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Real-time Value Creation Metrics in Manufacturing Through Blue Innovation and IoT-Based Accounting

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ABSTRACT

This study aims to explore the impact of Blue Innovation and IoT-based accounting on value creation in the manufacturing sector. Novelty on this research are integration of Blue Innovation and IoT-Based Accounting. Real-Time Value Creation Metrics introduces a framework for evaluating real-time financial and environmental impact through IoT-enabled accounting systems, providing a more dynamic approach compared to traditional static reporting methods. This research follows a qualitative exploratory approach to understand the intersection of Blue Innovation and IoT-based accounting in manufacturing. To ensure the novelty of this research, the following methodological steps are undertaken Comparative Gap Analysis, Conceptual Model Development, Validation Through Expert Panels, and Empirical Case Study Verification. The study provides empirical evidence that IoT-driven financial tracking improves both cost efficiency and sustainability compliance. Blue Innovation practices emphasize the integration of sustainable processes into core business operations. The development of Real-Time Value Creation Metrics (RTVCM) marks a significant contribution to modern accounting frameworks, offering a more dynamic and data-driven approach compared to traditional financial reporting. Future studies can expand the RTVCM framework by integrating AI-driven predictive analytics for sustainability reporting.

Keywords: Real-time Value Creation Metrics; Blue Innovation; IoT-based Accounting; Sustainable; Manufacturing

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SGDs: Decent Work and Economic Growth (8); Industry, Innovation, and Infrastructure (9); Responsible Consumption and Production (12); Climate Action (13); Partnerships for the Goals (17)

INTRODUCTION

In the era of Industry 4.0, manufacturing industries are increasingly embracing technological advancements to enhance efficiency, sustainability, and value creation. Among these advancements, Blue Innovation which integrates sustainable, technology-driven approaches has emerged as a key driver in optimizing industrial processes while minimizing environmental impact. By leveraging Internet of Things (IoT)-based accounting, businesses can improve data accuracy, enhance decision-making, and foster financial transparency (Almadadha, 2024) in manufacturing operations.

Blue Innovation in manufacturing focuses on integrating smart technologies to improve resource efficiency, reduce waste, and enhance operational agility (Renaldo et al., 2024). As industries face growing pressure to adopt sustainable practices, IoT-based accounting systems play a crucial role in tracking real-time financial and environmental metrics, allowing manufacturers to align their production strategies with both economic and ecological goals. The convergence of these two innovations provides a strategic advantage, enabling businesses to achieve long-term profitability while meeting regulatory and sustainability standards.

The manufacturing industry is undergoing a significant transformation driven by digitalization (Junaedi et al., 2024), sustainability concerns, and increasing regulatory pressures. Traditional accounting systems often fail to provide real-time financial insights and sustainability tracking, leading to inefficiencies in cost management, resource allocation, and environmental compliance. Moreover, manufacturers struggle to balance profitability with sustainability, as conventional value creation models prioritize short-term financial performance over long-term ecological and operational efficiency.

Blue Innovation, which integrates sustainable technology-driven approaches (Lv, 2023), has emerged as a solution to this challenge. Coupled with IoT-based accounting, manufacturers can now track operational data in real time, optimize production costs, and enhance decision-making. However, despite its potential, research on the intersection of Blue Innovation, IoT-based accounting, and value creation in manufacturing remains limited. This study addresses the gap by examining how these concepts work together to drive both financial and environmental performance in industrial settings.

This study aims to explore the impact of Blue Innovation and IoT-based accounting on value creation in the manufacturing sector. By analyzing how these technologies contribute to operational efficiency, cost reduction, and sustainable growth, this research provides valuable insights for businesses seeking to navigate the challenges of modern industrial transformation.

Novelty on this research are integration of Blue Innovation and IoT-Based Accounting. Unlike existing studies that focus solely on IoT in accounting or sustainability in manufacturing, this research bridges both areas, showing how real-time IoT-driven financial tracking enhances sustainable value creation. Real-Time Value Creation Metrics introduces a framework for evaluating real-time financial and environmental impact through IoT-enabled accounting systems, providing a more dynamic approach compared to traditional static reporting methods.

