

An Integrated Reporting Approach to Blue Accounting

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Abstract

There is increasing global interest in ocean ecosystem health and how to harness the untapped potential of the blue economy. Additionally, nature-related financial risks can materialise from the environmental impact of firms within the blue economy. These risks can materially affect the cash flows and economic performance of blue economy firms. Yet, there is a lack of empirical studies in accounting literature on Blue Accounting Disclosures, which involve reporting ocean-related sustainability practices in financial statements. This paper aims to develop a conceptual framework for Blue Accounting Disclosure that incorporates both financial and impact materiality, addressing the need for ocean-specific reporting guidance within existing sustainability frameworks. Adopting a qualitative research design, the study employs a systematic literature review, theoretical analysis, and conceptual modeling to create an integrated reporting disclosure model. The findings present an Integrated Blue Accounting Disclosure Model with four interconnected components: Materiality Assessment and Scoping, Impact Identification and Measurement, Risk and Opportunity Analysis, and Disclosure and Reporting Integration. The model provides a preliminary structured approach for incorporating marine ecosystem considerations into corporate reporting. The study contributes theoretically by extending materiality and stakeholder theories into the marine sustainability domain. It also advocates a shift from traditional financial reporting to forward-looking disclosures that align with the complexities of marine ecosystem stewardship and global sustainability goals.

Keywords: *Blue Accounting, Blue Accounting Disclosure, Integrated Reporting, Blue Economy*

1.0 Introduction

The World Economic Forum (2020) states that nature and its ecosystem services generate \$44 trillion in economic value, accounting for more than half (50%) of the world's total Gross Domestic Product (GDP), and are therefore at risk from nature loss. Moreover, human economic activities have already degraded or severely altered 75% of land and 65% of the marine environment. As a result, any further disruptions to nature present a clear and significant threat to humanity and global shared prosperity. The oceans cover 71% of the Earth's surface and hold 97% of all water (Intergovernmental Oceanographic Commission, 2024). According to the United Nations First Global Integrated Marine Assessment (2016), also known as the World Ocean's Assessment I, the oceans are becoming less clean, healthy, resilient, and productive. Furthermore, the impact of human stressors (Economic exploitation) on the oceans is expected to grow as the human population approaches nine billion by 2050. Therefore, the health of the oceans should be a critical

concern for humanity, as governments, businesses, and communities share a responsibility to ensure ocean health. The UN Global Compact Sustainable Ocean Principles provide a framework for responsible business practices across all ocean sectors and geographies. These principles expand on and support the ten pillars of the United Nations Global Compact, serving as a baseline for ocean-related sustainability practices (UN Global Compact, 2022).

According to Abreu, David, Segura, and Formigoni (2019), and Fuad and Setyawan (2020), to reinforce marine knowledge and support the blue economy, new ocean accounting standards, practices, and disclosure frameworks need to be developed and adopted to address this challenge within the field of Accounting. Thus, the rapid evolution of marine knowledge necessitates in-depth studies and corroborations in the ocean sciences by accountants to understand how the nature dependency and environmental footprint of blue economy firms impact oceans and marine biodiversity, as well as the resulting risks and opportunities for their cash flows and economic performance. This gap has prompted niche ocean sustainability research within corporate reporting to explore a new type of information disclosure that has given rise to Blue Accounting Disclosure.

There are two schools of thought on Blue Accounting. The first school of thought is rooted in the discipline of economics. This paradigm is anchored on a top-to-bottom approach of valuing and accounting for economic activities resulting from the ocean and marine ecosystems and integrating the economic contributions through the System of National Accounts or National Accounting Frameworks to provide a holistic view of an economy using methodologies such as the System of Environmental-Economic Accounting (Colgan, 2016; OECD, 2016; Ram, Ramrattan, & Frederick, 2019; Wang, He, Zhou, Gao, & Deng, 2018; African Union, 2022). The second school of thought originates in the discipline of Accounting. This new paradigm is predicated on a bottom-to-top approach and starts from a firm-wide level. The basic assumption of this paradigm is that the financial and impact materiality of ocean sustainability can be integrated into corporate reporting as sustainability-related disclosures by firms in the blue economy to demonstrate the extent of their ocean sustainability performance (Abreu et al., 2019; Fuad & Setyawan, 2020; Syah et al., 2020; Wanta, & Gunawan, 2021; Rahmayanti, & Sari, 2023; Nwachukwu, Ande & Ogenyi, 2024).

Decline in ocean health should raise national and global concerns, undermining Sustainable Development Agenda 2030 Goal 14 (Life Below Water). The oceans provide food, half of the world's oxygen supply, livelihoods, medicine, trade, and energy for billions of people worldwide (OECD, 2016). According to the United Nations World Ocean Assessment II (2021), three billion people depend on the ocean for their livelihoods. Declining livelihoods are linked to poverty levels. Thus, adopting and disclosing Blue Accounting demonstrates corporate responsibility in maintaining clean, productive oceans that provide a sustainable livelihood for communities that rely on the oceans for survival. Additionally, there are increasing global concerns regarding the loss of ocean biodiversity. These biodiversity losses are emphasised within the larger context of global sustainability goals such as United Nations Global Biodiversity Framework, United Nations Convention on the Law of the Sea of 1982, the UN Sustainable Ocean Principles of 2022, and the United Nations Sustainable Development Agenda 2030 Goals, specifically Sustainable Development Goal 14 (Life Below Water). Consequently, corporate reporting that does not adopt and disclose Blue Accounting can only signal a lack of commitment by businesses to these global frameworks and treaties.

