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Evaluation of Contractor Performance: Emphasizing Environmental Management Systems

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Abstract
This paper examines the Environmental Management System (EMS) performance of contractors within the construction industry through a comprehensive evaluation utilizing surveys and interviews. The study identifies strengths in Environmental Policy, Compliance, and Improvement, alongside weaknesses in Environmental Performance Monitoring and Communication. Factors influencing EMS effectiveness, including organizational commitment and stakeholder engagement, are explored, offering insights into enhancing environmental practices systematically. Practical recommendations are proposed, emphasizing the adoption of an EMS Guide to direct policy development, compliance, waste management, and employee training. Improving environmental communication practices, leveraging technology, and fostering regulatory compliance and management commitment are advocated to fortify EMS performance. Finally, this study emphasizes the strategic importance of EMS integration in achieving sustainable environmental outcomes and enhancing contractors' competitiveness and reputation in the construction sector.

KEYWORDS: Environmental Management System (EMS), contractors, performance evaluation, environmental policy, stakeholder engagement.

Introduction

An Environmental Management System (EMS) serves as a structured framework for organizations to effectively manage, evaluate, and continually improve their environmental performance[1]. Within the scope of sustainable development, environmental management has become critical, compelling institutions to adopt measures that mitigate their environmental impacts.

In support of EMS, sustainable practices are increasingly integrated into building construction materials. Researchers have explored various innovative approaches to enhance sustainability in construction. For instance, Macmac et al. [2] investigated the use of tire waste steel fibers in reinforced self-compacting concrete, highlighting the potential of recycling waste materials in construction. Adier et al. [3] demonstrated the feasibility of recycling concrete aggregates, illustrating how waste concrete can be effectively reused. Limco et al. [4] underscored the pressing need for developing green and eco-friendly alternatives, particularly emphasizing materials derived from biodegradable plant sources. Additionally, Villapa [5] introduced an innovative method for preparing soil blocks, showcasing the potential of earth-based materials in sustainable construction practices. These studies collectively contribute to advancing environmentally responsible approaches within the construction industry.Further exploration of alternative construction materials is evident in the work of Adier et al. [6], who discussed the use of bamboo as a sustainable building material. These materials not only offer environmental advantages but also provide mechanical benefits over conventional construction materials, as emphasized by Bacosa et al. [7]. The integration of these sustainable practices aligns with the objectives of EMS, promoting environmental stewardship and resource efficiency.

This heightened emphasis on environmental management stems from the imperative of sustainable development, encouraging institutions to adopt measures that curtail environmental impacts. Nonetheless, rural environmental governance often remains neglected due to a predominant focus on urban areas and a lack of awareness regarding

sustainable development, as noted by Hassanvand et al. [8]. Barbosa et al. [9] highlighted the profound environmental ramifications of waste, emphasizing that Environmental Management offers a viable avenue to mitigate environmental degradation and pollution. Concurrently, the pursuit of innovative and eco-friendly construction solutions, fostering a greener and more sustainable built environment, has gained traction.

Despite the increasing emphasis on environmental stewardship, many institutions lack specific guidelines or checklists to evaluate and enhance their environmental performance within their existing EMS frameworks. This study aims to address this gap by evaluating the performance of contractors concerning the EMS over a period of three years. Contractors are integral to institutional operations, encompassing construction, infrastructure development, and service provision. Their adherence to the EMS is pivotal in achieving environmental objectives and sustaining campus-wide sustainable practices.

Over the three-year investigation period, substantial efforts have been made to cultivate environmental consciousness and responsible practices among contractors. The primary objective of this research is to assess contractors' strengths and weaknesses in implementing the EMS. Through rigorous analysis, the study aims to identify factors influencing their performance levels. Understanding these factors will enable the institution to devise targeted strategies for enhancing contractors' environmental management practices, aligning them with broader sustainability objectives. Additionally, the study will recommend strategies for improving contractors' performance based on the insights gained.

