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Developing an Affordable and User-Friendly Tool to Evaluate the Fire Risk of Buildings in Sri Lanka

Opracowanie niedrogiego i łatwego w obsłudze narzędzia do oceny ryzyka pożaru w budynkach na Sri Lance

ABSTRACT

Purpose: This study presents a locally adapted, user-friendly, and cost-free fire risk assessment tool to enhance fire safety management in Sri Lanka. The tool supports non-specialists, including facility managers, inspectors, and building owners, in systematically evaluating compliance and mitigating fire risks across various building types.

Introduction: Fire safety is vital to the resilience and sustainability of modern buildings. In Sri Lanka, many buildings still function under outdated codes, weak enforcement, and limited technical capacity, compromising occupant safety and urban resilience. Despite rising awareness, fire protection remains largely a compliance exercise rather than a core aspect of sustainable governance. Persistent weaknesses are observed in evacuation design, structural fire protection, suppression systems, and fire safety management. This study presents an affordable, user-friendly fire risk assessment tool aligned with Sri Lanka's regulatory framework, assessing five key domains to determine compliance and preparedness while promoting risk-informed decision-making within the country's evolving built environment.

Methodology: Twelve critical fire risk factors relevant to Sri Lanka were identified through expert interviews. A checklist of 136 attributes was developed based on local fire regulations and British Standards, where local provisions were lacking. An additional 85 attributes addressed fire safety management and maintenance gaps. Altogether, 221 attributes were grouped into five domains: means of escape, structural fire precautions, detection, protection, and management. Fifty-four checklists were created for official building categories. Each attribute was assigned a Relative Importance Index (RII) derived from the twelve factors and evaluated through a four-tier compliance rating system.

Result: The developed tool covers 54 building categories and 221 attributes weighted by the Relative Importance Index (RII) derived from twelve key fire risk factors. It assesses compliance across four tiers, integrating 136 safety and 85 management elements within a structured framework. The tool enables evidence-based fire safety evaluations, enhances regulatory compliance, and allows non-specialists to perform reliable assessments. Freely accessible and user-friendly, it promotes awareness, supports immediate action, and serves as an effective platform to improve understanding of fire regulations and safety requirements across all official building categories in Sri Lanka.

Conclusion: The tool enables non-specialists to conduct reliable fire risk assessments, enhancing compliance, awareness, and safety. Its structured framework supports hazard identification, risk evaluation, and corrective action. Future integration with real-time data and AI analytics will strengthen proactive fire risk management and protection of lives and property.

Keywords: fire risk assessment, fire risk assessment methods, checklist methods, risk factors weightage and ranking, building fire safety

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ABSTRAKT

Cel: Niniejsze badanie przedstawia dostosowane do lokalnych warunków, przyjazne dla użytkownika i bezpłatne narzędzie do oceny ryzyka pożarowego, opracowane w celu usprawnienia zarządzania bezpieczeństwem pożarowym na Sri Lance. Narzędzie to umożliwia osobom niebędącym specjalistami, w tym zarządcom obiektów, inspektorom i właścicielom budynków, systematyczną ocenę zgodności z przepisami i identyfikację środków ograniczających ryzyko pożaru.

Wprowadzenie: Bezpieczeństwo pożarowe pozostaje kluczowe dla odporności i zrównoważonego rozwoju nowoczesnych budynków. Na Sri Lance wiele obiektów nadal funkcjonuje w oparciu o przestarzałe przepisy. W połączeniu z niedostatecznym egzekwowaniem prawa i ograniczoną wiedzą techniczną zagraża to bezpieczeństwu mieszkańców i odporności miast. Pomimo rosnącej świadomości, ochrona przeciwpożarowa pozostaje w dużej mierze kwestią spełnienia przepisów, a nie podstawowym aspektem zrównoważonego zarządzania. Utrzymujące się uchybienia obserwuje się w zakresie projektowania ewakuacji, ochrony przeciwpożarowej konstrukcji, systemów gaszenia pożarów i zarządzania bezpieczeństwem przeciwpożarowym. Niniejsze badanie przedstawia niedrogie, przyjazne dla użytkownika narzędzie oceny ryzyka pożarowego, dostosowane do ram regulacyjnych Sri Lanki, oceniające pięć kluczowych obszarów w celu określenia zgodności z przepisami i gotowości. Jednocześnie promuje podejmowanie decyzji opartych na wiedzy o ryzyku w ramach zmieniającego się środowiska budowlanego kraju.

