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The Role of Environmental Management Systems (EMS) in Driving Organizational Development and Environmental Sustainability

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ABSTRACT

An Environmental Management System (EMS) is a framework that helps in assessing the risks a business has on its environment while providing organizations with mitigation strategies to minimize the risks. This study aims to analyze the importance and impact of EMS on organizations and global sustainability goals. This review study uses a descriptive and analytical approach by including 67 studies for the review that were published in the last 5 years. The findings from this review suggest that the integration of EMS along with tools and techniques like ISO 14031, Cross-Functional Team (CFT), Matrix model, and Life Cycle Inventory (LCI) can be very useful in attaining global sustainability goals and maximizing the environmental efficiency of organizations. The study concludes that the integration of EMS in industries not only helps in minimizing environmental pollution but it also helps in managing the overall growth of the organizations.

INTRODUCTION

An Environmental Management System (EMS) aids in evaluating the risks that affect the business environment, establishing performance standards, and developing solutions for averting the unwanted effects essential for compliance and for establishing the reputation of an organization (Battersby, 2022). Environmental aspects are the characteristics of an organization's process, product, or service that can produce a positive or negative impact on the environment through pollution or by supporting sustainability (Кубатко *et al.*, 2021). These aspects can be tangible, for instance, the quantity of energy used, or the volume of waste that is dumped in the natural world, or intangible such as the possibility of the environment being polluted by a particular product (Dahlmann *et al.*, 2019). The factors that have been grouped under environmental analysis are relevant since they explain how different factors influence the environment (Fiorino, 2023).

These environmental issues and aspects are relevant to the creation of EMS including the international standard of ISO 14001 (Poltronieri *et al.*, 2021). ISO 14001 on EMS has provided elements that specify certain environmental aspects and also provided a way to handle them – sustainably (Bhateria, 2024). This puts the firms in a stance of being able to meet the legal issues, manage the negative impacts of these areas on the environment, and proceed towards the objective of improving environmental performance stepwise.

Environmental evaluation also plays a tremendous part in the formation of public policies and environmental legislation (Kraft, 2021). Decision makers and governments apply the knowledge from EMS in order to introduce measures that can help to regulate emissions and or consumption or encourage sustainability (Keohane *et al.*, 2019). For example, the incorporation of Environmental Impact Statements EIA in the assessment of environmental factors which are incorporated in numerous countries before commencement of vast development projects (Gunningham & Sinclair, 2019).

In the context of EMS implementation, there is the absence of a clear definition of environmental aspects that can be considered as any factor related to an organization's activities that may affect the environment (Abdelkareem *et al.*, 2021). Such impacts may be released to air, land, or water, reserve or resource depletion, species or habitat loss, and waste generation. For instance, in manufacturing industries, factors of the environment may include the discharge of gases into the atmosphere, consumption of non–renewable sources of energy, and generation of hazardous material (Yuan *et al.*, 2020). Environmental aspects are usually divided into two; direct and indirect. The direct environmental impacts are those which the organization can control and they include; energy use, discharge from production, or waste disposal. Another classification is the indirect environmental aspects which are those to a certain extent are not under the direct control of the organization, but the organization can affect them, for instance, the impact of the suppliers on the environment and the fate of its products once they are out of the organization (Li & Wang, 2019). It is argued that both direct and indirect aspects are important in order to understand the environmental consequences.

Knowledge of EMS is basic in environmental science as it serves as the basis for the determination and measurement of the environmental impact of human activity (Bresciani *et al.*, 2023). This footprint quantifies the pressure people

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have put on the earth's carrying capacity and is therefore instrumental in determining sustainability. Through analyzing environmental aspects, it becomes possible for scientists as well as environmental managers to identify specific areas that are most strained by human activities and come up with ways and means of minimizing the impacts (Bravi *et al.*, 2020). Additionally, EMS is essential in public enlightenment and sustainable development programs. Many individuals and organizations develop their environmental knowledge and thus can make a conscious effort to reduce their impact on the environment (Bhoi *et al.*, 2022). For instance, knowledge of the environmental impacts of energy consumption in homes for example the carbon footprint of electricity usage may trigger the use of renewable energy, efficient appliances, or reduced usage through changed behavior (Jiang *et al.*, 2020). Therefore, the implementation of EMS enables not only businesses but individuals and communities to act positively towards the environment.

In the corporate context, the use of EMS is rather valuable since many companies attempt to achieve sustainability objectives and satisfy the emerging global demand for eco-friendly industries (Kristensen *et al.*, 2021). Failure to manage environmental aspects can lead to legal fines, brand deterioration, or even poor performance due to inefficiencies, and wastage of resources (Said *et al.*, 2020). On the other hand, the companies that are able to properly address and control their environmental impacts will be able to compete for clients, customers, and government approvals as well as have a favorable image that is liked by investors (Fawehinmi *et al.*, 2020). In addition, more investors give consideration to the EMS factors while choosing a place to invest in.

The continuing improvement in many organizations has resulted in boosting the problem of pollution of the environment and this is a factor that is causing harm to the environment. Most organizations are incorporating environment-friendly measures and this necessitates the need to incorporate EMS into organizations to achieve the global sustainable goals. This review further discusses the application of new tools and techniques in EMS that can assist organizations in achieving these goals. The main question that is applicable to this paper is concerned with the recognition, evaluation, and monitoring of EMS in several sectors. This means that many organizations as they embrace the idea of environmental management and implement EMS lack real key environmental impacts and experience difficulties in the assessment of impacts comprehensively (Ikram *et al.*, 2019).

