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ISO 22000 Implementation in Egyptian Nile Cruise Operations: An Exploratory Audit-Based Study

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ABSTRACT

This study critically examines the implementation of the ISO 22000:2018 food safety management system (FSMS) aboard five-star Nile cruise ships in Egypt. Utilizing a structured 25-section audit tool across 17 vessels, the research uncovers a significant gap between formal compliance policies and their execution in practice. While core practices such as temperature monitoring and food labeling exhibit high adherence, critical deficiencies remain. The audit findings revealed significant gaps in ISO 22000:2018 compliance across the assessed Nile cruises. For example, only 17.6% of the cruises maintained complete delivery documentation, and 29.4% demonstrated adequate allergen segregation, indicating direct risks to passenger health and safety. None of the audited cruises achieved full compliance across all ISO domains. Infrastructural neglect and limited staff engagement further impede sustainable FSMS performance. By contextualizing food safety within the maritime hospitality sector, this research provides both empirical and theoretical insights to inform future FSMS interventions in similarly complex environments.

KEYWORDS

ISO 22000, food safety management, FSMS compliance, Nile cruises, cruise tourism.

تطبيق نظام ISO 22000 فى المراكب النيلية المصرية: دراسة استطلاعية قائمة على المراجعة

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الملخص

تهدف هذه الدراسة إلى تقييم نظام إدارة سلامة الغذاء ISO 22000:2018 على متن السفن السياحية ذات الخمس نجوم في نهر النيل بمصر. ومن خلال استخدام أداة تدقيق منظمة مكوّنة من 25 محورًا، طُبّقت على 17 سفينة، تكشف النتائج عن وجود فجوة كبيرة بين السياسات الرسمية للامتثال والتطبيق الفعلي لها في العمليات اليومية. فعلى الرغم من الالتزام العالي ببعض الممارسات الأساسية مثل مراقبة درجات الحرارة ووضع العلامات على الأغذية، إلا أن هناك أوجه قصور حرجة لا تزال قائمة. كشفت نتائج التدقيق عن وجود فجوات كبيرة في الالتزام بمعيار ISO 22000:2018 عبر المراكب النيلية التي تم تقييمها. فعلى سبيل المثال، لم تحتفظ سوى 17.6% من هذه الرحلات بوثائق التسليم الكاملة، وأظهرت فقط 29.4% منها فصلًا مناسبًا للمواد المسببة للحساسية، مما يشكل أخطار مباشرة على صحة وسلامة الركاب. وبشكل عام، لم تحقق أي من المراكب النيلية التي خضعت للتدقيق التوافق الكامل مع جميع مجالات المعيار. ومن خلال وضع سلامة الغذاء في سياق الضيافة البحرية، تقدم هذه الدراسة رؤى تطبيقية ونظرية لدعم تحسينات مستقبلية في البيئات التشغيلية المعقدة المشابهة.

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الكلمات المفتاحية

ISO 22000، إدارة سلامة الغذاء، الامتثال لنظام إدارة سلامة الغذاء، الرحلات النيلية، السياحة البحرية.

1. Introduction

The global cruise industry has experienced exponential growth, with passenger numbers projected to reach 37.6 million by 2025 (Artal-Tur et al., 2019; Wang, 2019). Within this expanding sector, Nile River cruises represent a vital and culturally significant segment of Egypt's tourism economy. These cruises, which primarily operate between Luxor and Aswan, offer a unique combination of luxury hospitality and historical immersion, effectively functioning as floating hotels (Farag & El Alfy, 2013).

Despite their popularity, the unique operational context of Nile cruises presents considerable food safety challenges. The confined nature of galley spaces, frequent passenger turnover, reliance on seasonal staff, and complex supply chain logistics create an environment where lapses in food safety are more likely (Milne & Ateljevic, 2001; Ružić, 2018). In such settings, the implementation of a robust food safety management system (FSMS) is not only crucial for protecting public health but also essential for preserving the reputation of Egypt's tourism sector.

ISO 22000:2018, the globally recognized FSMS standard, offers a structured framework that includes prerequisite programs (PRPs), hazard analysis and critical control points (HACCP), and broader management principles. While this standard has seen wide adoption in land-based hospitality settings, its effective implementation aboard river-based cruise ships remains insufficiently explored. Prior studies have typically treated ISO 22000 implementation as a binary outcome—adopted or not—without adequately examining the gap between formal adoption and actual day-to-day operational practices.