1) Methods and Methodology:

Figure 1 shows the research paradigm, it presents the sequence of activities used in the research. The researcher employed a descriptive research method to comprehensively depict contractor performance and its various variables. Data was gathered using survey questionnaires and interviews, with questions designed to address ten categories: Environmental Management System, Environmental Policy, Waste Management, Environmental Risk Assessment, Stakeholder Engagement, Environmental Performance Monitoring, Environmental Compliance, Environmental Training, Environmental Communication, and Environmental Improvement. Respondents rated their EMS knowledge on a scale from 1 to 5, with intermediate values rounded to the nearest whole number. Data collection began with obtaining a list of contractors from the Physical Plant Office and involved engaging contractors in ongoing projects. The accumulated data was summarized, analyzed, assessed, and interpreted using descriptive statistics, organizing the raw data in tabular form to facilitate a clear and systematic exploration of central tendencies, variations, and distribution patterns

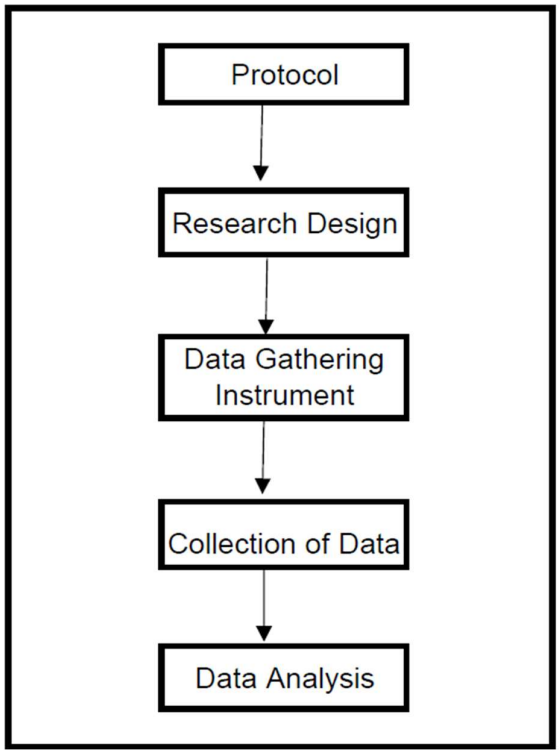

Figure 1. Research Paradigm

3) Results and Discussion:

a. Environmental Management System (EMS)

The evaluation of contractors' Environmental Management System (EMS) revealed consistent performance at a "Very Good" level across all aspects. Contractors achieved an average rating of 3.77, indicating strong understanding, implementation, documentation, review, and integration of EMS into business processes. These results underscore the contractors' effective management of environmental responsibilities within their operations, demonstrating a commitment to complying with EMS requirements and fostering sustainable practices.

b. Environmental Policy

Contractors demonstrated robust performance in their Environmental Policy, with an average rating of 3.81. They excelled in policy clarity, communication, alignment with business strategy, and adaptability to changing circumstances. These ratings highlight the contractors' proactive approach to articulating and implementing environmental policies that align with organizational objectives and regulatory frameworks.

c. Waste Management

The assessment of Waste Management practices showcased commendable performance, with an average rating of 4.20. Contractors demonstrated strong capabilities in waste segregation, hazardous waste disposal, waste minimization, compliance with regulations, and stakeholder communication. These results underscore their effective management of waste streams, ensuring environmental compliance and stakeholder engagement in waste management processes.

d. Environmental Risk Assessment

Contractors showed a high level of performance in Environmental Risk Assessment, with an average rating of 3.96. They excelled in identifying and assessing environmental risks, communicating risk management practices, and updating risk management plans. These findings highlight contractors' diligence in identifying and mitigating potential environmental risks associated with their operations, contributing to proactive risk management strategies.

e. Stakeholder Engagement

Contractors received an average rating of 3.81 in Stakeholder Engagement, indicating strong practices. They effectively updated risk management plans, communicated environmental performance, responded to stakeholder feedback, involved stakeholders in decision-making, and measured engagement effectiveness. These results underscore contractors' commitment to engaging stakeholders, fostering transparency, and integrating stakeholder input into environmental decision-making processes.

f. Environmental Performance Monitoring

Contractors achieved an average rating of 3.59 in Environmental Performance Monitoring, indicating robust practices in measuring, using, communicating, comparing performance, and updating metrics. While overall performance was strong, areas such as benchmarking against industry standards showed opportunities for enhancement. These results highlight contractors' systematic approach to monitoring environmental performance and their efforts to continuously improve performance metrics.