Furthermore, this research was also able to determine the aspect of a business integration of operations with sustainable activities. This raises the critical question: EMS can be defined as a verified system that shall facilitate the organizations in developing, documenting, and implementing a policy, and procedures that conform to environmental management standards, and this knowledge on the importance and impact of EMS and how this can help in growing environmental sustainability. The current review was to consider and evaluate procedures for the identification and management of environmental elements that are acknowledged and regulated in industries and certain sectors with high levels of pollution such as manufacturing, energy, and waste sectors. Moreover, this work tried to assess the ways of applying CFT and ISO 14031 to control and manage crucial environmental effects properly.

LITERATURE REVIEW

Climate Change and Global Warming

Subsequent studies have established that the rate of Climate change is continuously progressing and the effects of climate change are massive (Valérie Masson-Delmotte *et al.*, 2021). The IPCC's Sixth Assessment as stated in the report of 2021, it was established that the global temperature is rising at a higher rate than ever (Masson-Delmotte *et al.*, 2021). The report suggested that it is virtually evident the world is in the process of pulling a trigger and going a notch higher than 1.5°C as a result of global warming (Lynn & Peeva, 2021). This study further affirmed extreme weather conditions such as heat waves, and wildfire is mitigated by the degree of exposure to dry spells, droughts, and floods have become more frequent and severe in the recent times than they used to be in past decades.

Another study presented a closer view of the climate models as it investigated predictions of climate change which was initiated through the models developed in the 1970s with the modern rise of temperature and they proved that the majority of these models are accurate (Hausfather & Peters, 2020). This removes any form of doubt that there is indeed a significant wind of change blowing across the organization in the management of its human resources (Wang *et al.*, 2023). Also, the 2022 WMO State of the Global Climate report revealed worsening climate change impacts on food production, water, and migration (Forster *et al.*, 2023). The report pointed out that the affected areas which include Africa and South Asia are experiencing worsened drought conditions thus resulting in food shortages and displacement (Zemp *et al.*, 2022). This research therefore highlights the need for EMS in addition to mitigation measures for managing the global climate.

Bio-Diversity Loss

The most thought-provoking and the most reportage in terms of giving an overall picture of the state of the planet today is. They estimated that about one million of the species of living organisms are now threatened with extinction. During the next thirty years, or in some cases sooner, the climate of the earth has been projected to change due to actions initiated by people of the world (Pörtner *et al.*, 2021). This study relied on data the up-to-date accounts of the loss at the global level and it was the most comprehensive current assessment. The biodiverse species is a clear sign that drastic changes in the way of operating are still apparent. EMS is required

to turn around in order to make the firm's Environmental Management System effective (Das Neves, 2020).

A theoretical framework called "Bending the Curve", describes the way to reverse the declines while satisfying human demands (Leclère *et al.*, 2023). The study therefore revealed that it is achievable to shift the tide to prevent further erosion of the livelihoods of biological diversity through harmonised management of lands. Solutions of which management, sustainable agriculture, and conservation measures are part. More importantly, it emphasized the fact that if it continues to do its work, it will soon become much more challenging and complex to achieve all the desired results (Shin *et al.*, 2022). It also helped establish the goals of the Post-2020 Global Biodiversity Framework agreed in 2022 which includes the protection of 30% of the world's terrestrial and marine areas by 2030 (Xu *et al.*, 2021).

Another important study discussed the idea of "Half-Earth" which argues that to avoid the loss of biodiversity we must protect half of terrestrial and marine environments (Dinerstein *et al.*, 2019). The study offered empirical data on the large-scale conservation needs and the importance of global Biodiversity and ecosystem services with Environment Management System (EMS), which informed the debates on global conservation goals (Immovilli & Kok, 2020).

Pollution and Human Health

Air and plastic pollution in particular has continued to be an issue of interest in environmental research with health effects (Li *et al.*, 2021). According to a global, observational study air pollution continues to be the single, most important environmental risk factor that is responsible for the deaths of about 9 million people annually and this was in the year 2019 (Fuller *et al.*, 2022). Most of these deaths happened in low and middle-income countries, a factor that reveals environmental inequality. It also pointed out that although the industrial emissions have declined in some areas and increased in others there has been a growth in emissions from household sources like cooking using solid fuels and emissions from the transport sector (Balakrishnan *et al.*, 2019).

Probably, the most significant issue that has dominated the discourse in the last few years is that of plastics. According to a study global plastic waste input to the aquatic environment could increase by threefold by 2040 if no measures are being taken towards its reduction (Hamilton *et al.*, 2023). The study also presented the "Breaking the Plastic Wave" model, which provides strategies to minimize plastics pollution through better recycling, innovative product design as well as effective policies on waste management (Oelofse *et al.*, 2024). In particular, it stated that a further drastic decline in plastic waste is possible but only with a collective international effort which can only be possible through EMS and appropriate economic and policy implications for combating this problem (Fletcher *et al.*, 2023). Micro-plastic pollution has also become a well-discussed subject because of the consequences it has on human health and the environment. In a recent study, people were identified to have microplastics in their bloodstream meaning that the body can absorb plastics (Damaj *et al.*, 2024).

Sustainable Resource Management

According to a study, food production systems are responsible for emissions of over 25% of the world's greenhouse gases (Springmann *et al.*, 2020). Changes in diet as a way of lowering emissions and achieving sustainability with such changes as decreasing the intake of meat products (Springmann *et al.*, 2021). It has been recommended to use a "planetary health diet" which takes into account the nutritive needs of people as well as the environmental needs that are involved in the provision of food, and this has informed most of the discussions on sustainable diets (Springmann & Freund, 2022).

A study has indicated that about 64 percent of the world's population suffers from water scarcity for at least one month every year (Wolkeba *et al.*, 2024). It has been urged that more efforts and measures be taken to conserve water, especially in food production where water is used in a 70% proportion (Rathore *et al.*, 2024). This highlights the importance of integrating policies and EMS that support the use of water-efficient technologies and crop types that do not need much water (Musie & Gonfa, 2023).

