Degree Project in Technology, Work and Health

Second Cycle, 30 credits

Emergency Preparedness Towards a Sustainable Work Environment

A Case Study

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TRITA-CBH-GRU-2026:022
Stockholm, Sweden 2026

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Abstract

This master's thesis investigates the state of emergency preparedness within student dormitories, using EGEM Premium Residence in Cyprus as an in-depth case study. The research addresses a critical gap between the presence of basic safety infrastructure and the systemic implementation of robust emergency management frameworks. A mixed-methods approach was employed, integrating quantitative surveys, a structured on-site inspection using a custom-developed mobile application, participatory workshops, and an evacuation drill to triangulate the findings.

The investigation identified three critical systemic gaps: (1) occupant preparedness deficiency, with 75% of residents unaware of nearest fire exits and 85% having never participated in evacuation drills; (2) organizational system absence, including a lack of documented safety policies, maintenance records, incident reporting mechanisms, and health and safety representation; and (3) technological integration deficit, wherein existing safety infrastructure (fire detection, emergency exits, communication systems) operates in isolation rather than as a coordinated emergency management system. Risk analysis identified training gaps, electrical overloading, obstructed evacuation routes, and inadequate kitchen fire protection as high-priority hazards requiring immediate intervention.

A pivotal component of the research was the participatory evaluation of Information and Communication Technology (ICT) solutions. Findings reveal strong stakeholder consensus for user-centered digital tools, such as mobile applications with interactive evacuation maps and real-time monitoring systems, while surveillance-based technologies were met with resistance due to privacy concerns. The thesis concludes by proposing a phased intervention strategy, aligned with ISO 45001 principles, which prioritizes immediate remedial actions, mid-term policy development, and long-term strategic investments in feasible ICT. This evidence-based roadmap demonstrates how a synergistic combination of participatory engagement, systematic OHS frameworks, and context-appropriate technology can cultivate a sustainable and resilient safety culture in student accommodation environments.

The thesis concludes that sustainable emergency preparedness requires integrated intervention across organizational policy, human competence, physical infrastructure, and technological enablement, none of which, in isolation, produces optimal outcomes. The case of EGEM Premium Residence exemplifies common challenges in student housing globally while illuminating evidence-based solutions transferable to similar institutional contexts.

Keywords: Emergency Preparedness, ISO 45001, Risk Management, Participatory Design, ICT Integration, Student Dormitories

Sammanfattning

Denna masteruppsats undersöker beredskapen i studentboenden med hjälp av EGEM Premium Residence på Cypern som en fördjupad fallstudie. Forskningen tar upp en kritisk lucka mellan förekomsten av grundläggande säkerhetsinfrastruktur och den systematiska implementeringen av robusta ramverk för krishantering. En blandad metod användes, som integrerade kvantitativa undersökningar, en strukturerad inspektion på plats med hjälp av en specialutvecklad mobilapplikation, deltagande workshops och en evakueringsövning för att triangulera resultaten.

Undersökningen identifierade tre kritiska systemiska luckor: (1) bristande beredskap bland de boende, där 75 % av de boende inte var medvetna om närmaste brandutgångar och 85 % aldrig hade deltagit i evakueringsövningar; (2) avsaknad av organisatoriska system, inklusive brist på dokumenterade säkerhetspolicyer, underhållsregister, mekanismer för incidentrapportering och hälso- och säkerhetsrepresentation; och (3) brist på teknisk integration, där befintlig säkerhetsinfrastruktur (branddetektering, nödutgångar, kommunikationssystem) fungerar isolerat snarare än som ett samordnat krishanteringssystem. Riskanalysen identifierade utbildningsluckor, elektrisk överbelastning, blockerade evakueringsvägar och otillräckligt brandskydd i kök som högprioriterade faror som kräver omedelbar intervention.

En central del av forskningen var den deltagande utvärderingen av informations- och kommunikationsteknologiska (IKT) lösningar. Resultaten visar stark enighet bland intressenter om användarcentrerade digitala verktyg, såsom mobila applikationer med interaktiva evakueringskartor och realtidsövervakningssystem, medan övervakningsbaserade tekniker möttes av motstånd på grund av integritetsproblem. Avhandlingen avslutas med att föreslå en etappvis interventionsstrategi, i linje med ISO 45001-principerna, som prioriterar omedelbara åtgärder, utveckling av policy på medellång sikt och långsiktiga strategiska investeringar i genomförbar IKT. Denna evidensbaserade färdplan visar hur en synergistisk kombination av deltagande engagemang, systematiska ramverk för arbetsmiljö och kontextanpassad teknik kan odla en hållbar och motståndskraftig säkerhetskultur i studentboendemiljöer.

Avhandlingen drar slutsatsen att hållbar krisberedskap kräver integrerade insatser över organisationspolicy, mänsklig kompetens, fysisk infrastruktur och teknisk möjliggörande, varav inget isolerat ger optimala resultat. Fallet med EGEM Premium Residence exemplifierar vanliga utmaningar inom studentbostäder globalt samtidigt som det belyser evidensbaserade lösningar som kan överföras till liknande institutionella sammanhang.

Nyckelord: Nödberedskap, ISO 45001, Riskhantering, Deltagande Design, IKT-integration, Studenthem

Acknowledgements

I extend my sincere gratitude to Prof. Dr. Josue Eduardo Maia Franca, the administrative staff, and student residents of EGEM Premium Residence for their substantial contributions and participation in this research endeavour.

Firat Utku
Stockholm, 2025

Table of Contents

List of Figures

List of Tables

List of Acronyms and Abbreviations

Notations

Symbol	***Description***
%	*Percent sign*
&	*And*
≥	Greater than or equal to
≤	Less than or equal to
+	*Plus*
t	*Time*

Abbreviations

2D	*Two Dimensional*
3D	*Three Dimensional*
AI	*Artificial Intelligence*
AR	*Augmented Reality*
BIM	*Building Information Modelling*
CCTV	*Closed-circuit television*
E.g.	*For Example (exempli gratia in Latin)*
FEMA	*Federal Emergency Management Agency*
ICT	*Information and Communication Technology*
ISO	*International Organization for Standardization*
iOS	*iPhone Operating System*
IoT	*Internet of Things*
m/s	*Meter per Second*
OHS	*Occupational Health and Safety*

OSHA	*Occupational Safety and Health Administration*
TAM	*Technology Acceptance Model*
US	*United States*
VR	*Virtual Reality*

Chapter 1: Introduction

1.1 Background

The Importance of Emergency Preparedness in Student Residences

Student dormitories represent unique occupational and residential environments where emergency preparedness is both a legal obligation and a moral imperative. These facilities typically house populations aged 18-25, often living independently for the first time, in close communal settings that amplify both the frequency and potential severity of emergencies (Ellen, 2019). The dormitory context presents particular challenges: transient populations, diverse cultural backgrounds, limited prior emergency experience, and densely occupied spaces where evacuation must be coordinated rapidly and safely (Hostetter et al., 2024; Alexa & Brent, 2015). Additionally, the communal nature of such living arrangements presents unique challenges for risk management and evacuation planning (Roman & Raya, 2017).

Research on residential fire incidents demonstrates the severity of consequences resulting from inadequate preparedness. A longitudinal analysis of college dormitory fires found that inadequate emergency planning and limited occupant awareness significantly increased casualty rates, with some incidents resulting in severe injuries and fatalities (Conlon et al., 2022). Similarly, studies examining emergency preparedness among university students reveal that 60-75% of residents lack basic knowledge of evacuation routes, emergency response protocols, and nearest exits (Cox, 2022). This knowledge deficit directly reduces response efficacy during crises, as occupants may delay evacuation decisions, become disoriented regarding evacuation routes, or experience panic responses during low-visibility emergencies (Glauberman, 2018).

Beyond fires, student residences face a spectrum of hazards including earthquakes (particularly relevant for institutions in seismically active regions such as Cyprus), medical emergencies, active threat scenarios, and public health crises (Goddard et al., 2018; Victoria, 2025; Zhu et al., 2020). The occupational health and safety (OHS) framework must therefore encompass both acute and sustained threats, requiring systematic hazard identification, risk assessment, and evidence-based interventions (Alli, 2008). By systematically implementing these interventions, student dormitories can effectively mitigate potential hazards, strengthen institutional accountability, and enhance the overall safety and well-being of their residents (Nyakotyo & Goronga, 2024).

Furthermore, integrating communication protocols with local emergency services as well as national disaster agencies can increase capacity for large-scale events in a way that aligns with broader frameworks (Elvira, 2018).

The Role of Information and Communication Technology (ICT) in Modern Emergency Preparedness

Contemporary emergency management increasingly relies on ICT to enhance situational awareness, improve communication, and enable rapid response. Digital technologies serve multiple functions in emergency preparedness: they facilitate real-time hazard detection through sensor networks and automated monitoring systems; they enable dynamic communication through mobile applications and alert systems; they support decision-making through data analytics and predictive modelling; and they enhance training through simulation, virtual reality, and multimedia platforms (Morales et al., 2014; Reddick, 2011; Yiqing & Nan, 2021).

Building Information Modelling (BIM), for instance, creates comprehensive three-dimensional digital representations of structures, enabling emergency planners to visualize evacuation routes, identify bottlenecks, and simulate various emergency scenarios (Khattra & Jain, 2024; Gao et al., 2023). Internet of Things (IoT) technologies, including smart sensors, wearable devices, and real-time monitoring systems, provide continuous surveillance of environmental hazards such as smoke, temperature, and gas concentrations, enabling rapid detection and alerts (Himel et al., 2025; Gnoni et al., 2020). Artificial intelligence and machine learning algorithms analyse historical incident data, identifying patterns and predicting high-risk situations, thereby enabling proactive interventions (Liu & Yingnan, 2024; Park & Kang, 2024).

However, ICT integration must be approached critically and contextually. Technology adoption in safety-sensitive environments requires careful consideration of user acceptance, privacy concerns, cost-effectiveness, and alignment with organizational capability (Nancy, 2024; Natalia et al., 2023). Participatory design principles, which involve stakeholders directly in the development and evaluation of technological solutions, are essential to ensure that adopted technologies are both practically useful and socially acceptable (Velden & Mörtberg, 2014; Dindler et al., 2019).

In preparation for the safety assessment, a mobile application was developed by the researcher to digitize the emergency preparedness checklist and enable efficient, standardized data collection during the on-site inspection. This reflects the study's emphasis on practical integration of ICT to support safety management and serves as a preliminary technology prototype in the case setting.

Regulatory and Standards Framework

For students, the dormitory is their primary occupational living environment, and their safety is a core part of the institution's duty of care and operational sustainability. The central argument of this thesis is that student dormitories must be managed under a formal OHS framework. While a dormitory is a residential facility, the managing institution has a non-delegable duty of care to its residents that functionally mirrors an employer's OHS obligation to its workers (Xulu-Gama, 2019).

ISO 45001, the international standard for occupational health and safety management systems, provides a comprehensive framework for organizations to systematize emergency preparedness. Published in 2018, ISO 45001 emphasizes proactive hazard identification, risk assessment, continuous improvement, and stakeholder engagement (Šolc et al., 2022; Darabont et al., 2017). The application of ISO 45001 to a student dormitory is justified by the following rationale (Sivarama et al., 2021):

Organizational Control: The institution controls the physical environment (infrastructure, maintenance, fire systems) and the administrative processes (policies, training, emergency response) that directly affect resident safety. This level of control aligns precisely with the requirements of an OHS Management System.

Risk Mitigation Mandate: The dormitory context presents occupational-level risks (e.g., electrical fires from overloaded circuits, slips/trips on common stairs, exposure to improperly stored chemicals in staff areas) that require systematic management beyond basic fire code compliance.

Sustainable Work Environment: For the five staff members, the dormitory is their workplace, obligating the institution to provide them with a safe environment and appropriate emergency training. The OHS framework is thus essential for both staff and, by extension, the residents they are tasked to protect.

Therefore, ISO 45001 alignment offers a structured, internationally recognised pathway to enhance safety outcomes, particularly when combined with modern technologies and participatory methods, ensuring a sustainable and secure residential community (Chizubem et al., 2024; Omidi et al., 2023).

The Case Study Context

EGEM Premium Residence is a student residence located in Nicosia, Cyprus, with a total capacity of 290 beds in three branches; the main branch under review accommodates 80 people and an additional facility is under development. The residence is managed by a small staff of five, comprising one manager, two housekeepers, and two kitchen staff. Despite existing legal requirements, many student dormitories lack comprehensive emergency frameworks that systematically integrate hazard identification, risk management, staff competence, technological support, and continuous improvement (Daramola et al., 2024). This gap between regulatory expectations and operational reality creates substantial vulnerability and liability (Hassanain et al., 2018).

Preliminary observations and stakeholder discussions indicated significant gaps in emergency preparedness, including absent or outdated emergency protocols, limited staff training, inadequate equipment maintenance, and minimal resident awareness of emergency procedures.

Figure 1.1. View of the residence from the front facade (EGEM, n.d.)

1.2 Purpose

The thesis examines the emergency preparedness infrastructure at a student dormitory in Cyprus, identifying critical gaps and proposing evidence-based interventions aligned with international standards and modern technological capabilities. The study recognizes that effective emergency preparedness requires more than isolated safety measures; it demands a holistic, systemic approach integrating organizational policy, staff and resident competence, physical infrastructure, technological support, and a proactive safety culture.

Specifically, this research seeks to evaluate current emergency preparedness measures, assess the feasibility of integrating ICT to enhance preparedness, and develop actionable recommendations grounded in both international best practices and the specific needs, preferences, and constraints of the study site.

1.3 Objectives

The primary objectives of this research are fourfold:

- Evaluate current emergency preparedness measures by conducting a comprehensive risk assessment that identifies hazards, evaluates existing safety protocols, and quantifies gaps in resident and staff preparedness, fire safety infrastructure, evacuation planning, and health and safety management.
- Focus on enhancing preparedness through improved training programs, emergency protocols and technological innovations that increase resident and staff awareness of emergency procedures.
- Assess the feasibility and acceptability of ICT solutions by evaluating through participatory design methods, which digital technologies (digital evacuation maps, mobile alert systems, real-time monitoring, AI-driven analytics) are acceptable to stakeholders, practical within the operational and financial constraints of the site, and aligned with privacy and ethical considerations.
- Foster a proactive safety culture through participatory engagement, interactive workshops, and feedback mechanisms that ensure proposed safety enhancements are user-centered, integrated into daily operations, and sustained through continuous improvement cycles aligned with ISO 45001 principles.

