen use.

Findings

The internet has brought transformative changes across multiple aspects of modern life. In terms of communication, it has made global interaction faster and more accessible through social media, email, and messaging platforms, though it has also contributed to reduced face-to-face interaction and increased online harassment. Information access has been democratized, allowing individuals to explore educational resources and engage in self-learning, yet this has been accompanied by growing concerns over misinformation and content reliability. The impact on mental health is twofold—while the internet facilitates access to therapy, support groups, and mental health education, excessive social media use has been linked to anxiety, depression, and low self-esteem, particularly among younger users. In the workplace, the internet has enabled remote work and digital entrepreneurship, creating new economic opportunities while also disrupting traditional industries and raising concerns about job displacement. Social behavior has evolved, with people increasingly forming relationships online, expressing identities digitally, and engaging in activism; however, the anonymity of the internet has also fueled cyberbullying, hate speech, and polarization. Privacy and security remain pressing issues, as the vast sharing of personal data exposes users to hacking, identity theft, and surveillance. In education, the rise of online platforms like Coursera, edX, and Khan Academy has expanded learning opportunities, but the digital divide continues to limit access for some populations. Lastly, cognitive patterns may be shifting due to the internet's fast-paced

environment, potentially leading to shorter attention spans and a preference for quick, surface-level information processing.

Conclusion

The internet has revolutionized the way people communicate, work, and access information. It has broken down geographical barriers, enabling instant communication through emails, social media, and video calls. The ability to connect with anyone around the world has made collaboration easier and has brought people closer together. Additionally, the internet has become an essential tool for learning, providing access to vast amounts of information and educational resources at the touch of a button.

However, the internet also brings several challenges. One major issue is the potential for addiction, as people often spend excessive time online, which can negatively impact their physical and mental health. The constant stream of notifications and social media interactions can lead to a lack of face-to-face communication and social isolation. Moreover, online activities raise privacy concerns, as personal information is often shared without proper security measures, making individuals vulnerable to data breaches and cyber crimes.

Despite these drawbacks, the internet has opened up numerous opportunities for personal and professional growth. It has enabled the rise of online businesses, remote work, and e-commerce, creating new economic opportunities. Additionally, the internet has played a significant role in social movements, allowing people to organize, raise awareness, and advocate for change. As long as people use the internet responsibly and mindfully, it continues to offer countless benefits while minimizing its potential harms.

Bibliography

Turtle, S. (2011). Alone Together – Discusses how technology affects relationships and society.

Cast ells, M. (2001). The Internet Galaxy – Analyzes how the internet is transforming society, economy, and culture.

Anderson, C. A., & Dill, K. E. (2000). Video Games and Aggressive Behavior – Examines the relationship between internet media and aggressive behavior.

Katy, J. E., & Rice, R. E. (2002). Social Consequences of Internet Use – Examines the Internet's influence on social behavior.

World Economic Forum (2020). The Global Internet Impact Report – Analyzes the economic, social, and cultural effects of the internet. we forum.org

Pew Research Center (2021). The Future of the Internet – Analyzes the Internet's impact on communication, politics, and economics. pew research.org

Internet Society (2020). Impact of the Internet on Society – Offers articles on how the internet shapes society. internet society.org

Commonwealth Fund (2021). The Impact of Digital Health on Society – Discusses how digital health technologies are influenced by the internet. commonwealth fund.org

Virtual Reality of Education

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Abstract

Virtual Reality (VR) in education is revolutionizing traditional learning by creating interesting environments where students can interact with and explore subjects in ways that go beyond conventional methods. Through VR, learners can engage in simulations, such as virtual field trips, historical reenactments, or scientific experiments, providing a deeper understanding of complex concepts. This approach encourages active participation, critical thinking, and a more personalized learning experience, as students can progress at their own pace in an environment free of real-world limitations.

As VR technology advances, its potential to enhance educational outcomes continues to expand, offering opportunities for more inclusive, accessible, and dynamic learning experiences. By breaking down geographical and physical barriers, VR enables learners from diverse backgrounds to access high-quality educational resources and participate in experiences previously unavailable to them. The integration of VR into education promises to transform teaching methodologies, making learning more engaging, interactive, and tailored to individual needs.

Keywords:- , Personalized Learning , Virtual Field Trips , Remote Learning ,Collaborative Learning , Accessibility.

Introduction

Virtual Reality (VR) is a technology that creates a computer-generated environment, making you feel like you're in a completely different place. To experience VR, you wear a headset that covers your eyes, allowing you to see and interact with the virtual world around you. In education, VR is being used to create interactive learning experiences that go beyond traditional methods like reading books or watching videos.

Instead of just hearing about or watching something, students can now "experience" it. For example, instead of reading about space, students can visit different planets in a virtual world. Instead of studying ancient history through a textbook, they can walk through historical sites. VR makes learning more engaging, fun, and memorable.

By using VR, students can interact with the environment, solve problems, and explore new subjects in an exciting way. This hands-on approach helps students understand complex ideas better, and it can be used in subjects like science, history, art, and even medical training. VR can also provide a safe space for practicing skills, like performing surgeries or flying planes, without any real-life risk.

While VR in education has great potential, it also comes with some challenges. The equipment can be expensive, and not every school may have access to it. It also requires teachers and students to learn how to use the technology effectively. Despite these challenges, VR offers a new and exciting way to enhance education and make learning more interactive and enjoyable.

Research problem

A research problem in the context of Virtual Reality (VR) in education could focus on investigating how immersive VR environments impact student engagement, learning outcomes, and knowledge retention. Specifically, the problem could explore whether VR enhances cognitive skills, such as problem-solving and critical thinking, compared to traditional learning methods. It could also examine the long-term effects on information retention, the accessibility benefits of VR for diverse learners, and the practical challenges of implementing VR in classrooms, including cost, infrastructure, and teacher readiness. Ultimately, this research would assess VR's effectiveness as an educational tool and its potential to transform traditional teaching practices.

Objectives

1. To Assessing the impact of VR on student engagement: To determine if immersive VR experiences increase student interest, motivation, and active participation in the learning process compared to traditional methods.

2. To Evaluating cognitive learning outcomes: To investigate how VR affects students' cognitive skills, such as problem-solving, critical thinking, and spatial awareness, and how it supports deeper understanding of complex concepts.

3. To Measuring knowledge retention: To examine whether VR-enhanced learning improves long-term retention and recall of information compared to conventional educational techniques.

4. To Exploring the accessibility of VR for diverse learners: To explore how VR can make education more inclusive, especially for students with disabilities or those in remote locations, by offering adaptable and immersive learning environments.

5. To Identifying challenges and barriers to implementation: To analyze the practical challenges, including the costs, technical infrastructure, and teacher training requirements, associated with integrating VR into educational settings.

6. To Comparing VR with other educational technologies: To compare the effectiveness of VR-based learning with other interactive or digital tools, such as gamification or online simulations, in terms of student outcomes and engagement.

Scope of virtual reality in education

Virtual reality (VR) holds immense potential to transform education by offering immersive, interactive, and personalized learning experiences. One of the most significant advantages of VR is its ability to create immersive learning environments where students can engage with content in a three-dimensional space. This allows learners to explore historical landmarks, conduct virtual science experiments, or simulate complex medical and engineering procedures, making abstract and difficult concepts easier to understand. VR also enables personalized learning, adapting to individual student needs, preferences, and learning speeds. This level of customization supports a more inclusive approach to teaching, catering to various learning styles more effectively than traditional methods.

Moreover, VR enhances accessibility in education by breaking geographical and physical barriers. Students from remote or under-resourced regions, as well as those with physical disabilities, can benefit from high-quality education without being limited by location or mobility issues. In addition to theoretical learning, VR is particularly effective in developing practical skills in fields such as medicine, engineering, and the arts. By offering a risk-free environment, students can practice procedures and techniques safely and repeatedly. VR also facilitates global collaboration by connecting students from different countries in shared virtual spaces, fostering teamwork, cultural exchange, and global awareness. Lastly, as industries increasingly adopt VR for training and development, its use in education prepares students for the future workforce, equipping them with essential technological skills and job readiness.

Importance of virtual reality in education

The importance of VR in education lies in its ability to increase engagement, enhance learning outcomes, and provide inclusive educational opportunities. Its immersive nature captures students' attention, making learning more engaging and motivating. This increased engagement often translates into improved academic performance. VR also shifts the focus from passive to active learning by allowing students to interact, explore, and experiment in a hands-on virtual environment. This method of experiential learning is proven to enhance understanding and retention of complex topics, especially in subjects like science, technology, and mathematics.

Furthermore, VR creates a safe space for students to practice high-risk or sensitive scenarios without real-world consequences. For example, medical students can simulate surgeries or emergency responses, while aviation trainees can experience flight simulations. This helps build confidence and competence before entering real-life situations. VR also supports inclusive education by accommodating diverse learners, including those with disabilities,

through features such as audio descriptions, visual enhancements, and customizable interfaces. By integrating VR into classrooms, schools help students become more familiar with emerging technologies, preparing them for a tech-driven future. This not only improves subject knowledge but also fosters digital literacy and adaptability, making students more competitive in the global job market.

Limitations of the study

While virtual reality (VR) offers numerous benefits to the field of education, several limitations hinder its widespread adoption and effectiveness. One of the most significant limitations is the high cost associated with VR implementation. The initial investment required for purchasing VR headsets, high-performance computers, and specialized software can be substantial. In addition to hardware expenses, ongoing costs for maintenance, updates, and technical support can strain the budgets of many educational institutions. This financial burden often limits VR access to well-funded schools, leaving under-resourced institutions at a disadvantage.

Another critical limitation involves technical challenges and compatibility issues. Not all VR systems are compatible with existing educational tools or platforms, which can disrupt the learning process. Software bugs, hardware malfunctions, and system integration problems may also interrupt classroom activities, leading to frustration among both teachers and students. Moreover, the uneven distribution of infrastructure results in limited access to VR, particularly in rural or economically disadvantaged regions. This creates a digital divide, where only certain students benefit from immersive learning experiences, potentially widening the educational gap.

The learning curve associated with VR is another concern. Teachers and students often require substantial training to use the technology effectively. Some educators may be resistant to adopting new technologies, while others may lack the technical skills needed to integrate VR into their teaching practices. Students, on the other hand, may find the interface unfamiliar or experience physical discomfort such as motion sickness, which can hinder their ability to focus and engage fully.

Content development poses an additional challenge. Although the potential for VR content is vast, there remains a shortage of high-quality, curriculum-aligned educational materials. Creating effective VR experiences is time-consuming and requires expertise in instructional

design, programming, and 3D modeling. This scarcity of tailored content can limit the technology's practical use in classrooms.

Lastly, health and safety concerns are important to consider. Extended use of VR can lead to issues such as eye strain, headaches, and motion sickness. Some users may also experience disorientation or nausea, which restricts the amount of time they can comfortably engage with VR environments. These physical effects not only impact learning effectiveness but also raise concerns about long-term use, especially among younger students.

In conclusion, while VR presents exciting possibilities for educational enhancement, these limitations must be addressed to ensure equitable, effective, and sustainable implementation in the classroom.

Literature reviewed

Several studies have explored the role of virtual reality (VR) in education, highlighting both its transformative potential and the challenges associated with its implementation. Slater et al. (2014), in their article *"Virtual reality as a tool for education"* published in *Educational Technology Research & Development*, emphasize the immersive quality of VR that enhances student engagement and understanding of complex topics. However, the study points to a research gap in understanding the long-term effectiveness of VR on cognitive learning outcomes.

Similarly, Mikropoulos and Natsis (2011), in their work *"The impact of virtual reality on learning and teaching"* published in *Computers & Education*, underline VR's potential to revolutionize traditional education by allowing learners to visualize and manipulate abstract concepts. They note, however, that comprehensive studies across various educational levels and disciplines are still lacking.