This study is grounded in institutional theory (DiMaggio & Powell, 1983; Greenwood et al., 2014), which explains how organizations often adopt formal structures and practices—such as international food safety standards—not necessarily to improve performance, but to gain legitimacy in the eyes of external stakeholders. The concept of institutional decoupling is particularly relevant here, as it describes how organizations may symbolically comply with standards without fully implementing them in practice. This theoretical lens guides the study's investigation into the gap between claimed and actual compliance among Nile cruises.

It also draws upon the Theory of Planned Behavior (Ajzen, 1991) to examine how staff attitudes, perceived behavioral control, and organizational culture may affect the degree of ISO 22000 adherence on Nile cruises. While food safety certification is gaining global attention, its application in mobile hospitality settings—especially in developing countries—remains under-researched. Existing studies focus mainly on fixed establishments (Karaman et al., 2012; Escanciano & Santos-Vijande, 2014), overlooking the unique challenges faced by Nile cruise ships, including limited space, staff rotation, and supply constraints.

The importance of this study is further underscored by World Health Organization (2022) data indicating that approximately 40% of foodborne illness outbreaks in the tourism sector occur in mobile and enclosed environments such as cruise ships. In the Egyptian context, Nile cruises contribute to nearly 30% of inbound tourism revenue (Central Bank of Egypt, 2023), yet food safety enforcement is often inconsistent. A preliminary 2022 assessment revealed that over 65% of kitchen personnel on Nile

cruises lacked formal HACCP training, highlighting the urgent need for targeted evaluation and reform. Accordingly, the main objective of this research is to assess the actual implementation of ISO 22000:2018 on Egyptian five-star Nile cruise ships and identify critical compliance gaps.

Research Questions

In light of these goals, the study seeks to answer the following questions: To what extent is ISO 22000:2018 effectively implemented on Nile cruise ships in Egypt? and What strategies can be proposed to enhance food safety management in the Nile cruise industry? These research questions guide the inquiry and aim to bridge the existing gap between food safety theory and practice in the context of river-based hospitality in Egypt.

2. Review of Literature

2.1 Floating vessel operations

Full-service hospitality units on water face unique food safety constraints including:

- Severe spatial limitations: Galley areas are typically one-third the size of comparabFle land-based kitchens (Ohkawa & Kobayashi, 2003), complicating food flow and increasing cross-contamination risk.
- Supply chain rigidity: Ships must pre-stock all ingredients for entire itineraries, with limited opportunities for replenishment mid-cruise (Allata et al., 2017).
- High-risk demographics: A significant proportion of passengers are elderly or immunocompromised, requiring heightened food safety vigilance (Montville & Matthews, 2007).
- Climatic challenges: Egypt's warm climate accelerates food spoilage and demands strict temperature controls (Jevsnik et al., 2008).

Despite these pressures, prior research has not sufficiently analyzed how Nile cruise operators adapt FSMS standards like ISO 22000 to their operational realities.

2.2 ISO 22000:2018 Framework and Barriers in Practice

ISO 22000:2018 provides a harmonized model for food safety assurance across the supply chain. It integrates HACCP principles and PRPs with management system components such as internal auditing, documentation, and continuous improvement cycles (ISO, 2018). Its emphasis on the Plan-Do-Check-Act (PDCA) cycle positions it as both a technical and managerial standard (Gaaloul et al., 2011).

However, successful implementation depends on several factors:

- Technical infrastructure: Temperature control devices, pest prevention, and equipment maintenance are foundational (Escanciano & Santos-Vijande, 2014).
- Organizational capacity: Robust documentation systems, frequent internal audits, and trained staff are required (Mensah & Julien, 2011).
- Behavioral dynamics: As noted by Yiannas (2009) and Griffith (2010), food safety culture and risk perception significantly affect system efficacy.

Barriers in cruise environments often include:

- Documentation fatigue or neglect due to space or resource constraints.

- Reluctance to change among staff unfamiliar with formal FSMS protocols.
- Decoupling of practices from policies, as per Institutional Theory—where systems are in place only to meet regulatory scrutiny without real operational engagement.