1.4 Delimitations

The study is subject to several methodological and contextual limitations. The case study design, while enabling in-depth analysis of a specific dormitory, limits generalizability to institutions with different architectural configurations, organizational structures, regulatory environments, or cultural contexts. The sample size of 40 residents and 5 staff members, though appropriate for a single-site case study, may not capture the full range of perspectives within a larger population or diverse demographic cohorts.

Financial and logistical constraints precluded real-time evaluation of certain advanced technologies (wearable devices, extended virtual reality training) and structural engineering assessments (fire-resistance ratings), leaving their effectiveness speculative within this specific context. The absence of longitudinal follow-up data limits assessment of whether implemented interventions sustain their initial effectiveness over time or whether resident awareness and competence decay following the completion of this study.

Additionally, this research examines internal preparedness mechanisms rather than cross-institutional or regional coordination frameworks. While recommendations acknowledge the value of integration with national disaster agencies and broader emergency management systems, their detailed evaluation, compliance with national laws, or a detailed cost-benefit analysis of the proposed interventions are beyond the scope of the study.

1.5 Ethical Considerations

All participants provided informed written consent prior to participation in the surveys. Consent forms (Appendix A) explicitly described the purpose of the study, the nature of participation, anticipated risks and benefits, and the voluntary nature of involvement.

Personal data were anonymized throughout the study; survey responses were aggregated and reported only in statistical form without individual identifiers. Interviews and workshop discussions were conducted confidentially, with no names or identifying information retained in the datasets or analysis. Photographs were captured by the researcher with participant/facility consent; images that could identify individuals were anonymised and stored on an encrypted device; raw images will be deleted one year after the thesis' publication date.

An objective research approach was maintained throughout: no prior assumptions about the residence's safety status influenced data collection or analysis. The research sought to identify both strengths and deficiencies fairly, and all stakeholders were afforded equal opportunity to provide input and feedback. No coercion or undue influence was exerted on participants to participate or provide particular responses.

Chapter 2: Theoretical Framework

Risk Management Theory

Risk management is a systematic process for identifying, analysing, evaluating, and treating hazards within any organizational or physical environment (Wilson et al., 2012; Lynnaire, 2023). The core cycle comprises four stages:

- **Identification**: Systematically cataloguing potential hazards, including fire, electrical, structural, occupational, and environmental threats, relevant to the specific context.
- **Analysis**: Evaluating the likelihood of each hazard occurring and the potential severity of consequences, typically on scaled matrices (e.g., 1-5 ratings) enabling comparison and prioritization.
- **Evaluation**: Comparing analysed risks against predetermined criteria and organizational risk tolerance to determine which hazards require immediate intervention, periodic review, or acceptance.
- **Treatment**: Implementing control measures ranging from elimination (removing the hazard source), through engineering controls (redesigning systems), administrative controls (policies and training), to personal protective equipment or monitoring (Herstein et al., 2021; Rout & Sikdar, 2017).

Applied to student dormitories, risk management theory underpins the systematic assessment of fire safety infrastructure, electrical systems, occupant behaviour, and organizational procedures. A thorough risk assessment provides the empirical foundation for identifying which hazards pose greatest threat, thereby guiding targeted investments in mitigation and allowing evidence-based prioritization of interventions (Cardona & Tibaduiza, 2011).

Safety 1 and Safety 2 Paradigms

OHS management operates within two complementary paradigms, increasingly recognized as representing a strategic evolution in safety thinking (Hollnagel et al., 2015):

Safety 1 employs a reactive, failure-focused approach in which safety is defined as absence of adverse events. This paradigm emphasizes identifying breakdowns (e.g., situations malfunctioning fire alarms, obstructed exits, untrained staff), implementing corrective actions, and maintaining vigilance against recurring failures. Regulatory compliance is often driven by Safety 1 logic: if emergency equipment is regularly inspected and functional, fires are less likely to cause catastrophic outcomes.

Safety 2 adopts a proactive, adaptability-focused approach: safety is achieved by ensuring that things go right. This paradigm emphasizes understanding how systems normally function successfully, identifying the conditions that enable effective adaptation, and building organizational capacity to respond flexibly to unexpected. Safety 2 recognizes that complex systems like emergencies cannot be entirely predicted or controlled through pre-set procedures alone; rather, safety depends on the competence, situational awareness, and adaptive capacity of actors within the system.

For emergency preparedness in dormitories, the distinction is operationally important. Safety 1 approaches prioritize maintaining functioning fire alarms and clear exits. Safety 2 approaches additionally emphasize resident familiarity with procedures, staff competence to adapt guidance to varying scenarios, and a safety culture where occupants actively engage in preparedness rather than passively complying with rules (Gwynne et al., 2020; Hostetter et al., 2024).

The theoretical integration of both paradigms, ensuring nothing goes wrong (Safety 1) while building adaptive capacity (Safety 2), provides a comprehensive foundation for the study's mixed focus on both infrastructure audits and participatory engagement.

Participatory Design Theory

Participatory design is an approach to problem-solving and system development that places end-users at the centre of design and decision-making processes (Velden & Mörtberg, 2014; Dindler et al., 2019). Core principles include:

- **User-centred focus**: Solutions are designed by understanding actual user needs, constraints, and preferences rather than imposing solutions designed by experts alone.
- **Co-creation**: Stakeholders actively contribute to identifying problems, generating solutions, and evaluating feasibility.
- **Iterative refinement**: Design proceeds through cycles of prototyping, user feedback, and revision.
- **Empowerment**: Participation enhances stakeholders' understanding of issues and their agency in creating solutions.

In the context of emergency preparedness, participatory design is particularly valuable because it addresses a fundamental challenge: occupant compliance with and confidence in emergency protocols depends not only on the technical correctness of those protocols but also on occupants' understanding, acceptance, and perceived feasibility (López et al., 2023). Through participation in evacuation route design, obstacle identification, and emergency scenario simulation, residents develop practical familiarity with procedures and psychological investment in safety protocols. This active engagement aligns with Safety 2 thinking, building adaptive capacity, rather than merely ensuring passive compliance.

Participatory methods employed in the study, including interactive workshops, focus group discussions, and post-drill feedback sessions, operationalize this theoretical commitment to stakeholder involvement.

Technology Adoption and Integration

Understanding technology adoption is a crucial theoretical complement for this research, as a core objective involves empirically assessing the feasibility of ICT integration in the OHS context. Relevant frameworks include:

Technology Acceptance Model (TAM): Proposes that technology adoption is driven by perceived usefulness (the degree to which technology helps accomplish goals) and perceived ease of use (the degree to which technology is free from cognitive burden) (Davis, 1989). Developed by Fred Davis (1989), TAM posits that a user's decision to adopt a new technology is primarily determined by two constructs:

- **Perceived Usefulness:** The degree to which a person believes that using a particular system will enhance their job performance or effectiveness in an emergency.
- **Perceived Ease of Use:** The degree to which a person believes that using a particular system will be free of effort.

Socio-technical systems theory: Recognizes that technology does not exist in isolation but is embedded within social, organizational, and physical contexts. Successful technology integration requires alignment among technical capability, organizational processes, user competence, and cultural norms (Baxter & Sommerville, 2011). A sophisticated AI-driven fire prediction system may fail if staff lack training to interpret its outputs or if organizational procedures do not accommodate AI recommendations.

These frameworks inform the study's critical approach to technology assessment: rather than assuming that advanced technologies are inherently beneficial, the research empirically evaluates which technologies (e.g., a mobile app or AI surveillance) stakeholders find acceptable and feasible within the specific organizational and operational context of EGEM Premium Residence, not only in terms of cost but also in direct relation to user perception.

Chapter 3: Methods

3.1 Research Design

The study employed a mixed-methods research design combining quantitative and qualitative data collection techniques to enable comprehensive evaluation of emergency preparedness and triangulation of findings. Mixed-methods research is particularly appropriate for complex, real-world phenomena such as organizational safety, where quantitative data (survey responses, risk scores, evacuation times) provide measurable evidence of specific gaps, while qualitative data (workshop discussions, focus group insights, observational notes) illuminate the contextual factors, stakeholder perspectives, and implementation challenges that numbers alone cannot capture (Johnson & Onwuegbuzie, 2004; Morse & Niehaus, 2009; (Creswell & Plano Clark, 2018).

The research proceeded through sequential phases: (1) preliminary scoping and stakeholder engagement; (2) data collection through surveys, on-site inspection, and participatory workshops; (3) risk analysis and interpretation; (4) evaluation of technology feasibility; and (5) synthesis of findings into evidence-based recommendations. This phased approach enabled iterative learning: early survey and inspection data informed workshop content and discussion topics, and workshop feedback informed the evaluation of which technological solutions to recommend.

3.2 Data Collection Methods

3.2.1 Checklist Development and Validation

The on-site inspection employed a customized 34-item checklist (Appendix B) developed through the following process:

Foundation in established frameworks: The checklist synthesized requirements from multiple evidence-based sources: the ISO 45001:2018 standard clauses relevant to emergency preparedness and occupational health; the Occupational Safety and Health Administration (OSHA) emergency preparedness guidelines (US Department of Labor, n.d.); the Federal Emergency Management Agency (FEMA) comprehensive preparedness guidance (FEMA, 2010); and academic literature on dormitory fire safety and risk assessment.

Adaptation to context: Generic frameworks were adapted to the specific context of a student dormitory, with particular attention to hazards relevant to residential settings: overcrowded communal spaces, communal kitchen facilities, electrical overload in student rooms, fire risks from cooking and heating devices, and occupant behaviours specific to younger populations (Razon & Ahmad, 2017; Cox, 2022).

Content validation: The checklist was reviewed by the facility management at EGEM Premium Residence to ensure all items were observable, measurable, and actionable within the dormitory environment. This process ensured that the checklist addressed both infrastructure elements (e.g., location and functionality of fire extinguishers) and organizational elements (e.g., existence of written emergency procedures, maintenance documentation).

Application and scoring: Each of the 34 items was scored as "Yes" (compliant), "No" (non-compliant), and explanatory notes were added. This binary/categorical scoring enabled both quantitative aggregation (e.g., 11 compliant items of 34 total = 32.4% compliance) and qualitative analysis of specific deficiencies. The checklist covered six domains: fire safety and emergency equipment; evacuation planning and signage; occupational health hazards; training and competence; maintenance and documentation; and security and incident management. This approach aligns with established procedures for hazard identification in high-occupancy settings (Rout & Sikdar, 2017).

Validity and reliability: While the checklist is a custom tool rather than a published instrument, its validity is supported by its foundation in established international standards and regulatory guidance, its adaptation to the specific context through stakeholder consultation, and its use of observable, objective criteria. Reliability is enhanced by the systematic application of consistent scoring criteria across all items and by the retention of detailed observational notes enabling independent verification. However, as a custom tool applied in a single study, formal psychometric testing of reliability was not conducted.

3.2.2 Digital Tool Development: Custom Mobile Application

To enhance the efficiency, accuracy, and digital traceability of the data collection process, a custom mobile application was developed by the researcher prior to the on-site audit. The application, titled "Safety EGEM Assessment," was designed for Android and iOS platforms and served as the primary interface for administering the 34-item inspection checklist (Appendix B).

Application Development and Features:

Platform: The app was built using a cross-platform framework, ensuring compatibility with most modern smartphones.

Checklist Integration: The entire 34-item checklist was digitized within the app. Each item was presented as a discrete question with Yes/No/Not Sure response options and a mandatory field for observational notes (Figure 3.1).

Data Logging: The application automatically timestamped all entries and allowed for the direct capture and attachment of photographs from within the app, linking visual evidence directly to specific checklist items.

Data Export: Upon completion, inspection data could be exported in a structured format for quantitative analysis, streamlining the risk scoring process.

Application in the Research Process:

The application was used by the researcher during the on-site inspection. This digital tool replaced paper-based forms, reducing manual data entry errors and ensuring that all checklist items were addressed systematically. The use of this application represents a practical implementation of ICT to support the research methodology itself, demonstrating the feasibility and utility of such tools in safety management contexts.

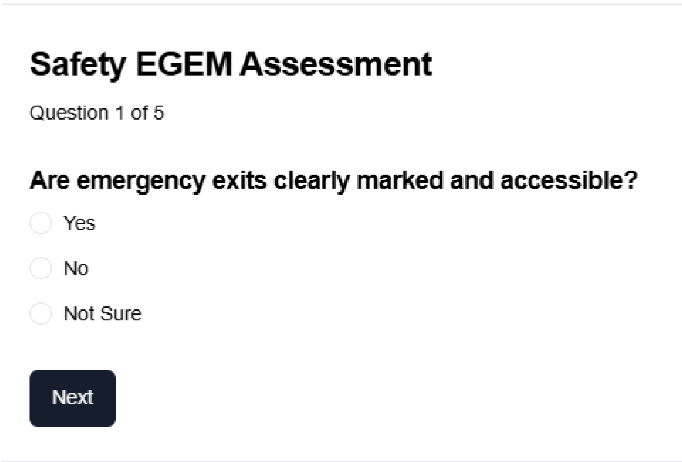

Figure 3.1. A view of the application's interface.

The development and deployment of the 'Safety EGEM Assessment' application served a dual purpose: it was the primary instrument for the on-site inspection, and it also functioned as a pilot study for technology integration. Following its successful use in streamlining data collection and improving accuracy, the application was explicitly included as a case study in the subsequent technology feasibility assessment. It was evaluated by stakeholders as an example of a low-cost, high-impact digital intervention with strong potential for scaling into routine safety audit protocols.

3.2.3 Surveys

Pre-intervention survey: A structured survey (Appendix D) was administered to 40 resident students and 5 staff members prior to the evacuation drill and participatory workshops. The survey employed dichotomous (Yes/No) response scales to assess baseline knowledge and preparedness:

- Awareness of emergency exits and evacuation routes
- Participation in prior evacuation drills and first aid training.
- Familiarity with emergency response protocols
- Confidence in existing safety measures
- Previous experience of workplace incidents or near-misses

Dichotomous scales facilitate rapid data collection, enable easy quantification, and allow comparison of proportional awareness across populations. The survey was administered in paper form with informed consent, and participants were offered the choice of completing the survey in English or with translation support.

Post- intervention survey: Following the evacuation drill, an anonymous post-drill assessment survey (Appendix E) was administered to the same 40 residents. This instrument employed dichotomous and scaled questions to gather feedback on:

- Clarity of evacuation routes and signage during the drill
- Perceived obstacles or bottlenecks
- Confidence in emergency response abilities post-drill
- Suggestions for improving future drills.

Anonymous administration encouraged candid responses about safety concerns and organizational deficiencies that participants might be reluctant to attribute to themselves if their names were recorded. Both surveys were designed following guidelines for reliable questionnaire development, ensuring questions were unambiguous and relevant (Creswell & Plano Clark, 2018).