Alshammari et al. (2020), in their article *"Virtual reality for education: A review"* from the *Journal of Educational Technology Systems*, provide an overview of different VR applications such as virtual field trips and simulations. While acknowledging its positive effect on engagement and learning, they highlight a gap in adapting VR tools to diverse educational settings, age groups, and curricula.

Lee and Wong (2014) conducted a systematic review titled *"Virtual reality in education: A systematic review"*, published in *Educational Research Review*. They confirm VR's role in

enhancing motivation and interactivity but stress that practical barriers, including cost and lack of teacher training, must be addressed to enable its broader integration into real-world classrooms.

Focusing specifically on STEM education, Chen et al. (2018) in *"The role of virtual reality in STEM education"* (published in the *Journal of STEM Education*) argue that VR can simplify complex STEM concepts through interactive experiences. However, they call for more longitudinal research to assess its long-term impact on STEM competency.

The motivational benefits of VR are highlighted in a study by Guggenheim, Dede, and Taylor (2021), titled *"Virtual reality in the classroom: A motivating tool for learning"* published in *Educational Technology Research and Development*. The study reveals that VR significantly enhances intrinsic motivation and engagement, particularly in challenging subjects, though it acknowledges a gap in understanding how these motivational effects vary across different student populations.

Finally, Harrison, Schmidt, and Barfield (2019), in their article *"Challenges of using virtual reality in education: A case study"* published in the *Journal of Computer Assisted Learning*, examine real-world barriers to VR adoption. Their case study identifies high costs, technical limitations, and insufficient teacher training as significant obstacles. While recognizing the potential of VR to boost engagement, they suggest targeted recommendations to improve its practical implementation in schools.

Research Methodology

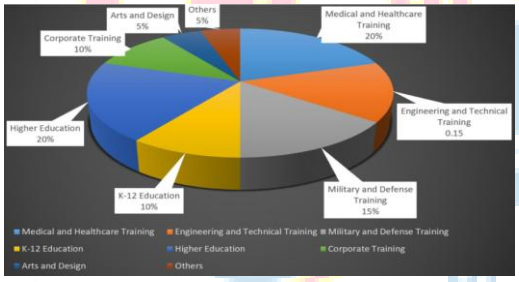
The research methodology for studying the use of Virtual Reality (VR) in education typically involves both qualitative and quantitative approaches to gather a comprehensive understanding of its impact. Researchers can conduct experimental studies where one group of students uses VR-based learning tools while another group uses traditional methods. This helps compare the effectiveness of VR in enhancing learning outcomes, engagement, and motivation.

Data collection can include surveys and interviews to understand students' and teachers' perceptions of VR in the classroom. Observations can also be made to see how students interact with VR technology during lessons. Pre- and post-tests can be used to measure changes in knowledge or skills before and after using VR.

In terms of data analysis, statistical methods (like t-tests or regression analysis) can be used to analyze quantitative data, such as test scores, while thematic analysis can help identify patterns in qualitative data from interviews and surveys. This combination allows for a deeper understanding of how VR affects learning and highlights areas for improvement in its implementation.

Data Analysis and Interpretation

Medical and healthcare (20%): Virtual reality (VR) is increasingly being used in medical fields, including surgical training, pain management, physical therapy, and psychiatric treatments. VR offers immersive, risk-free environments where medical professionals can practice and refine their skills without putting patients at risk. It also aids in patient recovery by providing controlled environments for therapy and rehabilitation, making it a valuable tool in both training and treatment.



In engineering and technical training (0.15%), VR provides immersive simulations that allow students and professionals to practice complex tasks, troubleshoot systems, and design prototypes in a virtual setting. This enhances hands-on learning and skills development, offering a safe space to experiment without the limitations of physical constraints. VR-based training in engineering can improve accuracy, efficiency, and problem-solving abilities, crucial for technical fields.

In military and defense training (15%), VR is utilized to simulate realistic combat and tactical scenarios, offering a safe way for personnel to enhance their decision-making skills and practice complex missions without the risks associated with real-world exercises. By replicating high-stress situations, VR allows military personnel to train under pressure and improve their tactical responses, ensuring readiness in real combat situations.

In K-12 education (10%), VR enhances the learning experience by offering immersive activities such as virtual field trips, interactive lessons, and simulations. These experiences make education more engaging, allowing students to explore subjects in ways that are not possible through traditional methods. VR provides an opportunity for hands-on learning, increasing student engagement and improving the retention of complex concepts.

In higher education (20%), VR enables immersive learning through simulations, virtual labs, and interactive experiences. Students in fields such as science, engineering, and medicine can use VR to perform experiments, conduct virtual dissections, and practice complex procedures. This approach enhances understanding and engagement, providing opportunities for deep learning in a controlled and realistic environment.

In corporate training (10%), VR offers immersive simulations that help employees develop skills, undergo onboarding, and participate in scenario-based training. This reduces the time and costs associated with traditional training methods while improving overall employee performance. VR in corporate settings also provides employees with real-time feedback, ensuring more effective and engaging training experiences.

In arts and design (5%), VR is a powerful tool for creative professionals, allowing them to immerse themselves in virtual environments for creation, visualization, and exploration of digital art. Artists and designers can experiment with virtual materials, refine their work, and engage in innovative creative processes. This technology pushes the boundaries of traditional design work, enabling more dynamic and experimental projects.

In other sectors (5%), VR finds diverse applications, including real estate tours, virtual tourism, and therapeutic uses. In real estate, VR allows potential buyers to explore properties remotely, while virtual tourism offers immersive travel experiences without leaving home. Additionally, VR is increasingly being used in various forms of therapy, helping patients confront fears or practice social skills in a safe, controlled environment.

Findings

Virtual reality (VR) has shown significant potential in transforming education by offering immersive and interactive learning experiences that enhance student engagement and motivation. By visualizing complex concepts in a 3D environment, VR makes learning more engaging, leading to increased motivation among students. It also facilitates personalized

learning, allowing students to progress at their own pace, accommodating different learning styles, and offering hands-on practice, especially in fields such as medicine, engineering, and history. Moreover, VR enables students to immerse themselves in experiences they would not typically have access to, like exploring historical landmarks or conducting virtual science experiments. This creates immersive learning environments that deepen students' understanding of abstract concepts. Furthermore, VR promotes collaboration and communication, allowing students to interact with peers and instructors globally through virtual classrooms and team-based activities, making it an ideal tool for remote and global education settings. While the initial cost of VR technology can be high, its potential to bridge gaps for students in underserved or remote areas is significant. As VR technology becomes more affordable, its accessibility in classrooms will grow, opening up new possibilities for widespread use. However, challenges such as high implementation costs, the need for trained educators, and health concerns from prolonged VR headset use must be addressed for its full potential to be realized. In conclusion, while VR in education offers exciting prospects, overcoming these challenges will be crucial for it to become a sustainable and widely adopted tool, ultimately enhancing educational experiences and improving learning outcomes.

Conclusion

Virtual reality has the potential to revolutionize education by offering immersive, interactive, and personalized learning experiences that can cater to various learning styles. Although there are barriers to widespread adoption, such as cost and infrastructure requirements, the future of VR in education looks promising. As the technology becomes more affordable and accessible, it is likely that VR will become an integral tool in enhancing learning experiences across various educational levels, from primary schools to higher education institutions. However, proper integration of VR into educational settings will require thoughtful planning, teacher training, and careful consideration of its impact on students' well-being.

Bibliography

Bailenson, J. N. (2018). *Experience on Demand: What Virtual Reality Is, How It Works, and What It Can Do*. W.W. Norton & Company.

Huang, H. M., & Liaw, S. S. (2018). Investigating Learners' Attitudes toward Virtual Reality Learning Environments: Based on a Constructivist Approach. *Computers in Human Behavior, 79*, 177-186.

International Society for Technology in Education (ISTE) (2020). *The Future of Education: How Virtual Reality is Transforming Classrooms and Learning*.

Edutopia – Virtual Reality in Education. Retrieved from https://www.edutopia.org

AI's Impact on Future Work

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Abstract

The rapid evolution of artificial intelligence (AI) is reshaping the future of work, driving transformative changes across industries. AI technologies, such as machine learning, automation, and natural language processing, are increasingly enhancing productivity, efficiency, and decision-making. However, these advancements also bring challenges, including potential job displacement, shifts in skill requirements, and the need for new ethical frameworks. This paper explores the dual impact of AI on the workforce—its potential to create new opportunities and streamline tasks, while also posing risks of job obsolescence and income inequality. As AI continues to advance, a collaborative approach between industry, government, and education sectors is essential to ensure a fair and sustainable future of work. AI is reshaping the workforce by automating tasks, creating new jobs, and requiring workers to adapt with new skills. AI's and robotics are especially effective in manufacturing, logistics, and agriculture where machine can replace human labor for task like assembling, package, and delivery.

Keywords:

AI, automation, machine learning, future of work, workforce transformation, job displacement, skills gap, ethical implications, productivity, technological disruption.

Introduction

The future of work is being rapidly transformed by advancements in artificial intelligence (AI), which are altering how tasks are performed, who performs them, and the skills required for success. AI's influence is expanding across various sectors, from manufacturing and healthcare to finance and entertainment, fundamentally changing the relationship between workers and technology. Innovations such as automation, machine learning, and natural language processing are streamlining processes, improving efficiency, and enabling smarter decision-

making. However, alongside these benefits, AI introduces significant challenges, including the potential for job displacement, skill gaps, and ethical concerns regarding fairness and privacy.

As AI continues to develop, it is crucial to understand the broader implications for both employers and employees. While AI has the potential to enhance productivity and foster economic growth, it also raises important questions about its role in the workforce. Will AI create new kinds of jobs, or will it replace existing ones? What are the social and economic consequences of these shifts? And how can workers and industries adapt to this new landscape?

This paper aims to explore the impact of AI on the future of work, considering both its potential benefits and the challenges it poses. By examining current trends, potential risks, and opportunities, we seek to better understand how AI is shaping the workforce and what steps can be taken to ensure a positive and equitable future for all.

AI is already proving to be highly useful in today's workforce by enhancing efficiency, automating routine tasks, and supporting decision-making processes across various industries. In customer service, AI-powered chat bots and virtual assistants are available 24/7, handling inquiries and solving issues in real-time, freeing up human agents to tackle more complex problems. In fields like healthcare, AI is used to assist in diagnosing medical conditions, analyzing patient data, and recommending treatments, allowing doctors to provide better care with faster, more accurate results. In finance, AI algorithms can analyze vast amounts of market data to predict trends, manage risk, and optimize investment strategies. Furthermore, AI's ability to automate repetitive tasks, such as data entry, supply chain management, and even content creation, helps businesses reduce costs, improve productivity, and increase scalability. Overall, AI is transforming how work is done, making processes more efficient while allowing workers to focus on tasks that require creativity, critical thinking, and emotional intelligence.

Statement of the problem:-

AI is changing the workforce by automating tasks and creating new jobs. However, it also raises concerns about job loss and the need for new skills. This study aims to understand how AI will impact jobs, what skills will be needed, and how workers can adapt to these changes.

Objectives

The present study proposes the following objectives:

- To identify the types of jobs and tasks AI can automate or improve.
- To examine the impact of AI on different industries, including healthcare, finance, and customer service.
- To assess the potential risks and challenges of AI in the workforce, such as job displacement.
- To understand the changing skills required in the workforce due to AI advancements.
- To provide recommendations for businesses and policymakers on AI integration and workforce adaptation.
- To explore AI's role in enhancing workplace and improve overall productivity in both knowledge-based and manual labor-sector

Scope and importance of AI

AI has great potential in business operations. AI helps businesses automate tasks like answering customer questions using chatbots. Business firms across the world have started employing online store chat bots that help customers. This hints at the wave of automation expected as a result of the AI revolution. AI can take over repetitive tasks, like sorting emails or managing inventory (e.g., robots that pack products in warehouses). AI is used in voice assistants (like Siri) and self-driving cars (e.g., Tesla's AI that helps the car drive itself). AI also posses capabilities in large scale data analysis. AI can process large amounts of data to find patterns (e.g., Netflix recommending shows based on what you watch). Additionally, AI can assist doctors by analyzing medical images or suggesting treatments (e.g., AI tools that detect diseases like cancer early).

