

# Organisational Attributes that Determine Integrated Safety, Health and Environmental Management Capability

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**Abstract.** Implementing separate Environmental Management System (EMS) and Safety and Health Management System (SHMS) can be costly for organisations and hence the advent of integrated management systems. The effective implementation of integrated safety, health and environmental (SHE) management would require companies to have the appropriate organisational capability. Within the academic literature, it is unclear which organisational attributes are important for ascertaining integrated SHE management capability of construction companies. This study sought to address this through a comprehensive review of literature relating to SHE management in construction and SHE management systems and models. The study revealed that organisational attributes that could determine integrated SHE management capability include: senior management commitment to SHE; SHE risks management; SHE objectives and programs; staff competencies; resources for SHE implementation; SHE roles and responsibilities; SHE communications; SHE documentation and control measures; SHE emergency plans; SHE monitoring and performance measurement; and SHE auditing and management review to capture lessons learned. These attributes could enable construction companies and other key industry stakeholders to understand construction companies' capability to implement an integrated SHE management system.

**Keywords:** Organisational, Maturity, Capability, Safety, health and environment

## 1 Introduction

Despite the social and economic significance of the construction sector in any nation's economy, it has earned the unenviable rank of being one of the highest contributors to the work-related injury, accounting for not less than 30% of the work-related fatalities, injuries and illnesses globally [1], [2]. Additionally, the construction sector is one of the main sources of environmental pollution and responsible for the substantial exploitation and consumption of both natural and processed resources. For instance, in the USA the construction sector accounts for about 21% of all occupational deaths from injuries [3]. In Botswana, the sector

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is also responsible for 55% of workplace accidents [4]. In addition to poor safety and health, the construction industry is also one of the largest industrial contributors to poor environmental sustainability. In the Organisation for Economic Co-operation and Development (OECD) countries, construction is responsible for about 25-40% of total energy use [5]. In the UK, the construction industry is responsible for 33% of all waste generated [6]. Certainly, there is an urgent need to improve safety, health and environment (SHE) management in the construction industry. To address the SHE problems in construction, many SHE management solutions and initiatives have emerged over the years. Amongst these initiatives have been the adoption and implementation of management systems particularly environmental management system (EMS) and safety and health management system (SHMS). The parallel implementation of such stand-alone systems within a company can, however, be costly [7], [8] and therefore having an integrated SHE management system is desirable.

More so in developing country context where financial resource commitment to health, safety and environmental issues is scant. The implementation of such an integrated management system would require companies to have the appropriate organisational capability. However, there is a lack of clarity within the academic literature, about what organisational attributes are important for ascertaining integrated SHE management capability of a construction company. This study, thus, through a review of the literature, investigates organisational attributes that determine a construction company's capability to implement an integrated SHE management. The next section presents a brief review of SHE management and capability maturity literature. Subsequently, the research method and findings are presented, followed by the discussions and concluding remarks.

## **2 Safety, Health and Environmental Management Capability in construction**

Though considerable efforts have been made to address SHE problems in construction, the industry today is still characterised by accidents, injuries, fatalities, and negative environmental impacts. Over the last few decades, the construction industry has embraced management systems (MSs) particularly, EMS and SHMS based on management system standards as a systematic approach for controlling the key management functions of safety and environment [7]. Construction companies are therefore implementing such management systems, to effectively address SHE issues and their associated undesirable outcomes and also demonstrate and achieve sound SHE performance

The implementation of EMS and SHMS in the industry, though on a low scale have provided an effective way for organisations to reduce environmental incidents and civil liabilities, improved awareness of environmental impacts of their operations, increased the efficiency of operations by cutting waste, lessening injuries and fatalities and improving a company's productivity [9], [10]. However, the parallel implementation of independent systems in a construction organisation is bureaucratic, onerous and costly [7]. More so, in the developing country contexts where the implementation of MSs tend to be low due to limited funds, resources and expertise [6]. As a consequence, integrated management of SHE through a single system is desirable to control and manage the key SHE operations, resources and structure with maximum effectiveness and minimum bureaucracy [8].