g. Environmental Compliance

The evaluation of Environmental Compliance reflected exemplary practices with an average rating of 4.00. Contractors demonstrated strong adherence to environmental laws and regulations, monitoring compliance, responding to violations, communicating compliance status, and updating practices. These findings underscore contractors' commitment to maintaining high standards of environmental compliance and transparency in their regulatory interactions.

h. Environmental Training

Contractors received an average rating of 3.72 in Environmental Training, indicating effective practices. They excelled in providing training, assessing program effectiveness, tailoring training to employee needs, communicating programs, and adapting to changing circumstances. These results highlight contractors' proactive approach to equipping employees with the necessary skills and knowledge to support environmental objectives.

i. Environmental Communication

Contractors achieved an average rating of 3.54 in Environmental Communication, reflecting satisfactory communication practices. They effectively communicated environmental performance, responded to stakeholder inquiries, conveyed policy and practices, used media for outreach, and adapted communication strategies. These findings emphasize the importance of clear and transparent communication in maintaining stakeholder engagement and support for environmental initiatives.

j. Environmental Improvement

Contractors demonstrated strong performance in Environmental Improvement with an average rating of 4.08. They excelled in setting targets, measuring progress, developing action plans, communicating improvements, and adapting plans. These results underscore contractors' proactive approach to continuous improvement, ensuring ongoing enhancement of environmental performance and outcomes.

4) Conclusion and Recommendations:

The implementation of Environmental Management Systems (EMS) offers organizations significant benefits, both environmentally and financially, positioning EMS as a strategic tool for achieving sustainability and gaining competitive advantages (Lai et al., [10]). This study conducted a comprehensive evaluation of contractors' EMS performance through surveys and interviews, revealing strengths in Environmental Policy, Compliance, and Improvement, alongside identified weaknesses in Environmental Performance Monitoring and Communication. These insights are pivotal for guiding targeted improvements in EMS effectiveness.

The evaluation highlighted commendable aspects of contractors' EMS performance, particularly their robust adherence to environmental policies and continuous improvement efforts. These strengths underscore proactive environmental stewardship. However, challenges in monitoring environmental performance effectively and communicating initiatives to stakeholders indicate clear opportunities for enhancement.

Crucial factors such as organizational commitment, resource allocation, and stakeholder engagement were identified as pivotal in shaping EMS effectiveness. Contractors are urged to prioritize these factors systematically to strengthen their environmental practices. The proposed EMS Checklist/Guide serves as a practical tool encompassing essential elements such as policy development, regulatory compliance, stakeholder engagement, waste management, risk assessment, performance monitoring, employee training, communication strategies, and continuous improvement initiatives.

Improving environmental communication practices emerges as a priority. This includes transparently sharing policies, promptly addressing stakeholder inquiries, and leveraging diverse communication channels, including social media. Regular updates and clear communication will build stakeholder trust and enhance the contractors' reputation as responsible environmental stewards.

Contractors play a crucial role in environmental management within the construction industry, influencing practices and performance outcomes significantly. By adopting environmentally friendly practices and technologies, they not only improve environmental performance but also gain a competitive edge. Training programs in environmental management are identified as beneficial for contractors, addressing challenges such as awareness gaps through targeted education and skill development (Grimm et al., [11]; Hsu et al., [12] ; Liu et al., [13]; Wang et al., [14]).

Furthermore, implementing the recommended strategies outlined in this study will bolster EMS performance comprehensively. These strategies encompass regulatory compliance, management commitment, robust training programs, efficient resource allocation, clear responsibilities, effective internal communication, rigorous monitoring and auditing, incentives for environmental excellence, active stakeholder engagement, and leveraging technological solutions.

In conclusion, these recommendations empower contractors to enhance EMS performance, promote environmental sustainability, meet regulatory obligations effectively, and align with organizational goals and stakeholder expectations. Additionally, drawing on Trierweiller et al. [15], which emphasizes the strategic importance of integrating environmental management within project-based sectors like construction, emphasizes the critical alignment of EMS with permanent organizational systems. By embracing the proposed EMS Checklist/Guide and implementing suggested strategies, contractors can establish a foundation for continual improvement in environmental practices, contributing positively to the environment while enhancing their industry reputation and competitiveness.

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6) Data Availability:

The data that support the findings of this study are available from the relevant public repository/ datasets link.

7) Conflict of interest:

The author declares that there is **no conflict of interest.**

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