Sampling and response rates: The 40 residents surveyed represented approximately 50% of EGEM's 80-resident capacity at the time of the study. The facility manager distributed survey forms to residents in common areas and provided a secure collection box. All 5 staff members participated. This sampling strategy captured a substantial proportion of the residential population and the entire staff cohort, enabling robust findings representative of the facility's occupant perspectives.

3.2.4 On-Site Inspection

A comprehensive on-site inspection was conducted using the 34-item checklist (Appendix B), which was administered digitally via the custom "Safety EGEM Assessment" mobile application. The inspection encompassed:

- **Common areas**: Corridors, staircases, emergency exits, assembly areas, kitchens, utility rooms.
- **Resident rooms**: Sample of 20 rooms to assess electrical hazards, prohibited items (heating devices, smoking materials), storage practices.
- **Infrastructure**: Fire detection and suppression systems, emergency lighting, alarm systems, signage, structural integrity.
- **Documentation review**: Maintenance records, incident logs, staff training records, safety policies.

The inspection was conducted by the researcher with facility management accompaniment. Photographs and detailed notes were retained for each observable hazard or deficiency. The systematic, criterion-based approach enabled objective documentation and later cross-referencing with risk assessment findings.

Validity and reliability: The on-site inspection's validity is supported by the structured checklist grounded in established standards, its systematic application by trained evaluators, and its complementation by photographic evidence. Reliability is enhanced through the objective, observable nature of most criteria (e.g., "Is the emergency exit door obstructed?" has a verifiable yes/no answer), consistency of application, and retention of detailed observational notes enabling independent verification.

3.2.5 Participatory Workshops

First interactive workshop: An interactive workshop was organized on-site, involving 45 participants: 40 residents, 5 staff members. The workshop employed facilitated small-group discussions and interactive exercises structured around the following topics:

- **Risk identification and prioritization**: Participants reviewed preliminary findings from the on-site inspection and survey regarding identified hazards, discussed their perceptions of which risks posed greatest concern and required urgent intervention.

- **Evacuation Route Design and Spatial Analysis:** Participatory analysis of evacuation logistics was conducted utilising a two-dimensional architectural representation (Figure 3.2) to facilitate systematic identification of current egress pathways, physical impediments to rapid evacuation, and spatial congestion points. Through collaborative deliberation, participants collectively developed an evacuation procedure specification addressing identified bottlenecks and establishing primary and secondary egress routes. This participatory process generated empirical requirements for a three-dimensional spatial model (Figure 3.3), which was subsequently constructed to enable interactive navigation and route visualisation. The three-dimensional model functioned as both a planning tool for facility management and an educational instrument allowing residents to develop spatial familiarity with emergency procedures and to engage in informed assessment of suitable emergency assembly locations.

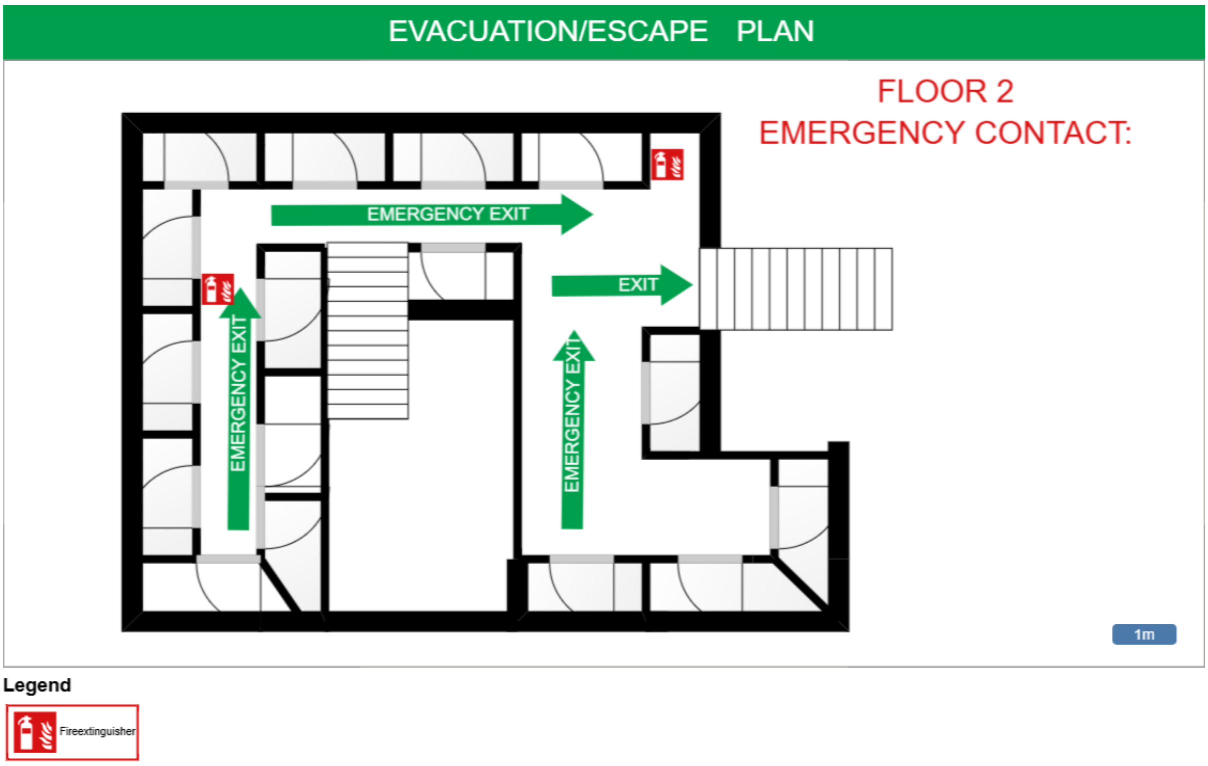

Figure 3.2. A sample evacuation map for the second floor of the building.

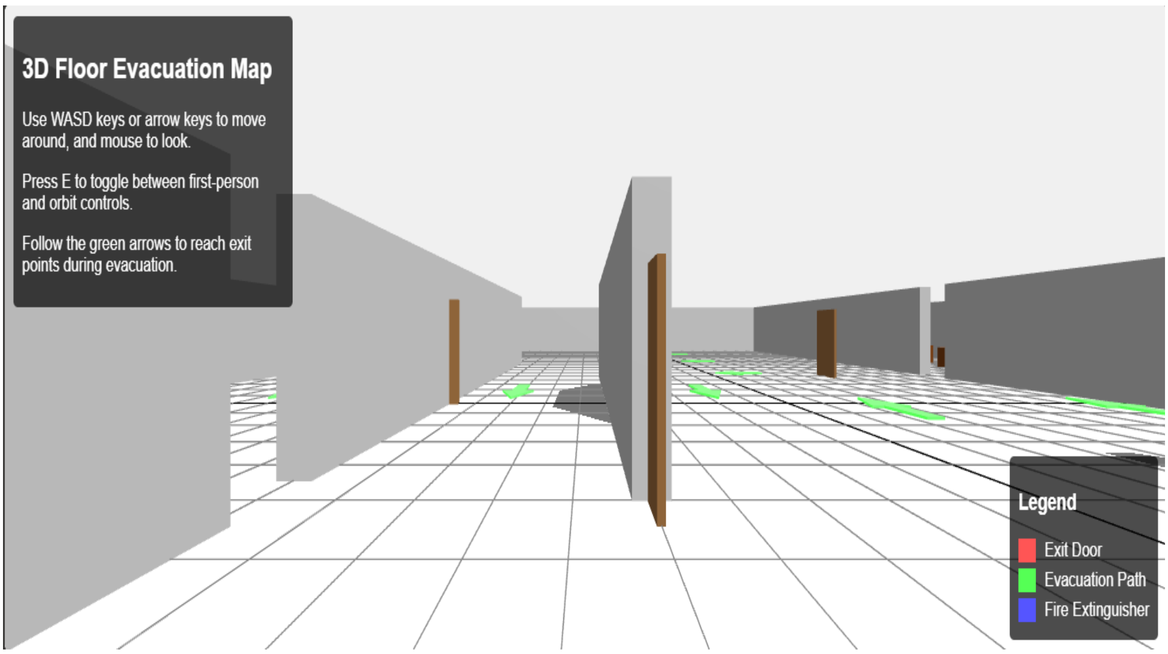

Figure 3.3. A view from the generated 3D evacuation map-1.

- **Emergency Response Protocol Development:** Participants discussed various possible scenarios, including fire, earthquake, medical emergencies, and threats of violence, which led to the identification of a suitable evacuation assembly area.

The workshop employed participatory design principles: Rather than presenting expert recommendations, the facilitator guided discussion such that residents and staff actively generated ideas and collaboratively evaluated feasibility. This approach ensured that proposed solutions reflected the operational realities and preferences of those who would implement them.

Post-drill focus group and feedback workshop: Following the evacuation drill, a second participatory workshop was organized with 40 residents to discuss the drill experience and gather feedback for iterative improvement. Structured focus group discussions explored:

- What worked well during the drill
- Obstacles encountered or confusion experienced
- Suggestions for improving evacuation procedures, signage, and communication
- Perceived effectiveness of the evacuation plan

Technology feasibility discussion: Participants were presented with some ICT solution ideas (mobile alert applications, digital evacuation maps, real-time monitoring systems) and asked to discuss their perceived utility, privacy concerns, usability, and whether they would support implementation. This feedback directly informed refinement of evacuation procedures and recommendations for infrastructure improvements.

Data quality in participatory workshops: The validity of participatory workshop data is supported by (1) the involvement of diverse stakeholder groups (residents of varying backgrounds, staff,), (2) the structured yet flexible facilitation approach allowing multiple perspectives to emerge, (3) detailed notes recording key discussion points and themes, and (4) participant feedback validation where preliminary conclusions were presented to participants for confirmation or correction. Trustworthiness is enhanced through transparency about the research purpose and how participant input would be used, and by the iterative nature of workshops where feedback from earlier sessions informed later discussions.

3.2.6 Evacuation Drill & Time Measurement Procedure

An evacuation drill and assembly point were designed and conducted based on the protocols and evacuation maps developed during the first workshop. Participants were instructed to evacuate to the designated assembly point as though in response to a genuine emergency. The drill was announced to residents in advance to ensure participation and safety, but the precise start time was not disclosed. Performance metrics were recorded, including:

- Response time from alarm activation to full evacuation
- Adherence to designated evacuation routes
- Identification of obstacles or confusion during evacuation
- Observed bottlenecks or congestion

The drill was designed to be as realistic as possible while maintaining safety. No residents were placed in actual danger, but the exercise provided experiential learning regarding evacuation procedures.

Evacuation Time Measurement Protocol:

The primary quantitative metric for the drill was the total evacuation time. This was measured using a standardized stopwatch function on a synchronized smartphone, following procedures established in evacuation literature (Gwynne et al., 2020; Gao et al., 2023). The measurement protocol was defined as follows:

Start Time (t=0): The moment the manual fire alarm was activated by the researcher at a predetermined location on the second floor. This was a clear, unambiguous start signal.

End Time: The moment the final resident crossed the boundary into the designated emergency assembly area in the external parking lot.

Additional Performance Data Collection:

To provide context for the evacuation time, the following data were also collected:

Head Count: The researcher at the assembly point manually counted residents as they arrived to ensure all participants had evacuated.

Route Adherence: Security camera footage was reviewed to note which evacuation route residents used.

Post-Drill Feedback: The anonymous post-drill survey (Appendix E) and subsequent focus group were used to gather qualitative data on perceived obstacles, congestion, and route clarity, which helped explain the quantitative time data.

3.2.7 Unannounced Sensor Activation

Prior to the first planned workshop, an unannounced sensor activation was conducted to establish baseline evacuation response without the benefit of prior training or preparation. This provided comparative data regarding occupant behaviour under conditions of genuine surprise, enabling assessment of improvements following structured training and protocol development.

3.3 Sampling Size & Target Population

Sample composition: The study focused on residents and staff at EGEM Premium Residence. At the time of data collection, the facility accommodated 80 residents; 40 residents (50% of total occupancy) participated in surveys. This sample provided a substantial and representative cross-section of views for a qualitative, in-depth case study and aligned with established methodological guidelines (Creswell and Plano Clark, 2018) for this type of research design.

Sampling strategy: This was a purposive, site-specific sample rather than a random sample. All staff were included due to their small number and central role in emergency response. Residents were recruited through facility announcements, with participation voluntary. The 50% resident participation rate reflects practical constraints of availability and consent but provides a representative cross-section of the residential population.

Inclusion and exclusion criteria: The study included all residents and staff present at the facility during the study period who provided informed consent. Exclusion criteria were minimal: individuals unable to consent due to language barriers were offered translation support.

Population characteristics: Survey respondents were primarily international students aged 18-30, reflecting the typical demographic of student housing. Gender distribution and specific nationalities were not systematically recorded, consistent with the anonymization protocol. Staff ages ranged from mid-20s to late-50s with varying tenure at the facility (from 6 months to 3+ years).

3.4 Validity and Reliability, and Research Quality

Quantitative Data

Validity: The survey instruments and checklist are valid to the extent that they measure what they intend to measure. Construct validity is supported through the explicit alignment of survey items with theoretical constructs (e.g., "awareness of emergency procedures" is measured through Yes/No questions about knowledge of exits and protocols). The checklist's validity is supported by its foundation in established standards (ISO 45001, OSHA, FEMA) and stakeholder consultation. Content validity, whether the instruments comprehensively cover the domain of interest, is supported through the multi-source development process and stakeholder review.

Reliability: Test-retest reliability (whether the same instrument produces consistent results upon repeated application) cannot be directly tested in a cross-sectional study; however, the internal consistency and clarity of questions enhance the likelihood of reliable responses. The checklist's reliability is supported through its use of objective, observable criteria and the systematic application of consistent scoring across all items.

Measurement precision: Survey responses are recorded as categorical data (Yes/No) enabling proportional quantification (e.g., "75% of residents were unaware of nearest fire exit"). Risk scores from the checklist are calculated using a systematic 5-point likelihood × severity matrix, enabling consistent comparison across hazards. Exact numerical results are retained and reported transparently, avoiding over-rounding that might obscure meaningful variation.

Qualitative Data

Credibility: Credibility in qualitative research refers to the confidence that research findings accurately represent participants' experiences and the studied phenomenon (Lincoln & Guba, 1985). Credibility is enhanced through: (1) prolonged engagement; the researcher held two sessions at different times; (2) persistent observation; detailed notes were retained for all workshops and discussions; (3) triangulation; workshop findings were cross-referenced against survey results and on-site inspection observations; (4) member checking; workshop conclusions were presented to participants for confirmation or correction.