The implementation of such a system by construction organisation, therefore require them to have the appropriate organisational capability in respect of SHE management. However, conspicuously missing in the body of academic SHE management literature is a thorough understanding of what constitutes SHE management capability of a construction company with the responsibility of improving SHE performance. In addition, no studies have

sought to identify and categorise SHE management capability attributes to aid objective assessment of SHE management capability of construction companies.

### **3 Towards SHE management capability modelling in construction**

Currently, one of the widely-accepted frameworks for assessing the maturity of organisations in the performance of its tasks and managing its organisational processes is the capability maturity model (CMM) and/or its extension, the capability maturity model integrated (CMMI) [11]; [12]. Increasingly CMM has become a tool, used to assess and improve organisational processes, systems, products, and competencies on the evolutionary path towards excellence and the attainment of desired outcomes [18]. The concept of CMM has been applied in the construction industry as a means of accessing capability in areas such as risk management [13], supply chain [14]) and BIM [15]. In the area of safety, health and environment, CMM frameworks have been developed to address safety culture [16], assess construction site safety management (AC2E performance matrix by Carillon Plc), and also for design in the offshore sector [17], [18]. However, no maturity model exists for assessing a construction company's capability to implement an integrated SHE management in construction. The first step in developing a CMM for SHE management is to identify and define the key attributes that will serve as the criteria in assessing capability to achieve the overall SHE goals of an organisation.

The application of CMM is reliant on the identification of key attributes referred to as key process areas (KPA) which represent performance indicators for benchmarking capability and process improvement areas across organisation and systems [11]. These capabilities attributes refer to a set of organisational processes, activities, practises, competencies and resources that are required or performed to reach some desired outcomes or achieve a set of goals [19]. They largely include processes, people, policy, and resources required to execute germane organisational functions. This study, therefore, explored the relevant attributes required for assessing construction organisations' SHE management capability as a precursor for developing an integrated SHE management CMM (SHEM-CMM).

### **4 Research Methodology**

A comprehensive review of literature related to SHE management and not limited to construction was used to generate a list of SHE capability attributes. The literature comprised of safety and health, and environmental management guides and international standards, journal articles and texts covering SHE management systems/models as outlined in Table 1. The relevant literature related to maturity models on safety and health, and environmental management [16], [20], AC2E performance matrix by Carillon Plc and the design safety maturity models [17], [18] were also reviewed.

The literature analyses revealed that existing SHE management texts, guides, and international standards generally follow the Plan - Do- Check- Act (PDCA) management approach and thus, share common requirements which allow most of the elements to be integrated. As a result, in developing the list of organisational attributes for ascertaining SHE management capabilities, information from already established internationally recognised SHE management standards and published works were extracted, by comparing their components in order to determine key similarities and differences, thereby establishing the potential integrated SHE capability attributes. The literature sources and the SHE management components and practices are shown in table 1.