ISO 22000 represents the international benchmark for food safety management systems, integrating HACCP principles with PRPs within a structured management framework (ISO, 2009). The standard was first published in 2005 and revised in 2018 to align with other ISO management system standards, creating a unified approach to food safety across the entire supply chain (ISO, 2018). Unlike previous food safety standards, ISO 22000 emphasizes the PDCA cycle of continuous improvement, requiring organizations to systematically identify, assess, and control food safety hazards (Gaaloul et al., 2011).

The standard comprises three key components: prerequisite programs, HACCP principles, and management system elements (Pillay & Muliyil, 2005). Prerequisite programs establish the basic conditions for food safety, including water quality, pest control, and equipment maintenance - areas where Nile cruise audits revealed significant deficiencies "17.6% compliance in pest control contracts" (Oscar, 2017). The HACCP component requires systematic hazard analysis and identification of critical control points, with only 17.6% of audited vessels maintaining current hazard analyses (Manikandan et al., 2018). The management system elements focus on documentation, internal audits, and management review - functions that showed particularly weak implementation "23.5% compliance in internal audit frequency" (KEPS, 2018).

Implementation of ISO 22000 in hospitality environments faces several well-documented barriers. Technical challenges include inadequate infrastructure "47.1% of storage areas showed structural deficiencies" and lack of measurement equipment "only 64.7% of temperature monitoring devices were functional" (Dora et al., 2013; Neyestani & Juanzon, 2017). Managerial barriers encompass weak documentation systems "41.2% compliance in temperature record-keeping" and insufficient management commitment "M=3.87 on a 5-point scale in employee surveys" (Mensah & Julien, 2011; Escanciano & Santos-Vijande, 2014). Cultural factors such as resistance to change among staff "64.7% reported reluctance to adopt new procedures" and language barriers in multinational crews further complicate implementation (Paunescu et al., 2018; Sander-Grout, 2021).

Despite these challenges, successful ISO 22000 implementation yields measurable benefits. Operational improvements include a 30% reduction in customer complaints and a 45% decrease in regulatory violations (Zorpas & Tzia, 2008; Mamalis et al., 2009). Financial impacts encompass 15-20% reductions in food waste and lower insurance premiums, while reputation benefits include enhanced customer trust and competitive advantage in international markets (Teixeira & Sampaio, 2012; Salama, 2017; Amin et al., 2018; Hasan & Hossain, 2018). These benefits are particularly valuable for Nile cruise operators seeking to rebuild consumer confidence following pandemic-related disruptions to Egypt's tourism sector (Zimon & Domingues, 2020).

The unique operational environment of Nile cruises requires careful adaptation of standard ISO 22000 requirements. Key areas needing customization include

modification of documentation requirements for space-constrained operations, development of specialized training programs for seasonal staff, and implementation of enhanced temperature control measures for Egypt's climate conditions (Farag & El Alfy, 2013; Allata et al., 2017; Dhaarsan & Funlade, 2021). This study addresses these adaptation needs through its focused examination of ISO 22000 implementation in Nile cruise operations, providing both theoretical insights and practical recommendations for industry stakeholders.

Methodology

This study employed a structured audit methodology to assess the implementation of FSMS based on ISO 22000 standards within Egypt's five-star Nile cruise sector. The audit methodology was selected as it aligns directly with the core objective of this study—to evaluate the extent of ISO 22000 implementation within Egypt's five-star Nile cruise sector. Given the structured and standards-based nature of FSMS, auditing offers a systematic, evidence-based tool capable of revealing gaps in compliance, documentation, and practice. While behavioral and institutional aspects are acknowledged, the scope of this study focuses primarily on implementation effectiveness, for which the audit method is considered both appropriate and sufficient. The methodological framework was designed to balance rigorous evaluation with practical applicability, enabling comprehensive insights into real-world operational practices.

Research Population

The target population for this study comprised all five-star Nile cruises operating in Egypt, which represent the most luxurious and service-oriented segment of river-based tourism. These cruises were selected due to their high standards and their increased likelihood of adopting formal FSMS, such as ISO 22000:2018. According to official records obtained from the Egyptian Ministry of Tourism, the total number of active five-star Nile cruises at the time of the study was 28 cruises. These cruises primarily operate along the Nile between Luxor and Aswan, with some stationed in Cairo and Giza.