Blue accounting adoption can serve as a powerful catalyst for the global blue economy. It can scale blue growth, unlocking the potential for value addition, job creation, and the incubation of blue start-ups. Therefore, corporate reporting that does not adopt and disclose Blue Accounting undermines the ability of firms to tap into the employment creation potential of the Blue Economy, as well as capacity to seize a significant portion of the projected blue economy job opportunities, which are expected to reach 57 million jobs by 2030 and 78 million jobs by 2063 in Africa (African Union, 2022). Also, corporate reporting that fails to adopt and disclose Blue Accounting undermines the ability of firms to develop the value-addition potential of the Blue Economy and diminishes the capacity to capture a significant portion of revenues from economic activities that contribute to Gross Value Added (GVA) (OECD, 2016).

Corporate reporting that does not integrate blue accounting disclosure also eliminates the capacity to mitigate significant nature-related financial risks that could crystallise and materially impact a firm's cash flows, financial position, and economic performance. Several empirical studies in literature have established a nexus between sustainability disclosures and mitigating nature-related and environmental risks, thus reducing blue economy firm exposure to potential liabilities.

Despite growing recognition of ocean-economy interdependencies, current corporate reporting practices inadequately capture the complex relationships between business activities and ocean ecosystem health. Traditional financial reporting focuses primarily on economic performance indicators that affect enterprise values while overlooking nature-related financial risks that may materially impact future cash flows and economic performance. This reporting gap creates several interconnected problems: First, investors and stakeholders have limited access to accessible information regarding corporate marine impact performance, which impedes informed decision-making and resource allocation toward sustainable blue economy growth. Second, firms operating in ocean-dependent sectors are under increased regulatory scrutiny and stakeholder pressure in the absence of clear guidelines on proper disclosure procedures. Third, the lack of an established blue accounting disclosure framework that allows for possible "blue washing" of marine sustainability performance, undermining market confidence and regulatory compliance.

Existing sustainability reporting requirements, while comprehensive in terms of climate-related disclosures, offer scant direction for ocean-specific sustainability reporting. IFRS S1 General Requirements for Disclosure of Sustainability-Related Financial Information, starting January 2024, addresses financial materiality aspects of sustainability-related risks but does not include topic-specific guidance for ocean and marine ecosystems. Similarly, established frameworks such as the Global Reporting Initiative (GRI) and upcoming guidelines developed by the Task Force on Nature-Related Financial Disclosures (TNFD) provide essential guidance but require adaptation for ocean-specific applications.

Further, there is no practical guidance on how to disclose the 'double materiality' in blue accounting in financial statements, which is a significant gap that needs to be addressed. This is because blue accounting requires two distinct materiality disclosures to stakeholders: a financial materiality disclosure of the effect of nature-related financial risks that can impact the enterprise value for investors and capital providers, and an impact materiality disclosure of the firm's effect on society and the environment. While IFRS S1 General Requirements for Disclosure of Sustainability-Related Financial Information allows for the disclosure of sustainability-related

risks and opportunities, it is not topic-specific and focuses only on sustainability-related financial materiality disclosures that can reasonably influence the decisions of primary users of general-purpose financial reporting. As a result, blue accounting adopting only IFRS S1 General Requirements for Disclosure of Sustainability-Related Financial Information remains insufficient and not fit for purpose. These underlying issues thus motivate and underscore the relevance of this study.

1.2 Research Objectives

This study addresses the identified research gap through the following primary objectives:

1. Theoretical Development: Establish a comprehensive theoretical framework for blue accounting disclosure grounded in established accounting theory, stakeholder theory, and institutional theory.
2. Practical Framework: Develop an integrated reporting approach that combines financial materiality requirements with impact materiality considerations for ocean sustainability disclosure.
3. Implementation Guidance: Provide preliminary practical recommendations for blue economy firms seeking to enhance their ocean sustainability reporting practices.

The study has theoretical relevance to both academic literature and professional practice. It theoretically broadens existing sustainability accounting frameworks to handle the distinct characteristics of marine ecosystems and blue economy businesses. Practically, it provides meaningful guidance for corporate reporting experts negotiating the complicated world of ocean sustainability disclosure regulations. Policy-wise, it lays the groundwork for regulatory authorities contemplating mandatory nature-related disclosure obligations for marine-dependent sectors.

2. Literature Review

2.1 Evolution of Blue Accounting Concepts

The concept of blue accounting arose from the convergence of environmental accounting, sustainability reporting, and ocean sciences studies. Early applications concentrated on national-level ocean accounting within environmental-economic accounting frameworks, using procedures developed by the System of Environmental-Economic Accounting (Colgan, 2016; OECD, 2016; Ram, Ramrattan, & Frederick, 2019; Wang, He, Zhou, Gao, & Deng, 2018; African Union, 2022). However, subsequent advancements have switched the focus to corporate firm-level applications, acknowledging the importance of corporate-level ocean sustainability reporting by blue economy firms.

Colgan (2016) presents essential insights into ocean economy measurement, moving away from standard national income accounting methodologies and toward integrated sustainability indicators. This study set key precedents for pricing ocean ecosystem services within economic frameworks, but mostly for macroeconomic rather than corporate-level applications. Subsequently, the Organisation for Economic Cooperation and Development (2016) broadened these principles to include both economic valuation and sustainability assessments of marine resources.

The origin of corporate-level blue accounting principles may be traced back to European Commission guidelines issued in 2001, which asked for greater marine environmental disclosures

from EU firms (European Commission, 2001a, and b; 2008; 2012a, and b; European Union Marine Strategy Framework Directive, 2008). These early frameworks stressed the incorporation of environmental factors into regular financial reporting formats, setting the groundwork for modern blue accounting development. The European Union Marine Strategy Framework Directive (2008) extended these responsibilities by establishing legal frameworks for systematic marine environmental reporting.