Studies have highlighted that there has been a rapid growth in renewable energy sources like solar and wind energy but they are still a challenge to address the global energy needs (Ang *et al.*, 2022). The work emphasized the need to deploy EMS for renewable energy alongside efficiency and storage along with other technologies towards de-carbonization by the middle of the current century (Gielen *et al.*, 2019).

MATERIALS AND METHODS

Search Strategy

This study includes review on existing literatures on the tools and techniques used in EMS for minimizing environmental pollution and managing environmental sustainability. The objectives of this approach were achieved by collecting, analyzing, and interpreting secondary data that was included in the study to have a thorough review of the applications of EMS on organizations and global sustainability. Table 1 shows the search strategy used in this review.

Inclusion and Exclusion Criteria

Table 1: Search strategy

Years	Search Engines	Keywords
2019- 2024	✓ Google Scholar ✓ PubMed	✓ Environmental Management System (EMS) ✓ Global sustainability

	✓ Web of Science ✓ ScienceDirect ✓ Scopus	✓ Cross-Functional Team (CFT) ✓ ISO 14031 ✓ Matrix model ✓ Life Cycle Inventory (LCI) ✓ Significant Environmental Aspect (SEA) ✓ Bio-diversity ✓ Environmental pollution ✓ Sustainable resource management ✓ Environmental aspects ✓ Resource efficiency

Inclusion and exclusion criteria were implemented in the data collection process of this study. The study's inclusion of sources were the studies that were published during the past five years and highlighted the importance and impact of EMS. The data collection also included studies that were published in English and were easily accessible for data collection. The selected studies include scholarly articles, research papers, review articles, reputable industry publications, and peer-reviewed journals. The studies that were not published in English and were older than five years were excluded from this study. Moreover, the study also excluded studies, articles, and papers that were not accessible.

Data Extraction

The search strategy used for this review was to obtain, identify, and analyze secondary data that highlighted the impact and importance of the Environmental Management System (EMS) in organizations and global sustainability. The first step in obtaining data was to identify a 'keyword' list that was most associated with the main idea of our area of study. The keywords were "Environmental Management System (EMS)", "Global sustainability", "Cross-Functional Team (CFT)", "ISO 14031", "Risk management", "Biodiversity", "Environmental pollution", "Environmental aspects", "Sustainable resource management", "Significant Environmental Aspect (SEA)","Life Cycle Inventory (LCI)", "matrix model", and "Resource efficiency". These keywords were used jointly and separately to increase the comprehensiveness of the literature search. Google Scholar, IEEE Xplore, and academic libraries were used to conduct systematic searches of the given keywords.

RESULTS AND DISCUSSION

Results

A total of 113 studies were identified for the study through the literature search, from these 113 studies 13 studies were inaccessible as they required verified access and subscription, 18 studies only showed abstracts which were not enough for conducting a thorough review, and 15 studies were excluded because they were not in English language. So, a total number of 67 studies were included in the review as these studies aligned with the aim of the research, which analyzes the importance and impact of EMS. Each study's authenticity was verified by conducting a thorough review of its abstract, title, and keywords. The 65 studies that were finalized for literature review included 39 research papers and 26 review articles which aligned with the title and aim of this research highlighting the impact and importance of Environmental Management System (EMS).

Discussion

Importance of EMS

Compliance with Environmental Regulations

An Environmental Management System (EMS) is an important part of the framework used to accomplish the environmental objectives of an organization and mitigate regulatory risk (Bravi *et al.*, 2020). Today's business organizations are fraught with the escalating number of environmental legislations such as pollution, waste, energy, water, and hazardous substances. Failure to observe these regulations attracts severe fines and legal ramifications, productivity loss, and deterioration of an organization's image (Ikram *et al.*, 2019). An EMS thus enables organizations to factor compliance in the middle of their operations to monitor and implement legal guidelines (Waxin *et al.*, 2019). This is made possible through establishing standard procedures for tracking the changes in regulation, compliance, and documentation of performance on environmental issues. Further, EMS demands periodic reviews and updates of the operations in compliance with new or altered regulations (Ojo *et al.*, 2021).

EMS's most significant benefit in regulatory compliance is the determination of environmental aspects and impacts during the planning process (Ociepa-Kubicka *et al.*, 2021). It assists organizations in learning about their legal requirements in the local context, the country, and the international level and responds to compliance issues (Oladinrin & Ojo, 2022). For instance, emissions, waste disposal, or water usage can all be controlled to meet the set legal standards to help organizations avoid regulatory violations in this area and therefore reduce their vulnerability to future regulatory probes (Mahzun *et al.*, 2020).

In addition, EMS provides for carrying out internal audits and inspections regularly to check whether the practices of the organization meet the legal demands (Bhateria, 2024). In case of any irregularities such auditors detect during these audits, adjustments are made to correct the situation, thus eradicating long-term liabilities (Mustonen, 2023). With the ever-changing environmental laws, EMS

offers organizations a systematic way of ensuring legal compliance to avoid legal risks, fines, and other legal repercussions that may hinder their operations (Whitford & Provost, 2019).

Resource Efficiency and Cost Reduction

There is so much emphasis put on the topic of sustainability in the present-day business world, and this has led to pressure on business organizations to use resources such as water, energy, and raw materials in the most efficient manner possible (Fadly, 2020). An EMS helps organizations set up a structured approach that enables them to assess their resource utilization profile in an organization and determine potential areas of improvement (Voinea *et al.*, 2020). When organizations avoid the wastage of scarce resources, they help save the environment and at the same time, there is cutting down on expenses (Wong *et al.*, 2020).