Research Sample

To identify the sampling frame, the researcher compiled a verified list of the 28 Nile cruise vessels, ensuring that all were operational during the data collection period. The list excluded cruises under maintenance or temporarily out of service. The selection process also considered the accessibility and willingness of cruise management to participate, as site visits and internal audits were required. Given the specificity of the research and the necessity for direct field access, a purposive (judgmental) sampling technique was employed. This non-probability approach was deemed appropriate due to the study's focus on five-star Nile cruises and the requirement for in-depth audits of onboard food safety practices. Cruises were selected based on predefined criteria, including their star rating, current operational status, and management's consent to participate in the assessment process.

While purposive sampling offers targeted insights, it introduces potential bias by limiting the sample to only those cruises that meet specific criteria. To

mitigate this, efforts were made to include a diverse representation of operational characteristics, such as varying fleet size, geographic coverage, and management practices. Furthermore, the 17 selected cruises—representing approximately 61% of the total population—showed repetitive compliance patterns during audits, suggesting data saturation and providing a sufficiently broad understanding of FSMS implementation. Despite these limitations, the sample size was deemed appropriate given the intensive nature of the audit process, which included a comprehensive 25-section checklist and multi-day visits to each cruise. This purposive sampling approach, while limiting generalizability, ensured a focused and detailed examination of food safety practices, making it suitable for the study's objectives.

Research Instrument

The audit checklist used in this study was derived directly from the ISO 22000:2018 standards, which provide a comprehensive framework for evaluating food safety management systems. As the checklist is based on an internationally recognized and validated standard, no additional piloting or expert review was deemed necessary. However, to ensure its applicability in the context of Nile cruise vessels, the researcher carefully reviewed the checklist's alignment with the operational conditions of these vessels. This ensured that the checklist accurately captured the key elements required for effective FSMS implementation while accounting for the unique challenges of the cruise environment, such as spatial constraints and varying staff structures. By utilizing the ISO 22000:2018 checklist, the study ensured that the audit was grounded in a globally recognized food safety management framework, enhancing the credibility and reliability of the findings.

Data Collection Procedures

A three-phase audit process was employed to ensure methodological consistency:

1. Pre-Audit Phase: Preparatory meetings were held with cruise management teams to explain the audit objectives and obtain necessary permissions. Calibration sessions were conducted among auditors to standardize the interpretation of checklist items and promote inter-rater reliability.
2. Fieldwork Phase: On-site assessments were carried out during regular operating hours by trained auditors. These evaluations combined direct observation, staff interviews, and documentation review. Particular attention was paid to critical control points as defined by HACCP plans, with verification of both their presence and effective implementation.

   Audits were conducted across different meal periods (breakfast, lunch, and dinner) to account for operational variability, and where feasible, extended over multiple days. Observations were recorded using standardized forms, and photographic documentation was collected where permissible and appropriate.
3. Post-Audit Phase: Preliminary findings were discussed with departmental supervisors to validate observations and resolve ambiguities, ensuring accuracy and transparency in the audit outcomes.

Data Collection Procedures

The audit process followed a structured three-phase approach to ensure methodological rigor and consistency across evaluations. Before commencing fieldwork, researchers conducted preparatory meetings with cruise management teams to explain the audit's purpose and secure necessary access permissions. This pre-audit phase also included examiner calibration sessions to ensure uniform interpretation and application of checklist criteria. On-site data collection involved comprehensive observational assessments conducted by trained auditors during normal operational hours. Auditors systematically moved through designated food preparation and service areas, evaluating compliance against each checklist item through direct observation, staff interviews, and documentation review. Particular attention was paid to critical control points identified in HACCP plans, with auditors verifying both the existence and proper implementation of control measures. To capture operational realities accurately, audits were scheduled across different service periods (breakfast, lunch, and dinner preparation) and conducted over multiple days when possible. All findings were contemporaneously documented using standardized recording forms, with photographic evidence collected where appropriate (while respecting operational privacy concerns). Post-audit, preliminary findings were reviewed with department supervisors to verify observations and clarify any ambiguous findings.

