



Green Accounting Maturity Assessment Based on the Capability Maturity Model Integration (CMMI)

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ABSTRACT

Green accounting has become increasingly critical as organizations face mounting pressure to address environmental sustainability. However, assessing the maturity of green accounting practices remains challenging due to the lack of structured frameworks. This study proposes a green accounting maturity model based on the Capability Maturity Model Integration (CMMI), adapting its five-level maturity framework to evaluate organizational capabilities in environmental accounting. The model integrates three key dimensions: measurement and recognition, reporting and disclosure, and integration and governance. By providing a systematic assessment tool, this framework enables organizations to benchmark their current state, identify improvement areas, and develop actionable roadmaps toward advanced green accounting practices. This theoretical contribution bridges the gap between process maturity models and environmental accounting literature, offering both academic insights and practical utility for organizations, regulators, and stakeholders in advancing sustainable finance and corporate environmental accountability.

Keywords: *green accounting, maturity model, CMMI, environmental accounting, sustainability reporting*

Introduction

Global pressure on corporate environmental accountability has intensified alongside growing awareness of the climate crisis and environmental degradation (Gray & Bebbington, 2001). Green accounting, also referred to as environmental accounting, has emerged in response to the need to integrate environmental considerations into organizational accounting systems (Schaltegger & Burritt, 2000). However, green accounting practices across organizations exhibit considerable variation in their levels of maturity, ranging from ad hoc approaches to comprehensive strategic integration (Burritt et al., 2002). Although various sustainability reporting frameworks, such as the Global Reporting Initiative (GRI), are available, these frameworks primarily focus on what should be reported (i.e., disclosure requirements) rather than how maturely such practices are managed and institutionalized (Brown et al., 2009). In



contrast, process maturity models such as the Capability Maturity Model Integration (CMMI) have demonstrated effectiveness in assessing the evolution of organizational capabilities across various domains (Paulk et al., 1993; CMMI Institute, 2010). Nevertheless, CMMI has yet to be systematically adapted to the context of green accounting.

This study aims to address this gap by developing a Green Accounting Maturity Model based on the Capability Maturity Model Integration (CMMI). The primary contributions of this study are threefold: (1) adapting the CMMI maturity progression philosophy to the context of green accounting; (2) operationalizing measurable maturity dimensions and indicators; and (3) providing a framework that can be utilized for organizational self-assessment and industry benchmarking.

Green accounting, also commonly referred to as environmental accounting, encompasses the identification, measurement, and allocation of environmental costs, as well as the integration of such information into business decision-making processes (Schaltegger & Burritt, 2000). Burritt et al. (2002) classify environmental management accounting (EMA) into two main categories: physical accounting, which involves the measurement of material and energy flows, and monetary accounting, which involves the quantification of environmental costs and benefits in monetary terms.

Gray and Bebbington (2001) emphasize that green accounting extends beyond mere regulatory compliance and serves as a strategic tool for enhancing environmental performance and organizational legitimacy. However, the implementation of green accounting faces various challenges, including measurement complexity, a lack of standardization, and organizational resistance to change (Burritt & Schaltegger, 2010).

Maturity models have long been used to assess the evolution of organizational capabilities. The concept of maturity models was initially popularized through the Capability Maturity Model (CMM) developed by the Software Engineering Institute to assess software development processes (Paulk et al., 1993). This model was subsequently developed into the more comprehensive Capability Maturity Model Integration (CMMI), which can be applied across various domains (CMMI Institute, 2010). CMMI defines five maturity levels: (1) Initial, characterized by ad hoc and unpredictable processes; (2) Managed, in which processes are planned and monitored; (3) Defined, in which processes are documented and standardized; (4) Quantitatively Managed, in which processes are measured and quantitatively controlled; and (5) Optimizing, which emphasizes continuous improvement and innovation (CMMI Institute,



2010).