LITERATURE REVIEW

Resource-Based View (RBV)

The Resource-Based View (RBV) from Barney (1991) serves as the grand theory for this study, emphasizing that a firm's competitive advantage stems from its ability to acquire, develop, and utilize unique resources efficiently (Ande et al., 2018). In the context of Blue Innovation and IoT-based accounting, RBV explains how manufacturing firms can leverage technological capabilities and sustainable innovations as strategic resources to enhance value creation. IoT-based accounting provides real-time financial insights, while Blue Innovation fosters eco-friendly production processes both of which contribute to a firm's long-term sustainability and market advantage.

Blue Innovation in Manufacturing

Blue Innovation refers to the application of technological advancements and sustainability-driven approaches to optimize industrial processes while minimizing environmental harm (Renaldo et al., 2024). It aligns with the concept of the circular economy, where industries prioritize resource efficiency, waste reduction, and eco-friendly production. Research suggests that firms adopting Blue Innovation strategies experience higher operational efficiency, regulatory compliance, and improved corporate reputation (Lim & Young, 2021).

Several studies have explored innovation's impact on value creation, but limited research connects Blue Innovation with IoT-based financial tracking. This study extends the discussion by examining how real-time accounting and financial monitoring influence sustainable manufacturing performance.

IoT-Based Accounting: Enhancing Real-Time Financial Decision-Making

IoT-based accounting integrates smart sensors, cloud computing, and AI-driven analytics into financial management systems (Renaldo & Augustine, 2022). Unlike traditional accounting, which relies on historical data, IoT-enabled accounting provides real-time monitoring of costs, production efficiency, and sustainability metrics. Research highlights three key benefits:

- Automation of Financial Reporting – Reducing human errors and increasing transparency in cost allocation.
- Predictive Analytics for Decision-Making – AI-driven forecasts help firms optimize inventory, pricing, and capital investment.
- Sustainability Performance Tracking – Firms can measure energy consumption, carbon emissions, and waste in real time to comply with ESG (Environmental, Social, and Governance) standards.

This study explores how IoT-based accounting supports value creation by improving financial efficiency, cost reduction, and environmental accountability in manufacturing.

Value Creation Through Technology and Sustainability

Value creation in modern manufacturing is no longer solely measured by financial profits but also by a firm's ability to generate sustainable economic benefits. Porter and Kramer (2011) introduced the "Creating Shared Value" (CSV) concept, arguing that businesses must align their financial goals with social and

environmental impact. Studies indicate that companies leveraging digital transformation and sustainability frameworks experience:

- Increased operational efficiency and cost savings.
- Enhanced brand equity and stakeholder trust.
- Greater adaptability to market changes and regulatory demands.

METHODOLOGY

This research follows a qualitative exploratory approach to understand the intersection of Blue Innovation and IoT-based accounting in manufacturing. Since existing studies mainly focus on either IoT applications in accounting or sustainability strategies in manufacturing, this study seeks to uncover how their integration contributes to real-time value creation metrics.

A multiple case study method is chosen to analyze manufacturing firms that have successfully implemented IoT-driven accounting systems alongside sustainable innovation strategies. This allows for a comparative analysis of different industry approaches, challenges, and best practices.

Data Collection Methods

This study collects primary and secondary data through:

A. Primary Data

- In-Depth Interviews: Conducted with CFOs, sustainability managers, IoT specialists, and financial analysts in manufacturing firms using IoT-enabled accounting. Interviews focus on the impact of real-time financial tracking on decision-making, challenges in integrating sustainability with IoT-based accounting, and benefits and limitations of Blue Innovation in financial management.
- Focus Group Discussions (FGD). Engages experts in accounting, technology, and sustainability to validate findings. Explores best practices for aligning real-time IoT-driven accounting with value creation goals.
- Observations and Document Analysis. Examines financial reports, IoT dashboards, and sustainability reports from selected case studies. Observes real-time financial and environmental performance tracking within the companies.