Data Analysis Approach

Audit data were analyzed through a structured, multi-step process aimed at translating observations into actionable insights. Each checklist item was scored on a binary scale (1 = compliant, 0 = non-compliant), allowing for objective and standardized evaluation across all assessed operators. These binary scores were then aggregated to calculate section-specific compliance percentages, from which overall FSMS performance metrics were derived. To deepen the analysis, a gap analysis was performed by reviewing recurring noncompliances, which were categorized into three main types: procedural, documentation-related, and infrastructure-based. Cross-sectional comparisons across different cruise operators and operational areas were conducted to identify root causes and prioritize corrective actions. Additionally, a benchmarking process was applied against ISO 22000 standards and recognized industry best practices, ensuring that recommendations were both compliant and operationally viable. The final output included detailed compliance profiles for each cruise operator, outlining strengths and specific areas needing improvement. This analytical approach provided a reliable, transparent, and adaptable framework, particularly suited to the unique operational context of Nile cruise vessels. The combination of binary scoring, standardized checklists, and layered analysis ensured the robustness and practical relevance of the findings.

Results and Discussion

The audit results reveal a mixed compliance landscape in Nile cruise food safety management, with notable strengths in operational practices but critical gaps in documentation, infrastructure, and hazard control. Below, we contextualize these findings using insights from the literature and propose targeted interventions.

Table (1) Audit Checklist Compliance Results

Section	Key Criteria Evaluated	Compliance Rate (%)	Major Findings
1. Supplier Program	Approved Supplier List, NFSA/HACCP certifications, Supplier Forms	52.9–70.6	Low certification compliance; outdated records
2. Receiving	Staff awareness, product specs, temperature monitoring, documentation	17.6–100	Poor documentation; strong staff training
3. Glass and Wood Policy	Absence of glass/wood in food areas	100	Fully compliant
4. Labelling and Traceability	Perishable/pre-prepared food labeling	94.1–100	High compliance
5. Storage	Organization, cross-contamination, pest control, temperature monitoring	29.4–100	Critical gaps in allergen/pest control
6. Cleaning and Sanitation	Schedule adherence, sanitizer availability, chemical storage, equipment maintenance	35.3–94.1	Low sanitizer availability; poor dishwashing machine upkeep
7. Maintenance of Premises	Equipment repair, temperature calibration, structural integrity	23.5–94.1	Cracked equipment (76.5%); uncalibrated gauges (41.2%)
8. Pest Control	Pest activity records, bait station maps, corrective actions	17.6–82.4	52.9% pest activity evidence; minimal documentation
9. Waste Management	Timely waste removal	94.1	Strong compliance
10. Personal Hygiene	Handwashing, health records	41.2-100	Gaps in health documentation
11. Training and Induction	Staff training records	70.6	Inconsistent documentation
12. Non-Conforming Product	Complaint handling procedures	64.7	Procedures exist but are inconsistently applied
13. Product Recall	Recall plan documentation	58.8	Plans not fully tested
14. Food Preparation	Cross-contamination, temperature control	70.6–76.5	Allergen separation weak (52.9%)

Section	Key Criteria Evaluated	Compliance Rate (%)	Major Findings
15. Thawing	Proper thawing methods	82.4	Monitoring lapses
16. Cooking	Temperature monitoring	88.2	Some uncalibrated equipment
17. Cooling	Cooling procedures	64.7	Delays in documentation
18. Reheating	Temperature checks	70.6	Incomplete records
19. Hot Holding	Safe holding temperatures	76.5	Minor lapses
20. Plating/ Packing/Service	Hygienic handling, utensil condition	23.5–82.4	Cracked utensils
21. Transportation	Temperature-controlled transport	70.6	Inconsistent logs
22. Customer Complaints	Complaint recording and follow-up	64.7	Slow follow-up actions
23. Laboratory Analysis	Periodic food testing	58.8	Documentation gaps
24. Security Measures	Restricted access monitoring	70.6	Minor lapses
25. Food Safety Program Mgmt.	System updates and reviews	47.1	Inconsistent implementation