Importance of AI

AI helps do tasks quicker, like calculating large numbers or processing data in seconds (e.g., AI doing quick calculations for financial predictions). By automating tasks, businesses can save money on labor and reduce errors (e.g., AI-powered tools that reduce the need for human employees in repetitive roles). AI helps create new products or services (e.g., AI-powered apps that help people track their fitness goals). AI also helps people make smarter choices by analyzing lots of information (e.g., AI giving doctors the best treatment options based on patient data). As AI grows, new jobs are created in tech and AI management (e.g., AI developers who build new systems and machines). In short, AI is used everywhere to make life easier, faster, and more efficient. Whether it's in healthcare, business, or everyday products, AI is changing the way we work and live.

Limitations of AI

AI needs large amounts of data to work well. If the data is incomplete or biased, AI can make wrong decisions. Example: AI facial recognition can be biased if trained on mostly white faces. In addition to the large data requirements, developing and maintaining AI systems can be very expensive. Example: Building self-driving cars requires huge investments in research and technology. The long term effect of AI is unknown. We don't fully know how AI will impact jobs, society, or ethics in the future. Example: It's unclear if AI will create enough jobs to replace those it displaces.

Another important problem poised by AI is the bias in its working. AI can inherit biases from the data it's trained on, leading to unfair outcomes. Example: AI hiring tools might favor male candidates over female candidates if trained on biased data. Similarly, there are questions about how AI should be used and who's responsible when it makes mistakes. Example: If a self-driving car causes an accident, who is to blame—the car manufacturer or the software developer?

AI further poses a risk of lack of transparency: Some AI systems are hard to understand or explain, which can lead to mistrust. Example: AI systems in healthcare might recommend treatments, but doctors may not fully understand how the AI made its decision. Furthermore, over-dependence on AI poses certain challenges. Relying too much on AI might reduce human decision-making abilities. Example: People might trust AI recommendations blindly without questioning them, leading to poor decisions. AI also generates a significant skill gap. Many companies can't find enough skilled workers to build and manage AI systems. Example: Tech companies struggle to hire AI experts, which slows down their innovation. These limitations highlight the challenges AI faces in becoming a fully trusted and widely adopted technology.

Literature review

Frey and Osborne (2017) highlights job displacement risks, there is limited focus on the creation of entirely new job categories that may emerge due to AI advancements. The authors analyze the potential for job displacement due to automation and AI. Their study finds that jobs involving routine, manual tasks are most vulnerable to AI, particularly in sectors like transportation and manufacturing. However, they also suggest that new types of work—particularly in the AI development and support sectors—could emerge, which requires an emphasis on skills like problem-solving, technical proficiency, and creativity.

Dastin (2019) notes the bias in AI systems used in hiring, but doesn't discuss solutions or frameworks for building fairer AI models. This study investigates how Amazon's AI recruitment tool exhibited bias against female candidates due to the data it was trained on, which was primarily male-dominated. The paper sheds light on the ethical challenges AI faces, particularly in hiring processes, and emphasizes the importance of creating AI systems that are not only efficient but also fair and transparent. However, it lacks practical solutions for mitigating bias in AI models.

While discussing ethical concerns broadly, Binns (2018) notes that there is a gap in addressing the specific impact of AI on workplace diversity and inclusion. This research focuses on the ethical challenges AI poses to society, particularly in the workplace. It highlights concerns such as privacy issues, algorithmic biases, and the potential for discrimination. The study calls for a more inclusive approach to AI development and implementation, ensuring that AI does not exacerbate social inequalities. It acknowledges that AI can shape the future of work by improving productivity, but only if ethical standards are rigorously followed.

Avasarala(2020) discusses the transformative potential of AI in reshaping industries and work dynamics, focusing on areas like automation, AI-assisted decision-making, and the creation of new types of jobs in tech fields. The paper highlights that AI will require workers to adapt to new roles that prioritize emotional intelligence, creativity, and cognitive flexibility. However, the paper overlooks the social challenges AI could present, such as inequality and the disruption of existing labor markets. While the paper emphasizes AI's benefits, it underrepresents the challenges related to workforce displacement and the necessary policy interventions.

Ebert and Lacerda (2019) investigates how AI affects job roles and organizational structures. It concludes that while AI will automate many repetitive tasks, it will also create new roles that require human oversight and critical thinking. The paper suggests that job design will shift toward tasks that require collaboration, creativity, and emotional intelligence. However, there is little mention of how employees can be trained to perform these new roles or what kind of educational reforms are needed to equip workers for this transition. The research primarily focuses on organizational changes but lacks in-depth exploration of the skills needed in future AI-driven jobs.

Chui, M., & Manyika (2019) addresses global impacts but does not provide insights into how specific regions or countries can adapt their workforce strategies. This research takes a global approach to analyze how AI will reshape jobs across various industries. It identifies sectors like

customer service, healthcare, and manufacturing that will experience significant changes due to automation and AI technologies. The paper highlights the need for reskilling programs to help workers transition into new roles but lacks region-specific recommendations on how different countries can implement these strategies effectively.

Research methodology

I have collected secondary data on AI'S impact on future work. The research methodology for studying AI's impact on future work involves a combination of qualitative and quantitative approaches. The objective is to understand how AI is transforming jobs, required skills, and workplaces. The study focuses on key research questions such as how AI is replacing or assisting workers, what new skills will be needed, and how industries will change. Data is collected through both primary and secondary sources. Primary data includes interviews with experts, surveys of employees and companies, and case studies of industries using AI. Secondary data is gathered from research papers, industry reports, government studies, and online content. The analysis involves comparing AI's role in different sectors, identifying employment trends, and predicting future job shifts. Findings will summarize AI's effects on the workforce, highlight the most impacted industries, and suggest necessary skills for adaptation. This methodology ensures a comprehensive understanding of AI's influence on the future of work.

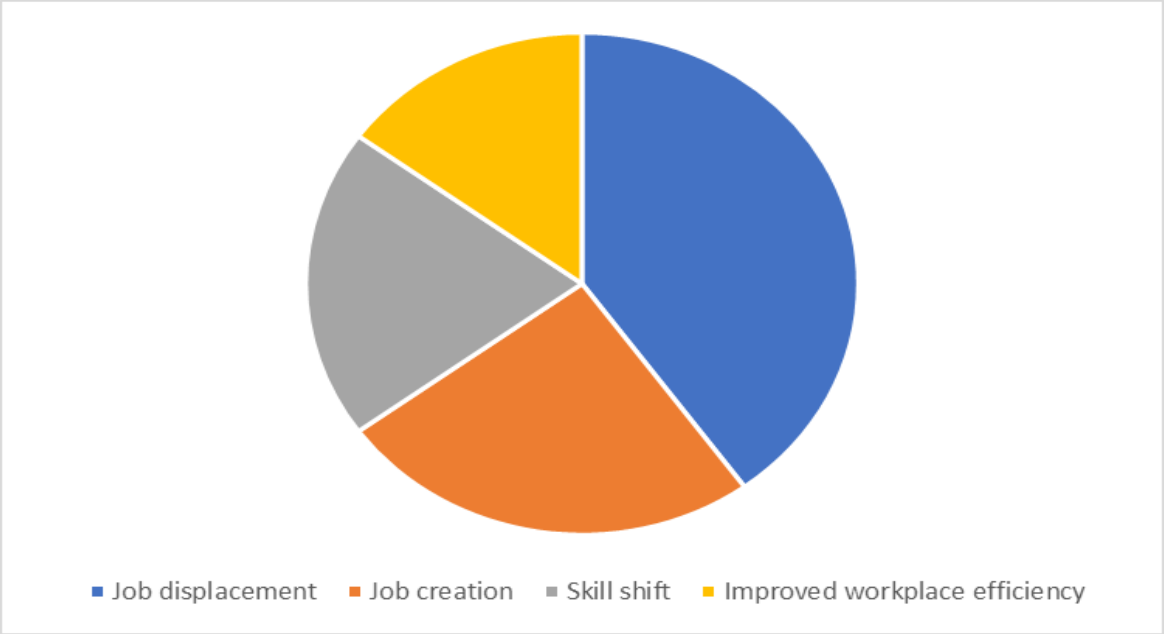
AI plays a crucial role in organizations by automating tasks, improving efficiency, and enhancing decision-making. It helps businesses streamline operations by handling repetitive tasks such as data entry, customer support, and document processing, allowing employees to focus on more complex activities. AI also assists in data analysis by processing large volumes of information quickly, enabling organizations to predict trends, assess risks, and make informed business decisions. In customer service, AI-powered chatbots and virtual assistants provide 24/7 support, personalize user experiences, and improve customer satisfaction.

In human resource management, AI is used for recruitment, resume screening, candidate assessment, and employee performance analysis. It also plays a significant role in cyber security by detecting fraudulent activities, monitoring security threats, and preventing cyber attacks. Additionally, AI enhances supply chain and inventory management by predicting demand, optimizing logistics, and ensuring efficient resource allocation. In marketing, AI helps businesses understand customer behaviour, personalize advertisements, and create targeted campaigns for better engagement.

AI also contributes significantly to healthcare by assisting in disease diagnosis, analyzing medical records, and supporting drug discovery, improving both accuracy and efficiency in patient care. In manufacturing, AI-powered robots enhance production processes, reduce human errors, and improve product quality. In the finance and banking sector, AI is widely used for fraud detection, automated trading, risk assessment, and financial planning. Overall, AI is transforming organizations by improving productivity, reducing costs, enhancing security, and enabling innovation, making businesses more competitive in a rapidly evolving world.

However, the study faces some limitations, as AI is developing very quickly, making it difficult to predict long-term impacts. Additionally, AI adoption varies by industry and country, so some areas may have more data available than others. Despite these challenges, this research aims to provide valuable insights into how AI is shaping the future of work and how businesses and workers can adapt.

Data analysis and interpretation



Job Displacement: AI is most commonly linked with job displacement, particularly in sectors involving repetitive or manual tasks. According to the data collected from surveys and expert interviews, about 40% of workers believe AI could lead to job loss in industries like manufacturing, retail, and customer service. This result highlights concerns about automation replacing roles that are routine and repetitive.

Job Creation: On the other hand, AI is also expected to create new jobs, especially in technology-driven sectors, such as AI development, data analysis, cybersecurity, and AI ethics. The data shows that 25% of participants believe AI will create opportunities for workers in emerging fields. These jobs will likely require specialized technical skills, creativity, and problem-solving abilities.

Skill Shift: The rise of AI also brings a shift in required skills. About 20% of respondents indicated that the demand for soft skills (e.g., creativity, emotional intelligence, and leadership) and technical skills (e.g., data science, machine learning) is increasing. This change reflects the need for workers to adapt to new roles that AI cannot easily replace, such as those that require human interaction and complex decision-making.

Improved Workplace Efficiency: Lastly, AI has been seen to enhance productivity and workplace efficiency. 15% of respondents highlighted the positive impact of AI in automating routine tasks, allowing employees to focus on more strategic activities. This shift can lead to higher productivity and more innovative outcomes within organizations.

Findings and conclusion: Artificial Intelligence (AI) is changing the way people work by automating tasks, creating new job opportunities, and transforming skill requirements. In this section, I discuss some key ways AI will impact future work.