In implementing an EMS, it is during the planning and implementation that prospects of resource efficiency can be noted. In these stages, companies analyze their operation to find out how they are utilizing their resources and where they are losing them (Ikram *et al.*, 2019). For instance, an EMS may reveal that power usage in production is high, water usage in cooling is high or waste production in packaging is high (Abisourour *et al.*, 2020). From this information, organizations can embark on more sustainable measures such as using energy-efficient equipment, recycling water used in production processes, or using renewable materials.

Moreover, EMS encourages the integration of practices that have a cost-saving factor in the long run (Ojo *et al.*, 2021). For instance, measures that can help save energy include installing LED bulbs instead of conventional bulbs, using solar energy, or improving the building's insulation will lead to lower energy bills. Similarly, through water recycling or the use of efficient irrigation systems, companies can cut their utility bills and at the same time have the added advantage of saving water (Herghiligiu *et al.*, 2019). Costs of disposal and material expenditure are also reduced in waste reduction programs such as reusing materials or adopting a circular economy.

Obtaining certification, for instance, ISO 14031, helps organizations to create competitive advantages in the market, appeal to environmentally concerned consumers, and enhance the company's relations with investors who have an environmental concern (Tessitore *et al.*, 2019). This can create new revenue streams and improve profit-making since more consumers are likely to go green when making their purchases (Wessels, 2024).

Enhancing Corporate Reputation and Stakeholder Trust

With the rise of environmental problems in the world, consumers and other users of the product demand responsible performance from the firms (Marrucci & Daddi, 2022). An EMS is useful in making organizations demonstrate their commitment towards the environment through the reduction of the negative impacts on the environment, therefore, promoting the organization's image to environmentally conscious customers (Oladinrin & Ojo, 2022). The idea is that adopting sustainable practices will help businesses create a competitive advantage and appeal to consumers who are conscious of the impact that they make when they are making their purchases.

EMS implementation is a clear indication that the organization is in the process of addressing the organization's detrimental impacts on the environment such as pollution or exploitation of natural resources (Díaz de Junguitu & Allur, 2019). This contributes to fostering good relations with the locals and the authorities hence establishing a social acceptance of the project. From the investor's perspective, especially from the ESG perspective, an EMS signifies a commitment to sustainability and, therefore, makes the company more valuable as an investment (Daud *et al.*, 2019).

Risk Management and Prevention

An EMS makes it easy for organizations to systematically prevent negative events such as spillages, emissions violations, or mishandling of hazardous wastes as the aspects are managed appropriately (Algheriani *et al.*, 2019). Managing risks before they occur assists the organization in avoiding environmental disasters that may cause legal actions, penalties, or loss of reputation. In addition, the EMS framework provides for monitoring and auditing of environmental issues, as well as corrective measures, which guarantee that risks to the environment are noted and acted upon accordingly (Samani *et al.*, 2019). Avoiding environmental losses is also useful in avoiding expensive clean-up or non-compliance fines that can lead to operational instability. Also, those organizations that have incorporated the EMS in their management systems are more ready to handle any environmental issues that may arise from factors such as disasters or changes in laws (Zimon & Madzík, 2020).

Tools and Techniques Used for Identifying Environmental Aspects

Cross-Functional Team (CFT)

Cross-functional team (CFT) is a team that is made for process innovation and has been adopted in environmental management and manufacturing to increase production output while at the same time decreasing the negative effects on the environment (Rosa-Masegosa *et al.*, 2021). Compared to the batch production system in which processes run in stages, CFT entails the flow of materials through production phases constantly (Yan *et al.*, 2021). This technology improves the efficiency of the flow of resources such as water energy and raw materials which leads to a strong cut down in wastage, emissions, and energy consumption. The procedure through which CFT's integrated to identify environmental aspects can be seen in Figure no1. It shows that for environmenta

aspect identification the required first step is to establish a CFT who establish, determine, and inspect the core processes through flow diagrams and identify the core environmental aspects.

Figure 1: Process of CFT's integration to identify environmental aspects

The main requirement from a CFT is to identify the environmental aspects through a flow diagram and to assist the flow diagram the CFT should consider the potential inputs and outputs of the organization as shown in Figure 2.

Figure 2: Inputs and outputs of the organization

In environmental management, CFT optimizes the use of inputs by avoiding waste of time and other necessary inputs. As has been observed in chemical manufacturing, CFT enables the production process to be controlled with extreme accuracy of reaction conditions to minimize by-products and energy consumption (Das, 2020). Whenever it brings about production efficiencies, CFT also saves costs and is environmentally friendly to help companies achieve goals of emission reduction, resource conservation, and sustainability without compromising on productivity and quality (Rogers & Jensen, 2019).

Importance of CFT in EMS

CFT is a central component in EMS since it offers the method of continuous improvement of production processes and management of resources (Ellafi *et al.*, 2020). CFT makes sure that the materials, energy, and water are used in the most efficient way possible by keeping a constant and uninterrupted flow in the production process hence minimizing wastage of any resource as well as time (Das, 2020). In addition to increased operational effectiveness, this structure also cuts back on emissions as well as the production of waste products.

The implementation of CFT in an EMS has the potential to decrease the organization's carbon footprint as well as the overall utilization of resources for instance fuel, water, and raw materials (Theodore & Theodore, 2021). This is useful to the organization in attaining environmental compliance and enhancing the organization's environmental performance in regard to the set standards (Xu *et al.*, 2022). Further, as stated by the CFT, the EMS promotes ongoing improvement, which is one of the pillars of the EMS and enables it to enhance performance over time and develop a more efficient, environmentally friendly, and profitable business model (Mardonova & Choi, 2019).