2.2 Contemporary Blue Accounting Definitions

Extant studies reveal two distinct schools of thought on blue accounting conceptualisation and application. The first, based on economics, takes a top-down approach that focuses on measuring the ocean economy at the national level and integrating it into national accounting frameworks. This paradigm emphasises macroeconomic indicators and sectoral contributions to Gross Domestic Product (GDP), using methodology developed by the System of Environmental-Economic Accounting (SEEA) (Colgan, 2016; OECD, 2016; Ram, Ramrattan, & Frederick, 2019; Failler et al., 2023; Wang, He, Zhou, Gao, & Deng, 2018; African Union, 2022).

The second school of thought originates in the discipline of Accounting. This new paradigm is predicated on a bottom-to-top approach and starts from a firm-wide level. The basic assumption of this paradigm is that the financial and impact materiality of ocean sustainability can be integrated into corporate reporting as sustainability-related disclosures by firms in the blue economy to demonstrate the extent of their ocean sustainability performance (Abreu et al., 2019; Fuad & Setyawan, 2020; Syah et al., 2020; Wanta, & Gunawan, 2021; Rahmayanti, & Sari, 2023; Nwachukwu, Ande & Ogenyi, 2024). Abreu, David, and Segura (2019) support for this approach, proposing new ocean-specific accounting standards that are similar to current climate-related disclosure requirements.

According to Fuad and Setyawan (2020), blue accounting is the creation of marine knowledge that begins with ocean assets within the blue economy, and blue accounting disclosure provides stakeholders and governments with useful information about corporate measures to improve marine ecosystem resilience and sustainability. This concept highlights blue accounting's informational function, as well as its role in assisting both private and public decision-making processes

Syah et al. (2020) argue that blue accounting and sustainability are interchangeable, with blue accounting disclosure indicating ocean sustainability reporting in financial statements. Their findings indicate that blue accounting building can begin with conceptual development, but they admit the need for more detailed implementation assistance. This viewpoint is consistent with the broader sustainability accounting literature, while stressing ocean-specific applications.

2.3 Theoretical Framework

2.3.1 Stakeholder Theory

Stakeholder theory provides critical theoretical foundations for understanding the motivations and mechanisms underlying blue accounting disclosures by blue economy firms. Freeman's (1984) important work established that firms have responsibilities to stakeholders other than shareholders, such as employees, consumers, suppliers, communities, and environmental constituents. In the context of blue accounting, marine ecosystems and dependent communities are important stakeholder groups whose interests may not be fully represented in standard financial reporting.

According to stakeholder theory, blue accounting disclosure serves several purposes, including reducing information asymmetry between management and stakeholders, demonstrating corporate accountability for marine and ocean stewardship, and allowing stakeholders to assess corporate sustainability performance. This theoretical lens explains why firms may voluntarily use blue accounting techniques in the absence of legislative requirements to gain support from key stakeholder groups and seek and maintain legitimacy in society.

2.3.2 Legitimacy Theory

Legitimacy theory contributes to stakeholder theory by understanding corporate motivations for sustainability disclosure. According to Suchman (1995), organizational legitimacy is "a generalised perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions." To preserve legitimacy, blue economy firms must demonstrate conformity with growing society expectations of maritime stewardship.

Blue accounting disclosure can be viewed as a legitimacy management technique, allowing businesses to demonstrate agreement with social expectations for ocean sustainability. As public awareness of marine degradation grows and regulatory frameworks evolve, firms are under increasing pressure to show appropriate marine and ocean stewardship and accountability. Blue accounting disclosure provides a means of conveying these efforts to stakeholders while perhaps avoiding regulatory involvement in institutional processes.

2.3.3 Institutional Theory

Institutional theory explains how organizational practices arise and spread through institutional forces and isomorphic processes. DiMaggio and Powell (1983) distinguish three types of institutional isomorphism: coercive (regulatory pressure), mimetic (uncertainty-driven imitation), and normative (professional norms and networks). Each of these strategies provides insight into blue accounting adoption.

Coercive pressures arise from regulatory requirements and stakeholder requests for improved marine sustainability reporting. Mimetic pressures emerge as market leaders adopt blue accounting techniques, putting competitive pressure on follower businesses. Professional networks, the creation of accounting standards, and educational institutions that promote sustainable reporting methods all create normative pressure.

2.4 Double Materiality Principle

The double materiality principle is an important theoretical foundation for blue accounting disclosure framework development. This idea distinguishes two distinct but related types of materiality: financial materiality (how sustainability issues affect enterprise value) and impact materiality (how corporate operations affect society and the environment). European sustainability reporting rules have pioneered this method, mandating firms to disclose both materiality dimensions in their sustainability reports.

Financial materiality in blue accounting contexts refers to nature-related financial risks that may have a material impact on business cash flows, asset valuations, and operational performance.

These risks include expenses associated with regulatory compliance, supply chain disruptions caused by marine damage, reputational damage from poor marine and ocean stewardship, and stranded asset risks in unsustainable marine resource sectors.

Impact materiality considers corporate effects on marine and ocean ecosystems and dependent coastal communities, regardless of financial returns. Impact materiality acknowledges that firms may have important social and environmental material impacts that require disclosure, even if they have no direct impact on enterprise value or financial performance. Impact materiality reporting fulfills broader accountability functions and facilitates stakeholder decision-making outside of investment decision-making.

2.5 Integration with Existing Sustainability Disclosure Frameworks

2.5.1 IFRS Sustainability Disclosure Standards

The International Sustainability Standards Board (ISSB) issued IFRS S1 General Requirements for Disclosure of Sustainability-Related Financial Information in June 2023, with an effective date of January 2024. This standard outline general requirements for sustainability-related financial disclosures, emphasising information valuable for primary users of general-purpose financial reports. However, IFRS S1 does not include topic-specific guidance for marine and ocean ecosystem-related disclosures, which creates implementation challenges for blue economy firms.