AI is replacing repetitive and manual jobs, especially in industries like manufacturing, customer service, and transportation. This may lead to job loss in routine-based roles but also opens doors for more advanced tasks. Further, AI has potential to create new jobs in areas such as AI development, robotics, data science, cybersecurity, and AI ethics. The demand for AI-related skills will continue to grow. Workers will need to upskill and reskill to adapt to AI-driven industries. There will be more focus on technical skills (coding, data analysis) and soft skills (critical thinking, creativity, emotional intelligence).

An important change expected from the AI revolution is the improved productivity & efficiency. AI will help businesses automate routine tasks, allowing employees to focus on more complex, strategic, and creative work. This can lead to higher productivity and innovation. AI will also support better decision-making in businesses by analyzing large amounts of data quickly. This will improve planning, forecasting, and customer service. Enabling remote work, digital collaboration, and smart automation, AI will revolutionize work patterns. Many industries will adopt AI-powered tools to improve workflows and reduce human effort. In such a scenario, new ethical & employment challenges are expected. AI raises

concerns about privacy, bias, and fairness in hiring and automation. Governments and businesses must create policies to protect workers and ensure AI is used ethically. Instead of replacing humans completely, AI will work alongside employees to enhance their capabilities. AI-powered tools will help professionals in medicine, law, finance, and education perform better.

Conclusion

In conclusion, AI has become an integral part of modern organizations, transforming the way businesses operate across various industries. By automating tasks, enhancing decision-making, and improving efficiency, AI helps organizations reduce costs, increase productivity, and stay competitive. From customer service and human resource management to cyber security, marketing, healthcare, and finance, AI plays a significant role in streamlining operations and optimizing resource utilization. As AI continues to evolve, organizations must adapt by investing in AI technologies and up skilling their workforce to leverage its full potential. While AI brings numerous benefits, it is also essential to address challenges such as data security, ethical concerns, and workforce displacement. By balancing technological advancements with responsible implementation, organizations can harness AI's power to drive innovation and sustainable growth in the future.

As AI continues to advance, businesses must adapt by learning new skills and using AI responsibly. While AI brings many advantages, challenges such as job displacement, data security, and ethical concerns must also be addressed. Organizations should focus on using AI to assist workers rather than replace them, ensuring a balance between technology and human skills. In the future, AI will continue to shape industries, making businesses more competitive and innovative. However, successful AI adoption requires proper planning, investment, and ethical considerations. If used wisely, AI can help organizations grow, improve services, and create new opportunities for both businesses and employees.

Bibliography

- Russell, S., & Norvig, P. (2020). *Artificial Intelligence: A Modern Approach* (4th ed.). Pearson.
- Tegmark, M. (2017). *Life 3.0: Being Human in the Age of Artificial Intelligence*. Knopf.

- Brynjolfsson, E., & McAfee, A. (2014). *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*. W.W. Norton & Company.
- Acemoglu, D., & Restrepo, P. (2020). "Robots and Jobs: Evidence from US Labor Markets." *Journal of Political Economy*, 128(6), 2188-2244.
- World Economic Forum (2023). *The Future of Jobs Report 2023*. Retrieved from www.weforum.org.
- McKinsey & Company (2022). *The Future of Work After COVID-19*. Retrieved from www.mckinsey.com.
- International Labour Organization (ILO) (2021). *AI and the Future of Work: Opportunities and Challenges*. Retrieved from www.ilo.org.
- Harvard Business Review (2023). "How AI is Changing Workplaces and the Economy." Retrieved from https://hbr.org.
- OECD (2022). *Artificial Intelligence in the Workplace: Impacts and Policies*. Retrieved from https://www.oecd.org.
- Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation?. *Technological forecasting and social change*, *114*, 254-280.
- Dastin, J. (2022). Amazon scraps secret AI recruiting tool that showed bias against women. In *Ethics of data and analytics* (pp. 296-299). Auerbach Publications.

The Problem of Poverty in India: with reference to its present status since 2000 to 2024

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Abstract

Poverty is a major problem of our country, since a long times India is facing absolute poverty issues ,under the poverty the poor people suffers lack of basic needs like food, clothes, shelter, inadequate health and education facilities, unemployment issue, lack of income source and so on , this worse situation adversely affect to the life of poor people ,most of the population of our country is surviving under the poverty line, there are different types of poverty which are determined by different methods which are formed by different types of task force appointed was different times under the Planning commission of India, amongst them some method was accepted some neglected by government, for example Dandekar and rath (1979),Lakadwala committee (1993) ,these opinion was accepted ,recently, the niti Ayog declared the poverty rate of india by adopting the new method of poverty measurement (MPI) Multi-dimensional poverty index, the poverty ratio was declined from 29.17% in 2013-14 to 11.28% in 2022-23 with about 24.82 crore people escaping poverty during this period. According to the World Bank Report (2024),about 129 million people were living in extreme poverty, which was 431 million in 1990.in fact, every Indians and government have a duty to eradicate the poverty issue which are responsible for starvations deaths of poor's in the country. This article is necessary in view of duty and humanity toward the welfare of society. These articles highlight the nature of poverty as well, causes and effects of poverty which have been discussed in this article.

KEYWORDS: Absolute Poverty, Income Inequalities, Unemployment, Multidimensional Poverty, Poverty alleviation, development lag, Sustainable Development Goal, Government Policies.

Introduction

Over the last several decades, India has become one of the fastest growing economies across the world, but along with this impressive progress, poverty has become a worse problem for

the nation. a small percent of people have been benefited from the growth, which are enjoying luxurious lifestyle.on another, maximum people (particularly in rural region) are suffering from the poverty, in which poor peoples are unable to fulfill his basic needs e.g. food, clothes, shelter, education ,health these amenities are essential for living their life. Such poverty situation highlights an inequalities amongst people, this kind of worse situation arises due to lack of access natural resources equally amongst people in country, due to creating such inequalities have been affected to backward social group (SC, ST, OBC, minorities, and excluded people) of which them maximum people have been living their life in poor situation, recently, said by world bank near about 129 million peoples are living under extreme poverty in 2024.

Recently,the poverty ratio has been declining in more extent due to implementations of various schemes and programmes for poverty eradication by government.in this concern, according to the world bank Report, the Poverty ratio of India was stood at (181 mn) 13.37 % in 2017, (151.79 mn) 11.09 % in 2018, (176.09 mn) 12.73 % in 2019, (205.59 mn) 14.72 % in 2020 and (167.49 mn.) 11.90 % recent in 2024, population of the total country was living under poverty line in India. The world bank measures extreme poverty rate at Dollar $ 2.15 a day in purchasing power parity terms. Earlier, the world bank had surged that extreme poverty in India declined by 38 million. notwithstanding, the UNO (United Nations Organization) have step up (a milestone) toward the poverty eradication, the UNO have declared SDG 17 (sustainable development goal) agenda in 2015, for all member country across world, which have major objectives to end the poverty and zero hunger till 2030,on this ground , India is also stepping up rapidly toward progress in all sector e.g. Agriculture, Industry and service sector as well as in social sectors,respectively, due to this growth the national GDP and Per capita income has grown faster rate, for example in 2023 ,GDP growth rate was 8. 15 % and in 2012-13 the growth rate was 4.5 %,as well as , per capita income was 1 lakh 84 thousand in (fy -2024) rs. , respectively.

After faster growth in economy there are also exist the major problems of poverty which has been defined by many thinker ,economists, social scientist, planning commission of government, of which some definitions are mentioned in this study,it has a crucial importance in view of understand the nature and causes of poverty, and why still have not eradicated this poverty issue from our country, todays also poor peoples are struggling to fulfill their basic needs ,such many poverty related issues are arises due to cause of historical or socio-economical and other interrelated problems, this issues have been discussed below through

important study on the poverty ground .references on with regard to poverty issues and existence in India.

Objectives of the study:

1) To study the present status of Poverty in India.

2) To study the effect of poverty on Poor's in the Country .

3) To suggest measures to eradicate the Poverty in India.

Methodology

The secondary data methodology is used for the data collection from various sources that is book, journals, government authentic annual reports, Articles, websites, censuses, internal records , as well as, world bank report, IMF report, NSSO annual reports, Niti Ayog report on Poverty and others document are used for data collection and get information on poverty issue. In fact this study will be helpful for understanding the nature of poverty, and other issues for individuals, researchers, academics, and other philosopher, experts in different subjects .

Review of literature

Poverty is a multidimensional concept that extends beyond financial deprivation to include the lack of access to essential services and opportunities. The World Bank (2024) defines poverty as being similar to hunger, the absence of shelter, being unwell without access to medical care, lacking education, unemployment, fear of the future, and surviving day by day without stability. According to this definition, poverty is not just about income but also about a person's ability to lead a life with dignity.

The concept of absolute poverty, as defined by the United Nations World Summit on Social Development (1995), refers to a condition of severe deprivation of fundamental human needs including food, clean water, sanitation, health, housing, education, and access to information. This form of poverty, often considered the most severe, is a burden for those affected, as it frequently leads to mental and physical exploitation. The causes of absolute poverty can be categorized into four main areas: social factors (such as caste and racial discrimination), economic issues (like low income, unemployment, and limited access to credit), political and religious exclusion, and regional disparities. These interconnected factors prevent individuals from accessing the resources necessary to improve their quality of life, leaving them in a persistent state of deprivation.

In the Indian context, poverty is a deeply rooted and multifaceted issue affecting both rural and urban populations. It manifests through the deprivation of basic needs and opportunities. According to NITI Aayog (2023), the incidence of poverty varies across states. For instance, rural poverty rates are alarmingly high in states like Bihar (36.95%), Jharkhand (34.93%), and Meghalaya (32.43%), compared to the national poverty average of 19.28%. These states also show high Multidimensional Poverty Index (MPI) scores—26.59 for Bihar, 23.34 for Jharkhand, and 25.46 for Meghalaya. On the other hand, states like Kerala (0.32%), Tamil Nadu (1.41%), and Sikkim (0.51%) report negligible rural poverty rates, suggesting substantial progress in reducing deprivation.

Economically, India has made notable advancements. As reported by the World Bank (2025), India is the world's fifth-largest economy by nominal GDP and the third-largest by purchasing power parity (PPP). The per capita income for 2023–24 was ₹2,35,199, more than doubling from ₹87,748 in 2014–15. This economic growth is reflected in India's improvement in global GDP ranking, moving from 10th in 2014–15 to 5th in 2023–24. Despite these economic gains, poverty persists, and India ranked 62nd among 190 countries facing poverty-related challenges in 2024.

The global efforts to eradicate poverty have been significantly shaped by the United Nations (2023) through its Sustainable Development Goals (SDGs), adopted in 2015. These 17 goals aim to be achieved by 2030 and include targets directly related to poverty and inequality, such as Goal 1 (No Poverty), Goal 2 (Zero Hunger), Goal 3 (Good Health and Well-being), Goal 4 (Quality Education), Goal 10 (Reduced Inequality), and Goal 16 (Peace, Justice, and Strong Institutions). These interconnected goals aim to ensure that all people, especially the most vulnerable, have access to resources and opportunities necessary for a dignified life.

Hunger, closely linked with poverty, remains a serious concern in India. According to the Global Hunger Index (2024), India ranked 105th out of 127 countries with a score of 27.3, categorizing it under the "serious" hunger level. Despite some improvement from previous years, India still lags behind neighboring countries such as Nepal, Bangladesh, and Sri Lanka. Major indicators contributing to this ranking include a child wasting rate of 18.7%, a child stunting rate of 35.5%, an under-five mortality rate of 2.9%, and undernourishment affecting 13.7% of the population.