The philosophy of maturity progression has been adapted to various domains beyond software, including corporate social responsibility (Maon et al., 2010), sustainability management (Baumgartner & Ebner, 2010), and supply chain management (Lockamy & McCormack, 2004). Becker et al. (2009) provide guidelines for designing maturity models that emphasize the importance of a theoretical foundation, clear progression logic, and measurable indicators. Green accounting practices cannot be separated from the broader context of governance and strategic integration. Eccles et al. (2014) demonstrate that companies with high sustainability performance tend to have strong governance structures, including board-level oversight and executive accountability. From the perspective of stakeholder theory, Freeman (1984) emphasizes that organizations need to consider the interests of multiple stakeholders, including those related to environmental accountability.

In the financial sector, particularly banking, the concepts of financed emissions and portfolio carbon footprinting have become increasingly important (Weber, 2014). The Partnership for Carbon Accounting Financials (PCAF) has developed a standardized methodology for measuring emissions associated with financing activities (PCAF, 2020), making this an increasingly critical aspect of green accounting practices within financial institutions.

Although the literatures on green accounting and maturity models have developed substantially as distinct fields, a significant research gap remains in several areas: (1) the absence of a maturity assessment framework specifically designed for green accounting; (2) the limited operationalization of the concept of maturity within the context of environmental accounting practices; and (3) the lack of systematic, objective, and replicable assessment instruments. This study seeks to address these gaps by developing a CMMI-based Green Accounting Maturity Model.

Research Method

This framework employs systematic content analysis as its primary methodological approach (Neuendorf, 2017). This approach is particularly appropriate for assessing the maturity of green accounting practices because it enables the researcher to systematically examine observable evidence of organizational practices, policies, disclosures, and governance mechanisms against predefined maturity criteria. Rather than relying solely on organizational self-assessment, systematic content analysis allows maturity to be evaluated based on documented and publicly available evidence, thereby reducing the potential for subjective bias and improving the



consistency of the assessment process.

The methodology offers several important advantages. First, objectivity is enhanced because the assessment is based on explicit coding criteria and observable evidence rather than depending exclusively on respondents' perceptions or self-reported assessments. This is particularly relevant in the context of green accounting, where organizations may have different interpretations of their environmental accounting capabilities and may overstate the extent to which such practices have been institutionalized. Second, the approach provides scalability, allowing the framework to be applied across a relatively large number of organizations and sectors using a consistent set of assessment criteria. This enables meaningful comparison of green accounting maturity across organizations with different characteristics and institutional contexts.

Third, systematic content analysis offers longitudinal capability, as the same indicators and coding procedures can be applied to organizational disclosures and documented practices across different periods. Consequently, the framework can be used not only to determine the current maturity level but also to identify patterns of maturity progression and organizational improvement over time. Fourth, the approach enhances replicability, since the assessment criteria, coding procedures, and evidence requirements can be explicitly documented and subsequently applied by other researchers. Replicability is particularly important for establishing the reliability and methodological rigor of a maturity model.

Furthermore, the use of systematic content analysis supports the development of a structured and evidence-based maturity assessment. Each maturity level can be associated with specific observable indicators, enabling the researcher to distinguish systematically between organizations that merely disclose environmental information and those that have embedded green accounting practices into governance, strategic decision-making, performance measurement, and continuous improvement processes. In this way, the proposed framework moves beyond assessing the presence or absence of green accounting practices and instead evaluates the degree of institutionalization, integration, measurement, and continuous improvement of such practices. This approach is consistent with the fundamental philosophy of maturity models, in which organizational capabilities are assessed progressively from initial and fragmented practices toward standardized, quantitatively managed, and continuously improving processes.

Results and Discussion



Adaptation of CMMI to Green Accounting

The framework developed in this study adapts the five maturity levels of the Capability Maturity Model Integration (CMMI) to the specific context of green accounting practices. The adaptation is intended to capture the progressive development of organizational capabilities, from fragmented and reactive environmental accounting practices to a strategic, quantitatively managed, and continuously improving system.