IFRS S1 mandates that firms disclose sustainability-related risks and opportunities that could reasonably influence the decisions of primary users. For blue economy firms, this includes nature-related financial risks resulting from marine and ocean ecosystem damage, regulatory changes impacting access to marine resources, and market opportunities from sustainable blue economy growth. Nevertheless, IFRS S1's focus on financial materiality limits its usefulness for comprehensive ocean sustainability reporting.

2.5.2 Global Reporting Initiative Framework

The Global Reporting Initiative (GRI) provides comprehensive impact materiality sustainability reporting guidance through its Universal Standards and topic-specific standards. Global Reporting Initiative (GRI) approach emphasises impact materiality, requiring firms to report on their most significant economic, environmental, and social impacts. The GRI 300 Environmental Standards series includes biodiversity-related disclosures (GRI 304) that can be adapted for marine and ocean ecosystem reporting, though ocean-specific guidance remains limited.

Global Reporting Initiative (GRI) materiality assessment process requires firms to identify and prioritise sustainability topics based on the significance of economic, environmental, and social impacts and influence on stakeholder assessments and decisions. For blue economy firms, this process should systematically consider marine and ocean ecosystem impacts, though current Global Reporting Initiative (GRI) guidance provides limited ocean-specific implementation support.

2.5.3 Task Force on Nature-Related Financial Disclosures

The Task Force on Nature-Related Financial Disclosures (TNFD), launched in 2021, aims to create a framework for nature-related financial reporting that complements climate-related disclosure frameworks. The Task Force on Nature-Related Financial Disclosures' approach emphasises both

financial and impact materiality, aligning with double materiality principles. The framework covers four main elements: governance, strategy, risk management, and metrics and targets.

The Task Force on Nature-Related Financial Disclosures focuses on nature-related financial risks and opportunities, supporting the development of blue accounting, especially regarding marine biodiversity and ecosystem services. However, it remains in the development stage, with limited guidance available so far. Integrating the Task Force on Nature-Related Financial Disclosures recommendations with existing reporting frameworks is a major challenge for implementing blue accounting.

3. Methodology

3.1 Research Design

This study employs a qualitative research methodology combining systematic literature review, theoretical analysis, and conceptual modeling to develop a comprehensive framework for blue accounting disclosure. The qualitative approach is particularly suitable for exploratory research in emerging fields where theoretical foundations require development and empirical data remains limited. The study methodology follows established procedures for conceptual research in accounting and sustainability reporting literature.

The research design incorporates three complementary methodological components: (1) systematic literature review to identify existing knowledge and research gaps, (2) theoretical framework analysis to establish conceptual foundations, and (3) conceptual modeling to develop practical implementation guidance. This multi-method approach enables comprehensive treatment of complex theoretical and practical issues while maintaining methodological rigor.

3.2 Systematic Literature Review Process

The systematic literature review follows PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines adapted for conceptual research contexts (Moher et al., 2015). The study strategy encompassed multiple databases, including Scopus, Web of Science, JSTOR, and Google Scholar, using combinations of keywords: "blue accounting," "ocean sustainability reporting," "marine accounting," "blue economy disclosure," and "nature-related financial disclosure."

Search criteria included: (1) peer-reviewed articles published between 2010-2025, (2) English language publications, (3) focus on corporate-level sustainability reporting or blue economy topics, and (4) theoretical or empirical contributions to accounting or sustainability literature. Initial searches yielded 347 potentially relevant articles, reduced to 189 after title and abstract screening, and further refined to 92 articles following full-text review such as Abreu et al. (2019; Fuad and Setyawan (2020) Syah et al. (2020) Wanta, & Gunawan (2021) Rahmayanti, & Sari, (2023), and Nwachukwu, Ande & Ogenyi (2024)

Additional sources included regulatory documents, accounting standards, international guidelines, and policy reports from organisations including the International Sustainability Standards Board, Global Reporting Initiative, European Commission, United Nations agencies, and professional accounting bodies. These sources provided essential context for understanding regulatory environments and implementation requirements.

3.3 Theoretical Analysis Framework

The theoretical analysis employed a systematic examination of relevant theoretical perspectives from accounting, sustainability, and organisational literature. Key theoretical frameworks analysed include stakeholder theory, legitimacy theory, institutional theory, and materiality concepts. This analysis aimed to identify the theoretical foundations most relevant for blue accounting disclosure development while considering practical implementation requirements.

Theoretical analysis followed established protocols for conceptual research, including: (1) identification of core theoretical propositions, (2) assessment of theoretical relevance for blue accounting contexts, (3) evaluation of theoretical compatibility and integration opportunities, and (4) development of a synthesised theoretical framework supporting practical application. This process enabled rigorous theoretical foundation development while maintaining practical relevance.

3.4 Conceptual Modeling Process

Conceptual modeling employed established frameworks from accounting theory and sustainability reporting literature to develop practical guidance for blue accounting implementation in an integrated reporting framework. The modeling process integrated insights from literature review and theoretical analysis to create coherent frameworks addressing both theoretical rigor and practical applicability. The conceptual modeling process included: (1) identification of key conceptual elements from literature and theoretical analysis, (2) development of logical relationships between conceptual elements, (3) integration with existing reporting frameworks and standards, and (4) validation through comparison with established sustainability reporting practices. This approach enabled the development of theoretically grounded yet practically applicable guidance. Figure 1 shows a diagrammatic representation of conceptual modeling process