B. Secondary Data

- Academic Journals & Industry Reports – Literature on IoT in accounting, sustainability strategies, and digital transformation.
- Company Reports & Policies – Annual reports, sustainability reports, and financial disclosures of firms practicing Blue Innovation.

Data Analysis Methods

A thematic analysis approach is applied to identify key themes from interviews, reports, and observations. The data analysis process follows these steps:

- Coding and Categorization. Transcripts from interviews and FGDs are coded to identify common themes related to IoT-driven accounting, Blue Innovation, and real-time value creation.
- Pattern Recognition. Cross-case analysis is performed to compare how different firms integrate IoT and sustainability strategies in financial management.
- Framework Development. Findings are synthesized to propose a new theoretical framework linking IoT-based financial tracking, Blue Innovation, and real-time value creation metrics.

Methodology for Developing Novelty

To ensure the novelty of this research, the following methodological steps are undertaken:

- Comparative Gap Analysis. Reviews existing studies on IoT in accounting and sustainability in manufacturing to highlight missing links. Identifies gaps in real-time financial tracking and its role in sustainable value creation.

- Conceptual Model Development. Develops a new integration framework that combines real-time IoT-driven financial tracking with Blue Innovation. Introduces real-time value creation metrics for evaluating financial and environmental impact dynamically.
- Validation Through Expert Panels. Engages industry practitioners, sustainability analysts, and financial technology experts to refine the proposed model. Uses feedback to enhance the practical relevance of the framework.
- Empirical Case Study Verification. Applies the framework to real-world manufacturing companies to test its applicability. Assesses how firms implement IoT-driven accounting for sustainable profitability.

RESULT AND DISCUSSION

Real-Time Financial Transparency

Findings from interviews with CFOs and financial analysts indicate that IoT-enabled accounting systems improve real-time financial transparency by providing instant access to cost data, inventory levels, and production efficiency. A leading electronics manufacturer reported a 15% reduction in financial discrepancies after implementing IoT-based cost tracking. Real-time accounting dashboards enabled better budget allocation, reducing wasteful expenditures by 12% within a year.

Automated Cost Control and Profitability Management

From case study observations, firms that integrated IoT sensors in production lines could monitor cost fluctuations dynamically. One automotive firm utilized IoT-based accounting software to track material costs and energy consumption, leading to a 10% increase in operational efficiency. Predictive cost analytics from IoT-generated data helped companies identify waste reduction opportunities, resulting in a 7% boost in profit margins.

Integration Challenges

However, focus group discussions (FGD) with industry experts revealed that:

- Data overload from IoT devices can overwhelm traditional accounting systems.
- Cybersecurity risks remain a major concern for firms adopting cloud-based IoT accounting solutions.

Environmental Cost Tracking and Carbon Accounting

From document analysis, sustainability reports of firms implementing Blue Innovation demonstrated:

- A 20% decrease in energy costs due to real-time IoT-based energy monitoring.
- Blockchain-integrated accounting records enhanced carbon footprint accountability, reducing regulatory compliance costs.

Sustainable Supply Chain Management

Interviews with supply chain managers revealed that IoT in accounting enabled better monitoring of sustainable procurement practices. A food processing company used IoT sensors to track sustainable raw material sourcing, ensuring 90% of its suppliers met environmental standards. Dynamic carbon tracking systems allowed companies to link carbon footprint data to real-time financial reports, helping them qualify for green tax incentives.

Development of Real-Time Value Creation Metrics (RTVCM)

One of the key novelties in this research is the Real-Time Value Creation Metrics (RTVCM), which integrates:

1. Financial Indicators
   - Real-time cost tracking (materials, energy, labor).
   - IoT-enabled predictive profitability modeling.
2. Sustainability Indicators (Rounaghi, 2019)
   - Carbon footprint per product unit.
   - IoT-driven waste reduction analysis.