The Use of ISO 14031

Overview of ISO 14031

ISO 14031 is focused on the evaluation and enhancement of the environmental effect in the space systems and the management of the space programs (Gomes da Silva *et al.*, 2020). This standard prescribes a procedure for assessing the impacts of the environment and the organization's performance in the sphere of space systems, satellites, and space exploration equipment. ISO 14031 comprises major aspects such as the confirmation of environmental performance indicators; energy intensity; resource use; and the emissions relating to space systems (Obamen *et al.*, 2021).

It also looks at the factor of monitoring to ensure that the space programs do not compromise on the standards of the environment as well as the goals of sustainability. ISO 14031 allows the organization to assess and monitor its environmental performance and set objectives and targets for it thereby helping an organization to minimize the risks it faces in the environment (Falqi *et al.*, 2020). Figure 3 provides an illustration of the process adopted by ISO 14031 which highlights the organization's process of identifying and analyzing cost and their output on environmental aspects.

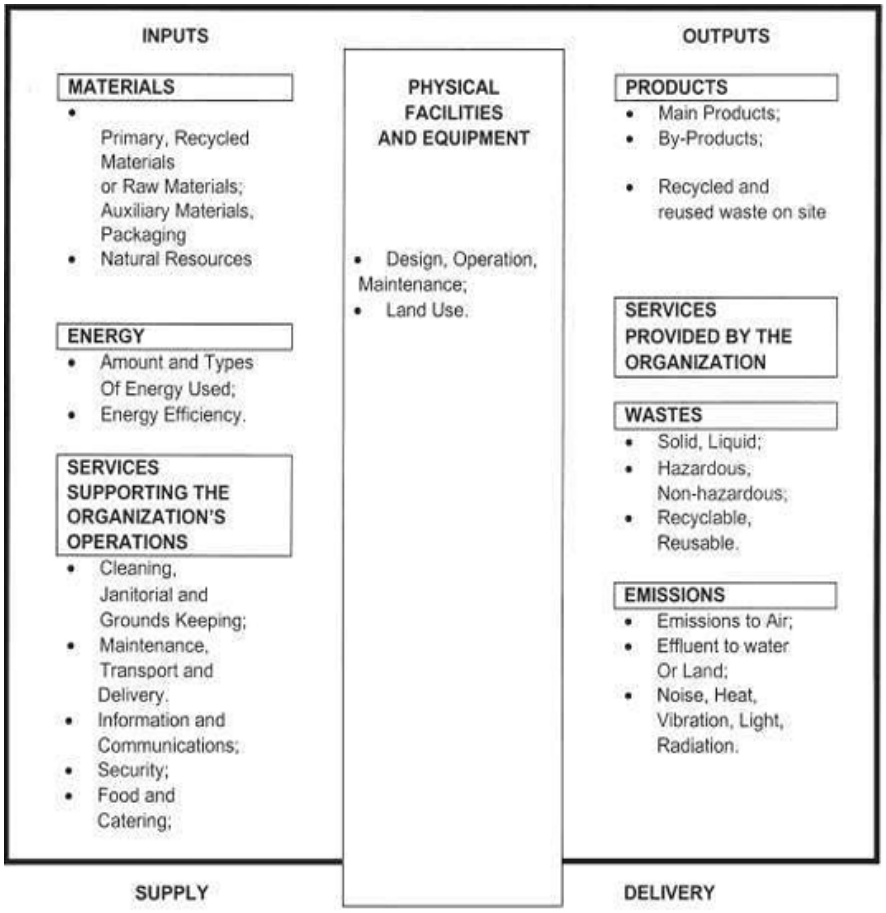

Figure 3: Operations of the organization

Integration of ISO 14031 with EMS

The incorporation of ISO 14031 into the EMS has a lot of advantages in the management of the environmental elements in space systems. ISO 14031 can be applied to supplement other EMS frameworks because of the unique approach that the framework takes to meet space-related tasks (Al-Anbari *et al.*, 2020). Application of the ISO 14031 in an EMS will support the evaluation and enhancement of the environmental performance of space programs in the Organization in a more efficient manner. It helps in setting the right objectives and KPIs regarding the space industry and anything concerning the environment (Al-Hashimi & Kareem, 2020). This also seeks to increase compliance with environmental laws

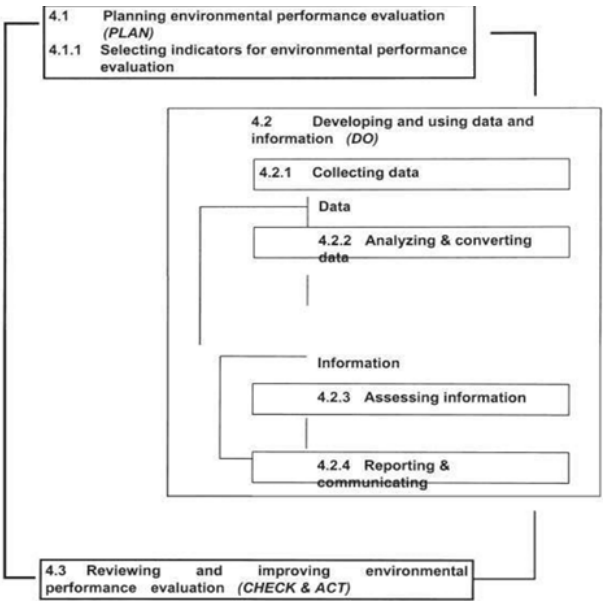

Figure 4: The EPE process

that apply to space systems, improve risk management if performance assessment is conducted in a targeted approach, and improve sustainability initiatives. The Environmental Process Evaluation (EPE) outline is provided in Figure-4 which is integrated by ISO 14031 and is similar to the management model of "Plan-Do-Check-Act"which identifies the indicators for improving environmental evaluation.