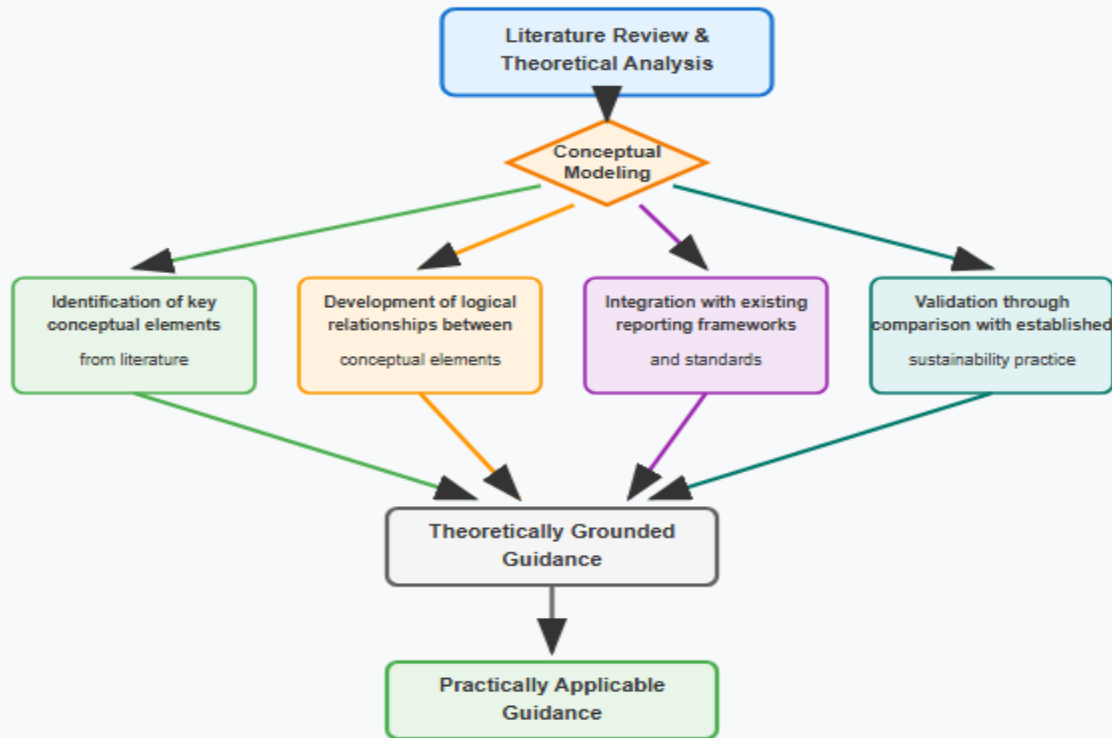


Figure 1: Conceptual Modeling Process
Source: Authors Conceptualisation (2025)

4. Conceptual Framework Development

4.1 Integrated Blue Accounting Disclosure Model

Building upon the theoretical foundations and literature analysis, we propose an Integrated Blue Accounting Disclosure Model that synthesises financial materiality requirements with impact materiality considerations. This model addresses the fundamental challenge of blue accounting implementation: how to systematically capture and report the complex relationships between corporate activities and marine ecosystem health within existing corporate reporting structures. The proposed model consists of four interconnected components: (1) Materiality Assessment and Scoping, (2) Impact Identification and Measurement, (3) Risk and Opportunity Analysis, and (4) Disclosure and Reporting Integration. Each component builds upon established sustainability reporting practices while incorporating ocean-specific considerations and requirements. Figure 2 shows a diagrammatic representation of the Integrated Blue Accounting Disclosure Model

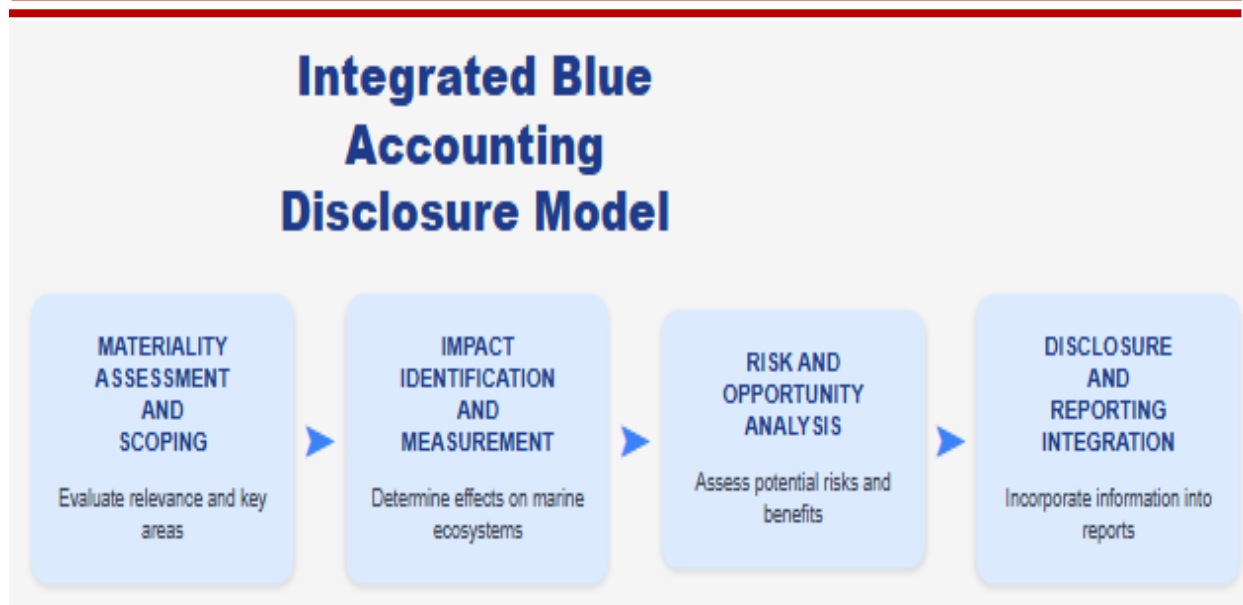


Figure 1: Integrated Blue Accounting Model

Source: Authors Conceptualisation (2025)

4.1.1 Materiality Assessment and Scoping

The materiality assessment component establishes systematic processes for identifying and prioritising ocean-related sustainability topics based on both financial and impact materiality criteria. This assessment begins with comprehensive stakeholder engagement to understand expectations and concerns regarding corporate marine stewardship performance. Stakeholder groups include investors, regulators, local communities, environmental organizations, customers, and industry associations.