**Table 1.** SHE management literature sources

| Component /Practices | Environmental management system (EMS) standards and published works |                |                 |                              |                  | Component /Practices | Safety and health management system (SHMS) standards, guidelines and published works |                 |                 |                 |                  |                    | Component /Practices  | Integrated management system (IMS) standards and published works |                 |                          |
|----------------------|---|----------------|-----------------|------------------------------|------------------|----------------------|--|-----------------|-----------------|-----------------|------------------|--------------------|---|--|-----------------|--------------------------|
|                      | ISO (2015) [21]   | EC (2008) [22] | BSI (2003) [23] | Responsible Care (2015) [24] | Chan (2011) [25] |                      | HSE (2013) [26]  | BSI (2007) [27] | ILO (2001) [28] | BSI (2012) [23] | IOSH (2015) [29] | AS/NZS (2001) [30] |   | Hughes and Ferret (2015) [31]                                    | BSI (2012) [23] | Hamid et al. (2004) [32] |
| SMC                  | ✓   | ✓              | ✓               | ✓                            | ✓                | SMC                  | ✓  | ✓               | ✓               | ✓               | ✓                | ✓                  | Leadership and commitment   | ✓  | ✓               | ✓                        |
| EMS-C                | ✓   | ✓              | ✓               |                              | ✓                | SHMS-C               | ✓  | ✓               | ✓               | ✓               | ✓                | ✓                  | Implementation team   |  | ✓               | ✓                        |
| PR                   | ✓   | ✓              | ✓               | ✓                            |                  | PR                   | ✓  | ✓               | ✓               | ✓               | ✓                | ✓                  | Baseline review   |  | ✓               | ✓                        |
| EMS-B                | ✓   | ✓              | ✓               |                              |                  | SH-B                 | ✓  | ✓               | ✓               | ✓               | ✓                | ✓                  | Identification of IMS Hazards, aspects and impacts identification | ✓  | ✓               | ✓                        |
| IEAI                 | ✓   | ✓              | ✓               | ✓                            | ✓                | ISHH                 | ✓  | ✓               | ✓               | ✓               | ✓                | ✓                  | Risk assessment and identification of control measures            | ✓  | ✓               | ✓                        |
| AEAI                 | ✓   | ✓              | ✓               | ✓                            | ✓                | SHRA                 | ✓  | ✓               | ✓               | ✓               | ✓                | ✓                  | Legal and other requirements                                      |  | ✓               | ✓                        |
| ICULR                | ✓   | ✓              | ✓               | ✓                            | ✓                | ICULR                | ✓  | ✓               | ✓               | ✓               | ✓                | ✓                  | Integrated management policy                                      | ✓  | ✓               | ✓                        |

|       |        |   |   |   |   |   |        |   |   |   |   |   |   |   |  |   |   |   |
|-------|--------|---|---|---|---|---|--------|---|---|---|---|---|---|---|--|---|---|---|
|       | ENVPO  | ✓ | ✓ | ✓ | ✓ | ✓ | SHPO   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Objectives and Targets of IMS                            | ✓ | ✓ | ✓ |
|       | ENOT   | ✓ | ✓ | ✓ | ✓ | ✓ | SHOT   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Management programmes of IMS                             |   | ✓ | ✓ |
|       | ENVMP  | ✓ | ✓ | ✓ |   | ✓ | SHMP   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Organisational roles and responsibilities                | ✓ | ✓ | ✓ |
|       | SRR    | ✓ | ✓ | ✓ |   | ✓ | SRR    | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Resources  | ✓ | ✓ | ✓ |
|       | PAR    | ✓ | ✓ | ✓ |   |   | PAR    | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Communication  | ✓ | ✓ | ✓ |
|       | EINV   | ✓ | ✓ | ✓ | ✓ | ✓ | EINV   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Participation and Consultation of Employees              |   | ✓ | ✓ |
|       | COENVI | ✓ | ✓ | ✓ | ✓ | ✓ | CSHI   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Training and awareness                                   | ✓ | ✓ | ✓ |
|       | EINV   | ✓ | ✓ | ✓ | ✓ | ✓ | EINV   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Competence of employees                                  | ✓ | ✓ | ✓ |
| DO    | ITNT   | ✓ | ✓ | ✓ | ✓ | ✓ | ITNT   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Documentation of the IMS                                 | ✓ | ✓ | ✓ |
|       | COE    | ✓ | ✓ | ✓ | ✓ | ✓ | COE    | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Control of documents                                     | ✓ | ✓ | ✓ |
|       | EMSDO  | ✓ | ✓ | ✓ | ✓ | ✓ | SHMSDO | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Operational Control                                      | ✓ | ✓ | ✓ |
|       | EMSDC  | ✓ | ✓ | ✓ | ✓ | ✓ | SHMSDC | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Emergency preparedness and response plans and procedures |   | ✓ | ✓ |
|       | OPC    | ✓ | ✓ | ✓ | ✓ | ✓ | OPC    | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Performance monitoring and measurement                   | ✓ | ✓ | ✓ |
| CHECK | EPAR   | ✓ | ✓ | ✓ | ✓ | ✓ | EPAR   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Evaluation of Compliance                                 |   | ✓ | ✓ |
|       | MAM    | ✓ | ✓ | ✓ |   | ✓ | PMAM   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Incidents investigation                                  |   | ✓ | ✓ |