At the Initial level, green accounting practices remain ad hoc, reactive, and largely unsystematic. Organizations at this stage generally lack formal policies, standardized procedures, and clearly defined responsibilities related to environmental accounting. Environmental activities tend to be driven primarily by minimum regulatory compliance or philanthropic and charity-based corporate social responsibility initiatives. Environmental information is not yet systematically incorporated into accounting processes or strategic decision-making.

The Managed level represents an emerging stage of organizational awareness and management. Organizations begin to plan and monitor basic green accounting activities, although implementation remains relatively limited and inconsistent across organizational functions. Environmental policies may have started to be formulated, while selected environmental metrics are monitored periodically. At this stage, green accounting is increasingly recognized as relevant to organizational operations, but its implementation has not yet been fully institutionalized.

At the Defined level, green accounting practices become formally documented and standardized across the organization. Sustainability strategies are clearly articulated and supported by measurable environmental objectives, established governance structures, and systematic reporting practices. Organizations at this level increasingly adopt recognized reporting frameworks, such as the Global Reporting Initiative (GRI), and environmental accounting activities become embedded within formal organizational procedures. The transition to this level indicates that green accounting is no longer dependent on individual initiatives but has become an established organizational process.

The Quantitatively Managed level reflects a more advanced stage in which green accounting practices are supported by comprehensive metrics, rigorous performance monitoring, and stronger integration with conventional financial accounting. Environmental information is systematically measured, analyzed, and used to support managerial decision-making.



Organizations at this stage also demonstrate stronger accountability mechanisms and increasingly rely on data-driven approaches to evaluate environmental performance and financial implications. The integration of environmental and financial information enables organizations to assess environmental performance not merely as a reporting requirement but as an important component of organizational performance management.

The highest level, Optimizing, represents a stage characterized by continuous improvement, innovation, and organizational leadership in green accounting. Organizations at this level continuously refine their environmental accounting practices in response to emerging environmental risks, technological developments, stakeholder expectations, and evolving regulatory requirements. Green accounting becomes an integral component of organizational innovation and strategic transformation. Organizations may also demonstrate leadership within their respective industries through the adoption of advanced accounting practices and contributions to the development of environmental accounting standards and practices.

Green Accounting Maturity Dimensions

Based on the literature review and the adaptation of the CMMI maturity progression, the proposed framework identifies three core dimensions of green accounting maturity: Measurement and Recognition, Reporting and Disclosure, and Integration and Governance. These dimensions represent complementary aspects of organizational capability and collectively provide a comprehensive basis for evaluating the maturity of green accounting practices.

The first dimension, Measurement and Recognition, assesses the organization's ability to identify, measure, and recognize environmental costs, benefits, impacts, and related information within its accounting processes (Schaltegger & Burritt, 2000). This dimension reflects the extent to which environmental considerations have been transformed into measurable accounting information that can support organizational decision-making. It encompasses environmental cost identification, carbon accounting and footprinting, as well as the measurement of green portfolios and environmental assets, particularly in the financial sector. Higher maturity within this dimension is reflected in increasingly comprehensive, systematic, and reliable measurement practices.

The second dimension, Reporting and Disclosure, focuses on the quality, consistency, transparency, and comprehensiveness of organizational environmental and sustainability reporting. Drawing on the perspective of legitimacy theory (Suchman, 1995), this dimension



considers the extent to which organizations communicate their environmental performance and associated risks to external stakeholders. It includes the quality of sustainability reporting, climate-related risk disclosure, and broader stakeholder communication. Mature organizations are expected not only to disclose environmental information but also to provide relevant, consistent, and decision-useful information that enables stakeholders to understand the organization's environmental performance and its implications.