Financial materiality assessment evaluates how ocean-related sustainability issues may affect enterprise value through multiple pathways: regulatory compliance requirements, supply chain dependencies on marine resources, operational risks from marine environmental changes, reputational risks from poor marine stewardship, and market opportunities from sustainable blue economy development. This assessment requires a systematic analysis of business model dependencies on marine ecosystems and potential financial impacts from marine degradation.

Impact materiality assessment examines corporate effects on marine and ocean ecosystems and dependent communities, regardless of financial return implications. This assessment encompasses direct operational impacts (pollution discharge, habitat disturbance, resource extraction), indirect supply chain impacts (supplier marine practices, transport-related marine impacts), and cumulative impacts (contribution to broader marine degradation patterns). Impact assessment requires collaboration with marine and ocean science experts to ensure technical accuracy and comprehensiveness.

4.1.2 Impact Identification and Measurement

The impact identification and measurement component establishes systematic approaches for quantifying corporate marine ecosystem impacts using established scientific methodologies and indicators. This component recognizes that effective blue accounting disclosure requires the

integration of marine and ocean science methods with accounting measurement principles to ensure both technical accuracy and reporting relevance.

Direct impact measurement includes quantifiable operational effects on marine and ocean ecosystems, such as pollution discharge volumes and composition, habitat disturbance area and intensity, resource extraction volumes and sustainability indicators, and biodiversity impact metrics. Measurement approaches should follow established environmental management standards (ISO 14001) and marine and ocean science protocols while remaining compatible with corporate reporting requirements.

Indirect impact measurement addresses supply chain and life cycle impacts on marine ecosystems through systematic assessment of supplier practices, transport-related marine impacts, and product life cycle effects. This measurement involves collaboration with supply chain partners and may require third-party verification to ensure accuracy and completeness. The methodologies should align with established life cycle assessment standards while considering marine and ocean-specific factors.

4.1.3 Risk and Opportunity Analysis

The risk and opportunity analysis component systematically evaluates nature-related financial risks and opportunities resulting from corporate dependencies on and impacts to marine ecosystems. This analysis builds on established enterprise risk management frameworks while integrating marine-specific considerations and climate-ocean interactions. Physical risk assessment examines how changes in the marine environment may influence corporate operations, supply chains, and market conditions. Key physical risks include the effects of sea level rise on coastal infrastructure, ocean acidification's impact on marine resource availability, temperature shifts affecting marine ecosystem productivity, and extreme weather events that disrupt marine activities. Conducting a physical risk analysis involves combining climate science projections with business impact assessments.

Transition risk analysis assesses potential impacts from regulatory, market, and technological shifts related to marine sustainability. Transition risks include stricter marine protection regulations, carbon pricing's influence on marine transport, shifts in consumer preferences toward sustainable marine products, and technological disruptions within traditional marine industries. Evaluating transition risks requires monitoring policy developments, market trends, and technological innovations.

Opportunity analysis identifies potential benefits from proactive marine sustainability efforts, such as securing access to sustainable finance, gaining competitive advantages through leadership in marine stewardship, opening new markets via blue economy development, and achieving operational efficiencies through sustainable marine practices. Opportunity assessment involves strategically analyzing market trends and stakeholder expectations.

4.1.4 Disclosure and Reporting Integration

The disclosure and reporting integration component establishes systematic approaches for incorporating blue accounting disclosures into corporate reporting structures while maintaining compatibility with existing reporting frameworks and standards. This component addresses the

practical challenge of implementing blue accounting within established corporate reporting processes and systems.

Financial statement integration addresses how marine-related sustainability information can be incorporated into traditional financial reporting structures. Key considerations include provision recognition for marine restoration obligations, asset impairment assessment incorporating marine risk factors, contingent liability disclosure for potential marine damages, and revenue recognition for marine ecosystem services. Integration approaches must comply with established accounting standards while enhancing transparency regarding marine-related financial implications.

Sustainability report integration establishes systematic approaches for presenting blue accounting information within sustainability reporting frameworks. Integration approaches should align with established standards (GRI, SASB, TNFD) while providing ocean-specific disclosure guidance (Eccles & Krzus, 2010). Key elements include governance arrangements for marine stewardship, strategic approaches to marine sustainability management, risk management processes for marine-related risks, and performance metrics and targets for marine impact reduction.

4.2 Double Materiality Implementation Framework

The double materiality implementation framework provides detailed guidance for applying the double materiality principle within blue accounting disclosures. This double materiality implementation framework recognises that effective blue accounting disclosure requires systematic consideration of both financial materiality (inside-out perspective: how marine and ocean issues affect enterprise value) and impact materiality (outside-in perspective: how corporate activities affect marine and ocean ecosystems).

4.2.1 Financial Materiality Assessment Process

Financial materiality assessment for blue accounting follows established frameworks for sustainability-related financial disclosure while incorporating marine-specific considerations. The assessment process begins with a comprehensive business model analysis to identify marine ecosystem dependencies and vulnerabilities. This analysis examines operational dependencies (marine resource inputs, coastal location requirements), supply chain dependencies (marine transport, marine resource suppliers), and market dependencies (marine tourism, marine product markets).

Risk identification encompasses multiple categories of nature-related financial risks: physical risks from marine environmental changes, transition risks from marine policy and market changes, liability risks from marine environmental damages, and reputational risks from poor marine stewardship. Risk assessment requires quantitative analysis where possible, supported by scenario analysis and sensitivity testing to understand potential financial impacts under different marine environmental and policy scenarios.