Transferability: While findings from a single dormitory cannot be directly generalized to all student housing facilities, transferability is supported by detailed contextualization of the study site, clear documentation of methods, and explicit identification of which findings are specific to EGEM versus potentially relevant to similar institutions. Chapter 5 discusses which recommendations are context-specific versus potentially generalizable.

Dependability: This refers to the consistency and transparency of research processes. Dependability is enhanced through: (1) a detailed audit trail documenting all data collection, analysis, and decision-making steps; (2) retention of raw data (survey forms, inspection photographs, workshop notes); (3) explicit documentation of the analysis process used to generate findings; (4) reflexivity, acknowledgement of the researcher's role and potential biases.

Confirmability: Confirmability refers to the neutrality and objectivity of findings, whether conclusions derive from the data rather than researcher bias. Confirmability is supported through: (1) data triangulation (multiple data sources converging on similar conclusions); (2) stakeholder involvement in data interpretation; (3) transparent presentation of both supporting and contradicting evidence; (4) reflexive awareness of potential researcher biases (e.g., the researcher's background in engineering might predispose toward technological solutions; this bias was actively monitored and balanced through critical evaluation of technology feasibility).

Mixed-Methods Integration

The integration of quantitative and qualitative data strengthens overall research quality through triangulation: when survey data (e.g., "75% of residents unaware of nearest exit"), inspection findings (e.g., "exit signage lacks photoluminescent properties"), and workshop discussions (e.g., "residents stated signage is difficult to see in low light") converge on similar conclusions, confidence in those findings increases substantially. Conversely, where quantitative and qualitative data diverge, deeper investigation is warranted to understand contextual factors that might explain apparent inconsistencies.

3.5 Risk Analysis Methodology

Following hazard identification through the on-site inspection and checklist (Appendix B), a structured risk analysis was conducted (Appendix C) using a 5×5 risk matrix approach. This widely-used methodology in occupational health and safety enables systematic hazard prioritization (Patricia, 2014; Wilson et al., 2012).

Methodology: For each identified hazard, two dimensions were evaluated (Table 3.1):

- **Likelihood**: The probability of the hazard occurring, rated on a 5-point scale
- **Severity**: The potential consequence if the hazard materializes, rated on a 5-point scale:

Table 3.1. Severity & Likelihood Scale (Emma, 2020).

Likelihood (L)	*Severity (S)*
1: Rare	*1: Insignificant*
2: Unlikely	*2: Minor*
3: Moderate	*3: Significant*
4: Likely	*4: Major*
5: Almost Certain	*5: Severe*

Risk calculation: Risk Level = Likelihood × Severity, yielding a score between 1 and 25.

Risk prioritization: Risks are categorized according to their calculated score (Table 3.2).

Table 3.2. Risk Evaluation Criteria (Patricia, 2014).

Risk Level	*Action Required*
1-4 (Low-Very Low)	*Acceptable – Maintain safety measures.*
5-9 (Moderate)	*Review periodically & consider improvements.*
10-12 (High)	*Immediate review required; implement safety upgrades.*

15-25 (Very High)	*Unacceptable – Urgent action needed.*

This methodology enables transparent, systematic prioritization of interventions based on evidence rather than subjective impression (Patricia, 2014). The resulting risk matrix (Appendix C) identifies which hazards require immediate action (very high priority) versus those that can be addressed through ongoing improvement processes.

3.6 Technology Feasibility Assessment

A critical element of this research is the evaluation of which ICT are feasible and appropriate for EGEM Premium Residence. This assessment was conducted through multiple methods:

3.6.1 Stakeholder Acceptability Evaluation

During participatory workshops, stakeholders were presented with descriptions of potential ICT solutions:

- **Mobile evacuation applications**: Interactive maps accessible via smartphone, with real-time alerts and evacuation guidance.
- **Real-time environmental monitoring**: IoT sensors providing continuous monitoring of fire, gas, temperature, and other hazards.
- **Wearable safety devices**: Badges or smartwatches for staff enabling location tracking and emergency communication.
- **Artificial intelligence analytics**: Machine learning algorithms analysing historical incident data to predict high-risk situations.
- **3D digital evacuation maps**: Three-dimensional building models integrated into planning and training systems.
- **Virtual reality training**: Immersive VR simulations of emergency scenarios for training purposes.

Participants were asked to evaluate each technology against criteria including:

- **Perceived usefulness**: Does the technology genuinely improve safety outcomes?
- **Ease of use**: Is the technology intuitive and accessible to diverse users?
- **Privacy concerns**: Does the technology create unacceptable surveillance or data privacy risks?
- **Cost-effectiveness**: Is the benefit proportionate to the cost and ongoing maintenance?
- **Alignment with preferences**: Does the technology reflect what residents and staff would actually use?

Table 3.3. Analytical Framework for Stakeholder Support Classification.

Support Classification	Definition	Quantitative Threshold
High Support	*Strong endorsement with enthusiasm; widespread receptivity across participant cohort*	*>50% of participants expressed explicit approval*
Moderate Support	*Mixed reactions with balanced representation of supportive and reserved perspectives; neither*	*Even distribution of responses; approximately 40-60% range of support*

	consensus nor opposition predominates	
Low Support	*Substantial reservations or resistance; limited endorsement; minority position within participant group*	*<50% of participants expressed approval; notable skepticism or concerns articulated*

Detailed notes from these discussions were synthesized according to Table 3.3. to identify which technologies stakeholders viewed as acceptable versus problematic.

3.6.2 Contextual Feasibility Analysis

For recommended technologies, contextual feasibility was assessed across multiple dimensions:

- **Technical capacity**: Does the facility have or can it acquire the necessary technical infrastructure (internet bandwidth, server capacity, CCTV system, device compatibility)?
- **Organizational capability**: Does the facility have or can it develop the staff competence to implement and maintain the technology?
- **Financial sustainability**: What are the initial costs (hardware, software, training) and ongoing operational costs (maintenance, updates, support)?
- **Integration with existing systems**: Will the technology integrate smoothly with existing facility operations, or create disruption?

3.6.3 Linkage to Data Collection

Technology recommendations presented in Chapter 5 are explicitly linked to evidence collected during this research: if stakeholders expressed strong support for a technology in workshops, this is documented; if privacy concerns were raised, this is transparently noted; if cost was identified as a barrier, this is included in the feasibility assessment. Technologies that received lukewarm response, significant stakeholder concerns, or poor contextual fit are either not recommended or recommended as lower-priority future considerations.

Each technology was rated across four dimensions:

- Technical Feasibility
- Cost/Procurement Likelihood
- User Acceptability
- Privacy/Ethics risk

These four scores produced a feasibility matrix used in the Discussion to prioritize interventions. This approach ensures that technology recommendations are grounded in empirical data from participatory engagement rather than reflecting abstract technological possibilities or researcher preferences.

3.6.4 Feasibility Scoring Matrix

To systematically compare and prioritize the proposed ICT solutions, a feasibility scoring matrix was developed. Following the workshops, each technology was rated by the researcher on a scale of 0 to 3 across four predefined criteria:

- **Technical Feasibility (0-3):** Compatibility with existing infrastructure and technical complexity.
- **Cost/Procurement Likelihood (0-3):** Affordability of initial investment and ongoing costs.
- **User Acceptability (0-3):** Level of support and perceived utility from stakeholders, as expressed in workshops.
- **Privacy/Ethical Risk (0-3, reverse-scored):** Level of concern regarding surveillance and data privacy, where a higher score indicates lower risk.

The scores for each criterion were summed to produce a total feasibility score out of 12. Technologies scoring 10-12 were considered 'High' priority, 7-9 'Medium', and ≤6 'Low'. This matrix provided a transparent and evidence-based tool for generating the final technology recommendations in Chapter 5.

Table 3.4: Feasibility-rating method.

Criterion	0	1	2	3
Technical Feasibility	*No infrastructure / incompatible*	*Minor retrofit needed*	*Works with existing systems*	*Plug-and-play or native support*
Cost / Procurement Likelihood	*Very high / unrealistic*	*High*	*Moderate / manageable*	*Low cost / in-house*
User Acceptability	*Strong resistance*	*Some reservations*	*Mostly supportive*	*High enthusiasm*
Privacy / Ethical Risk	*Severe/ unacceptable*	*Significant*	*Manageable with controls*	*Minimal*

Total score: 10–12 = High Feasibility Priority; 7–9 = Medium; ≤ 6 = Low Feasibility.

Chapter 4: Analysis and Results

This chapter presents the findings from surveys, on-site inspections, participatory workshops, and the evacuation drill.

4.1 Survey Findings

Pre-Intervention Survey: Residents

A structured survey was administered to 40 residents and 5 staff prior to the evacuation drill and participatory workshops. Results are presented in Table 4.1.

Table 4.1: Pre-Intervention Survey Findings, Residents (n=40), Staff (n=5).

Survey Item	***Yes (%)***	***No (%)***
Do you know where the nearest fire exit is?	*10 (25%)*	*30 (75%)*
Have you ever participated in a fire or emergency evacuation drill?	*6 (15%)*	*34 (85%)*
Do you know what to do if the emergency sensors are activated?	*10 (25%)*	*30 (75%)*
Have you experienced at least one near miss at work in the past year? (Staff only)	*4 (80%)*	*1 (20%)*
Have you ever been trained in first aid? (Staff only)	*0% (0)*	*5 (100%)*

Key observations: The survey revealed substantial gaps in resident awareness and preparedness. Three-quarters of residents were unable to identify the nearest fire exit, an essential component of evacuation readiness. The vast majority (85%) had never participated in an evacuation drill, limiting their practical familiarity with procedures. Correspondingly, the staff had not received any formal first aid training.

Table 4.2: Key findings of the post-drill assessment survey, Residents (n=40).

Survey Item	***Yes (%)***	***No (%)***
Were the emergency exit routes and signage clear during the drill?	*6 (15%)*	*34 (85%)*
Did you encounter any obstacles (e.g., congestion) during evacuation?	*16 (40%)*	*24 (60%)*

Do you feel more confident in your ability to respond to an emergency after participating in the drill?	*32 (80%)*	*8 (20%)*
Do you support implementing regular emergency drills?	*36 (90%)*	*4 (10%)*

4.2 On-Site Inspection Findings

The comprehensive on-site inspection using the 34-item checklist (Appendix B) identified the current state of emergency preparedness infrastructure and organizational systems. Overall compliance was low: 11 of 34 items were scored as "Yes" (32.4% compliance), 23 items as "No" (67.6% non-compliance). All checklist items and related photographic records were collected using the mobile application, enabling immediate categorization and digital storage of findings.

Fire Safety Infrastructure

Findings:

- Fire sensors, gas detectors, and alarm systems were observed in place.
- Fire extinguishers are present in common areas and the kitchen.
- Smoke detectors are functional.

Deficiencies:

- No maintenance or testing documentation for fire safety equipment was available at the time of inspection; therefore, equipment operability could not be independently verified.
- Fire blankets are absent from the kitchen, a high-risk area for grease fires.
- Sprinkler systems are absent throughout the facility.
- Emergency lighting is absent in the stairwells.
- Emergency exit signage lacks photoluminescent properties, reducing visibility in low-light conditions.

Observations: While basic fire detection and suppression equipment exists, the absence of maintenance records raises substantial concerns about functionality during emergencies. Equipment age, battery status, and serviceability cannot be verified.

Emergency Exit and Evacuation Route

Findings:

- One primary emergency exit door equipped with a push-bar system and outward swing mechanism (Figure 4.2).
- Emergency staircase connects all floors.
- Evacuation route is marked with signage (Figure 4.1).

Figure 4.1. Emergency exit sign (ANSI, 2016).

Deficiencies:

- The primary emergency exit door has tools and equipment stored directly in front, obstructing rapid egress (Figure 4.2).
- A glass-framed door constructed with fire-resistant glazing (such as ceramic or wired glass) in a non-combustible frame, and equipped with intumescent seals and a self-closing mechanism, can qualify as a fire-rated door designed to contain smoke and flames for 30–120 minutes (Simon, 2023). It was not confirmed whether the existing door meets these standards.

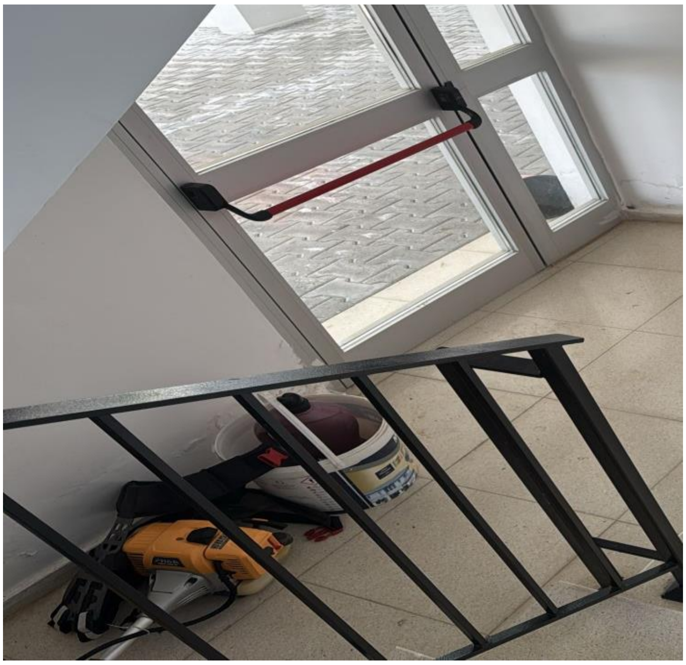

Figure 4.2. Emergency door of the dormitory and tools.

- To ensure the safety of building occupants during evacuation, internal fire escapes must be fully enclosed and supported by fire-resistant walls and self-closing doors with fire-resistant, smoke seals and panic bars, as well as 50-60 Pa pressurization systems, exhaust dampers and ventilation shafts to prevent smoke infiltration. Additionally, battery-backed emergency lighting, photoluminescent signage, and ground-level markers are necessary to guide evacuees in low-visibility conditions (Nick, 2024). The emergency staircase lacks fire-resistant designation; it functions as a standard internal staircase without compartmentation or smoke seals (Figure 4.3).

Figure 4.3. Designated emergency staircase of the dormitory.

- Multiple objects (boxes, storage items) are placed on emergency exit stairs, creating tripping hazards (Figure 4.4).

Figure 4.4. Objects on the emergency exit stairs.