The third dimension, Integration and Governance, assesses the extent to which green accounting has been incorporated into organizational strategy, governance structures, and performance management systems (Eccles et al., 2014). This dimension encompasses strategic integration, governance arrangements, and performance management and incentive mechanisms. At higher maturity levels, environmental accounting is expected to be embedded within strategic planning and organizational governance rather than being treated as a separate sustainability function. Environmental performance is increasingly connected to managerial accountability, organizational objectives, and incentive structures, thereby strengthening the strategic role of green accounting.

Observable Indicators

To operationalize the proposed maturity framework, observable indicators are developed for each combination of maturity level and green accounting dimension. These indicators are designed to identify tangible evidence of organizational practices through systematic content analysis of publicly available corporate documents, including annual reports, sustainability reports, and corporate websites. The use of observable indicators enables the assessment to move beyond general statements of environmental commitment and instead focus on evidence demonstrating the actual development and institutionalization of green accounting practices.

For the Measurement and Recognition dimension, particularly in the area of carbon accounting, the indicators reflect a progressive development of organizational capabilities. At the earlier stages, organizations may demonstrate basic recognition of greenhouse gas emissions and limited environmental measurement practices. As maturity develops, organizations increasingly adopt systematic approaches to emissions inventories, establish clearly defined reduction objectives, and improve the consistency and reliability of environmental data. At more advanced stages, carbon accounting becomes increasingly comprehensive and may incorporate broader categories of emissions, including financed emissions in financial institutions, supported by recognized methodologies such as those developed by the Partnership



for Carbon Accounting Financials (PCAF). At the highest level of maturity, organizations demonstrate an orientation toward continuous enhancement through advanced carbon monitoring, climate scenario analysis, and the development of credible net-zero transition strategies.

Overall, the observable indicators provide a structured mechanism for distinguishing between different stages of green accounting capability. The progression does not merely reflect an increase in the quantity of environmental information disclosed but represents a substantive movement from fragmented environmental practices toward standardized, integrated, quantitatively managed, and continuously improving green accounting systems. This progression is consistent with the underlying logic of CMMI while allowing the maturity concept to be meaningfully contextualized within environmental accounting and sustainability management.

Conclusion

This study develops a CMMI-based Green Accounting Maturity Model to address a significant gap in the existing literature by providing a structured framework for assessing the maturity of green accounting practices. By incorporating three core dimensions—measurement, reporting, and integration—across five progressive maturity levels, the proposed framework provides a comprehensive yet parsimonious approach to evaluating the development of organizational capabilities in green accounting. Rather than focusing solely on the presence or absence of environmental accounting practices, the framework emphasizes the extent to which such practices are institutionalized, systematically managed, integrated into organizational processes, and continuously improved.

The primary theoretical contribution of this study lies in the integration of process maturity modeling with the environmental accounting literature. By adapting the maturity progression logic of CMMI to the context of green accounting, this study extends the application of maturity models beyond their conventional domains and provides a conceptual basis for understanding the progressive development of environmental accounting capabilities. The framework also offers practical utility for multiple stakeholders, including organizations, regulators, investors, and other users of corporate environmental information. Its transparent, objective, and replicable structure enables organizations to evaluate their current level of green accounting maturity while identifying areas that require further development. At the broader institutional level, the framework may also support industry benchmarking, regulatory and policy



development, and investment analysis by providing a more systematic basis for comparing organizational environmental accounting capabilities.

The implementation of the proposed framework is expected to encourage organizations to progress from fragmented and reactive environmental accounting practices toward more advanced, integrated, quantitatively managed, and continuously improving systems. Such progression can strengthen the strategic role of green accounting in organizational decision-making and contribute to the broader objectives of sustainable finance, environmental transparency, and corporate environmental accountability. Nevertheless, the proposed model remains conceptual and requires further empirical examination to establish its validity and reliability across different organizational and institutional contexts. Future research should therefore focus on empirical validation, cross-context replication, refinement of observable indicators, and investigation of the dynamics underlying maturity progression. Such research would further strengthen the theoretical foundations and practical applicability of the CMMI-based Green Accounting Maturity Model.

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