Opportunity identification examines potential financial benefits from proactive marine sustainability management, including cost savings from efficient marine resource use, revenue opportunities from sustainable marine products and services, competitive advantages from marine stewardship leadership, and access to sustainable finance for marine sustainability investments.

Opportunity assessment should consider both short-term and long-term financial implications while maintaining conservative estimation approaches.

4.2.2 Impact Materiality Assessment Process

Impact materiality assessment for blue accounting requires a systematic evaluation of corporate effects on marine ecosystems and dependent communities using established impact assessment methodologies. The process begins with comprehensive impact scoping to identify potential marine ecosystem effects across the corporate value chain, from raw material extraction through product disposal.

Direct impact assessment examines immediate corporate effects on marine ecosystems through operational activities. Key impact categories include marine pollution (chemical discharge, plastic waste, noise pollution), habitat disturbance (coastal development, dredging, infrastructure construction), resource extraction (overfishing, mineral extraction, water use), and biodiversity impacts (species endangerment, ecosystem disruption). Impact assessment should employ established marine science methodologies while maintaining compatibility with corporate reporting requirements.

Indirect impact assessment addresses corporate contributions to marine ecosystem degradation through supply chain activities, transportation requirements, and product life cycle effects. This assessment requires collaboration with supply chain partners and may involve third-party verification to ensure completeness and accuracy. Methodologies should align with established life cycle assessment standards while addressing marine-specific considerations and cumulative impact effects

4.3 Framework Integration with Existing Standards

4.3.1 IFRS S1 Integration Approach

Integration with IFRS S1 General Requirements for Disclosure of Sustainability-Related Financial Information requires systematically adapting blue accounting concepts to align with established financial reporting standards. IFRS S1 emphasizes sustainability-related financial information that could reasonably influence primary users' decisions, highlighting financial materiality considerations.

Blue accounting integration with IFRS S1 should focus on four core elements: governance (oversight arrangements for marine sustainability management), strategy (approaches to marine-related risks and opportunities), risk management (processes for identifying and managing marine risks), and metrics and targets (performance indicators for marine sustainability). Each element needs marine-specific adaptation while remaining compatible with overall IFRS S1 requirements.

Governance disclosures should cover board-level oversight of marine sustainability issues, management responsibility for marine stewardship, integration of marine considerations into strategic planning, and stakeholder engagement strategies for marine sustainability. Strategy disclosures should analyze business model dependencies on marine ecosystems, approaches to marine-related risks and opportunities, and scenario analysis concerning marine and ocean environmental and policy changes.

4.3.2 Global Reporting Initiative Integration Approach

Integrating with Global Reporting Initiative standards requires systematically adapting GRI frameworks to meet ocean-specific sustainability reporting needs. GRI's focus on impact materiality aligns well with blue accounting impact assessments, although ocean-specific guidance is still limited within current GRI standards.

Blue accounting integration with GRI should utilize existing environmental standards, particularly GRI 304 (Biodiversity), while creating ocean-specific adaptations that address marine ecosystem traits and corporate impact pathways. Important adaptations include marine biodiversity indicators, ocean pollution metrics, marine resource use efficiency measures, and indicators for marine habitat protection.

Approaches to integration should remain compatible with GRI's materiality assessment processes and incorporate marine-specific stakeholder engagement and impact evaluation requirements. This entails ongoing consultation with marine science experts, coastal communities, marine industry groups, and environmental organizations with marine expertise.

4.3.3 Task Force on Nature-Related Financial Disclosures Integration

Integration with TNFD frameworks requires systematically aligning blue accounting approaches with emerging nature-related financial disclosure requirements. TNFD's focus on both financial and impact materiality aligns well with the double materiality approach promoted for blue accounting disclosure, creating opportunities for seamless framework integration.

Blue accounting integration with TNFD should address the four core TNFD elements (governance, strategy, risk management, metrics, and targets) while including marine-specific considerations and methodologies. This integration should utilize TNFD's LEAP approach (Locate, Evaluate, Assess, Prepare) for assessing nature-related risks and opportunities, while adapting methodologies for marine ecosystem applications.

Integration strategies should ensure consistency with broader nature-related disclosure frameworks while offering ocean-specific implementation guidance. This includes developing marine-specific indicators, metrics, and targets that align with TNFD requirements and address the unique features of marine ecosystems and blue economy operations.

5. Discussion and Implications

5.1 Contribution to Knowledge

This study provides several important preliminary contributions to the sustainability accounting literature and corporate reporting theory. First, it broadens existing theoretical frameworks to account for the distinctive features of marine ecosystems and blue economy activities, filling a notable gap in environmental accounting research. The combination of stakeholder theory, legitimacy theory, and institutional theory offers a strong foundation for understanding the motivations and mechanisms behind blue accounting adoption.

Second, the study enhances the application of double materiality theory by illustrating how financial and impact materiality can be systematically integrated into ocean sustainability reporting. This contribution addresses ongoing debates about materiality assessment in

sustainability reporting and offers practical guidance for implementation. The proposed framework provides a clear method for meeting both investor information needs and broader stakeholder accountability.

Third, this research adds to the emerging field of nature-related financial disclosure by creating ocean-specific frameworks that complement existing climate-related disclosure approaches. It recognizes that nature-related risks go beyond climate issues to include biodiversity, ecosystem services, and natural resource dependencies, which require specialized assessment and reporting methods.

5.2 Practical Implications for Corporate Reporting

The proposed blue accounting disclosure model offers several preliminary practical benefits for corporate reporting professionals and blue economy firms. First, it provides systematic guidance for implementing ocean sustainability reporting within existing corporate reporting structures, reducing implementation barriers and costs. The framework's compatibility with established reporting standards (IFRS S1, GRI, TNFD) enables integration into existing reporting processes while enhancing marine sustainability transparency.