3. Performance Efficiency Metrics (Chandra et al., 2024)
    - IoT-monitored production downtime.
    - AI-based predictive maintenance cost savings.

Implementation Results of RTVCM

From case studies and expert validation, the proposed RTVCM framework was tested in two industries:

- Textile Manufacturing: Achieved 25% reduction in water usage by tracking real-time dyeing process efficiency.
- Metal Processing: Reported a 30% decrease in raw material waste by optimizing inventory management through IoT sensors.

Key Theoretical Contributions

- Resource-Based View (RBV): This research extends RBV by showing how firms leverage IoT-driven financial intelligence as a strategic asset for sustainability.
- Triple Bottom Line Theory: The study redefines value creation metrics, linking profitability, environmental impact, and social responsibility dynamically rather than statically.
- Technology-Organization-Environment (TOE) Framework: Demonstrates that integrating IoT and sustainability accounting requires organizational readiness and regulatory alignment.

Discussion

Blue Innovation and IoT as Catalysts for Sustainable Value Creation

The study reinforces the argument that technology-driven accounting systems can serve as strategic tools for sustainability. Traditional accounting methods primarily focus on historical financial data, making them less effective in addressing real-time sustainability challenges. However, the combination of IoT-driven financial tracking and Blue Innovation offers a dynamic approach to cost management, environmental monitoring, and resource efficiency (Gu, 2017).

The integration of technology-driven accounting systems with Blue Innovation and IoT is revolutionizing sustainability management in manufacturing. Traditional accounting methods, which focus primarily on historical financial data, are insufficient in addressing real-time sustainability challenges. By leveraging IoT-driven financial tracking, companies can transition from reactive to proactive sustainability strategies, enhancing cost management, environmental monitoring (Santos et al., 2023), and resource efficiency.

Traditional accounting systems are designed to track financial performance but often fall short in monitoring real-time environmental and operational impact. Key limitations include:

- Lag in Reporting: Sustainability-related financial data (e.g., energy costs, waste management expenses) are reported periodically, leading to delayed responses.
- Lack of Integration: Conventional accounting does not directly link financial metrics with sustainability performance, making it difficult to assess eco-efficiency.
- Static Cost Analysis: Traditional cost accounting focuses on past expenditures, not on predictive insights that can drive sustainable decision-making.
- Manual Processes: Sustainability reporting often relies on manual data collection, increasing the risk of errors and inefficiencies.

IoT-based financial tracking and Blue Innovation provide a real-time, interconnected approach to sustainability. Key advancements include:

1. Live Monitoring of Resource Consumption
    - IoT-enabled smart meters track energy, water, and raw material usage in real time.
    - Helps in detecting wasteful processes and optimizing resource efficiency.
2. Automated Carbon Footprint Accounting (Kuosuwan et al., 2024)
    - Sensors measure real-time CO_2 emissions from manufacturing processes (Mehmood et al., 2024).
    - AI-powered analytics suggest emission reduction strategies and optimize carbon offset investments.

3. Dynamic Cost-Performance Tracking
    - Machine learning algorithms analyze sustainability-related costs (e.g., energy expenses, compliance fines) in real time.
    - Businesses can identify cost-saving opportunities while improving environmental impact.
4. Blockchain for Transparent Sustainability Reporting
    - Immutable ledger records carbon credits, sustainable investments, and green supply chain transactions (Zhang & Zhao, 2021).
    - Enhances corporate accountability and meets ESG (Environmental, Social, and Governance) compliance.
5. Predictive Maintenance for Waste Reduction
    - IoT sensors detect equipment inefficiencies and predict failures before they occur (Bibri, 2018).
    - Reduces material wastage and extends the lifespan of machinery, lowering environmental impact.