|     |        |   |   |   |   |   |       |   |   |   |   |   |   |                                       |   |   |   |
|-----|--------|---|---|---|---|---|-------|---|---|---|---|---|---|---------------------------------------|---|---|---|
|     | EOC    | ✓ | ✓ | ✓ | ✓ | ✓ | EOC   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Non-conformity and corrective actions | ✓ | ✓ | ✓ |
|     | NCP    | ✓ | ✓ | ✓ |   | ✓ | IIVES | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Records Control                       |   | ✓ | ✓ |
|     | RC     | ✓ | ✓ | ✓ | ✓ | ✓ | NCP   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Combined Internal Audits              | ✓ | ✓ | ✓ |
|     | EMSAUD | ✓ | ✓ | ✓ | ✓ | ✓ | RCM   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Integrated Management review          | ✓ | ✓ | ✓ |
|     | TALL   | ✓ | ✓ | ✓ | ✓ | ✓ | SHAUD | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Continuous improvement and innovation | ✓ | ✓ | ✓ |
| ACT | MR     | ✓ | ✓ | ✓ | ✓ | ✓ | TALL  | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |                                       |   |   |   |
|     | PER    |   | ✓ |   |   |   | MR    | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |                                       |   |   |   |
|     | CERT   | ✓ | ✓ | ✓ | ✓ |   | CERT  | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |                                       |   |   |   |
|     | SD     | ✓ | ✓ | ✓ |   | ✓ | SD    | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |                                       |   |   |   |
|     | CI     | ✓ | ✓ | ✓ |   | ✓ | CI    | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |                                       |   |   |   |

Notes: AEAI=Assessment of environmental aspects and impacts in order to select significant aspects; CERT= Certification; CI=Continuous improvement; COE =Competency of Employees; COENVI=Communication of environmental information to all employees; CSHI=communication of safety and health information; EMSAUD = environmental management systems auditing ; EMS- B = EMS budgets ; EMS-C = EMS champion selection; EMSDC=EMS documentation control; EMSDO=EMS Documentation; EINV=Employees involvement; ENVPO =Environmental policy ; ENVMP=An environmental management program and an action plan ; ENOT = Environmental objectives and targets; EIOPM=Establishment and implementation of operational control measures; EOC= Evaluation of compliance with relevant laws and regulation; OPC = Operational control; EPAR=Emergency preparedness and response; ICULR= Identification, communication and updating all applicable legal and other requirements; IEAI = Identification of all environmental aspects and related impact; IIVES= incidents investigations; ISHHR = investigation of safety and health hazards and risks; IPT=Identification of training needs and provision training programmes; MAM= Monitoring and measurement; MR = Management review; NCCPA=Nonconformance and corrective and preventive action; PAR= Provision and Allocation of Resources; PER = Publishing Environmental report; PMAM = Performance monitoring and measurements; PR= Preliminary review; RC= Records control; RCM = Records control and management; SD = Self-declaration of an EMS/SHMS adoption; SHAUD = SHMS Auditing; SH-B = safety and health budgeting; SHMP = safety and health management programme; SHMS-C = safety and health and management safety champion selection; SHMSDC=safety and health documentation control; SHMSDO=safety and health documentation; SHOT = Safety and Health objectives and targets; SHPO= safety and health policy; SHRA safety and health risks assessment SMC = Senior management commitment and leadership; SRR = Structure, roles and responsibilities; TALL=Taking action on lessons learned