Observations: Physical obstructions represent immediate safety hazards that could delay evacuation or impede movement during emergencies.

Electrical and Fire Hazards in Resident Rooms

Findings:

- On-site inspection of a sample of resident rooms revealed widespread electrical overloading: multiple devices connected to single power strips; extension cords daisy-chained together; power strips in close proximity to water sources.

- 20% of inspected rooms (4 rooms) displayed evidence of prohibited heaters or other high-wattage appliances.
- Smoking evidence (ash, cigarette butts) was observed in rooms despite facility smoking ban policy.
- In the participatory sessions, 35% of the residents reported using prohibited heating devices or smoking.

Observations: Electrical overloading and prohibited appliances create acute fire risk. The presence of these violations despite facility policies suggests inadequate room monitoring and enforcement.

Kitchen Fire Safety

Findings:

- Kitchen staff reported no formal training in fire safety or responses to cooking-related incidents.
- Fire extinguishers are present but kitchen-specific fire suppression tools (fire blankets) are absent.
- No documented procedures exist for managing grease fires or other kitchen emergencies.

Observations: Kitchens present elevated fire risk, particularly from cooking fires. The absence of specific fire safety training and specialized suppression tools creates substantial vulnerability.

Evacuation Assembly Area

Findings:

- No designated emergency assembly area is identified or signed.
- Residents reported during workshops that they were uncertain where to assemble following evacuation.

Observations: The absence of a designated assembly point creates confusion about post-evacuation accountability and complicates rescue coordination.

Emergency Planning Documentation

Findings:

- No comprehensive, documented emergency response plan addressing multiple hazard scenarios (fire, earthquake, medical emergency, violence) was identified during on-site inspection and document review.
- No written evacuation procedures or escape route maps are available to residents or staff.
- No emergency contact information is posted or provided to residents.

Observations: The absence of standardized written procedures for emergency response creates reliance on ad hoc decision-making and substantially increases risk of inconsistent or inappropriate occupant guidance.

Health and Safety Management Systems

Findings:

- No formal safety policy exists.
- No regular risk assessments or safety audits are conducted.
- No health and safety representative is appointed.
- No structured incident reporting or near-miss logging system exists (despite staff reporting 4 of 5 experiencing near-misses).
- No maintenance inventory or scheduled maintenance records are maintained.

Observations: The absence of systematic safety management means that hazards are not regularly identified, assessed, or addressed. The occurrence of near-misses without formal documentation prevents organizational learning and trend identification.

Water Quality and Sanitation

Findings:

- Water tanks exist but have not been professionally cleaned.
- No records of water quality testing exist.
- No preventive measures against Legionella proliferation are documented.

Observations: While no immediate water contamination issues are evident, the absence of systematic tank maintenance and testing presents potential public health risks.

Security and Surveillance

Findings:

- CCTV cameras are installed and operational.
- Fingerprint recognition entry system is functional.
- The administration verbally declared that a violent incident had occurred last year and that an intervention plan had been implemented.

Deficiencies:

- Operational status could not be independently confirmed due to absent maintenance documentation
- No formal security incident reporting procedure exists.
- No incident database or trend analysis is maintained.

Observations: While surveillance infrastructure exists, lack of maintenance documentation and formal incident procedures limits security effectiveness.

Training and Competence

Findings:

- No formal training plan exists for residents or staff.
- No emergency response, fire safety, or first aid training has been conducted.
- No training records are maintained.

Observations: The complete absence of structured training represents a critical gap, particularly given the small staff complement responsible for emergency leadership.

4.3 Risk Prioritization Findings

The risk analysis (Appendix C) identified 34 discrete hazards and scored each according to likelihood and severity. Results are summarized by priority category below. The complete risk analysis table is provided in Appendix C; the following presents key findings organized by risk level.

Very High Priority Risks (Risk Score 15-25)

Table 4.3: Very High Priority Hazards.

Hazard	Likelihood	Severity	Risk Score	Justification
Lack of safety training plan	*4 (Likely)*	*4 (Major)*	*16*	*Widespread resident and staff unawareness of procedures increases accident risk and reduces response effectiveness during emergencies*
Resident unawareness of emergency procedures (75% unaware of nearest exit)	*4 (Likely)*	*4 (Major)*	*16*	*High likelihood given survey findings; severity reflects potential for panic and inefficient evacuation during fires or other crises*

Key findings: Two hazards were scored as very high priority. Both relate to the absence of structured training and awareness. The fact that 75% of residents are unaware of the nearest fire exit, combined with the absence of regular evacuation drills, creates a scenario where occupants may become confused, delay evacuation, or attempt exit through unsafe routes during actual emergencies.

High Priority Risks (Risk Score 10–12)

Table 4.4: High Priority Hazards**.**

Hazard	*Likelihood*	*Severity*	*Risk Score*	*Justification*
Overloaded electrical sockets	*3 (Moderate)*	*4 (Major)*	*12*	*Observed in 20% of rooms; creates fire hazard with potential for*

				rapid, uncontrollable spread
Lack of documented safety policy and compliance procedures	*3 (Moderate)*	*4 (Major)*	*12*	*Non-compliance with regulatory requirements; creates legal liability and operational confusion*
Fire safety deficiencies in kitchen	*3 (Moderate)*	*4 (Major)*	*12*	*Absence of training, fire blankets, and procedures; kitchens present elevated cooking-related fire risk*
Smoking and unauthorized heater use	*3 (Moderate)*	*4 (Major)*	*12*	*Despite facility bans, 35% of residents reported use; creates direct fire ignition risk*
No emergency evacuation plan or assembly area	*3 (Moderate)*	*4 (Major)*	*12*	*Absence of documented procedures and designated assembly point increases confusion during emergencies*
No maintenance inventory or scheduled maintenance	*3 (Moderate)*	*4 (Major)*	*12*	*Safety-critical systems cannot be verified as functional; equipment failures may occur during emergencies*
Obstacles on emergency exit routes and stairs	*3 (Moderate)*	*4 (Major)*	*12*	*Physical obstructions directly impede evacuation; tools stored near exit door prevent rapid egress*

No regular emergency drills or training	*3 (Moderate)*	*4 (Major)*	*12*	*Occupants lack practical familiarity with procedures, reducing response effectiveness*

Key findings: Eight hazards were scored as high priority, requiring immediate intervention. These encompass infrastructure deficiencies (electrical overloading, kitchen fire safety gaps), organizational gaps (absent safety policy, no maintenance records, no evacuation plan), and occupant behaviour (smoking, unauthorized heating devices). The consistency of "Moderate likelihood × Major severity = 12" across these items reflects that while each individual hazard might not occur every day, their occurrence would have substantial consequences, and multiple pathways to occurrence exist.

Medium Priority Risks (Risk Score 5–9)

Multiple hazards were identified as medium priority (requiring periodic review and improvement), including chemical storage procedures, cleaning protocols, slip and fall hazards, missing first aid kit documentation, water tank maintenance, and communication gaps. These are detailed in Appendix C but are not elaborated here as lower priority than high and very high-risk items.

Low and Very Low Priority Risks (Risk Score 1–4)

Hazards such as roof security, pest control procedures, and general facility tidiness were scored as low priority due to either low likelihood or low severity, or both. These are addressed in long-term recommendations but do not require urgent intervention.

4.4 Participatory Workshop Findings

First Interactive Workshop

An initial workshop involved 45 participants (40 residents, 5 staff) and proceeded through structured discussions:

Risk Identification and Prioritization:

- Participants confirmed that fire was perceived as the most urgent hazard, aligned with objective risk analysis
- Residents found that items on the rear emergency staircase (Figure 4.4) were a significant obstruction when rapid evacuation was required.
- Staff highlighted concerns about their lack of training to lead evacuation procedures
- Participants agreed that the current situation was inadequate in terms of emergency and evacuation planning.

Evacuation Route Design:

- Participants collaboratively designed evacuation routes using the 2D map.
- An alternative route utilizing the rear emergency staircase was identified for situations where the main exit might be blocked.

- The external parking area was designated as the emergency assembly point,. determined to be at safe distance from the building while remaining accessible.
- The prepared evacuation route was simulated on the 3D map (Figure 4.5).

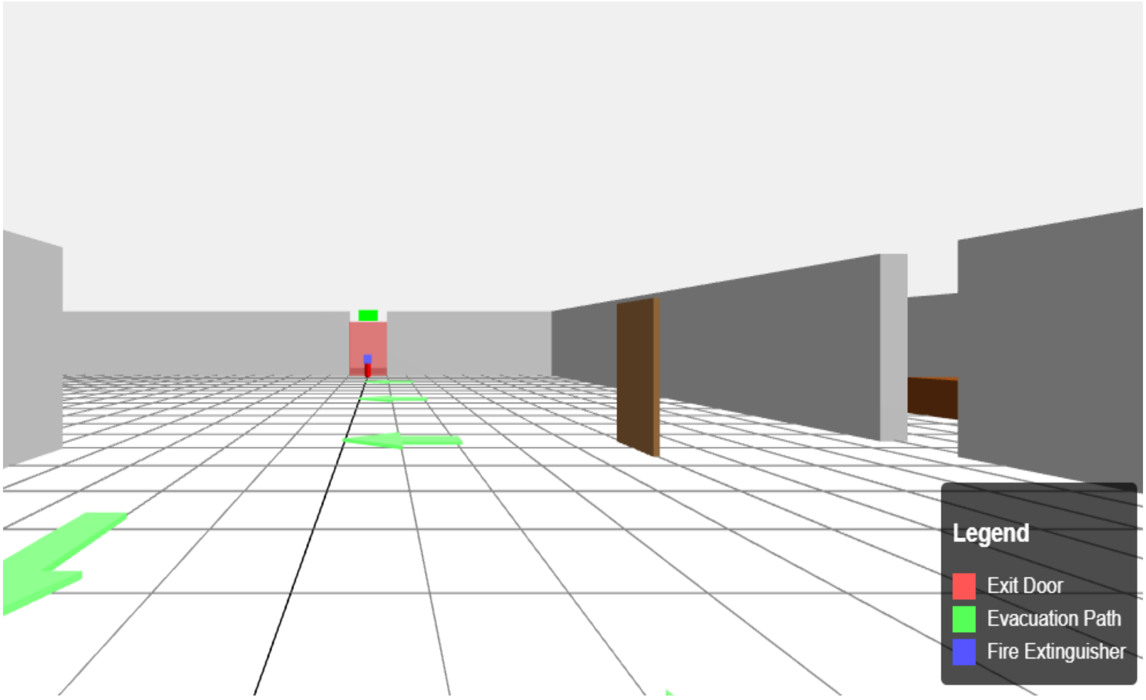

Figure 4.5. A view from the generated 3D evacuation map-2.

Unannounced Sensor Activation

Prior to the first structured workshop, an unannounced emergency sensor activation was conducted. Results:

- **Response time**: Of 40 residents present, only 7 (17.5%) evacuated immediately.
- **Resident behaviour**: The majority (33 residents, 82.5%) either remained in their rooms, attempted to contact staff for clarification, or exited slowly without urgency.
- **Confusion**: Many residents were uncertain whether the alarm was a drill, a false alarm, or a genuine emergency.

This baseline finding was critical: it demonstrated that without training and familiarity, occupants do not respond effectively to emergency signals, regardless of alarm functionality.

Evacuation Drill Results

Following the first workshop, a full evacuation drill was conducted to test the proposed plan. The total evacuation time, measured from alarm activation to the final occupant's arrival at the assembly area as defined in the methods, was 2 minutes and 55 seconds. Additional performance metrics are summarized in Table 4.5.

Drill parameters:

- Announced in advance (residents told a drill would occur, but not the exact time).
- All 40 residents and 5 staff present were asked to evacuate to the designated assembly area.
- Performance metrics were recorded: evacuation time, adherence to designated routes, obstacles encountered.

Table 4.5: Evacuation Drill Performance Metrics (n=40).

Metric	*Result*
Total evacuation time (alarm to final occupant at assembly area)	*2 minutes 55 seconds*
Number of residents evacuated	*45 of 45 (100%)*
Participants using primary evacuation route	*37 of 45 (82%)*
Participants using alternate route	*8 of 45 (18%)*
Reported obstacles or confusion	*3 (7%)*
Assembly point reach time (first occupant)	*20 seconds*
Assembly point reach time (median occupant)	*1 minute 35 seconds*

Key observations: The drill achieved full evacuation in approximately 3 minutes, within the acceptable range for a 45-person occupancy (Gao et al., 2023). However, evacuation time distribution was not uniform: the first occupants reached the assembly area in 20 seconds, while the final occupants required almost 3 minutes. This suggests variable response times and possible confusion among some participants about where the assembly point was located, despite workshop discussion. Three residents reported minor confusion about the proper evacuation route, though all ultimately reached the assembly area safely.

Post-Drill Focus Group

Following the evacuation drill, a second participatory workshop involving 40 residents conducted a focus group discussion:

What Worked Well:

- The designated assembly point was accessible and easily reached.
- Residents appeared to adhere to planned procedures.

Obstacles and Improvements Identified:

- **Exit signage clarity**: 85% of participants stated that exit signage was difficult to discern, particularly regarding directional guidance.
- **Congestion and bottlenecks**: 40% of participants reported congestion or crowding near the main entrance, indicating that the narrow doorway creates a bottleneck during simultaneous evacuation by multiple floors.
- **Confusion about alternate routes**: 8 residents used the alternative stair route, while 3 reported uncertainty about where it led and whether it was the "correct" route.
- **Assembly point signage**: The parking area designated as the assembly point lacked clear signage or markers indicating where residents should gather, leading to dispersal rather than organized grouping.

Figure 4.6. Evacuation assembly area sign (Industrial Hub, n.d.).

Feedback on Proposed Improvements:

When asked whether they would support specific enhancements, participants indicated:

- Improved exit signage (with larger arrows, photoluminescent properties): High support
- Anti-slip tape on stairs: High support
- Designated assembly point signs and markers: High support
- Regular scenario-specific drills (nighttime, fire on different floors): High support

Technology Feasibility Discussion:

When presented with potential ICT solutions, participants provided the following feedback:

- **Mobile evacuation applications**: High support. Residents stated that a smartphone app with evacuation maps, real-time alerts, updates (e.g., if a door was blocked) and multilingual support would be useful, particularly for international residents. Privacy concerns were minimal for a non-tracking application.
- **Real-time environmental monitoring**: High support. Participants appreciated the safety benefit of rapid hazard detection but expressed some scepticism about whether the facility could maintain such systems reliably.
- **Wearable tracking devices for staff**: Low support. Participants expressed concern about surveillance and privacy, perceiving constant location tracking as intrusive.
- **AI-driven predictive analytics**: High support. Participants viewed AI risk prediction as potentially useful but were uncertain about practicality and concerned about the "black box" nature of AI decision-making.
- **3D digital evacuation maps**: High support. Participants appreciated the ability to visualize the building in three dimensions and explore evacuation routes from different perspectives.
- **Virtual reality training**: High support. Residents thought VR evacuation drills would be valuable for training but were concerned about accessibility (equipment cost, learning curve).