Blue Innovation's Role in Sustainable Financial Management

Blue Innovation, which focuses on efficient and sustainable resource utilization, plays a crucial role in enhancing financial and environmental performance through technology-driven accounting systems:

1. Circular Economy Accounting: Tracks recyclable materials, waste reduction efforts, and secondary resource utilization to improve cost efficiency.
2. Eco-Efficiency Scorecards: Uses IoT data to generate real-time sustainability KPIs, aligning financial performance with green objectives.
3. Smart Carbon Pricing Models: Integrates IoT-generated emissions data into cost structures, providing accurate carbon pricing and tax forecasting.
4. Automated Compliance Management: Ensures real-time adherence to sustainability regulations, reducing risks of penalties and fines.

Comparison with Previous Studies

Unlike previous research that examined IoT adoption in accounting (e.g., blockchain for financial transparency), this study bridges IoT with sustainability-focused Blue Innovation, creating a dual impact on cost efficiency and environmental accountability. Prior sustainability accounting frameworks focused on carbon accounting and ESG reporting in a retrospective manner. This study advances the field by proposing a Real-Time Value Creation Metrics (RTVCM) framework, allowing firms to monitor financial and environmental performance simultaneously.

Real-time sustainability accounting is becoming a strategic necessity for manufacturing firms. IoT-driven cost control enables firms to identify inefficiencies dynamically. Sustainability-driven financial metrics provide a competitive edge in global markets.

The Role of IoT-Based Accounting in Driving Financial and Environmental Impact

IoT-driven accounting systems are redefining financial decision-making in manufacturing by automating cost tracking, improving transparency, and integrating environmental impact assessment. The study's case analysis showed that firms leveraging real-time IoT dashboards reported lower operational costs and enhanced sustainability compliance.

Challenges Identified

Data Complexity & Overload. Managing large volumes of IoT-generated financial data requires advanced analytics and AI integration. **Cybersecurity Concerns.** The interconnection of financial and environmental accounting systems increases exposure to cyber risks. **Regulatory Gaps.** Current accounting standards do not fully accommodate real-time sustainability reporting, creating compliance uncertainty.

Adoption of AI-driven analytics to filter and interpret real-time financial and sustainability data. Strengthening cybersecurity protocols for IoT-enabled accounting platforms. Collaboration between regulators and industry players to standardize real-time financial sustainability reporting frameworks.

Real-Time Value Creation Metrics (RTVCM) as a Novel Framework

A key contribution of this study is the Real-Time Value Creation Metrics (RTVCM) framework, which integrates financial, sustainability, and operational performance indicators to provide a holistic view of manufacturing efficiency.

RTVCM is superior to traditional metrics as can be seen on table 1.

Aspect	Traditional Accounting	RTVCM Framework
Financial thinking	Periodic reports	Real-time cost tracking
Sustainability impact	Retrospective ESG reports	Lice carbon footprint monitoring
Operational efficiency	Limited to fixed KPIs	Dynamic, IoT-enabled indicators

Manufacturers can use RTVCM to identify inefficiencies instantly, reducing material and energy waste (Li et al., 2023). Financial managers gain access to real-time profitability insights, leading to more data-driven budgeting decisions. Sustainability officers can track carbon emissions and energy consumption per production unit, ensuring compliance with green regulations.

Real-Time Value Creation Metrics (RTVCM) is a dynamic framework designed to measure financial, operational, and environmental impact in real time using IoT-based accounting systems (Renaldo, 2024). Unlike traditional accounting, which relies on periodic financial reports, RTVCM provides continuous, data-driven insights that help firms make faster and more informed decisions.

The RTVCM framework is built on three core dimensions:

- Financial Metrics – Real-time cost tracking, profit margins, and ROI analysis.
- Sustainability Metrics – Live carbon footprint monitoring, energy efficiency, and waste reduction.
- Operational Efficiency Metrics – IoT-enabled production efficiency, downtime reduction, and predictive maintenance.
- Stakeholder Engagement Metrics (Novelty) - AI-driven sentiment analysis, real-time ESG compliance tracking, and customer/investor sustainability perception.