Through this integration, there is a possibility of coming up with a conceptual framework and environmental management system with space programs for the attainment of sustainable goals and resource optimization for the limited planet's resources (Mansour *et al.*, 2021). Besides, it promotes communication and reporting of environmental performance improving engagement with the stakeholders and compliance with the legislation in the space industry(de Azevedo *et al.*, 2024). Further, it enhances communication and reporting of environmental performance enhancing stakeholder engagement and compliance with legal requirements in the sensitive space industry (Alsulamy *et al.*, 2021).

Life Cycle Inventory (LCI) Tool

Life Cycle Inventory (LCI) is an important tool in the framework of EMS as it offers a structured approach for the calculation of environmental loads linked with the life cycle of a distinct product, service, or process. In EMS frameworks, it contributes to the identification of various inputs, which include raw materials, and energy, as well as the outputs which include emissions and wastes at every process step of the product life cycle, namely extraction of raw materials, production, use and disposal of the product (Ferrari *et al.*, 2021). Such information allows for the evaluation of environmental impacts in terms of carbon footprint, water intensity, and pollution. Integrating LCI with an organization's EMS will help organizations to make informed decisions on how to reduce the amount of resources used and wastes produced as well as enhance their energy efficiencies effectively improving their sustainability. It is also helpful in matters concerning compliance with environmental laws and requirements, production of reports, gaining eco-labels, or conforming to the ISO 14001 standard. Finally, it helps business entities to adopt measures of effectively anticipating environmental change and hazards that in turn enhance environmental performance hence long-term goals of sustainable development.

Matrix Model

The adoption of the matrix model under an EMS includes a more dynamic and flexible approach to addressing organizational environmental performance in various organizational units. The EMS, through the matrix structure, can correlate the organization's environmental goals and objectives with different departments and ongoing projects thus guaranteeing the achievement of sustainability and compliance objectives across production, purchasing, and administrative functions. This approach enhances integrated working as resources are utilized in the best way possible, accountability on environmental issues is given across functional units, and on matters to do with the environment there is efficiency in communiqué (Schwarz *et al.*, 2021). The matrix also promotes improved decision-making regarding the existing issues arising from EMS as it presents a detailed indication of how environmental impacts interact with the processes, resulting in a systemized administrative strategy toward environmental concerns in the organization. Figure 5 shows the matrix model applied in a case by 17 organizations of Jonkoping and their comparison with Norrbotten and Vasterbotten on different organizational aspects to analyze the significant environmental aspect.

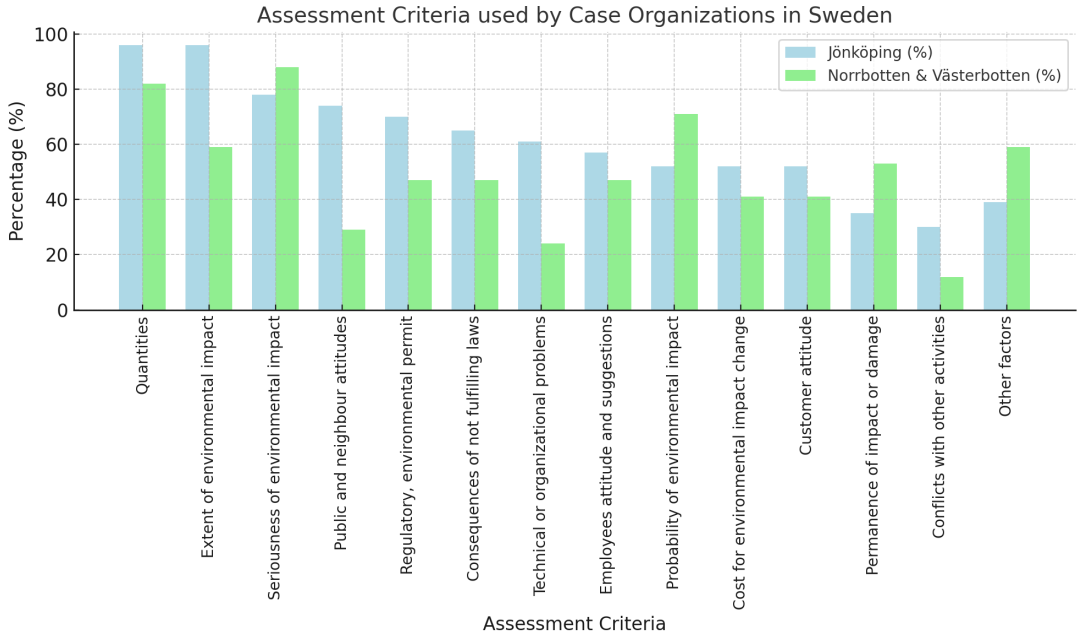

Figure 5: Matrix model used by organizations in Jonkoping

Process of Identifying Significant Environmental Aspect (SEA)

The process of identifying SEA in an EMS context is a systematic approach used to determine the environmental needs appraisal of an organization, its products, or services (Quebral Jr & Barcellano, 2024). It starts with the consideration of all the activities that have an impact on the environment hence entails the following; energy used, wastes produced, and emissions related together resultant from different operations (Craik & Gu, 2022). Figure 6 shows a bar graph that represents the ratings of various environmental aspects that help in determining the SEA.