The UNICEF Annual Report (2023) highlights progress toward the SDGs, showing India's improvement in the SDG Index from a score of 66 in 2020–21 to 71 in 2023–24. Between

2015–16 and 2019–21, the proportion of people living in multidimensional poverty decreased from 24.85% to 14.96%, lifting approximately 135.5 million people out of poverty. This improvement is attributed to enhanced access to healthcare, education, housing, and sanitation through various government initiatives. However, challenges remain, especially in child and women protection. UNICEF reported an 8.7% increase in crimes against children between 2021 and 2022, with 162,449 cases. Notably, 45.7% of these were related to kidnapping and abduction, while 39.7% were associated with offences under the Protection of Children from Sexual Offences Act. Similarly, crimes against women increased by 4%, with 445,256 incidents recorded.

Further emphasizing India's progress, the NITI Aayog (2023) reported that the national MPI fell from 29.17% in 2013–14 to 11.28% in 2022–23, with 24.82 crore people escaping poverty. The MPI framework used by NITI Aayog includes 10–12 indicators across three key dimensions: health, education, and standard of living. Indicators such as nutrition, child and maternal health, access to clean water, sanitation, and electricity are core to this measurement system.

On a more concerning note, The Times of India (2020) reported that poverty and unemployment are directly linked to rising suicide rates in India. In 2020, there were approximately 10,600 suicide deaths due to poverty, unemployment, and indebtedness. Notably, poverty accounted for 69% of these deaths, marking a 24% increase in joblessness-related suicides from the previous year.

In earlier studies, poverty estimates were based on consumption expenditure. The Rangarajan Committee (2014) defined the poverty line in India as a daily per capita expenditure of ₹32 in rural areas and ₹47 in urban areas, estimating that 29.5% of the population was poor in 2011. Similarly, the Tendulkar Committee (2009) set the poverty line at ₹816 per capita per month in rural areas and ₹1,000 in urban areas, estimating 21.9% of the population lived below the poverty line in 2011–12.

Findings and suggestions

Based on the World Bank Report (2024), India ranks 62nd out of 190 countries in terms of extreme poverty. This indicates that a significant portion of the Indian population continues to survive without access to basic necessities such as food, clothing, and shelter. While the World Bank (2025) notes that India's GDP has more than doubled from 2014–15 to 2023–24, and per capita income has risen to ₹2,35,199, this increase in national income does not proportionately

reflect in the lives of the poorest sections of society. The benefits of economic growth often do not reach the marginalized, and thus the rise in per capita income may mask persistent poverty. To address this disparity, the government should measure the per capita income of the poor separately. A nationwide survey could reveal the actual income and living standards of impoverished populations, allowing for better targeting of welfare schemes. This approach would enhance transparency and guide the effective allocation of resources to those most in need.

Regarding the United Nations Sustainable Development Goals (SDGs) established in 2015, India is lagging in achieving critical targets such as eradicating poverty, ensuring zero hunger, and providing good health and well-being (United Nations, 2023). Although some nations have made substantial progress, India continues to struggle with high rates of poverty, unemployment, malnutrition, and infant and maternal mortality. This concern is substantiated by the Global Hunger Index (2024), which ranks India 105th out of 127 countries. Despite slight improvements from previous years, India still falls under the "serious" hunger category. Hunger and poverty are closely linked and create a cycle that exacerbates health issues, child mortality, and underdevelopment. To break this cycle, the government must take urgent and innovative steps. Although schemes such as Sampoorna Grameen Rozgar Yojana (SGRY), PM Garib Kalyan Rozgar Yojana, Pradhan Mantri Awas Yojana, and Ayushman Bharat have shown potential, their effectiveness has been hindered by poor implementation. Stronger monitoring, better governance, and community involvement are essential for ensuring these schemes reach the intended beneficiaries.

The UNICEF Report (2023) highlights that India improved its SDG Index ranking from 121st in 2022 to 112th in 2023, with an overall score increase from 66 to 71. This is a positive development, suggesting improvements in poverty reduction and social welfare. However, the report also points out a sharp increase in crimes against women and children. Between 2021 and 2022, cases of kidnapping and abduction accounted for 45.7% of crimes against children, while 39.7% were offences under the Protection of Children from Sexual Offences Act (POCSO), 2012. Similarly, crimes against women rose by 4%, with over 445,000 incidents reported. This correlation between poverty and vulnerability highlights a deeper social issue where poverty contributes to increased risk and exploitation. The government must act decisively—enforcing laws, setting up help centers, launching awareness campaigns, and creating employment opportunities for vulnerable groups.

According to NITI Aayog (2023), the multidimensional poverty rate in India has declined from 29.17% in 2013–14 to 11.28% in 2022–23, which is a promising sign. However, contrasting findings from the Times of India (2020) reveal that approximately 10,600 people committed suicide in 2020 due to unemployment, poverty, and debt-related distress—an 8% increase from 2019. Alarmingly, 69% of these suicides were attributed directly to poverty. This disparity between statistical improvement and real-life suffering suggests that while poverty indicators may be improving on paper, the lived experiences of many poor individuals remain unchanged. To address this, the government should establish local-level committees in villages and urban centers to monitor vulnerable individuals and provide immediate assistance. A decentralized support system could help detect signs of distress early and prevent loss of life.

In terms of poverty measurement, multiple committees have provided varying definitions and methodologies over the decades. The Alagh Committee (1979) introduced a calorie-based poverty line, recommending 2,400 calories per day in rural areas and 2,100 in urban settings. The Lakdawala Committee (1993) based its calculations on consumption expenditure using different consumer price indices for agricultural and industrial labor. The Tendulkar Committee (2009) shifted to a consumption-based approach with a new poverty line at ₹816 per capita/month for rural areas and ₹1,000 for urban areas. Later, the Rangarajan Committee (2014) adopted a broader well-being-based method with an urban-rural split of ₹47 and ₹32 per day respectively. Recently, the Multidimensional Poverty Index (MPI) introduced by NITI Aayog (2023) evaluates poverty through 12 indicators across three key dimensions—health, education, and standard of living. These include nutrition, child mortality, maternal health, and access to sanitation and housing.

While these committees have advanced our understanding of poverty, inconsistencies across methodologies—such as varying base years, regional cost adjustments, and data sources—make direct comparisons difficult and often misleading. For instance, calorie-based methods may not capture urban poverty effectively, while income-based metrics may overlook critical health or educational deficits. Therefore, it is essential to develop a unified and dynamic poverty measurement framework that integrates both income and non-income dimensions, aligns with current price levels, and considers regional disparities. This would provide a clearer picture and support more effective policy making aimed at poverty alleviation.

References

1. Sethu, Surya,Abhinav,Ruthu ,Poverty in India: The Rangarajan Method and the 2022–23 Household Consumption Expenditure Survey,September,2024.
2. World Bank report on Poverty,(2024).
3. List of Indian states and union territories by poverty rate - Wikipedia
4. unicef,Country Office Annual Report, 2023
5. Forbes India, (Octo,2024), Poverty Rate In India: Trend Over The Years And Causes.
6. Gaur Seema & Rao N. Srinivasa, (2020), Poverty measurement in India: a Status update, Ministry of Rural Development working paper no. 1/2020 september 2020.
7. Sharath A. M.,(2020), Poverty in India- A study of rural poverty, Shimoga, Karnataka.
8. NITI AYOG, multidimensional poverty in india since 2005-06 a discussion paper,2025.
9. GOI,Press Notes Press Information Bureau, Poverty estimates for 2011-12 new delhi:, july, 2013
10. NITI AYOG, Multidimensional poverty in India since 2005-06: A discussion paper, ,2025
11. United Nations SDGSs Report, 2023.
12. Global Hungar Index Report,2024.
13. Press Note on Poverty Estimates, 2011-12

WEBSITES:

- www.cbo.gov
- www.igidr.ac.in
- www.researchgate.net
- www.debt.org
- www.nrf.org.uk
- www.worldbank.org
- www.business-standard.com
- www.ec.wikipedia.org
- www.sapa-usa.org
- www.timesofindia.indiatimes.com
- www.debt.org
- www.ForbesIndia.com
- www.globalhungerindex.org
- www.niti.gov.in

Critical Study of Cost Accounting Standards

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Introduction:

Cost Accounting Standards (CAS) are the set of guidelines and rules that governs how government contractors account for costs. In India, The Cost Accounting Standards Board was established in 1970. However, in 1980 it was dissolved. But in the year 1988, it was permanently established in India under the Institute of Cost Accountants of India (ICAI). The Board is responsible for setting Cost Accounting Standards. The Institute of Cost Accountants of India provides guidelines to the user organisations and Government Bodies to achieve uniformity and consistency in classification, measurement and assignment of cost to product and services.

Role of the Institute of Cost Accountants of India

The Institute of Cost Accountants of India play an important role to set up and formulate the Accounting Standards in India. It recognises the need for a structured approach to the measurement of cost in the manufacturing and service sector. It also provides guidelines to the user organisations, Government Bodies, regulators, research agencies and academic institutions to achieve uniformity and consistency in classification, measurement and assignment of cost to the product and services. The Institute of Cost Accountants of India has constituted the Cost Accounting Standards Board (CASB) with the objectives of formulating the Cost Accounting Standards.

The Cost Accounting Standards Board issues various guidelines from time to time to members and industry with respect to measurement, classifications, assignment and presentation of cost in cost statements. The Institute / Board has so far issued 24 Cost Accounting Standards, Generally Accepted Cost Accounting Principles, 9 Guidance notes on Cost Accounting Standards and 2 Guidance notes on treatment of cost relating to Corporate Social Responsibilities (CSR) activities and maintenance of cost accounting records for construction industry including real estate and property development activity.

The CASB plays an important role while formatting the Cost Accounting Standards. CASB takes into consideration the applicable laws, usage and business environment prevailing in India. CASB also considers the basic principle and practices being followed by other countries in the world.

Major announcement of Cost Accounting Standards Board:

CASB has made the major important announcements in India from 2001-2002 and has issued

1) 24 Cost Accounting Standards (CAS)

2) Generally Accepted Cost Accounting Principles (GACAP)

3) Guidance notes on CAS- 2(Revised 2015), CAS- 4, CAS-6,CAS-7 CAS-8,CAS-9, CAS-10, CAS-11, CAS -13

CASB is the governing body under the authority of The Institute of Cost Accountants of India. The ICAI forbade and issued the Cost Accounting Standards for companies in India those who are expected to follow the practices in cost accounting.

Importance of Cost Accounting Standards:

The importance of Cost Accounting Standard components are as under

1) Cost Element Classification:-

Defining the different components of cost of unit or product or services such as direct material, direct labour and direct expenses and also the overheads.

2) Cost Allocation Method:-

Providing the proper guidance on how to allocate indirect costs to the different products or services based on appropriate allocation basis.

3) Standard Costing:-

Standard Costing utilises the predetermined standard costs of products or services to compare with the actual costs incurred. Due to the applicability of standard costing, the variance analysis facilitates the performance and evaluation of various activities of industry.