Projekt i metody: W wywiadach z ekspertami zidentyfikowano 12 krytycznych czynników ryzyka pożarowego istotnych dla Sri Lanki. Opracowano listę kontrolną zawierającą 136 atrybutów w oparciu o lokalne przepisy przeciwpożarowe i normy brytyjskie w przypadku braku lokalnych regulacji. Dodatkowe 85 atrybutów dotyczyło luk w zarządzaniu bezpieczeństwem pożarowym i w zakresie konserwacji. Łącznie 221 atrybutów pogrupowano w pięć obszarów: drogi ewakuacyjne, środki zapobiegawcze dotyczące konstrukcji budynków, wykrywanie, ochrona i zarządzanie. Stworzono 54 listy kontrolne dla oficjalnych typów budynków. Każdemu atrybutowi przypisano Wskaźnik Względnej Ważności (RII) na podstawie 12 czynników i oceniono go za pomocą czterostopniowego systemu oceny zgodności.

Wyniki: Opracowane narzędzie obejmuje 54 kategorie budynków i 221 atrybutów ważonych wskaźnikiem względnej ważności (RII), wywodzącym się z dwunastu kluczowych czynników ryzyka pożarowego. Ocena zgodności na czterech poziomach, integrując 136 elementów bezpieczeństwa i 85 elementów zarządzania w ramach ustrukturyzowanych ram. Narzędzie umożliwia przeprowadzanie opartej na dowodach oceny bezpieczeństwa pożarowego, zwiększa zgodność z przepisami i pozwala osobom niebędącym ekspertami przeprowadzanie takich ocen. Jest ono ogólnodostępne i przyjazne dla użytkownika, promuje świadomość, wspiera natychmiastowe działania i stanowi skuteczną platformę do poprawy zrozumienia przepisów przeciwpożarowych i wymogów bezpieczeństwa we wszystkich oficjalnych kategoriach budynków na Sri Lance.

Wnioski: Narzędzie to umożliwia osobom niebędącym specjalistami przeprowadzanie rzetelnych ocen ryzyka pożarowego, zwiększając zgodność z przepisami, świadomość i bezpieczeństwo. Jego ustrukturyzowana struktura wspiera identyfikację zagrożeń, ocenę ryzyka i działania naprawcze. Przyszła integracja z danymi w czasie rzeczywistym i analizami opartymi na sztucznej inteligencji wzmocni proaktywne zarządzanie ryzykiem pożarowym oraz ochronę życia i mienia.

Słowa kluczowe: ocena ryzyka pożarowego, metody oceny ryzyka pożarowego, metody oparte na listach kontrolnych, ważenie i ranking czynników ryzyka, bezpieczeństwo pożarowe budynków

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Introduction

The number of complex and high-rise buildings in Sri Lanka has increased rapidly [1], alongside a 24% rise in fire-related accidents from 2015 to 2024, threatening lives, property, and the environment [2]. Fires are concentrated in densely populated areas [3]. Between 1974 and 2007, Sri Lanka recorded 2,703 major fires [4], while annual incidents in Colombo rose from 113 in 2013 to 182 in 2018, before falling slightly to 152 in 2020 [5–6]. In 2023 alone, a residential fire and a chemical factory blaze killed two people; another house fire killed a woman and two children; and a retail store fire injured 23, six of them critically [7]. These events underscore fire safety as a critical challenge [8].

Globally, over one million people died in fires between 1993 and 2015, with annual losses of 3.8 million fires and 44,300 deaths, costing up to 1% of GDP [9–10]. Countries such as Pakistan and India recorded 10,000–25,000 fire deaths annually from 2010 to 2014. In Asia, fires are the second most frequent disaster type, reflecting high safety non-compliance [4]. These trends highlight the need for accessible fire risk tools suitable for non-specialists to improve mitigation and provide low-cost, adaptable global solutions. Fire research increasingly applies risk analysis to practical problems [11]. Facility managers must conduct regular assessments to identify hazards and maintain compliance [12]. Yet Sri Lanka lacks qualified fire engineers and reliable local data for quantitative analysis. Existing tools are costly, require expert training, and fail to match Sri Lanka regulations, highlighting the need for a free, code-compliant solution usable across all building types.

Building fire safety depends heavily on codes and standards [13]. Prescriptive regulations require active and passive protection of fire-resistant structures, adequate staircases, maximum travel distances, and sprinklers [14–16]. Many buildings in Sri Lanka lack even basic systems such as hydrants, hose reels, sprinklers, and detection equipment [1]. Industrial buildings meet only 65% of fire regulations, exposing enforcement gaps [17].