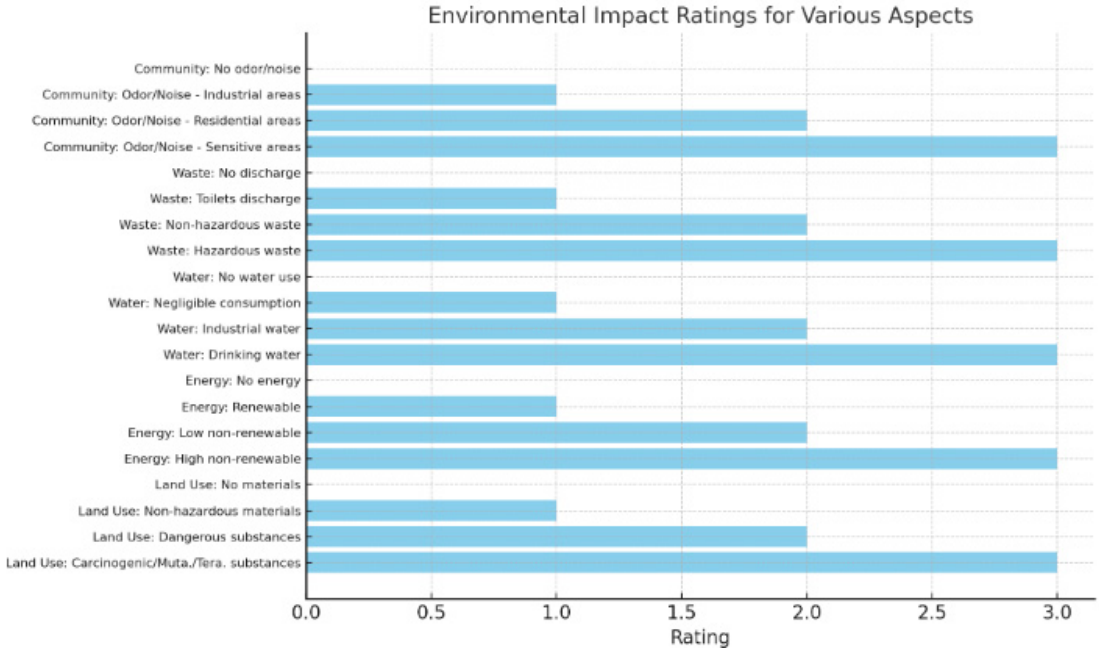

Figure 6: Environmental aspect ratings for various aspects

The subsequent step is to assess whether these aspects have some influence on the environment, for better or worse, based on some factors; such as the ambiance, water contamination, and dwindling of natural resources, among others. Figure 7 shows the ratings of an organization according to the efforts made by it to prevent pollution which can minimize the impact on environmental aspects.

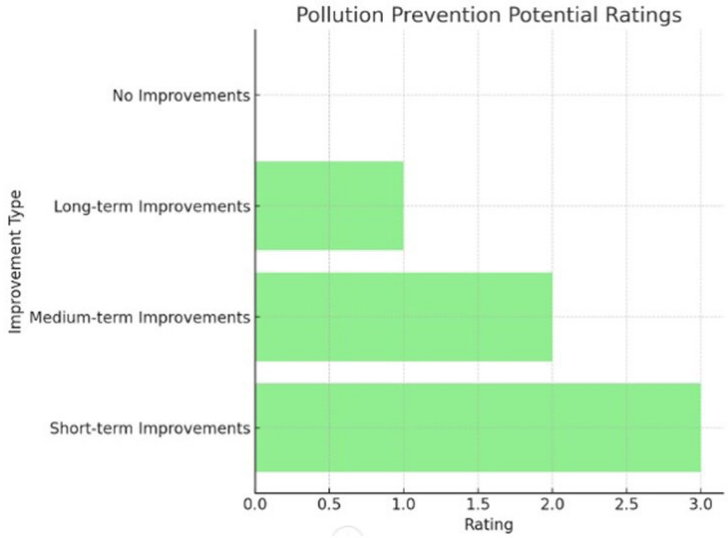

Figure 7: Pollution prevention potential ratings

Next, the occurrence of each aspect is evaluated in terms of its frequency and the size of the effects that take place in the organization. Figure 8 shows a graph that calculates the frequency of occurrence and its ratings in an organization about an environmental aspect which is an integral part of identifying the SEA and processing it through EMS.

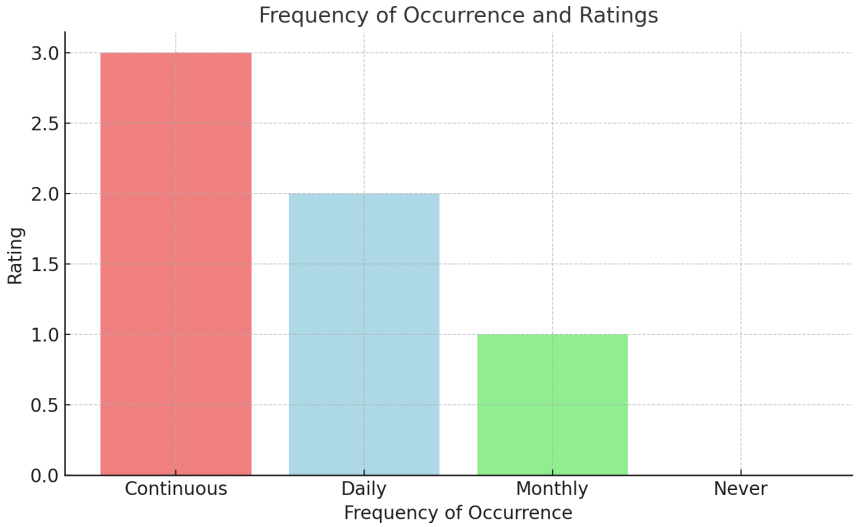

Figure 8: Frequency of occurring ratings in the process of identifying SEA

Following the legal and regulatory demands is also important as any non-conformity can dramatically increase the relevance of some of those aspects. Moreover, stakeholders' opinions are taken into account, because even if some more important issues are missed by the organization, it will receive feedback from its external partners. Figure 9 shows the community concerns regarding the organization's functions and its impact on the environment, this calculates the community complaints and identifies the SEA according to that.