Summary: Participatory discussions revealed strong resident enthusiasm for technological solutions that directly supported evacuation and communication (mobile apps, 3D maps) while rejecting surveillance-focused technologies. This feedback directly informed the technology recommendations presented in Chapter 5.

4.5 Key Findings Summary

This section synthesizes the quantitative and qualitative findings into a consolidated overview:

Fire Safety Deficiencies

The inspection identified significant fire safety gaps despite the presence of basic fire detection and suppression equipment:

- Equipment lacks maintenance documentation, raising questions about functionality.
- Fire blankets are absent from the kitchen.
- Sprinkler systems are absent.
- Emergency lighting is non-functional in several areas.
- Exit signage is visually unclear.

- Electrical overloading is present in 20% of resident rooms.
- Prohibited heating and smoking devices are used despite facility bans.

Inadequate Preparedness Among Residents and Staff

Survey data revealed:

- 75% of residents unaware of the nearest fire exit.
- 85% of residents had never participated in an evacuation drill.
- 100% of staff had received no first aid or emergency response training.
- 80% of staff (4 of 5) reported experiencing at least one near-accident.

Evacuation Planning Deficiencies

Physical inspection and workshop discussions identified:

- No documented emergency evacuation plan.
- Obstacles blocking emergency exits and stairs.
- Absence of a designated evacuation assembly area.
- Lack of evacuation maps or directional signage.

Organizational Gaps

The facility lacks:

- A comprehensive safety policy.
- Regular risk assessments or audits.
- Maintenance inventory or scheduled maintenance records.
- Incident reporting system or near-miss documentation.
- Health and safety representative.
- Staff training in emergency procedures or first aid.

Positive Response to Interventions

Despite substantial gaps, the study identified strong potential for improvement:

- After a single evacuation drill, 80% of residents reported increased confidence (Appendix E).
- 90% of residents expressed support for regular emergency drills (Appendix E).
- Strong stakeholder support for digital evacuation applications and 3D mapping.
- Participatory workshop approach generated substantive suggestions for infrastructure improvements.

Chapter 5: Discussion

This chapter explores the integration of ISO 45001 standards at EGEM, addressing gaps identified in Chapter 4. The framework's emphasis on continuous improvement and stakeholder engagement aligns with the goal of fostering a proactive safety culture.

5.1 Key Findings and Implications

The comprehensive assessment of emergency preparedness at EGEM Premium Residence reveals a facility with foundational safety infrastructure (fire detection, emergency exits, communication systems) that is significantly undermined by systemic organizational and human factors gaps. The core finding is not that EGEM is uniquely deficient; rather, it exemplifies common patterns in student housing where basic infrastructure compliance exists but is disconnected from systematic risk management, regular training, documented procedures, and stakeholder engagement. Three critical gaps emerge from the data:

Gap 1: Occupant Preparedness and Awareness. Survey data demonstrating that 75% of residents lack awareness of the nearest fire exit, 85% have never participated in an evacuation drill, indicate that residents are substantially unprepared for emergency response. This gap is not attributable to lack of intelligence or motivation; rather, it reflects the absence of structured training and drill programs. Confidence levels rose to 80% after a single evacuation drill, demonstrating that preparedness can be rapidly increased through direct participation and experiential learning.

Gap 2: Organizational Systems and Documentation. The facility lacks formal safety policies, documented emergency procedures, maintenance records, incident tracking, and health and safety representation. These organizational gaps mean that hazards are not systematically identified or addressed, and the facility cannot demonstrate compliance with regulatory requirements or learn from incidents. The absence of maintenance documentation for fire safety equipment raises particular concern: even if extinguishers and detectors are functionally adequate, their readiness cannot be verified.

Gap 3: Technological Integration. While EGEM has operational sensors, security cameras, and access control systems, these are not integrated into a coherent emergency management system. Information is siloed; residents lack access to evacuation information; real-time hazard data (from smoke detectors, fire alarms, main sensor panel) is not communicated to residents or integrated into emergency decision-making. Modern emergency management requires that information flow, from sensors detecting hazards, to decision-makers interpreting that information, to occupants receiving real-time guidance, be seamless and reliable. Furthermore, the successful development and deployment of a custom mobile application for data collection in this very study serves as a proof-of-concept. It demonstrates that even with limited resources, bespoke digital tools can be created to streamline safety audits, improve data reliability, and facilitate analysis, pointing towards a tangible path for addressing this technological gap.

The data presented in Chapter 4 demonstrate that all three gaps are addressable through systematic intervention combining organizational reform (policies, training, documentation), physical infrastructure improvements, and strategic technology integration.

5.2 Comparative Analysis with Literature

Alignment with Research on Dormitory Emergency Preparedness

The findings from EGEM align closely with established research on emergency preparedness in student housing:

Occupant awareness and preparedness gaps: The high prevalence of unawareness among residents (75% unaware of fire exits) mirrors Cox (2022), who found similar knowledge deficits in university students, attributing them to limited prior exposure and resource constraints. This underscores the critical need for interventions that are not one-time events but embedded, ongoing processes. The study's emphasis on participatory workshops to build awareness complements Hostetter et al. (2024), who stress inclusive planning for diverse needs, including disabilities. However, EGEM's small staff size (5 members) exacerbates training gaps, differing from larger institutions in literature where dedicated safety teams enable more robust programs (Anaba et al., 2024).

Importance of evacuation drills: Glauberman (2018) stresses that occupant familiarity with evacuation procedures, developed through regular drills, directly improves response effectiveness and evacuation time. EGEM's finding that a single evacuation drill increased resident confidence to 80% empirically supports this literature. Conlon et al. (2022) document a dormitory fire where inadequate emergency planning and limited occupant drill experience contributed to severe casualties, providing sobering context for the importance of EGEM's identified preparedness gaps.

Role of fire safety infrastructure: While EGEM maintains fire detection and basic suppression equipment, the absence of maintenance documentation aligns with findings by Thomas (2002) and Yao & Chow (2002), who demonstrate that equipment functionality cannot be assumed without systematic maintenance. The risk analysis (Table 4.3 & 4.4) echoes Rout and Sikdar (2017), emphasizing prioritization of high-severity hazards like fires. Kinateder et al. (2018) specifically address exit signage, finding that occupants often fail to recognize or locate exit signs, particularly in low-light conditions or when signs lack photoluminescent properties, directly consistent with EGEM's 85% post-drill report of unclear exit signage.

Electrical and smoking-related hazards: Folorunso et al. (2018) document that electrical overloading is a primary cause of dormitory fires. EGEM's finding of electrical overloading in 20% of inspected rooms and the reported use of prohibited heating devices (35% of residents) align with this literature on prevalent occupational fire hazards in student housing.

Staff preparedness: Rosen et al. (2023) emphasize that staff emergency response training is essential for effective crisis management. EGEM's finding that 100% of staff had received no emergency response or first aid training represents a significant organizational vulnerability documented across residential facility literature.

Regulatory compliance gaps: Hassanain et al., 2018 & Anaba et al., 2024 document that many student dormitories lack comprehensive emergency frameworks despite legal requirements, creating compliance and liability risks. EGEM's absence of documented safety policies and procedures exemplifies this broader pattern.

The achieved evacuation time of under three minutes for 45 occupants can be contextualized within the literature on evacuation modelling. Research suggests that for a population of this size, the ideal evacuation time under optimal conditions, including adequate exits, functional systems, and prepared occupants, is 2–3 minutes, while realistic scenarios with minor congestion often extend this to 3–5 minutes (Gao et al., 2023; Zechen & Hasung, 2024). Results falling within the 'ideal' range is a positive indicator, yet it must be interpreted considering the specific factors that influence evacuation performance.

Key factors cited in the literature include building design and exit accessibility, where multiple well-distributed exits can reduce evacuation times significantly (Gao et al., 2023); the efficiency of alarm systems and emergency lighting (Croner-i, 2021); and, crucially, occupant awareness and pre-movement time, which can account for up to two-thirds of the total evacuation time (Gao et al., 2023; Li et al., 2020). In this case, the pre-workshop baseline of significant occupant unawareness was mitigated by the prior participatory session and the announcement of the drill, which likely reduced pre-movement delays. Furthermore, the absence of major congestion during the drill suggests that the building's design and exit capacity were not critical limiting factors for this occupancy level. Therefore, the successful evacuation time can be attributed to a combination of the co-designed plan, the raised occupant awareness from the intervention, and the inherent adequacy of the physical infrastructure for a drill of this scale.

Divergence from Literature and Context-Specific Factors

Several aspects of EGEM's situation differ from or add nuance to general dormitory preparedness literature:

Seismic risk context: Cyprus is in a seismically active Mediterranean zone (Victoria, 2025). While fire is the primary immediate hazard at EGEM, earthquake preparedness was raised by stakeholders in workshops but not systematically evaluated in the study. This represents a context-specific gap not typically emphasized in Northern European or North American dormitory literature, reflecting EGEM's geographic location.

International resident population: EGEM houses primarily international students who may have limited familiarity with Cypriot emergency response procedures, local building codes, or cultural norms regarding emergency communication. This adds complexity beyond typical research on single-country student populations.

Small staff complement: EGEM's operation with only 5 staff members (1 manager, 2 housekeepers, 2 kitchen staff) creates particular dependency on staff competence. Larger institutions with dedicated safety personnel may implement emergency programs more systematically. EGEM's small scale is both a constraint (limited resources for comprehensive programs) and an opportunity (changes can be implemented rapidly with strong management commitment).

Technology adoption readiness: Participants in EGEM's participatory workshops demonstrated strong enthusiasm for mobile applications and digital mapping, potentially higher than observed in some populations with lower smartphone penetration or digital literacy. This suggests EGEM may be particularly well-positioned to benefit from ICT integration for emergency preparedness.

5.3 Strategic Recommendations: Feasible Technologies and Integrated Interventions

Based on the empirical findings from this research and grounded in the gaps identified above, strategic recommendations are organized by timeframe and priority. Critically, technology recommendations are linked directly to evidence from participatory engagement and feasibility analysis. The costs were determined hypothetically by the researcher for the local market in Cyprus and are not based on formal supplier quotes or detailed budget analysis.

- Minimal: Under €1000
- Moderate: €1000–€2000
- High: Above €2000

Immediate Actions (Months 1–3)

These interventions address very high and high priority risks and can be implemented rapidly with minimal financial investment:

1. Clear Evacuation Routes & Upgrade Signage

- Remove obstructions from exit doors, stairwells, and hallways.
- Install photoluminescent exit signage and wayfinding arrows.
- Mark floor-level paths and assembly points outdoors.
- Conduct weekly inspections to maintain clear routes.
- **Rationale**: Eliminates urgent physical hazards and confusion during emergencies.
- **Feasibility**: Highly feasible; can be completed by facility staff within 1–2 weeks.
- **Cost: M**inimal.

2. Electrical Safety Campaign and Monitoring

- Inspect rooms for overloaded circuits and banned devices.
- Provide short educational leaflet on electrical hazards.
- Monthly room checks to ensure compliance.
- **Rationale**: Reduces high fire risk linked to overloaded circuits.
- **Feasibility**: Feasible using existing facility staff; one staff member can conduct monthly inspections.
- **Cost**: Minimal.

3. Emergency Response Training for Staff

- Short training course covering evacuation roles, fire response, and first aid.
- Designate specific roles and responsibilities for each staff member during emergencies (e.g., floor coordinator, assembly point manager, emergency communications).
- **Rationale**: Staff lack any formal emergency training; this is a critical gap affecting crisis response capability.
- **Feasibility**: High, offered by local providers or online.
- **Cost**: Minimal.

4. Evacuation Drill and Feedback Loop

- Conduct drills and gather resident input via forms or quick discussions.
- Conduct focus group discussions to synthesize feedback and identify refinements.

- **Rationale**: Reinforces training; provides empirical data on procedure effectiveness and identifies remaining barriers.
- **Feasibility**: High; uses existing facility capacity and established participatory methods.
- **Cost**: Minimal.

5. Corridor & Stairwell Housekeeping Protocol

- Design and enforce rules to prevent storage in emergency routes.
- Track compliance with checklists.
- **Rationale**: Directly removes physical obstruction hazards.
- **Feasibility**: High; enforceable through routine operations.
- **Cost**: Minimal.

Mid-Term Actions (Months 4–9)

These interventions address high and medium priority risks and typically require moderate financial and organizational investment:

1. Comprehensive Safety Policy Development and ISO 45001 Alignment

- Define procedures for fire, earthquake, medical, active threat, pandemic events.
- Create multilingual written emergency policies.
- Designate a health and safety representative (can be the facility manager or designated staff member with additional responsibility).
- **Rationale**: Transforms ad-hoc safety practices into documented, systematic framework; demonstrates legal compliance; provides clear guidance for staff and residents.
- **Feasibility**: Moderate; requires external consultation (ISO 45001 specialist or safety management consultant) and significant staff time.
- **Cost**: Moderate.
- **Link to technology**: This policy provides the organizational framework within which technology (mobile apps, alert systems) will operate.

2. Maintenance Documentation System

- Record certification and inspection data for extinguishers, alarms, and lighting.
- Schedule six-month service cycles.
- For equipment requiring certification (fire extinguishers), ensure certification tags are visible and dates are tracked.
- **Rationale**: Addresses high-priority risk of non-functional safety equipment; demonstrates regulatory compliance.
- **Feasibility**: Moderate; requires engagement of certified maintenance providers; estimated one-time cost for initial comprehensive servicing plus six-month check costs.
- **Cost**: Moderate.
- **Technology option**: Simple digital tracker (spreadsheet or low-cost app).

3. Resident Training and Awareness Program

- Mandatory onboarding training & annual refreshers.
- Distribute multilingual emergency information cards with key information and emergency numbers.
- Post evacuation maps and emergency procedures in each residential floor and common areas.
- **Rationale**: Addresses very high priority risk of resident unawareness; builds on participatory workshop feedback indicating strong resident receptivity to training.
- **Feasibility**: Moderate; initial program development and ongoing annual sessions.
- **Cost**: Moderate.
- **Technology integration**: Electronic orientation modules can supplement in-person training; videos demonstrating evacuation procedures can be made available on facility intranet or YouTube.