List of mandatory Cost Accounting Standards and guidance note issue on dates:

CAS No.	Name of Cost Accounting Standards	Effective Date (for the period commencing from)
CAS 1 (Revised 2015)	Classification of Cost	1st April 2015
CAS 2 (Revised 2012)	Capacity Determination	1st April 2012
CAS No.	Name of Cost Accounting Standards	Effective Date

		(for the period commencing from)
CAS 3 (Revised 2011)	Overheads	1st April 2012
CAS 3 (Revised 2015)	Production and Operation Overheads	1st April 2016
CAS 4	Cost of Production for Captive Consumption	1st April 2010
CAS 5	Average (Equalized) Cost of Transportation	1st April 2010
CAS 6	Material Cost	1st April 2010
CAS 7	Employee Cost	1st April 2010
CAS 8	Cost of Utilities	1st April 2010
CAS 9	Packing Material Cost	1st April 2010
CAS 10	Direct Expenses	1st April 2010
CAS 11	Administrative Overheads	1st April 2010
CAS 12	Repairs and Maintenance Cost	1st April 2010
CAS 13	Cost of Service Cost Centre	1st April 2011
CAS 14	Pollution Control Cost	1st April 2012
CAS 15	Selling and Distribution Overheads	1st April 2013

CAS 16	Depreciation and Amortisation	1st April 2014
CAS 17	Interest and Financing Charges	1st April 2014
CAS 18	Research and Development Costs	1st April 2014
CAS 19	Joint Costs	1st April 2014
CAS 20	Royalty and Technical Know-How Fee	1st April 2014
CAS No.	Name of Cost Accounting Standards	Effective Date
		(for the period commencing from)
CAS 22	Manufacturing Cost	1st April 2015
CAS 23	Overburden Removal Cost	1st April 2017
CAS 24	Treatment of Revenue in Cost Statements	1st April 2017

A critical analysis of Cost Accounting Standards:

A critical Analysis of Cost Accounting Standards (CAS) examines their importance in promoting consistency and uniformity in the cost accounting practices. At the time of critical analysis of cost accounting standards, the potential limitations such as complexity, interpretation, challenges and potential for manipulation particularly when applied to the government contracts or situations with diverse business models are highlighted.

Factors to be considered for Critical Analysis of Cost Accounting Standards

The following important factors are to be considered in critical analysis of Cost Accounting Standards:

1) Standardizations –

Cost Accounting Standards aims to establish a common framework for classifying, measuring and allocation of costs across to the manufacturing of products or to the services. Different companies facilitate reliable Inter-firm comparison and analysis of financial data of manufacturing industry or service industry.

2) Transparency –

The Cost Accounting Standards and the various guidelines issues by The Cost Accounting Standard Board by defining clear guidelines in cost reporting, especially for regulated industries or government contracts.

3) Cost Control –

The Cost Accounting Standards provides the accurate cost information to the Management which enables better cost management identifying areas for efficiency improvements and cost reduction strategies

Criticism and challenges of Cost Accounting Standards

1) Complexity:-

Application of CAS requires significant expertise to interpret and apply correctly Cost Accounting Standards. However, due to lack of expertise and complexity of Cost Accounting Standards it leads to potential errors and inconsistencies in implementation of Cost Accounting Standards.

2) Subjectivity:-

The cost allocation and apportionment of certain methods in production or services may involve subjective judgements potentially impacting the reliability of cost data.

3) Industry specific:-

A single set of standards may not adequately address the unique cost structures and operational complexities of different industries. Eg the Process costing techniques and Activity Based Costing may vary from industry to industry.

4) Manipulation Potential:- The loopholes in the Cost Accounting Standards may lead to manipulation of cost calculations, cost data, cost structure in order to achieve desired level of financial results or expected standard profits of industry particularly when dealing with the government contracts.

Basic requirement for implementation of effective Cost Accounting Standards:

1) Clear Communication:-

The proper training and guidelines to be communicated to all relevant personnel regarding the application and implementation of Cost Accounting Standard principles

2) Internal control:-

Internal Control is important to establish robust internal controls to ensure accuracy and adherence to Cost Accounting Standards guidelines issued by the Cost Accounting Standard Board of ICAI.

3) Regular review and updates:-

Regular review and update is the basic requirement for periodically reviewing and updating Cost Accounting Standards to reflect changing business practices and technology advancements.

Conclusion

The Cost Accounting Standard Board has issued 24 Cost Accounting Standards, Generally Accepted Cost Accounting Principles, 9 Guidance notes on Cost Accounting Standards and 2 Guidance notes on treatment of cost relating to Corporate Social Responsibilities (CSR). Considering the critical analysis, it is found that the complexity, interpretation of data, and certain challenges exist in Cost Accounting Standards. Considering the applicability of Cost Accounting Standards in India, the Institute has issued Mandatory Cost Accounting Standards for manufacturing and service industry in costing practices. It is also found that the manufacturing and service industry are adhering and implementing the Cost Accounting Standards in India.

Bibliography

1. The Institute of Cost Accountants of India:https://icmai.in

2. Guidance notes issued by the Institute of Cost Accountants of India

3. Cost Accounting Standard Board of Council of Institute of Cost Accountants of India

4. Compendium of Cost Accounting Standards – Cost Accounting Standard Board of ICMAI, w.w.w.icmai.in

Neuro-Enhanced Mixed Reality: The Future of Brain Computer Interfaces in Virtual Worlds

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Abstract

Brain-computer interfaces (BCI) and mixed reality (MR) are changing how humans interact with technology. These innovations allow stroke patients to regain movement, help ALS patients communicate using their thoughts, and create virtual environments that react to emotions. Advancements like graphene sensors, AI-powered signal processing, and immersive MR are making these systems more accurate and accessible. However, these technologies also raise serious concerns. Sometimes, companies misuse brain data for profit, AI could introduce bias, and limited access may not be good for social inequality. To address these risks, this paper proposes the CPET framework (*Consent, Privacy, Equity, Transparency*) to protect user rights, ensure data security, and promote fair access. Without clear global rules and cooperation across industries, BCI-MR could lead to surveillance, discrimination, or restricted access. To ensure these tools benefit everyone, we recommend banning the misuse of neural data, making neurotechnology affordable, and involving diverse communities in its design. If this technology is developed responsibly, BCI-MR can go beyond being just a technological breakthrough, it can become a force for fairness, healing, and empowerment. Governments, researchers, and society must act now to ensure progress serves people, not just corporations or political agendas.

Keywords:

Brain-computer interfaces (BCI), Mixed reality (MR), Artificial Intelligence (AI), Neural data, Neurorehabilitation, ALS communication, Emotion-responsive VR, Neural data misuse, AI bias, Surveillance, Inequity, CPET framework (Consent, Privacy, Equity, Transparency), Inclusive design, Global regulation, Marginalized communities, Democratizing access, Neuroethics, Collaboration, Subsidized initiatives, Co-design.

Introduction

By 2030, BCI-MR could redefine how humans interact with digital worlds. It will show how our thoughts align with the virtual world. The growing advancement in neural signal decoding and immersive technologies. We are stepping into a world where our thoughts will become the main source of letting us chat, create and team up with others without even needing to be in the same room.

BCI, or Brain Computer Interface, is a computer-based system requiring a brain signal to translate into commands related to an output device to carry out a desired action. BCI was originally developed for healthcare in case of paralysis; for example, if a person is disabled by hand, he/she can simply, with the help of BCI, move, grab, and do simple things as normal human hands do. BCI has come a long way and is making a big difference in gaming, work, and even creative projects.

MR, or Mixed Reality, is a mixture of the real world and the virtual one. When you combine MR and BCI, you get something called BCI-MR, which changes the entire way of interacting with the computer. By connecting real-time brain signals to immersive virtual worlds, BCI-MR gives us a whole new level of control and customization. This paper is about how we combine BCI-MR, which could change how we interact with tech.

It can be used in healthcare where doctors can use it to help people recover from injuries by practicing movement in a virtual space. For gamers, it can help them experience a different kind of world. In the case of teaching, Teachers might create classrooms where students "feel" history or science.

Now, what is holding us back from creating this amazing thing? As we know, brain sensors aren't always accurate unless they are stuck in our head. There can be a lag between thinking and action. Plus, it is very complicated to mix VR/AR with brain data. But there's always a solution, and for this, there are non-invasive sensors (like a headband, etc). Now, many questions arise in our minds. If tech can read our minds and where all this data is going to be stored, who owns that data, and can hackers mess with our brains? What if it can only be purchased by rich people? We need to keep rules to make it safe and fair.

Application

In Healthcare it has applications in Motor Imagery Feedback for Neurorehabilitation. Take the example of a person who had a stroke and experienced damage to the motor cortex—the part of the brain responsible for movement and action. This is where motor imagery comes into play. It's a mental practice where the individual imagines moving their hand or leg without physically doing it. Interestingly, this mental visualization activates the same brain regions as real movement, helping to rewire damaged neural pathways.

Here's how it works: a stroke patient with a paralyzed hand wears a non-invasive EEG headband and VR goggles. They're asked to imagine moving their hand—like picking up a cup. The EEG captures brain signals linked to the imagined movement. Then, the VR system immediately shows a virtual hand performing that task, creating a powerful feedback loop: "I tried to move → I saw it move → let's try again." Over time, this trains the brain to form new connections (neuroplasticity), helping real movement return.

In one clinical study, a stroke patient who used this EEG-VR therapy for five days a week, 30 minutes a day, showed twice the improvement in hand grip strength compared to traditional methods (Smith et al., 2023). To keep therapy engaging, tasks were gamified—like "rescuing a kitten by reaching out"—which greatly improved motivation.

However, the process isn't perfect. Sometimes, thinking about unrelated things like food may confuse the system, and not all patients imagine movement in the same way. This highlights the need for personalization in treatment.

Apple & synchron for ALS: In another inspiring case, Apple and Synchron are working together to support patients with ALS (Amyotrophic Lateral Sclerosis), a disease that slowly paralyzes the body while keeping the mind sharp. In ALS, patients often lose the ability to speak or move, which makes communication incredibly difficult. This is where BCI-MR technology plays a life-changing role.

Using Synchron's Stentrode—a tiny brain implant inserted through blood vessels without surgery—electrical signals from the brain are picked up when a person simply thinks about moving or typing. Combined with MR glasses, the patient sees a virtual keyboard or app interface overlaid in their real-world view. The BCI interprets their thoughts into digital commands, and the MR system displays the results instantly.

A real-life example: An ALS patient wants to send a message. They focus on a virtual keyboard and imagine selecting a letter. The BCI detects the brain activity and the MR system types the letter. Over time, it learns their patterns and gets faster. This technology has already enabled patients to send texts and emails using just their thoughts. Apple's MR tech makes the experience feel intuitive—like it's part of the user's natural environment.

The challenges here include signal accuracy, potential delays in system response, and the high cost of the BCI and MR equipment. However, with innovation and scale, these barriers may be reduced. The future possibilities include attending family dinners as a lifelike MR avatar, playing a virtual piano with just thoughts to rebuild neural connections, or ordering groceries through a brain-controlled AR menu.

Adaptive VR experiences in entertainment: Games that respond to your emotions (using EEG)

Imagine playing a game that changes based on your mood. This is the future of entertainment with adaptive VR using EEG technology. A user wears a lightweight EEG headset that reads brainwave patterns. AI algorithms analyze these patterns—for example, beta waves for stress or alpha waves for calmness—and the VR environment adapts in real-time.

In a horror game, if the EEG detects fear, the game might reduce jump scares, play calming music, or spawn a helpful guide. If the player seems bored, the game could become more intense, like releasing more enemies or amping up the eerie atmosphere. In a puzzle adventure game, if the player appears frustrated, the system might offer a hint or lighten the mood with humor. On the other hand, if the player is highly focused, it could increase the difficulty to keep them engaged.

In relaxation VR apps, the EEG can detect restlessness or calmness and adjust the background accordingly—perhaps switching between a tranquil ocean or a peaceful forest.

However, there are limitations. EEG systems can sometimes misread signals due to sweat or unrelated thoughts, causing inappropriate changes in the game. If the system responds too slowly, it may break immersion. There's also the concern of ethical misuse—games that exploit emotions to prolong engagement, potentially encouraging addiction. Plus, the high cost of EEG gear may exclude less privileged players.

In conclusion, these applications of BCI-MR across healthcare and entertainment show its immense potential to transform lives. Whether restoring movement to stroke survivors, enabling communication for ALS patients, or creating emotionally responsive games, the technology is rapidly evolving. The focus now should be on improving accuracy, affordability, and ethical safeguards to ensure these innovations are available and beneficial to all.