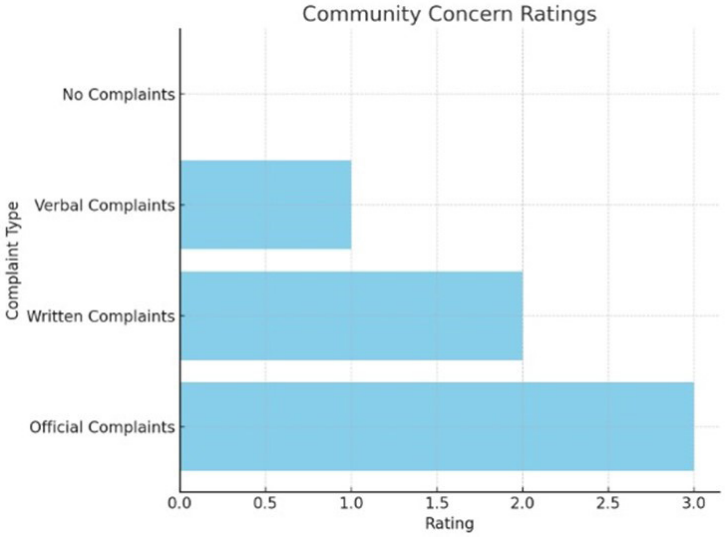

Figure 9: Community Concern ratings

Last but not least, a risk and opportunity analysis is carried out, and aspects are ranked according to their relevance. This overall method guarantees that the efforts of organizations are directed at mitigation of significant environmental aspects, then enhancing sustainability and compliance.

Impact of EMS on Organizations and Environmental Sustainability

Environmental Performance Improvement

EMS has a proven track record for enhancing energy consumption, waste, and pollution minimization in many industries. For instance, Toyota was able to adopt and incorporate waste reduction through the use of EMS where it was able to reach a state of no waste to landfill where most of its wastes are recycled or disposed of. EMS was adopted by 3M and implemented in a way that helped the company develop new approaches to pollution prevention, and significantly decrease the emissions (Leitão *et al.*, 2019). When it comes to space systems, ISO 14031 serves a very important function of giving a framework for assessing and reporting environmental performance (Ociepa-Kubicka *et al.*, 2021). The implementations of this standard assist space agencies and companies in containing the effects of their activities on space, for instance, effective resource consumption and reduction of unnecessary space debris (Dejrah, 2024). The impact of ISO 14031 on space-

related environmental management can therefore be seen through the integration of the standard in an attempt to improve sustainability and get better environmental results in space programs (Voinea *et al.*, 2020).

Competitive Advantage and Innovation

EMS results in new development of cleaner technologies and products due to the fact that the companies that practice the system have to undertake sustainability measurements. For instance, EMS has been implemented by Philips to innovate energy-savvy lighting products; the firm has transformed the market with sustainable strategies (Chen *et al.*, 2020). This is also supported by ISO 14031 and CFT which increases the competitiveness of companies in the more developed sectors. The environmental management and audit standard, ISO 14031, contains procedures for assessing and improving environmental performances, a system that enables aerospace and hi-tech companies to understand the essence of environmental management and reduce the impacts on the environment (Herghiligiu *et al.*, 2019). CFT reduces the utilization of resources in production lines and implements the best practices that would improve production. All these tools contribute to the growth of new solutions in cleaner technologies to improve the sustainability of firms and to gain a competitive advantage by responding to the growing demand for sustainable products and services in the market (Bravi *et al.*, 2020).

Employee Engagement and Corporate Culture

The employees' concerns about environmental issues are perhaps one of the most important impacts of EMS in developing a sustainable organizational culture. EMS encourages employees to embrace efforts in a way that boosts the development across the different sectors of the firm (Adebayo *et al.*, 2020). At Unilever, EMS is integrated into corporate culture by involving the employees in sustainability goals for instance emissions and waste management through training and other activities (Tegon, 2021). The EMS integration of CFT in Boeing enhanced the operations' efficiency and minimized wastage while the utilization of ISO 14031 would enable the aerospace organization to evaluate its environmental performance effectively. (Baxter, 2021). This approach has also helped in improving environmental performance and fostering a culture of change and improvement in organizations as well as employees.

Economic Benefits

The company that has been able to achieve EMS and CFT with a considerable Return on Investment is General Electric, as the firm has been able to reduce energy bills and wastage through the help of EMS and CFT (Кубатко *et al.*, 2021). They automate processes, use fewer resources, and reduce expenses hence increasing the company's profits. Similarly, ISO 14031 helps in attaining economic benefits because of environmental risks in space system programs (Karaeva *et al.*, 2023). ISO 14031 is a guideline to the assessment and improvement of environmental performance and therefore allows space agencies to identify areas that might be at risk or prone to other challenges. It minimizes the chances of compliance and environmental-related mishaps which are usually costly to the company (Feoktistova *et al.*). Thus, it minimizes potential adverse effects and helps to ensure stable financial performance, therefore, ISO 14031 can be described as an effective tool for monitoring the economic effects of environmental management within the framework of the high-tech and space industries.

CONCLUSION

EMS is a crucial framework that can help in improving sustainability and reducing the level of harm to the environment. The EMS incorporates CFT, ISI 14031, matrix model, and LCI tool to obtain the environmental frameworks and have quantitative standards. The role of CFT is to point out and manage the opportunities or threats connected with the environment and ISO 14031 has a system that can be followed to monitor and evaluate these in a bid to enhance the environmental results. Through the integration of these tools in EMS, more industries have been able to develop new technologies and strategies that are sustainable to global needs. The application of EMS in industries also assists in the management of environmental pollution and the growth of organizations.

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