Strengths: Foundations of Compliance

The high levels of compliance in critical control areas demonstrate a solid foundation in food safety management. Notably, temperature control practices showed strong adherence—88.2% compliance in cooking processes and 76.5% in hot holding—aligning with ISO 22000's emphasis on thermal processing as a Critical Control Point (CCP) for mitigating biological hazards (ISO, 2018). Equally, full compliance in the labeling and traceability of perishables (100%) reflects the effective implementation of Prerequisite Programs (PRPs), particularly "Good Storage Practices," which support rapid product recall and supply chain transparency (Allata et al., 2017). The complete absence of high-risk materials such as glass and wood in food zones (100%) further underscores adherence to physical hazard controls as prescribed under ISO 22000, Clause 8.5.3. These findings mirror industry trends, wherein cruise operators prioritize visible and verifiable controls—like temperature logs—to meet international tourist expectations and regulatory scrutiny (Whyte et al., 2018).

Systemic Risk Areas

1. Documentation Failures

The audit revealed severe documentation gaps, particularly in supplier certification (52.9% compliance) and receiving records (17.6%). These findings align with institutional theory (DiMaggio & Powell, 1983), which posits that organizations

often adopt policies ceremonially to gain legitimacy without operational integrational phenomenon termed decoupling. For instance, while Nile cruises formally adopted ISO 22000 documentation requirements, the lack of updated records and supplier verification reflects superficial compliance. This decoupling mirrors Escanciano and Santos-Vijande's (2014) observations in land-based hospitality, where documentation systems were maintained only for audits rather than daily use. The absence of pest control records (17.6%) further exemplifies this, as crews prioritized visible tasks (e.g., temperature logs) over "invisible" paperwork, perceiving the latter as low value despite its critical role in hazard control (Mortimore & Wallace, 2013).

2. Infrastructure Deficiencies

Cracked equipment (76.5%) and uncalibrated gauges (41.2%) underscore a misalignment between TPB's constructs and actual practices. Staff attitudes toward maintenance were often dismissive ("if it works, don't fix it"), while perceived behavioral control was low due to limited resources (e.g., lack of backup thermometers). This resonates with Griffith's (2010) assertion that FSMS failures stem from staff viewing safety protocols as external impositions rather than intrinsic priorities. Additionally, subjective norms—such as management's focus on passenger experience over "backstage" repairs—reinforced neglect. Institutional pressures also played a role: cruises invested in cosmetic upgrades (e.g., dining décor) to attract tourists while deferring equipment repairs, illustrating how market-driven isomorphism skews resource allocation (Salunke, 2016).

3. Procedural Gaps

Inconsistent cleaning chemical availability (35.3%) and poor allergen segregation (29.4%) reflect TPB's intention-action gap. Interviews revealed that staff understood protocols but intentions to follow them wavered under time pressure. For example, cooks prioritized speed over allergen separation during peak hours, demonstrating Ajzen's (1991) observation that intent alone cannot drive compliance without enabling conditions (e.g., adequate staffing). Meanwhile, the lack of corrective action records (23.5%) signals institutional decoupling: crews performed ad-hoc fixes (e.g., removing pests) but avoided documentation to evade accountability behavior noted in maritime contexts by Lyu et al. (2017).

The study also uncovered operational patterns specific to the Nile cruise environment that remain underrepresented in the existing literature on FSMS implementation. Unlike land-based kitchens, the compact layout of galley spaces on Nile cruises—often less than one-third the size of comparable hotel kitchens—significantly limits the feasibility of allergen segregation and cross-contamination prevention zones. More than 75% of the audited cruises lacked clearly demarcated areas for allergenic and non-allergenic foods, with staff prioritizing refrigeration space over labeling or zoning protocols. As one supervisor remarked, "We prioritize fridge space for staples over labels." Another notable pattern is the impact of the Nile's geographic and logistical limitations on supply chain reliability. Many cruises operate on fixed itineraries with limited access to mid-route provisioning. Consequently, over half (52.9%) of cruise vessels reported incomplete delivery records, undermining traceability—a core component of ISO 22000.

Seasonal staffing also presents a distinctive operational challenge. Temporary employees, who comprise up to 65% of kitchen staff during peak tourism seasons, often lack FSMS training and institutional familiarity. This staffing structure correlates with reduced compliance in documentation and hygiene practices, affirming earlier observations by Montville & Matthews (2007) and Escanciano & Santos-Vijande (2014). These patterns underscore the need for a cruise-specific approach to FSMS implementation, especially within the unique logistical and environmental constraints of the Nile River context.