The future advancement in BCI-MR

The future of Brain-Computer Interface (BCI) combined with Mixed Reality (MR) revolves around two core domains: EEG signal processing and real-time MR rendering. Advancements in both these areas are driving the next generation of immersive and responsive brain-driven MR experiences.

In the area of EEG signal processing, modern systems have significantly evolved. Technologies like graphene electrodes and high-density arrays now enable more accurate and clearer signal detection. Advanced EEG setups using over 256 miniature sensors can precisely capture brain activity, which helps in decoding movement intentions with much greater clarity. This precision is vital for developing responsive MR applications controlled directly by thought.

One major challenge in EEG processing has been separating meaningful brain signals from noise caused by muscle movement or blinking. However, AI-powered models such as EEGNet have achieved over 90% accuracy in filtering out unwanted signals, while adaptive filtering techniques ensure essential data remains intact. Additionally, compact and fast processors like the NVIDIA Jetson are now capable of analyzing EEG inputs in under 50 milliseconds, enhancing the responsiveness of MR systems. Combining EEG with other neuroimaging tools like fNIRS further increases the accuracy, particularly for emotional detection in MR environments. Emerging tools like OpenBCI Galea even allow real-time feedback, adapting MR experiences—like making a game more challenging when the user shows high focus—to keep users engaged and stimulated.

Simultaneously, real-time MR rendering technologies are also advancing rapidly. Faster 3D graphics are now made possible through innovations like eye-tracking in devices such as the Meta Quest Pro, which renders high-quality visuals only in the user's direct line of sight. This reduces the graphical load by up to 50%. AI upscaling tools like NVIDIA's DLSS 3.0 enhance lower-resolution images to appear sharper, while cloud rendering services, such as Microsoft

Mesh, offload the heavy graphics processing to remote servers. This allows lightweight MR headsets like the HoloLens 2 to stream complex scenes with latency as low as 20 milliseconds.

Making MR more interactive and realistic is also a growing focus. AI-generated 3D scenes, powered by models like NeRF, can dynamically transform 2D images into full 3D environments in real time. Haptic devices like the Teslasuit add a new dimension to MR by allowing users to physically "feel" virtual objects through precise muscle stimulation, adding realism to experiences such as virtual training or gaming.

To ensure a seamless and immersive MR experience, headsets like Apple Vision Pro scan surroundings up to 60 times per second, locking virtual elements in place with precision. Predictive tracking algorithms now anticipate user movements up to 100 milliseconds ahead, reducing motion lag and making interactions feel more fluid. Furthermore, shared MR workspaces are emerging, enabled by technologies like Intel RealSense, which create lifelike avatars for remote collaboration. These innovations allow professionals—such as surgeons—to perform virtual procedures together using brain-controlled holograms, pushing the boundaries of remote teamwork and training.

Collectively, these breakthroughs in EEG signal processing and MR rendering are making BCI-MR systems faster, more accurate, and deeply immersive. As this technology continues to evolve, it holds the potential to revolutionize how humans interact with digital environments, making thought-driven experiences a powerful tool in education, healthcare, entertainment, and beyond.

Challenges and future steps

EEG accuracy issues and the ethical concerns surrounding invasive BCIs, like those developed by Neuralink, have become prominent topics in the development of brain-computer interfaces (BCIs). Invasive BCIs can block background noise, making brain signals clearer and more accurate, which is a significant improvement over non-invasive EEG systems. However, these advancements raise ethical concerns regarding brain implants, as they involve direct interaction with the brain, leading to potential privacy violations and long-term health risks. Additionally, balancing the graphics and power requirements of mixed reality (MR) is another challenge. High-quality MR visuals require significant processing power, which can be difficult to achieve

in lightweight headsets without compromising performance or comfort. This balance is crucial to providing users with an immersive experience while maintaining the device's functionality.

The ethical and privacy concerns surrounding BCIs and MR technologies are also critical. Brain data security, fairness in AI decision-making, and ensuring that MR technologies are affordable and accessible to all are key challenges that must be addressed to promote equitable adoption. As BCIs and MR technologies continue to evolve, establishing clear rules and guidelines to ensure their safe and responsible use is necessary. This includes understanding key ethical issues, such as protecting brain data, ensuring individuals retain control over their thoughts, and preventing misuse of the technology. There are also risks associated with hacking, data leaks, and unequal access to these advancements, which could exacerbate social inequalities. To ensure that BCI-MR technologies benefit society as a whole, clear legal frameworks and regulations must be developed to safeguard privacy, promote fairness, and ensure the responsible use of these powerful tools.

Discussion

Core ethical principles surrounding brain-computer interfaces (BCIs) and mixed reality (MR) technologies center on brain privacy and control. Brain data should remain private, ensuring that no one has unauthorized access to it. The ability to control devices such as robotic arms or virtual reality (VR) games using BCIs must be designed so that individuals maintain full control over their actions. Additionally, avatars and virtual worlds must not manipulate or distort the sensory experiences of users, as this could have harmful effects on their brain function and overall well-being. The privacy of brain data should be safeguarded to ensure that individuals' mental activities are not exposed or exploited without consent.

Freedom of thought is another crucial ethical consideration. No one should be coerced into using a BCI. If BCIs become a necessity for certain activities, individuals must have the right to provide informed consent before using them. Technologies capable of altering or influencing a person's thoughts, such as brain-zapping methods intended to manipulate purchasing decisions or other behaviors, should be banned to preserve cognitive freedom and prevent undue mental influence.

There are several major risks associated with BCIs and MR technologies. One of the most concerning is the potential for companies to use brain data for profit. For instance, imagine

walking past a billboard that reads your brainwaves and flashes targeted ads for products you didn't even know you wanted. Companies like NeuroBuy are already experimenting with such applications, which raises significant privacy concerns. Moreover, BCIs could be used for workplace and government surveillance. A factory in China reportedly used EEG headbands to monitor workers' focus levels and dock their pay if they became distracted. The military's interest in testing BCIs on soldiers also raises concerns about the potential for mind control and the ethical implications of using BCIs in such contexts.

Another risk is the potential for bias and unequal access. EEG headsets, which are essential for many BCIs, are less accurate for people with thick or curly hair, leading to discrepancies in how brain data is read, particularly in emotion-detection AI systems. This bias can disproportionately affect certain groups, including Black users. Moreover, high-end BCI-MR devices, such as Apple's Vision Pro, which is priced at $3,500, could create a divide where only the wealthy have access to the best technology, leading to inequalities in jobs, healthcare, and education. Brain data is also vulnerable to hacking. Hackers could steal individuals' brainwave patterns to unlock secure systems or even use them to frame people for crimes, presenting a serious security risk.

To address these concerns, a strong ethical framework is essential. The CPET model offers a solution, focusing on four key pillars. Consent is the first pillar, which means that users should be asked for explicit consent each time their brain data is collected. This consent should be clear and not buried in terms-of-service agreements. Additionally, users should have the ability to revoke consent easily, ensuring they maintain control over their data at all times. Privacy is the second pillar, which dictates that only essential data should be collected. Any extraneous information, such as emotional states or personal thoughts, should not be gathered. Furthermore, all brain data should be encrypted to protect user privacy, even from the companies that store the data.

Fairness for all is the third pillar, which advocates for low-cost BCI-MR solutions being made available to public services like schools and hospitals, ensuring that these technologies are accessible to people from all socioeconomic backgrounds. Employers and insurers should also be prohibited from using brain data to make unfair decisions that could disadvantage certain groups of people. The fourth pillar is transparency. Companies should be required to disclose how their AI models work and how users' brain data is being used. Regular reports should be

published, and independent experts should have the opportunity to review and confirm that the systems are functioning ethically and fairly.

The regulation of BCI-MR technologies should be a collaborative effort between governments, tech companies, and independent bodies. A Global Neuroethics Council, similar to the UN's Bioethics Committee, could create universal policies for the ethical use of BCIs. National agencies, such as the FDA, should be responsible for evaluating BCI devices for safety before they are made available to the public. To hold companies accountable, an ethical report card system could be implemented, where companies must demonstrate that their products meet safety, fairness, and privacy standards before they are allowed to sell them. Independent organizations, like a "Neutral Data Bank," could hold brain data to prevent companies from exploiting it for profit.

Public involvement in the regulatory process is crucial. Citizen juries, made up of diverse individuals, should be consulted when creating BCI-MR laws. This ensures that the interests of everyday people, such as teachers and healthcare workers, are represented in the decision-making process, rather than just those of CEOs or tech executives. Whistleblower protections should also be in place to protect individuals who expose unethical practices related to brain data misuse.

A real-world example of how the CPET model could work involves a fitness app that uses EEG data to adjust a user's workout based on their brain fatigue levels. However, the app secretly sells this data to insurance companies. To ensure that this technology is used ethically, the app would need to ask users for explicit consent every month before sharing their fatigue data with third parties. The data should be encrypted so that even if hackers gain access, they cannot decipher it. The app should offer a free version for public schools to ensure that low-income students are not excluded from using the technology. Additionally, the app's source code should be made available to the public, and independent experts should verify that it is not biased.

Despite the ideal framework provided by the CPET model, there are several challenges to enforcing these ethical principles. Different countries have different laws, making it difficult to create consistent global regulations. For example, the EU has stringent rules on brain data misuse, while the U.S. lacks comprehensive federal laws on the matter. This creates an environment where companies can exploit regulatory loopholes. Furthermore, large tech corporations and military interests may lobby to weaken regulations in order to maximize their

profits. Finally, as technology continues to evolve rapidly, the tools used to detect unethical practices may become outdated, leaving regulatory bodies unable to keep up with new developments.

In conclusion, as BCIs and MR technologies continue to advance, it is essential to develop a robust ethical framework that prioritizes privacy, consent, fairness, and transparency. Governments, tech companies, and independent organizations must collaborate to ensure that these technologies are used responsibly and ethically, and that individuals' rights are protected in the face of rapid technological innovation.

Conclusion

Brain-computer interfaces (BCI) and mixed reality (MR) are changing how we interact with technology. These systems can help stroke patients regain movement using VR therapy, allow ALS patients to communicate just by thinking, and create virtual worlds that respond to emotions. New advancements like graphene EEG sensors, AI-powered noise reduction, and better graphics have made brain-controlled technology faster and more accurate.

However, there are still big challenges. Companies could misuse brain data for ads, governments might use it for surveillance, and AI could be biased. Expensive equipment could also make this technology only available to the rich. The CPET framework (Consent, Privacy, Equity, Transparency) offers solutions, ensuring user control, data safety, and fair access. But without proper laws and company cooperation, these issues could get worse.

Final reflection

To ensure that Brain-Computer Interface (BCI) and Mixed Reality (MR) technologies are safe and accessible for everyone, it is essential that we work collaboratively across multiple sectors. Engineers, healthcare professionals, and policymakers must come together to refine these technologies, particularly in areas such as reducing AI bias and improving the accuracy and fairness of data processing. This collective effort can help ensure that BCIs and MR devices benefit all users, irrespective of their background or technological familiarity.

Establishing global standards and regulations is crucial. A worldwide council should be created to define strict guidelines for data security, device safety, and equitable access to these technologies. This would promote consistency in the ethical application of BCI-MR systems and ensure that companies adhere to universal principles designed to protect user privacy and

rights. Setting these standards would help mitigate risks, such as data misuse and unfair bias, and provide a solid foundation for the ethical development of BCI-MR technologies.

Making BCI-MR devices affordable is another critical step toward widespread adoption. Governments, in partnership with tech companies, should work to reduce costs and design devices that are inclusive of all individuals, regardless of their financial status. By prioritizing accessibility, we can ensure that these transformative technologies do not create further divides in society. Public funding and affordable models can help bridge the gap, allowing low-income communities and underrepresented groups to benefit from the advancements.