Second, the framework offers competitive advantages for early adopters through increased stakeholder trust, better access to sustainable finance, and lowered regulatory compliance risks. Firms adopting comprehensive blue accounting disclosure can differentiate themselves from competitors while demonstrating leadership in emerging sustainability reporting demands. This positioning may become especially valuable as regulatory requirements and stakeholder expectations grow.

Third, the framework supports improved risk management by systematically identifying and assessing nature-related financial risks. Blue economy firms face substantial risks from marine environmental decline, regulatory shifts, and stakeholder pressure that may not be fully addressed by traditional risk management tools. The proposed method allows for proactive risk detection and handling, aiding strategic decision-making.

5.3 Policy and Regulatory Implications

The research findings have important implications for policy development and regulatory framework evolution. First, the study demonstrates the feasibility of integrating ocean sustainability reporting within existing corporate reporting structures, supporting arguments for enhanced regulatory requirements for marine-dependent industries. The blue accounting disclosure model provides a preliminary foundation for regulatory bodies considering mandatory nature-related disclosure requirements.

Second, the double materiality approach advocated in this study aligns with emerging regulatory trends in Europe and other jurisdictions that require consideration of both financial and impact materiality in sustainability reporting. This alignment suggests that the proposed framework may prove relevant for firms operating in multiple jurisdictions with varying sustainability reporting requirements.

Third, the study's emphasis on stakeholder engagement and accountability supports broader policy objectives regarding corporate responsibility and sustainable development. The blue accounting disclosure model focus on marine ecosystem protection and community impact assessment aligns with international commitments under the UN Sustainable Development Goals, the Convention on Biological Diversity, and other international agreements.

5.4 Industry and Sector Applications

The proposed blue accounting disclosure model has initial applications across various sectors of the blue economy, though implementation methods may need sector-specific modifications. Maritime transport companies can use the framework to evaluate and report fuel consumption impacts, ballast water effects, and port infrastructure impacts on marine ecosystems. The framework supports improved reporting on emission reduction efforts, adoption of sustainable fuels, and navigation practices in marine protected areas.

Fisheries and aquaculture operations can utilize the framework to demonstrate sustainable fishing practices, manage ecosystem impacts, and engage communities. Key uses include stock assessment reporting, bycatch reduction strategies, habitat protection measures, and sustainable feed sourcing. The framework also facilitates certification scheme integration and transparency in supply chains.

Offshore energy companies can adopt the blue accounting disclosure model to evaluate and report operational impacts on marine ecosystems while showing a commitment to marine environmental protection. Applications include seabed disturbance assessment, marine mammal protection measures, decommissioning planning, and cumulative impact assessments. The framework supports integration with environmental impact assessments and compliance with regulations.

Coastal tourism operators can use the framework to demonstrate marine environmental stewardship while promoting sustainable tourism. Key applications include supporting marine protected areas, waste management, coral reef protection, and community benefit programs. The framework also aids in certification processes and stakeholder engagement enhancement.

5.5 Challenges and Implementation Barriers

Despite its potential benefits, implementing blue accounting faces several significant challenges that require careful consideration and strategic approaches. First, the relative newness of ocean sustainability metrics creates measurement and comparability difficulties. Unlike climate-related metrics that have benefited from decades of development, marine ecosystem indicators remain less standardized and may vary significantly across geographic regions and ecosystem types.

Second, the complexity of marine ecosystem interactions creates challenges for impact attribution and measurement. Marine ecosystems are influenced by multiple factors, including climate change, pollution, fishing pressure, and coastal development, making it difficult to isolate corporate-specific impacts. This complexity calls for sophisticated assessment methods and may require collaboration with marine science experts.

Third, the global nature of marine ecosystems introduces jurisdictional and regulatory complexities for multinational companies. Ocean sustainability reporting may need to address varying national and regional requirements while maintaining consistency with international

frameworks. This complexity necessitates careful coordination with legal and regulatory compliance teams.

Fourth, the cost and complexity of establishing a comprehensive blue accounting disclosure model may pose barriers for smaller companies or those with limited sustainability reporting experience. Implementation involves investment in data systems, staff training, stakeholder engagement processes, and possibly third-party verification services. These costs can be especially challenging for small and medium enterprises within the blue economy sectors.

5.6 Research Limitations and Considerations

Several limitations affect this research's scope and generalizability. First, the relative newness of blue accounting concepts limits available empirical evidence, necessitating reliance on conceptual development and theoretical analysis. Second, the rapidly evolving nature of sustainability reporting standards creates uncertainty regarding future regulatory requirements and implementation guidance.

Third, our focus on corporate-level blue accounting may not fully address sector-specific implementation challenges across diverse blue economy industries. Fourth, the emphasis on developed market reporting frameworks may limit applicability in emerging market contexts with different regulatory environments and stakeholder expectations. These limitations suggest important directions for future empirical research and practical validation.

5.7 Future Research Studies

This study highlights several important directions for future research to advance blue accounting theory and practice. First, empirical research examining blue accounting implementation experiences would offer valuable insights into practical challenges and success factors. Case studies with early-adopting firms could identify best practices and strategies while documenting lessons learned.

Second, quantitative research exploring the relationship between blue accounting disclosure and corporate performance outcomes would help develop the business case and support investor decision-making. Possible research questions include links between marine sustainability reporting and access to capital, market valuation, operational performance, and stakeholder trust measures.

Third, comparative research analyzing blue accounting approaches across different national and regional contexts would deepen understanding of regulatory and cultural influences on implementation. Such research could explore how other legal systems, stakeholder expectations, and characteristics of marine ecosystems impact the development and adoption of blue accounting.

Fourth, interdisciplinary research combining marine science perspectives with accounting and finance approaches would strengthen the technical foundations of blue accounting frameworks. Collaboration between accounting researchers and marine scientists could improve measurement methods, indicator development, and impact assessment approaches.

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