## 5 Findings and discussions

The SHE capability attributes obtained from a review of the literature are shown in Table 2. The attributes include: Senior management commitment; SHE policy; Objectives and targets; SHE management programme; SHE risk management; Management of outsourced services; operational control; SHE emergency preparedness and response; SHE performance monitoring and measurement; SHE incidents investigation; SHE system auditing; Roles and responsibilities; Training; Employee involvement; Competence; Physical and financial resources; Communications; Documentation and control; Lessons and knowledge management. These, SHE capability attributes share similarities with the requirements of existing integrated management systems, the criteria proposed by Strutt *et al.* [18] for the development of an offshore design safety capability maturity model (DSCMM) and the health and safety maturity model (HSMM). A significant difference, however, is the reliance on 12 key safety processes areas and 6 key safety factors in comparison with the 27 capability attributes that emerged in this study.

**Table 2** Summary of organisational capability attributes for SHE management

| No. | Capability attributes                                       | Description and examples of indicators of attributes  | Related key process area category |           |        |           |             |
|-----|---|---|-----------------------------------|-----------|--------|-----------|-------------|
|     |   |   | Strategy                          | processes | People | Resources | Information |
| 1   | Senior management commitment                                | Senior management commitment to safety, health and environment (SHE) management                       | x                                 |           |        |           |             |
| 2   | SHE implementation team                                     | SHE teams solely for the implementation of SHE management in the company                              |                                   |           | x      |           |             |
| 3   | Baseline review   | A preliminary review of the company's current status of SHE management processes                      | x                                 |           |        |           |             |
| 4   | Hazards, environmental aspects and impacts identification   | Systems, processes and procedures for SHE hazards and environmental aspects and impact identification |                                   | x         |        |           |             |
| 5   | SHE Risks assessment and identification of control measures | Systems, processes and procedures for SHE risks assessment and identification of control measures     |                                   | x         |        |           |             |
| 6   | Legal and other requirements                                | Identification, having access to and analysing applicable legal and other                             |                                   |           |        |           | x           |

|    |                                       | requirements which apply to all activities   |   |
|----|---------------------------------------|--|---|
| 7  | SHE Policy                            | An integrated policy that serves as the foundation for a company's she development and implementation  | x |
| 8  | SHE objectives and targets            | SHE objectives and targets for a company in line with SHE policy   | x |
| 9  | SHE Management programme              | Company's action plans for achieving SHE objectives and targets  | x |
| 10 | SHE roles and responsibilities        | Availability of dedicated SHE roles, and responsibilities within an organisational hierarchy   | x |
| 11 | SHE resources                         | Provision of physical and financial resources for SHE implementation   | x |
| 12 | SHE Training                          | Provision of suitable SHE training for personnel   | x |
| 13 | SHE Competence                        | The skills, knowledge and experience of personnel to undertake responsibilities and perform SHE activities                                   | x |
| 14 | Management of outsourced SHE services | Process or a mechanism for assessing the competence outsourced personnel, subcontractors and suppliers with regards to the management of SHE | x |
| 15 | SHE Communication                     | Communication of relevant SHE information and requirements to personnel and other relevant stakeholders                                      | x |
| 16 | Employee Involvement in SHE           | Consultation and involvement of all employees at all   | x |

|    |  | stages of SHE management  |   |
|----|--|---|---|
| 17 | SHE Documentation                                  | Provision and maintenance of adequate SHE documentation and records   | x |
| 18 | Control of SHE documents                           | Processes and procedures for ensuring that SHE documents are maintained, current and available to employees   | x |
| 19 | SHE Operational Control                            | Processes, procedures and measures for controlling SHE risks, to ensure SHE regulatory compliance in operational functions and to achieve the overall SHE objectives. | x |
| 20 | SHE Emergency Preparedness and Response            | Emergency procedures and measures to minimise the impact of uncontrolled events and unexpected incidents.   | x |
| 21 | SHE Performance Monitoring and Measurement         | Systems, processes and procedures to monitor and measure SHE performance  | x |
| 22 | Evaluation of Compliance                           | Processes and procedures to monitor and access compliance with SHE regulations and other applicable requirements  | x |
| 23 | SHE Incidents Investigations                       | Processes and procedures for investigating the causes of SHE incidents.   | x |
| 24 | Non-conformance; corrective and preventive actions | Processes, procedures and systems for the identification and correction of problems and prevention of their recurrence.   | x |