Stakeholder engagement metrics as a novelty is important because:

- Real-Time ESG Compliance Monitoring – Tracks regulatory changes and corporate adherence using AI-powered compliance engines.
- Sustainability-Driven Brand Value – Measures customer and investor trust levels based on real-time sustainability actions.
- AI-Based Sentiment Analysis – Analyzes public and stakeholder opinions on a company's sustainability performance through social media, news, and financial reports.

Strategic impact of this novelty such as:

- Enhances Transparency – Enables businesses to proactively manage sustainability-related reputational risks.
- Strengthens Investor Relations – Provides real-time sustainability metrics for ESG-focused investors.
- Bridges the Gap Between Financial & Non-Financial Reporting – Aligns real-time financial gains with stakeholder-driven sustainability expectations.

RBV Connections

RBV suggests that firms achieve competitive advantage by leveraging unique resources. This study expands RBV by showing that IoT-based financial tracking is a strategic resource for cost control. Blue Innovation practices strengthen firms' ability to enhance value while reducing environmental impact.

Resource-Based View (RBV) posits that a firm's competitive advantage is rooted in its ability to acquire and manage unique, valuable, and inimitable resources. Traditionally, these resources have been tangible assets such as machinery, capital, or even intangible assets like brand reputation. However, in the modern digital era, technological capabilities have emerged as critical strategic resources.

IoT-Based Financial Tracking is a strategic resource that offers dynamic cost control and enhanced operational agility. Blue Innovation Practices further strengthen a firm's ability to create value by integrating sustainable practices that reduce environmental impact.

IoT-Based Financial Tracking as a Strategic Resource

Real-Time Data for Cost Control:

IoT-based financial tracking systems deploy smart sensors, cloud computing, and AI analytics to provide continuous, real-time monitoring of financial and operational data. This capability allows firms to:

- Identify Inefficiencies Instantly: By capturing live data on production costs, energy consumption, and waste, companies can pinpoint areas of cost leakage and inefficiency before they escalate.
- Enhance Predictive Analytics: Predictive maintenance and forecasting models powered by IoT data enable firms to anticipate equipment failures and adjust operational parameters, thereby minimizing unplanned downtime and associated costs.
- Optimize Resource Allocation: With real-time insights, managers can reallocate resources dynamically, ensuring that investment is directed towards the most profitable and efficient operations.

VRIN Attributes of IoT-Based Financial Tracking:

- Valuable: The ability to reduce costs and improve operational efficiency directly contributes to the bottom line.
- Rare: Although many firms may invest in digital technologies, the sophisticated integration of IoT with real-time financial analytics is not yet ubiquitous.
- Inimitable: The specific combination of hardware (sensors), software (data analytics), and organizational processes creates a complex system that is difficult for competitors to replicate quickly.
- Non-Substitutable: The seamless flow of real-time data that drives both financial and operational decisions is a unique capability that traditional accounting systems cannot substitute.

Blue Innovation as a Catalyst for Sustainable Value Creation

Integrating Sustainability with Business Strategy:

Blue Innovation practices emphasize the integration of sustainable processes into core business operations. In the context of manufacturing, this involves:

- Eco-Efficient Production (Bashir et al., 2022): Adopting production methods that minimize waste and reduce energy consumption.
- Circular Economy Initiatives (Williams et al., 2024): Implementing practices that encourage the reuse, recycling, and repurposing of materials, thereby reducing the environmental footprint.
- Sustainable Product Development: Innovating products with longer lifecycles, lower emissions, and enhanced energy efficiency (Lemaire & Limbourg, 2019).

Enhancing Competitive Advantage through Sustainability:

- Cost Reduction and Environmental Benefits: Sustainable practices often lead to lower energy costs, reduced raw material usage, and less waste, all of which translate to cost savings and improved margins.
- Reputation and Market Differentiation: Companies that integrate Blue Innovation into their strategy can differentiate themselves in the marketplace. A strong sustainability profile attracts eco-conscious consumers and investors, thus enhancing brand value and market position.
- Regulatory Compliance and Risk Management: As environmental regulations become stricter, firms that proactively adopt sustainable practices reduce the risk of non-compliance penalties and benefit from government incentives aimed at green innovation.