Conclusion

This study presents a comprehensive audit-based evaluation of FSMS implementation aboard five-star Nile cruise operations, benchmarked against ISO 22000:2018 standards. While certain core elements—such as temperature control and traceability of perishables—demonstrated commendable compliance, the overall findings revealed widespread systemic deficiencies that compromise food safety outcomes. Particularly troubling were critical lapses in documentation practices, infrastructure maintenance, and hazard control protocols. These gaps reflect deeper issues in organizational food safety culture and indicate a disconnect between formal FSMS frameworks and day-to-day operational execution. As Egypt positions its Nile cruise industry as a high-value tourism segment, such shortcomings not only threaten passenger health but also risk damaging international perceptions of service quality and safety assurance.

The audit findings highlight significant deficiencies in FSMS implementation across Nile cruise operations, particularly in documentation practices. Only 52.9% of suppliers provided valid NFSA or HACCP certifications, breaching ISO 22000's traceability requirements (Clause 8.3) and increasing supply chain risks. Furthermore, just 17.6% of delivery records were properly completed, reflecting broader traceability issues. These results are consistent with Karaman et al. (2012), who identified weak documentation as a major barrier to effective FSMS implementation in the food service industry. Infrastructure-related shortcomings further compounded these vulnerabilities. Facility inspections revealed that 76.5% of food contact surfaces and equipment exhibited physical damage—including cracked cutting boards and chipped serving ware—contravening maintenance provisions under Clause 7.1.3 of ISO 22000. These defects increase the risk of microbial contamination and reflect a broader neglect of preventive maintenance strategies. Compounding these risks, 41.2% of temperature monitoring devices were found to be uncalibrated, rendering critical control point (CCP) monitoring unreliable. These findings mirror operational challenges identified by Escanciano and Santos-Vijande (2014) in the hospitality sector.

High-risk hazard control areas were also found to be underperforming. Evidence of pest activity was documented in 52.9% of storage areas, yet pest control documentation—such as bait station placement and monitoring records—was present in only 17.6% of cases. This shortfall represents a significant lapse in operational prerequisite programs, particularly regarding environmental monitoring and contamination prevention (Mortimore & Wallace, 2013). Equally concerning was the lack of allergen control protocols. Collectively, these audit results suggest that while some foundational FSMS components are in place, significant gaps remain in

documentation, equipment integrity, and hazard control. Without targeted interventions and ongoing monitoring, these deficiencies could undermine the health and trust of international clientele, as well as the global competitiveness of Egypt's Nile cruise tourism sector.

Theoretical Contribution

This study makes several notable contributions to the evolving body of food safety management theory. Firstly, it offers empirical validation of implementation challenges previously identified by Karaman et al. (2012), particularly the persistent gap between formal policy adoption and actual operational practice. The audit findings provide compelling support for Institutional Theory (DiMaggio & Powell, 1983), illustrating the phenomenon of ceremonial compliance, wherein organizations adopt internationally recognized frameworks such as ISO 22000 primarily for legitimacy, without fully integrating their principles into everyday activities. This decoupling was especially evident in documentation, monitoring, and corrective action procedures.

Secondly, the results expand the discourse on HACCP system implementation in specialized, non-traditional environments. While the foundation principles of HACCP, as articulated by Mortimore and Wallace (2013), remain broadly applicable, this study highlights how the maritime context introduces unique constraints—such as limited spatial layouts, equipment instability due to vibration, and high staff turnover—that complicate standard application. These insights reinforce the call by Lyu et al. (2017) for sector-specific adaptations to food safety management frameworks.

Most significantly, this research contributes to the theoretical understanding of risk perception and food safety culture. The consistently low compliance with corrective action protocols (23.5%) suggests an underestimation of food safety risks among operational staff—a behavioral dynamic previously explored by Griffith (2010). This supports Yiannas' (2009) assertion that the success of food safety systems is contingent not only on technical implementation but also on addressing psychological and cognitive factors within the workforce. By combining audit evidence with these theoretical frameworks, the study offers a multidimensional understanding of why FSMS implementation often falters in high-pressure, high-turnover service settings.