4. Kitchen Fire Safety Enhancement

- Provide fire safety training specific to kitchen staff, including grease fire response, proper appliance use, and fire suppression equipment.
- Install fire blanket in kitchen.
- Establish documented procedures for high-risk kitchen activities.
- Conduct quarterly kitchen safety reviews.
- **Rationale**: Addresses high-priority kitchen fire hazard.
- **Feasibility**: High; training can be provided by local fire service.
- **Cost**: Moderate.

5. Incident Reporting System Implementation

- Establish a simple incident reporting form allowing residents and staff to report accidents, near-misses, and safety concerns.
- Designate health and safety representative to review reports quarterly.
- Document trends and implement corrective actions.
- Communicate trends and actions back to residents/staff .
- **Rationale**: Converts undocumented near-misses into data enabling organizational learning and hazard prevention.
- **Feasibility**: High; can use simple low-cost digital tools (Google Forms, Jotform).
- **Cost**: Minimal.

6. Initial Technology Implementation: Mobile Evacuation Application

Feasibility Assessment and Stakeholder Feedback:

- **Stakeholder support**: The majority of workshop participants stated that they support the mobile evacuation application.
- **Perceived utility**: Residents valued real-time access to evacuation maps, particularly multilingual support for international residents.

- **Privacy concerns**: Minimal for non-tracking application; participants explicitly rejected tracking features.
- **Technical feasibility**: EGEM has internet infrastructure; all residents possess smartphones; low technical barriers.

Recommended Implementation:

- Partner with or commission development of a simple mobile application integrating:
  - Floor-specific evacuation maps with multiple route options.
  - Real-time alert capability (manually triggered by staff or integrated with sensor system).
  - Emergency contact information and local emergency services numbers.
  - Multilingual interface.
  - Push notification capability for emergency alerts.
- **Rationale**: Directly supports occupant access to evacuation information, aligns with strong stakeholder preference, enhances real-time communication capability. The positive experience of developing and using the 'Safety EGEM Assessment' app for data collection in this research provides a foundational model and confidence for implementing a more complex resident-facing mobile application for evacuation guidance and alerts.
- **Feasibility**: Moderate to high; requires technical partnership but does not require EGEM to develop software in-house.
- **Cost**: Moderate.

Long-Term Actions (Months 10–24)

These interventions represent strategic investments in systemic resilience and advanced technology integration:

1. Building Information Modelling and 3D Digital Evacuation Maps

Feasibility Assessment and Stakeholder Feedback:

- **Stakeholder support**: Participants have high support for 3D digital evacuation maps and the benefit of mobile access to such maps.
- **Technical feasibility**: 3D models can be created using architectural plans (which facility managers confirmed exist) and BIM software or simpler 3D modelling tools.
- **Educational value**: Residents and staff can explore building geometry, identify evacuation routes from different perspectives, and practice navigating before an emergency.

Recommended Implementation:

- Commission creation of 3D digital model of EGEM's main building using BIM software or cloud-based BIM platforms.
- Integrate evacuation routes, emergency exits, assembly points, and hazard zones into 3D model.

- Develop interactive platform allowing residents/staff to navigate model, explore routes, and simulate evacuation decisions.
- Integrate 3D model into mobile application and web-based platform accessible from desktop/tablet devices.
- Use 3D model for staff training, allowing simulation of different emergency scenarios.
- **Rationale**: Addresses gap in visual access to evacuation routes; aligns with strong stakeholder support; provides multi-modality learning (visual, interactive, spatial reasoning) enhancing retention.
- **Feasibility**: Moderate; requires specialized expertise but multiple commercial solutions exist.
- **Cost**: High.

This investment becomes particularly valuable if EGEM expands to the additional 100-bed facility mentioned as under development; a single 3D model framework can be replicated across multiple buildings.

2. Advanced Integration of IoT and Sensor Data

Feasibility Assessment: Current state: In EGEM, fire detectors, smoke detectors and gas detectors are connected to a main panel, and the panel is not integrated with any platform (e.g. mobile application).

- **Stakeholder feedback**: There was high support for real-time environmental monitoring from workshop participants, with skepticism focused on reliability and maintenance rather than principles.
- **Technical feasibility**: Modern IoT platforms can integrate heterogeneous sensors into unified dashboard; EGEM's existing sensors may be retrofitted or replaced with IoT-compatible devices.
- **Operational value**: The integration of sensor panels with mobile devices allows for real-time alerts via SMS, email, or in-app notifications. Real-time data enables staff to identify hazards rapidly, validate alert system functionality, and respond with situational awareness.

Recommended Implementation:

- Conduct audit of existing sensors to determine IoT compatibility.
- Integrate alerts: if smoke detected above threshold, automated SMS/email notification sent to staff; if gas detected, similar protocol.
- Integrate sensor data with mobile application: residents can access current facility status (normal operation vs. alert state).
- **Rationale**: Transforms isolated safety equipment into integrated early warning system; provides data supporting informed decision-making during emergencies; addresses high-priority risk of non-functional equipment by enabling remote verification of sensor status.
- **Feasibility**: Moderate; requires technical expertise in IoT systems; can be implemented by external consultant with ongoing support.

- **Cost**: Moderate.

Privacy and ethics considerations: Sensor data would be environmental (temperature, smoke, gas) not personal; no resident privacy implications.

3. AI-Driven Predictive Risk Analytics and Maintenance Scheduling

Feasibility Assessment and Link to Data:

- **Participatory feedback**: There was support from workshop participants but considerable skepticism; the main concern was explainability ("How will we know if the AI is right?").
- **Technical feasibility**: Machine learning algorithms can analyse historical incident data, sensor readings, and maintenance records to identify high-risk patterns and predict likely failure points.
- **Organizational readiness**: Implementation requires at least 6–12 months of incident data collection and systematic maintenance records.

Recommended Implementation:

- Following 6–12 months of incident data collection and IoT sensor operation, partner with machine learning specialist to develop predictive model.
- Model inputs: historical incidents (from incident reporting system), maintenance records, sensor data patterns, seasonal variations, occupancy patterns.
- Model outputs: risk predictions (e.g., "high probability of electrical hazard in Building A in Q3 based on historical patterns"), maintenance recommendations (e.g., "fire extinguisher calibration due based on usage pattern"), anomaly detection (e.g., "unusual temperature pattern detected suggesting HVAC malfunction").
- Implement explainability framework: for each prediction, provide clear explanation of underlying factors.
- Integrate predictions into maintenance scheduling system and staff alert protocols.
- **Rationale**: Moves from reactive maintenance (responding to failures) to proactive maintenance (predicting and preventing failures); addresses high-priority risk of non-functional safety equipment.
- **Feasibility**: Moderate requires specialized data science expertise; best implemented as partnership with external consultant or university research group rather than in-house.
- **Cost**: High.

4. Comprehensive Staff and Resident Training Program with Advanced Modalities

Recommended Implementation:

- Develop comprehensive training curriculum covering:
    - General emergency preparedness (hazard awareness, evacuation procedures, assembly protocols).
    - Scenario-specific training: fire, earthquake, medical emergency, active threat.

    - Staff leadership skills: guiding resident evacuation, communicating under stress, providing first aid.
    - Resident-specific modules: for residents with mobility limitations, those with relevant expertise (e.g., resident medical students), internationals (cultural and language-specific modules).
- Implement training delivery through multiple modalities:
    - **In-person orientation**: Mandatory for all new residents and staff.
    - **Online modules**: Self-paced modules covering theoretical content (available via facility intranet or platform such as Moodle).
    - **VR evacuation simulations**: Immersive virtual reality scenarios allowing residents to practice evacuation procedures in simulated environments (especially valuable for nighttime evacuation scenarios, multi-floor buildings, or scenarios with obstacles).
    - **Mobile learning**: Short videos and interactive content accessible via mobile app for just-in-time learning refresher.
    - **Classroom drills**: Regular practical exercises.
- Establish training schedule: initial orientation for all new residents, quarterly refresher sessions for all residents, annual certification for staff.
- **Rationale**: Addresses very high priority risk of resident and staff unawareness; multiple modalities accommodate diverse learning preferences and accessibility needs; evidence (Tasnim et al., 2024; Suwaryo et al., 2024) indicates VR-based training significantly improves retention and practical performance.
- **Feasibility**: Moderate; online modules and mobile content can be developed in-house or using commercial platforms; VR training requires investment in hardware (headsets) and software or partnership with external VR training provider.
- **Cost**: High.

5. Integration with National Disaster Preparedness Framework

Recommended Implementation:

- Establish formal communication protocols with Cyprus Civil Defence and local fire authority.
- Participate in national emergency preparedness exercises.
- Align dormitory emergency procedures with national emergency management protocols.
- Provide facility contact information and emergency contact procedures to civil authorities.
- Receive training from civil authorities on emerging threats (e.g., active shooter, pandemic response updates) and communicate relevant information to residents and staff.
- **Rationale**: Moves beyond internal preparedness to embed EGEM within broader emergency management ecosystem; addresses research finding that Cyprus's seismic risk requires coordination with national-level response capabilities.
- **Feasibility**: High; requires primarily administrative coordination and attendance at meetings/training.

- **Cost**: Minimal.

5.4 Technology Recommendations: Feasibility Assessment Summary

The recommendations above integrate technology strategically based on evidence from participatory methods, feasibility analysis, and prioritization of occupant safety over technological sophistication. Building on the participatory data and contextual analysis, Table 5.1 summarises the comparative feasibility of each proposed ICT intervention. Scores integrate technical readiness, estimated cost, stakeholder acceptability, and ethical/privacy considerations derived from the field data. The resulting priorities guide the strategic recommendations that follow.

Table 5.1: Feasibility Matrix for Proposed ICT Interventions.

Proposed Technology	Technical Feasibility	Cost / Procurement	User Acceptability	Privacy Risk	Total	General Feasibility Level
Mobile emergency-app with interactive evacuation maps	*3*	*3*	*3*	*3*	*12*	*High*
IoT sensor integration (Real-time sensor dashboard)	*2*	*2*	*3*	*3*	*10*	*High*
Digital 3D evacuation map (BIM visualisation)	*2*	*2*	*3*	*3*	*10*	*High*
VR/AR training simulation for drills	*2*	*1*	*2*	*3*	*8*	*Medium*
Wearable Tracking Badges	*1*	*1*	*1*	*0*	*3*	*Low*
AI predictive analytics	*2*	*1*	*1*	*2*	*6*	*Low*

Key principle: Technology recommendations prioritize solutions that stakeholders explicitly support, address identified gaps directly, and are operationally feasible for EGEM's small staff complement. The feasibility matrix clarifies that cost-effective, user-accepted digital monitoring tools (mobile apps, IoT sensors, digital signage) represent realistic short-term improvements for EGEM Premium Residence. In contrast, AI-intensive tracking and analytics systems are less suitable given current privacy concerns and resource levels. This differentiation strengthens the thesis' contribution by linking technology selection directly to empirical evidence rather than generic future-tech expectations.

The custom 'Safety EGEM Assessment' mobile application, developed and deployed for the on-site inspection, served as a practical proof-of-concept. Its successful implementation demonstrates that low-cost, high-impact digital tools are not only acceptable but also operationally feasible within the dormitory's context. Consequently, it was included in the feasibility matrix as a prime example of a scalable digital intervention for routine safety audits, meriting high priority for institutional adoption.

5.5 Limitations and Future Research Directions

Study Limitations

Single-site case study design: The findings derive from one student dormitory in Cyprus. While representative of common challenges in student housing, findings cannot be directly generalized to institutions with different architectural configurations, regulatory environments, cultural contexts, or organizational capacities. Broader comparative research across multiple dormitories would strengthen generalizability.

Sample size: 40 residents (50% occupancy) and 5 staff members provided rich data but represent a specific moment in occupancy. Seasonal variations in resident population, staff turnover, or changes in resident demographics could influence findings. Longitudinal tracking of the same cohort over multiple semesters would enable assessment of behaviour change sustainability.

Technology evaluation limited to participatory assessment: While participatory workshops provided qualitative stakeholder feedback on technology feasibility, the study did not implement advanced technologies (wearable devices, VR training, AI analytics) for real-world pilot testing. Therefore, recommendations about VR, AI, and advanced IoT integration are grounded in literature and stakeholder feasibility assessment rather than direct implementation evidence.

Absence of structural engineering assessment: The study did not evaluate the structural integrity, fire-resistance ratings, or seismic resilience of the building. The assessment focused on occupational preparedness and management systems rather than building code compliance or structural engineering. For a comprehensive safety evaluation, structural assessment would be necessary.

Follow-up data not collected: The study captured baseline conditions and immediate post-intervention effects (e.g., evacuation drill performance). Longitudinal data tracking whether resident awareness and confidence sustain post-study, whether staff training impacts are retained, or whether organizational policies are consistently implemented would strengthen assessment of intervention sustainability.

Limited evaluation of cultural and linguistic factors: While the study noted EGEM's international resident population and recommended multilingual resources, cultural differences in emergency response behaviour and how cultural background influences emergency preparedness were not systematically explored.

Future Research Directions

Longitudinal implementation studies: Research following EGEM's implementation of recommendations over 12–24 months would assess: (1) Whether resident preparedness knowledge improves and sustains; (2) Whether organizational systems (incident reporting, maintenance documentation) are consistently maintained; (3) Whether technology adoption enhances preparedness; (4) What barriers emerge during implementation and how they are addressed.

Comparative studies across multiple institutions: Research comparing emergency preparedness at multiple dormitories varying in size, location, regulatory environment, and organizational capacity would identify context-specific versus generalizable findings and explore how institutional factors influence preparedness effectiveness.

Technology pilot and evaluation studies: Real-world pilot implementation of mobile evacuation apps, VR training, or AI predictive analytics at EGEM or similar institutions would provide empirical data on adoption rates, user engagement, impact on evacuation time, and cost-effectiveness, moving beyond theoretical feasibility assessment to demonstrated effectiveness.

Behavioural studies during emergencies: Research examining occupant behaviour during actual emergencies (or high-fidelity simulated emergencies with stress induction) would provide insights into how preparedness training translates to real-world performance, which psychological factors influence response effectiveness, and where training should be reinforced.

Comparative cross-cultural research: Studies examining whether emergency preparedness and response behaviour varies across different cultural populations, and how preparedness programs can be culturally adapted to maximize effectiveness, would enhance the applicability of findings to increasingly diverse dormitory populations.

Cost-benefit analysis of interventions: Research quantifying the financial costs of implementing various recommendations against avoided incident costs, liability reduction, and operational efficiency gains would support institutional investment decisions about emergency preparedness.