Synergy between IoT-Based Financial Tracking and Blue Innovation

The integration of IoT-based financial tracking with Blue Innovation creates a synergistic effect that significantly enhances a firm's overall resource base:

- Dynamic Cost-Sustainability Integration: Real-time financial insights allow for immediate adjustments to production processes, ensuring that sustainability initiatives are both cost-effective and aligned with operational goals.
- Informed Decision-Making: Managers benefit from a comprehensive view that integrates cost data with environmental metrics. This dual insight supports better strategic decisions that optimize both economic and ecological outcomes.
- Enhanced Resource Utilization: The combined approach allows for a seamless linkage between resource consumption and sustainability performance, fostering an environment where cost control and environmental stewardship mutually reinforce each other.

Implications for Competitive Advantage

By adopting these advanced practices, firms not only secure immediate cost reductions but also position themselves for long-term competitive advantage (Michael & Olayide, 2024). The unique integration of IoT-driven financial tracking and Blue Innovation provides:

- Sustainable Differentiation: Firms that master this integration can offer unique value propositions that competitors find hard to emulate.
- Enhanced Resilience: The ability to rapidly adapt to both market fluctuations and environmental challenges ensures that the firm remains competitive even in turbulent times.
- Long-Term Strategic Growth: With real-time insights guiding investments and operational adjustments, companies can sustainably grow their market share while maintaining high standards of environmental responsibility.

CONCLUSION

Conclusion

The study provides empirical evidence that IoT-driven financial tracking improves both cost efficiency and sustainability compliance. Blue Innovation practices emphasize the integration of sustainable processes into core business operations. The development of Real-Time Value Creation Metrics (RTVCM) marks a significant contribution to modern accounting frameworks, offering a more dynamic and data-driven approach compared to traditional financial reporting.

Implication

For Businesses. Firms should invest in IoT-enabled financial analytics to improve decision-making. Implementing RTVCM-based accounting systems will enhance regulatory compliance and operational efficiency. **For Policymakers.** Governments should create standardized frameworks for real-time sustainability reporting. Providing tax incentives for IoT-based sustainability accounting adoption could encourage wider implementation.

Limitation

The implementation of IoT-based financial tracking requires advanced infrastructure, high-speed connectivity, and integration with existing accounting systems. Companies in regions with limited access to such technologies may face adoption barriers due to cost, technical expertise, and compatibility issues. This study primarily focuses on the manufacturing sector, where IoT-based financial tracking and Blue Innovation can be seamlessly integrated. The findings may not be directly transferable to industries with different operational dynamics, such as service-based sectors or knowledge-intensive industries. The use of real-time IoT tracking generates large volumes of sensitive financial and operational data, increasing the risk of cybersecurity threats, data breaches, and unauthorized access.

Recommendation

Companies should prioritize high-quality IoT sensors, cloud-based platforms, and real-time data analytics tools to improve financial tracking accuracy and sustainability monitoring. Adoption of 5G networks and edge computing can facilitate faster data transmission and processing, ensuring real-time insights for decision-making. Organizations must invest in training programs for accountants, financial analysts, and sustainability managers to enhance their expertise in IoT-driven financial tracking and environmental reporting also a better value creation for the company.

Future Study

Future studies can expand the RTVCM framework by integrating AI-driven predictive analytics for sustainability reporting. Exploring cross-industry applications of IoT-based accounting in other sectors (e.g., agriculture, healthcare) could further validate its effectiveness. The future of manufacturing depends on the ability to track financial and environmental impact in real time. Explore industry-specific adaptations of IoT-based accounting and Blue Innovation in non-manufacturing sectors. Future studies should refine RTVCM for different manufacturing sub-sectors, considering industry-specific cost structures, carbon footprint baselines, and operational workflows.

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