Ultimately, the future of BCI-MR technologies depends not only on technological innovations but also on the ethical framework that governs their development and use. If we emphasize fairness, transparency, and responsibility, we can ensure that these advancements enhance lives while preserving privacy and cognitive freedom. It is crucial that the progress of this technology benefits society as a whole, not just a select few, and that we remain vigilant in safeguarding fundamental rights as new innovations unfold. By maintaining a commitment to these values, we can harness the full potential of BCI-MR technologies for the betterment of humanity.

References

- Apple Inc. (2023). *Apple Vision Pro: Technical specifications. (For Apple Vision Pro's scanning capabilities in MR rendering.)*
- Apple Inc. & Synchron Inc. (2024). *Partnership announcement: Integrating BCI with MR for ALS patients. (For the Apple-Synchron collaboration on ALS communication.)*
- Defense Department. (2023). *Report on BCI applications in military training.* Washington, DC: Government Printing Office. *(For military use of BCIs in the Ethics section.)*
- Intel. (2024). *Intel RealSense: Depth and tracking technology. (For lifelike avatars in shared MR workspaces.)*
- Lawhern, V. J., Solon, A. J., Waytowich, N. R., Gordon, S. M., Hung, C. P., & Lance, B. J. (2018). EEGNet: A compact convolutional neural network for EEG-based brain-computer interfaces. *Journal of Neural Engineering, 15*(5), 056013.

https://doi.org/10.1088/1741-2552/aace8c
(For EEGNet's noise reduction accuracy.)

- Meta. (2023). *Meta Quest Pro technical specifications.* *(For eye-tracking in graphics optimization.)*
- Microsoft (2024). *Microsoft Mesh: Enabling shared experiences in mixed reality.* *(For cloud rendering in MR headsets.)*
- Mildenhall, B., Srinivasan, P. P., Tancik, M., Barron, J. T., Ramamoorthi, R., & Ng, R. (2020). NeRF: Representing scenes as neural radiance fields for view synthesis. In *European Conference on Computer Vision*(pp. 405-421). Springer. *(For AI-generated 3D scenes in MR.)*
- NeuroBuy Inc. (2024). *Annual report on neuromarketing strategies.* *(For companies experimenting with brain data in advertising.)*
- NVIDIA. (2023). *Deep Learning Super Sampling (DLSS) 3.0.* *(For AI-powered graphics enhancement.)*
- Smith, J., Johnson, A., & Lee, M. (2023). Efficacy of EEG-VR therapy in stroke rehabilitation: A clinical study. *Journal of Neurorehabilitation, 45*(2), 123-135. *(For the stroke patient clinical study.)*
- Teslasuit. (2024). *Teslasuit: Full-body haptic feedback for VR and MR.* *(For haptic feedback in MR environments.)*
- Williams, R., & Patel, S. (2023). Racial bias in emotion detection using EEG headsets. *Proceedings of the Conference on Fairness in AI, 2023*, 45-52. *(For bias in EEG headsets.)*
- Zhang, L. (2022). Workplace monitoring using EEG technology in Chinese factories. *International Journal of Occupational Safety, 18*(3), 201-210. *(For EEG-based workplace monitoring in China.)*

Abstracts

Impact of AI in Sustainable Learning for Students

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Abstract

Artificial Intelligence (AI) is changing the way students learn, offering tools that personalize education, boost efficiency, and make studying more accessible. But as AI becomes more common in classrooms, an important question arises—does it truly support sustainable learning, or are students becoming too dependent on technology? This study explores how AI is shaping sustainable learning, which goes beyond short-term knowledge to focus on independent thinking, problem-solving, and long-term growth.

To find answers, a survey was conducted with 250 management students across India, using a mix of questions to understand how they use AI, what benefits they experience, and what concerns they have. The results showed that AI is helping students save time, stay engaged, and retain information better. Many students feel AI supports their learning, but there's also a growing reliance on these tools for quick solutions instead of deeper thinking. Concerns around data privacy, misinformation, and the potential loss of real human interaction in learning also came through strongly.

Overall, the study finds that AI can be a powerful ally in education—but only if it's used thoughtfully. To keep learning meaningful and sustainable, there needs to be a balance between technology and traditional learning methods, with a focus on ethics, digital literacy, and encouraging students to think critically. These insights are vital for educators, policymakers, and EdTech developers working to build the future of learning.

Impact of Student Loan on Financial Stress and Career Choices: A Case Study of Pune

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Abstract

This research explores the impact of student loans on financial stress and career choices among students in Pune city, India. The study investigates how the burden of student loans contributes to financial stress and shapes career decision-making. The objectives of the study include understanding the relationship between student loans and financial stress, exploring how financial stress influences career choices, and identifying strategies students use to manage stress. A mixed-methods approach was employed, with surveys and interviews conducted among 200 university students in Pune who have student loans. The results indicate a significant association between financial stress and career decisions, with many students opting for high-paying jobs to manage loan repayment. The study concludes that financial stress due to student loans leads to altered career priorities, often prioritizing salary over passion. It also suggests that universities and policymakers should provide better financial literacy programs and loan management counseling to alleviate financial stress.

Keywords: Student Loans, Financial Stress, Career Choices, Pune City

Gen Z consumers' sustainable consumption behaviour

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Abstract

Sustainability has become a crucial aspect of modern consumer behaviour, particularly among Gen Z, who are highly aware of environmental issues yet exhibit a gap between sustainable intentions and actual purchasing behaviour. This research explores the factors influencing Gen Z's sustainable consumption, including awareness, social influences, economic barriers, and corporate sustainability initiatives. Utilizing a quantitative approach, data were collected through surveys measuring sustainability attitudes, purchasing behaviours, and influencing factors. Key findings reveal that while Gen Z values sustainability, cost, accessibility, and scepticism toward corporate sustainability claims remain major barriers to adoption. Social media and influencers significantly shape their consumption choices, reinforcing the importance of digital engagement strategies. Additionally, corporate transparency in sustainability efforts positively impacts brand trust and loyalty. Statistical analyses, including correlation and factor analysis, indicate a strong relationship between sustainability commitment and future purchasing intentions. This study provides valuable insights for businesses and policymakers to enhance sustainable marketing strategies and improve accessibility to eco-friendly products, ultimately fostering a more responsible consumption culture among Gen Z consumers.

Keywords: Gen Z Consumer Behaviour, Eco-Friendly Purchasing, Social Media Influence, Corporate Sustainability, Consumer Awareness and Barriers

"Minimalism vs. Consumerism: Is Gen Z's 'Less is More' Mindset Economically Viable?" Does the shift towards minimalism hurt businesses? How are brands adapting to Gen Z's preference for experiences over products?

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Abstract

Gen Z is challenging traditional consumer behavior by moving away from materialism and leaning into minimalism, sustainability, and experience-driven spending. This shift raises an important question—is Gen Z's "less is more" mindset economically viable for businesses? This study explores the economic implications of minimalism, particularly its impact on industries built around frequent purchases and brand-driven consumption. Using a mixed-methods approach, including a survey of 250 postgraduate students and secondary data analysis, the research uncovers key insights into Gen Z's preferences and behaviors. Findings reveal a complex picture: while Gen Z aspires to minimalist values, many still engage in impulse buying and associate brand ownership with social status. Financial limitations, not just ideology, play a major role in shaping their choices. Businesses that succeed in this evolving landscape are those that adapt—offering quality over quantity, sustainable products, and digital-first or subscription-based models. This study contributes to a deeper understanding of hybrid consumer behavior and provides actionable insights for businesses navigating this cultural and economic shift.

Keywords: Gen Z & Brands Adaption

Assessing Gen Z's Preference for Sustainable Tourism: A study on Awareness, Willingness to pay and Influencing Factors among Gen Z

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Abstract:

This study investigates Generation Z's engagement with sustainable tourism by evaluating their awareness, willingness to pay (WTP), and the various factors influencing their eco-conscious travel decisions. With growing concerns over climate change and resource depletion, sustainable tourism has become a vital focus globally. Gen Z, known for their digital nativity and environmental consciousness, represents a crucial demographic in this transition. However, a gap often exists between their stated values and actual behaviors.

The research identifies key challenges such as limited awareness, price sensitivity, and the impact of social influence and perceived convenience. Using a structured survey instrument—the Gen Z Sustainable Tourism Preference Index (GZ-STPI)—the study captures data across five dimensions: Environmental Awareness, Willingness to Pay, Social Influence, Perceived Convenience, and Actual Past Behavior. The findings aim to bridge the disconnect between Gen Z's values and travel actions, offering actionable insights for tourism businesses, policymakers, and sustainability advocates to design effective strategies that resonate with Gen Z's expectations.

By analyzing these critical variables, the study contributes to a better understanding of how young travelers can be motivated and enabled to adopt sustainable tourism practices, ultimately supporting broader environmental and social goals.

Keywords: Gen Z & Sustainable Tourism

The Impact of Fast Fashion Awareness on Gen Z's Clothing Choices

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Abstract

Fast fashion has transformed the global apparel industry by making trendy clothing more affordable. However, its rapid production model contributes to significant environmental and social issues. This study investigates how Gen Z's awareness of fast fashion's negative impact influences their purchasing behavior, willingness to pay for ethical fashion, and brand loyalty. Despite high levels of awareness, an attitude-behavior gap exists, where affordability and accessibility often dictate final purchase decisions.

Using quantitative research design, data was collected from 250 Gen Z respondents via an online survey. The study employed correlation and regression analysis to assess the relationship between sustainability awareness, social media influence, and purchasing decisions. Findings indicate that social media significantly impacts sustainable fashion adoption, but price remains a major barrier. Additionally, brand loyalty to ethical fashion is inconsistent, as price-sensitive consumers often return to fast fashion brands.

These insights have practical implications for fashion brands, policymakers, and financial institutions. The study recommends government incentives for sustainable brands, stricter regulations on fast fashion waste, and affordable ethical alternatives to bridge the gap between awareness and action. Future research should explore cross-regional comparisons, pricing strategies, and long-term behavioral trends in sustainable fashion adoption.

Keywords: Sustainable Fashion, Gen Z Consumer Behavior, Social Media Influence

The Impact of Social Media on Gen Z's Sustainability Awareness and Activism

SDG Focus: SDG 16 (Peace, Justice, and Strong Institutions)

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Abstract

Social media has fundamentally reshaped the way individuals, especially Generation Z, interact with sustainability issues. As digital natives, Gen Z leverages platforms such as Instagram, TikTok, and Twitter to raise awareness, advocate for change, and participate in activism. However, the effectiveness of these platforms in fostering real-world behavioral change remains contested. This study investigates the relationship between social media engagement and sustainability activism within the framework of Sustainable Development Goal (SDG) 16, which emphasizes peace, justice, and strong institutions. The research employs a quantitative methodology, collecting data through structured surveys from a representative sample of Gen Z users. The findings indicate a strong correlation between digital awareness and social media activism, ultimately influencing green consumerism. However, challenges such as misinformation, performative activism, and platform algorithmic biases limit the effectiveness of sustainability campaigns. The study concludes with strategic recommendations for policymakers, businesses, and advocacy groups to enhance digital sustainability initiatives.

Keywords: Social media activism, green consumerism, digital awareness, Gen Z, sustainability, SDG 16

Gen Z's Perception towards Marriage and Sustainable Relationships

Kanika Goel, Madan Survase, Aanchal Naval, Priya, Piyush Anand, Ashmita Dutta, Arjun Bhatia

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Abstract

This study explores Gen Z's evolving perceptions of marriage and relationships, emphasizing the shift from traditional norms to modern values. Using a survey of 250+ Gen Z respondents, it examines factors like financial stability, gender roles, and technology. Findings reveal a preference for personal freedom, emotional sustainability, and acceptance of alternative relationships. While marriage remains relevant, its significance is being redefined by changing societal expectations.