Integration with national emergency management systems: Research examining how institutional dormitory preparedness can be effectively integrated with broader regional and national emergency management frameworks would support development of coordinated, multi-level emergency response systems.

Chapter 6: Conclusion

Emergency preparedness in student dormitories represents a critical intersection of occupational health and safety, duty of care to vulnerable populations, regulatory compliance, and organizational resilience. The comprehensive case study of EGEM Premium Residence reveals that while foundational safety infrastructure exists, fire detection, emergency exits, communication systems, the absence of systematic risk management, regular training, documented procedures, and stakeholder engagement creates substantial vulnerability during emergencies.

The study identified three core gaps: (1) occupant unawareness and limited preparedness for emergency response; (2) absence of organizational systems for policy documentation, maintenance tracking, and incident reporting; and (3) lack of technological integration transforming isolated safety equipment into coherent emergency management systems. These gaps are not unique to EGEM; they reflect patterns documented across residential facility literature globally.

Critically, the research demonstrates that all three gaps are addressable through systematic, evidence-based intervention. Post-drill survey (n=40) showed 80% reported increased confidence, compared to pre-intervention baseline of 25% awareness of emergency procedures. However, without a control group, causality cannot be definitively established. High stakeholder support for regular emergency drills and digital evacuation tools demonstrates strong receptivity among residents and staff to preparedness initiatives.

The theoretical foundation integrating Risk Management Theory, Safety 1 and Safety 2 paradigms, and Participatory Design Theory provides a coherent framework for both identifying safety gaps and designing solutions. Risk Management Theory enables systematic hazard prioritization. Safety 2 principles emphasize building adaptive capacity and safety culture alongside Safety 1 compliance with regulations. Participatory Design ensures that solutions reflect occupant needs and preferences, enhancing adoption and sustainability.

The strategic recommendations provided in Chapter 5 are organized by feasibility and timeframe, enabling EGEM to implement immediate high-impact interventions while planning longer-term systemic improvements. Critically, technology recommendations are grounded in empirical evidence from participatory engagement: mobile evacuation apps and 3D digital maps (which received strong stakeholder support) are prioritized, while surveillance-focused technologies (which stakeholders rejected) are explicitly not recommended. In addition, the study itself operationalized ICT through the development of a custom mobile application for data collection, which served as a successful mini-pilot for the kind of digital tooling that can enhance safety management systems.

The integration of ISO 45001 standards throughout the recommendations provides a pathway toward formal certification and systematic continuous improvement. While full ISO 45001 accreditation may be a longer-term goal, aligning organizational policies, risk assessment procedures, training protocols, and documentation with ISO standards provides structure and credibility.

This research demonstrates that emergency preparedness is not merely a technical problem amenable to equipment installation, but a sociotechnical challenge requiring integration of hardware (fire detection, exits, emergency lighting), software systems (policies, procedures, maintenance documentation), human competence (training, awareness, decision-making), organizational commitment (resource allocation, leadership prioritization), and technological enablers (alert systems, communication platforms, decision-support tools). Optimal outcomes require coordinated intervention across all these dimensions.

For EGEM Premium Residence, the path forward is clear: immediate removal of physical obstructions, rapid staff training, and commencement of resident awareness programs address the highest-priority gaps. Mid-term development of comprehensive policies, maintenance systems, and initial mobile technology deployment establish systematic frameworks. Long-term investment in advanced technologies and integration with national emergency management systems build resilience and scalability as the organization expands.

Ultimately, this research advocates for a paradigm shift in how student housing institutions approach emergency preparedness: from viewing it as compliance checklist to be completed and filed, toward understanding it as foundational to mission, providing safe, supportive communal living environments where residents can focus on their education rather than anxiously wondering whether staff and systems are prepared to protect them during crises. Effective emergency preparedness requires systematic frameworks, human commitment, and technological support. When integrated thoughtfully, these elements create resilience, the capacity to prevent, respond to, and recover from emergencies while maintaining trust and continuity of mission.

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Appendix A: Survey Consent Form

Consent Form for Participation in Survey

Project Title: Emergency Preparedness Towards a Sustainable Work Environment

Principal Investigator: Firat Utku

Purpose of the Study: The study aims to assess the current state of emergency preparedness at EGEM Premium Residence and propose recommendations for improvement.

Participation and Voluntary Nature: Your participation in this survey is completely voluntary. You may refuse to participate or withdraw at any time without any consequences.

Confidentiality: All responses will be anonymized and used solely for research purposes. No personal data will be shared outside the research team.

Duration: The survey will take approximately 10 minutes to complete.

Risks and Benefits: There are no anticipated risks to participating in this study. The findings will contribute to improving emergency preparedness and safety in student housing.

Consent Statement: I have read and understood the above information. By proceeding with the survey, I voluntarily agree to participate in this study.

[ ] I agree to participate in this survey.

Signature: _____________

Date: _____________

Appendix B: Check-List

CHECKLIST			
QUESTION	**YES**	**NO**	**DESCRIPTION**
Is there an established safety policy and are continuous improvement processes in place (e.g. ISO 45001)?		N	No formal policy; no structured improvement process
Is the policy accessible to all relevant parties (students, staff, and visitors)?		N	No written policy to distribute
Are regular audits and reviews conducted to assess the effectiveness of the policy and identify trends / technologies?		N	No systematic audit process
Are employee and student opinions and feedback on the safety policy collected, and are surveys and meetings organised to revise the safety policy?		N	No formal feedback collection
Are training needs for all roles/workflows identified in an annual training plan and is appropriate training provided?		N	No training plan; no emergency training conducted
Are all legal and regulatory requirements identified and documented?		N	No documentation of applicable regulations
Are there measures to ensure the privacy and security of personal data collected from students and staff and are these kept electronically?		N	Data stored manually; no electronic security protocols
Is the air quality and ventilation good and are the air conditioning system and filters checked regularly?	Y		Good natural and mechanical ventilation; filters replaced periodically but no maintenance records
Are risk assessments carried out periodically?		N	No systematic risk assessment process
Are fire sensors, gas detectors, water sprinkler, fire blanket (kitchen), alarm buttons and extinguishers properly positioned and checked periodically?		N	Fire sensors, gas detectors, alarms, and extinguishers present; no maintenance records; no fire blankets in kitchen; no sprinkler system

Do security cameras work and are they periodically maintained?	Y		Cameras operational; no maintenance logs
Are floors and stairs slip-resistant, well-maintained, and equipped with handrails and non-slip treads?		N	Handrails present; non-slip treads absent No non-slip ..
Are uneven surfaces or tripping hazards identified and addressed?		N	Facility generally well-maintained; no observed tripping hazards
Are emergency trainings and evacuation drills conducted and is there a assembly area?		N	No drills conducted; no assembly area designated
Are all entries to the building recorded electronically?	Y		Fingerprint recognition system in operation
Are there 'caution' signs for relevant surfaces (electrical panels, hot surfaces, etc.)?	Y		Caution signage present on electrical panel
Are first aid trainings provided and is there a responsible person for the first aid room/cabinet and is it well equipped and conveniently located?		N	No formal first aid training; infirmary operates continuously with stocked first aid kit but no routine inspection documented
Is the roof locked?	Y		Roof access locked
Is there an emergency and evacuation plan (pandemic, fire, earthquake, suicide, etc.) and does it include all necessary information (contact numbers, etc.)?		N	No written emergency plan; procedures undocumented
Are there emergency exit doors with push-bar systems, sensors, signs that glow in the dark, properly positioned buttons and emergency escape stairs that meet the relevant standards and are the routes open?		N	Push-bar and outward swing present; routes obstructed by stored items; signage lacks photoluminescent properties
Is there an actual inventory and periodic maintenance list?		N	No documented inventory or maintenance schedule
Are there records of work accidents and near misses?		N	No incident logging system; staff report

			near-misses but not formally documented
Is the lighting suitable for employees and students?	Y		Adequate lighting; no measurements required for operational purposes
Are all materials, including chemicals, used for their intended purpose?	Y		Cleaning supplies appropriately stored; no formal training in chemical use
Is there a cleaning plan, including common areas, and is liquid soap, toilet paper, etc. available in the toilets?		N	Regular informal cleaning; no documented plan; supplies availabl e
Are work clothes, non-slip slippers, etc. provided and are changing and rest rooms available?		N	No uniforms provided; no designated changing room
Are routine room checks performed and is smoking and using heaters prohibited?	Y		Informal checks conducted; smoking and heaters prohibited but no systematic enforcement; evidence of violations observed
Is electrical system maintenance carried out and there is no overloaded electrical sockets.		N	Overloaded sockets observed in approximately 20% of inspected rooms
Is the electrical panel kept closed and has a warning sign and contact numbers on it?	Y		Panel secured; caution signage present
Are health and safety representatives appointed and trained?		N	No designated health and safety representative
Are chemical materials properly stored and locked up?	Y		Cleaning cabinet organized and secured; no

			formal training or control forms.
Are water tanks regularly cleaned and is there a record of domestic water analyses?		N	No professional cleaning; no water quality testing records
Are necessary forms and procedures available (general rules, incident reporting, violence response, mental health support)?		N	No documented procedures except informal violence incident response
Are waste containers suitable and are wastes collected periodically?	Y		Appropriate waste management; no documentation records

Appendix C: Risk Analysis Table

Risk	Likelihood	Severity	Risk Level
Lack of documented safety policy and continuous improvement processes	3 (Moderate)	3 (Significant) (e.g., confusion, non-compliance)	9 (Medium)
Policy not communicated	3 (Moderate)	2 (Minor) (e.g., lack of awareness)	6 (Medium)
No regular audits and risk assessments	3 (Moderate)	4 (Major) (e.g., missed hazards)	12 (High)
Overloaded electrical sockets.	3 (Moderate	4 (Major) (e.g., fires, electrical hazards)	12 (High)
Missing forms and procedures	3 (Moderate)	4 (Major) (e.g., delays, errors)	12 (High)
Unauthorized Access	1 (Rare)	3 (Significant) (e.g., theft, crime)	3 (Low)
No feedback collection	3 (Moderate)	2 (Minor) (e.g., missed improvement opportunities)	6 (Medium)
Legal/regulatory requirements not identified	3 (Moderate)	4 (Major) (e.g., non-compliance, penalties)	12 (High)
No data privacy and security measures	3 (Moderate)	4 (Major) (e.g., data breaches, legal issues)	12 (High)
Improper storage of chemicals	2 (Unlikely)	3 (Significant) (e.g., poisoning, contamination)	6 (Medium)
Lack of cleaning plan	3 (Moderate)	2 (Minor) (e.g., contamination, hygiene issues)	6 (Medium)
Waste collection	1 (Rare)	2 (Minor) (e.g., Pest, hygiene issues)	2 (Very Low)
Suitable waste containers	1 (Rare)	2 (Minor) (e.g., Pest, hygiene issues)	2 (Very Low)
No safety training plan	4 (Likely)	4 (Major) (e.g., accidents, injuries)	16 (Very High)
Fire safety measures	2 (Unlikely)	5 (Severe) (e.g., mass deaths)	10 (High)
Security camera maintenance	1 (Rare)	3 (Significant) (e.g., lack of incident surveillance and evidence)	3 (Low)
Missing handrails/slip-resistant surfaces	3 (Moderate)	2 (Minor) (e.g., slips, falls)	6 (Medium)
Poor Air Quality	1 (Rare)	2 (Minor) (e.g., headaches)	2 (Very Low)

Unlocked roof door	1 (Rare)	4 (Major) (e.g., falls)	4 (Low)
Uneven surfaces/tripping hazards	2 (Unlikely)	2 (Minor) (e.g., trips, falls)	4 (Low)
Smoking and heaters	3 (Moderate)	4 (Major) (e.g., fires)	12 (High)
No emergency/first-aid trainings or drills	3 (Moderate)	4 (Major) (e.g., unpreparedness during emergencies)	12 (High)
No assembly area	3 (Moderate)	3 (Significant) (e.g., confusion during evacuation)	9 (Medium)
Missing workflows / instructions	3 (Moderate)	2 (Minor) (e.g., errors, inefficiency)	6 (Medium)
No caution signs	2 (Unlikely)	2 (Minor) (e.g., missed warnings)	4 (Low)
Poor Lighting	1 (Rare)	3 (Significant) (e.g., confusion during evacuation)	3 (Low)
First-aid cabinet	2 (Unlikely)	3 (Significant) (e.g., inadequate first aid)	6 (Medium)
Poorly maintained water tanks	2 (Unlikely)	3 (Significant) (e.g. bacterial threat)	6 (Medium)
Lack of work clothes, non-slip slippers.	3 (Moderate)	2 (Minor) (e.g., contamination, falls)	6 (Medium)
No emergency plan / unobstructed evacuation routes	3 (Moderate)	4 (Major) (e.g., delayed evacuation, injuries)	12 (High)
Missing emergency exits / equipment	3 (Moderate)	4 (Major) (e.g., trapped during emergencies)	12 (High)
No maintenance inventory (including ventilation, electrical system)	3 (Moderate)	3 (Significant) (e.g., equipment failure, accidents)	9 (Medium)
No accident / near miss records	3 (Moderate)	2 (Minor) (e.g., missed opportunities to prevent future incidents)	6 (Medium)
No health & safety representatives	3 (Moderate)	2 (Minor Injury) (e.g., missed employee concerns, safety issues)	6 (Medium)

Appendix D: Survey Form

All responses are confidential and anonymous.

Instructions: Please answer each question with Yes or No based on your current knowledge. There are no correct or incorrect answers.

40 Students
Question 1: Do you know where the nearest fire exit is?
75% of residents were unaware of the nearest fire exit.
Question 2: Have you ever participated in a fire (emergency, evacuation) drill?
85% of residents had never participated in a drill.
Question 3: Do you know what to do if the emergency sensors are activated?
75% of the residents could not give an answer.
5 Employees
Question 1: Have you experienced at least one near miss at work in the past year?
80% of employees reported at least one near-miss incident in the past year
Question 2: Have you ever been trained in first aid?
100% of the employees have never participated in first aid training.

Appendix E: Post-Drill Assessment Survey

This survey is anonymous; please do not write your name.

Instructions: Answer each question with Yes or No based on your experience during the drill.

40 Students
Question 1: How clear were the emergency exit routes/signages during the drill?
85% of participants found exit signage unclear during the drill.
Question 2: Did you encounter any obstacles during evacuation?
40% reported congestion near the front door.
Question 3: Are you confident in your ability to respond to emergencies after participating in the drill?
80% of participants reported increased confidence.
Question 4: Do you support implementing regular emergency drills?
90% supported regular drills.