|                                      |  |   |   |    |   |   |  |   |
|--------------------------------------|--|---|---|----|---|---|--|---|
| 25                                   | SHE Records Control                          | Processes and procedures for maintenance and management of records of SHE performance                       | x |    |   |   |  | x |
| 26                                   | SHE System Auditing                          | Processes and procedures to conduct SHE audit to assess compliance and SHE management system effectiveness. | x |    |   |   |  |   |
| 27                                   | SHE Lessons Learned and Knowledge Management | Learning lessons from inspection, accident investigations audits etc. and acting on them.                   |   |    |   |   |  | x |
| Related key processes area frequency |  |   | 5 | 12 | 5 | 1 |  | 5 |

Following the work by Mahamadu *et al.*, [34] on the determination of Organisational attributes for the design for occupational safety and health capability (DfOSH) and the categorisation of attributes in capability modelling [11], the emergent SHE attributes were further reclassified. The reclassification adopted are: ‘*strategy*’ for the organisation’s vision and senior management commitment for SHE management; ‘*people*’ for describing organisations human capital, their roles, responsibilities and involvement in SHE management; ‘*process*’ for required organisation’s procedures, processes and systems for SHE management; ‘*information*’ for SHE related documents, data, lessons, records and their communication across an organisation, and ‘*resources*’ for describing attributes related to the financial and physical resources necessary for effective SHE implementation. From Table 2, the majority of the SHE management capability attributes are either related to ‘*process*’ followed by ‘*strategy*’ ‘*people*’ and then *information*. The resources category was associated with the least number. The high number of processes related criteria is unsurprising and supports the primary ethos of CMMI/CMM which is premised on a philosophy that key process improvement leads to sustained and repeatable attainment of goals. For construction companies to effectively manage SHE issues, there is a need for commitment, leadership and management (including all appropriate organisational processes), and competent personnel operating in an environment where people are engaged and trusted [26]. The process attributes are therefore recognised as an important aspect of SHE management capability, albeit the strategy, resources, systems, information and people that facilitate the processes also need full consideration. However, the prevalence of particular types of the integrated SHE attributes does not necessarily indicate their weight or importance and therefore, further research is required to determine the relative importance of the attributes.

## 6 Conclusions

The use of integrated SHE management systems could help construction organisations manage SHE challenges while reducing the cost of implementing separate or stand-alone management systems. In order to implement integrated SHE management systems successfully, there is a need for understanding what constitutes a construction company’s capability to effectively manage SHE issues. The study explored the integrated SHE management capability attributes of construction companies as a precursor for identifying metrics for the development of a bespoke SHEM-CMM. This study, based on the review

of literature, revealed 27 organisational attributes that could determine integrated SHE management capability. The findings highlight the prevalence of process and strategy capabilities attributes. The findings also acknowledge the role of people and information capability attributes. The study further highlights the prevalence of process, people and strategy capabilities attributes. Overall, the research findings could assist construction companies and other stakeholders (e.g. clients who appoint construction companies) to ascertain and understand the construction company's capability in effectively implementing integrated SHE management system. Moreover, it could aid the objective assessment of integrated SHE management capability maturity of construction firms and allow them to target efforts at addressing any areas of capability deficiency. Future work will involve refinement of the 27 attributes by the way of further integrating closely related attributes. Additionally, future work would ascertain the relative importance of the attributes and also define maturity levels and a scoring method for the assessment of integrated SHE management capability.

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