Practical Implications

The findings of this study offer actionable and tailored recommendations for stakeholders in the Nile cruise food service ecosystem.

For cruise operators, immediate attention should be directed to three key areas:

1. Equipment integrity: Replace damaged food contact surfaces and monitoring devices and implement a routine calibration schedule to ensure consistent functionality.
2. Digital documentation: Adopt food safety management software (as suggested by Zimon & Domingues, 2020) to enhance record-keeping, improve traceability, and support real-time compliance monitoring.
3. Cultural transformation: Foster a shift in organizational culture by implementing regular, role-specific training, introducing peer accountability

mechanisms, and promoting leadership-driven engagement in food safety performance, as emphasized by Yiannas (2009).

For regulatory bodies, such as the national food safety authority, the study suggests strengthening enforcement through incentive-based mechanisms. Introducing a supplier blacklisting system for non-compliance and requiring mandatory pest control contracts with certified third-party providers (Paola, 2020) could elevate industry standards.

Industry associations and policymakers should prioritize developing Nile cruise-specific FSMS guidelines that address the operational challenges identified by Ružić (2018). A tiered certification model could reward incremental improvements, encourage competition, and establish clear benchmarks for cruise operators at different operational levels.

Training institutions and FSMS educators should update their instructional strategies by incorporating behavior-based learning methods, particularly those based on the Theory of Planned Behavior (Ajzen, 1991). Programs should focus on fostering personal responsibility, strengthening perceived behavioral control, and creating normative pressure to ensure ongoing compliance.

Additional context-specific strategies are recommended to enhance FSMS implementation on Nile cruises:

1. Digital tools: Cruise operators could implement mobile-based, multilingual, and offline-compatible traceability applications to streamline documentation, facilitate audit readiness, and reduce paperwork in low-connectivity environments.
2. FSMS training: Training should be redesigned into modular, video-based content in native languages (e.g., Arabic, Hindi) with visual aids. This approach accommodates seasonal staff and varying literacy levels, which is crucial in the diverse cultural environment of cruise operations.
3. Spatial constraints: Introduce color-coded allergen control zones using removable floor mats and dedicated utensils. This solution is cost-effective, flexible, and does not require structural changes.

A pilot testing framework should be established to trial these strategies with a sample of cruise operators. Regular audits and staff feedback would help assess effectiveness and inform future implementation.

Finally, it is recommended that the NFSA, in collaboration with tourism and hospitality associations, develop a customized FSMS guideline for Nile cruises. This framework should consider the unique environmental, logistical, and workforce challenges of Nile cruise operations and help bridge the gap between formal compliance and practical performance.

Study Limitations

While this study offers valuable insights into FSMS implementation on Nile cruises, several limitations should be acknowledged to contextualize the findings. First, observer bias may have influenced audit results, particularly in areas where compliance behaviors were highly visible, such as handwashing or temperature monitoring. Despite standardized checklist use, subtle subjective judgments may have

affected scoring. Secondly, the potential for a Hawthorne effect—where staff alter their behavior due to being observed—cannot be ruled out. For example, temperature logbooks were more consistently filled during scheduled audit times compared to random spot-checks, suggesting reactivity to observation.

Language barriers and cultural misunderstandings also presented challenges during staff interviews. Many food handlers were non-native Arabic speakers, with some communicating in regional dialects or foreign languages (e.g., Hindi, Urdu). This occasionally required translation assistance, which may have reduced the depth or clarity of some qualitative responses. Thirdly, the study focused exclusively on five-star cruises, which, while significant, may not fully represent mid-tier or budget cruise operations where FSMS resources and practices may differ. Therefore, caution is advised when generalizing findings beyond this luxury cruise segment. Lastly, while purposive sampling was used to select the sample of five-star Nile cruises, several additional limitations must be acknowledged. Observer bias could have influenced the audit findings, though standardization of the process and involvement of multiple observers helped mitigate this. Limited generalizability applies as the sample was restricted to 17 out of 28 five-star vessels, and the findings may not represent other cruise categories or regions. Seasonality could also impact compliance, as food safety practices may vary with seasonal fluctuations in passenger traffic or staff turnover. These limitations highlight areas for future research, including expanding the sample, considering longer data collection periods, and addressing the effects of seasonality on food safety practices.

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