The Construction Industries Development Authority [18] issues prescriptive codes assumed to manage hazards effectively if followed [19–21]. However, weak oversight and limited resources hinder enforcement [22], a challenge shared by many developing nations where firefighting authorities lack adequate power and infrastructure [23]. Even with modern suppression technologies, fireproofing remains problematic worldwide [24]. resources, the study seeks to establish a structured yet affordable methodology that enhances fire safety awareness, compliance, and protection of lives and property across diverse building types.

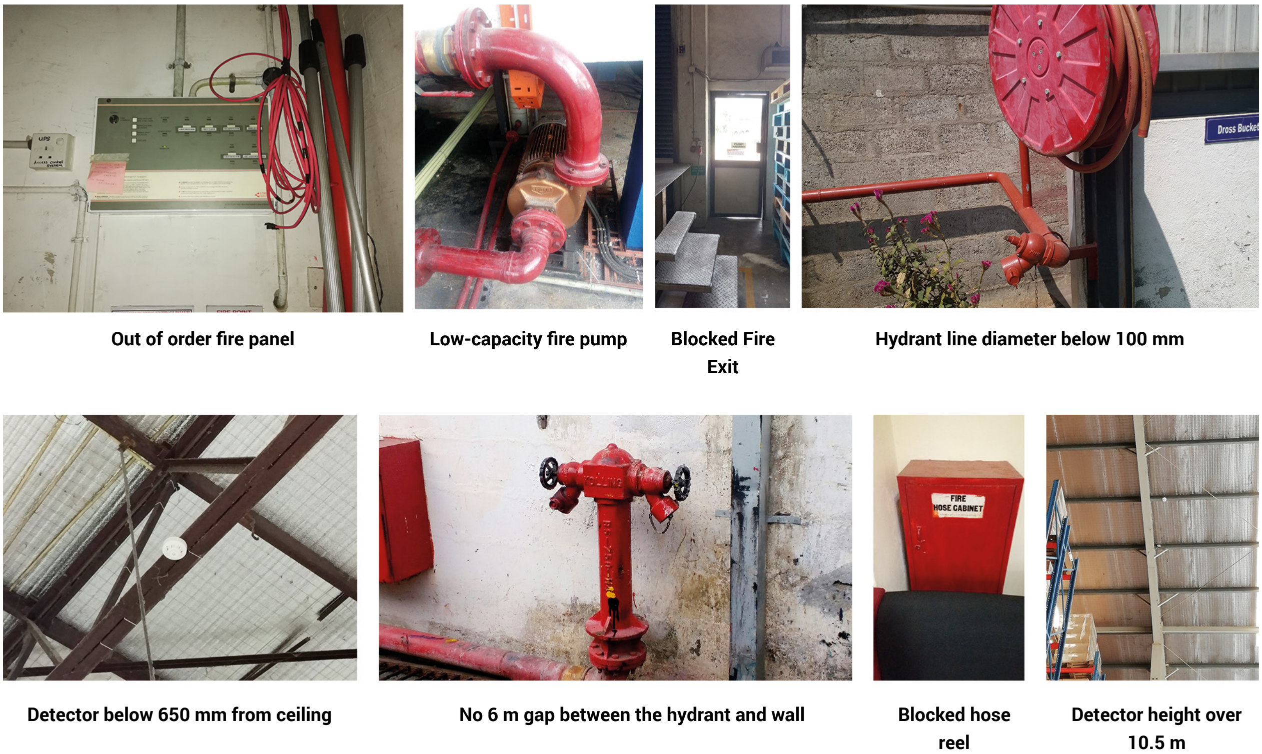

Figure 1. Fire safety gaps found in building in Sri Lanka
Source: Own elaboration.

Effective fire risk management begins with systematic analysis to identify hazards, quantify risks, and implement mitigation [25], [8], [26]. Despite many models developed in the past two decades [27], no universally accepted methodology exists [28]. Data gaps, inconsistent risk criteria, and the need for specialized expertise limit comprehensive quantitative assessments [29–30]. In Sri Lanka, the severe shortage of fire engineers and the absence of standardized, locally adapted frameworks hinder the reliability of evaluations.

Given these challenges, this study investigates how a locally adapted, user-friendly, and cost-effective fire risk assessment tool can be developed to enable non-specialists, such as building owners, facility managers, and safety professionals. This will allow to effectively evaluate and manage fire risks in Sri Lanka, where advanced quantitative methods, commercial software, and qualified professionals remain limited. Accordingly, the research aims to design a mobile-friendly, Sri Lanka standard-aligned assessment tool tailored to local conditions, supporting systematic evaluation, timely corrective actions, and practical risk prioritization. By bridging the gaps in expertise, data availability, and financial

Methodological Approaches to Fire Risk Assessment

Fire risk assessment is "the assessment of the risks to people and property as a result of unwanted fires" [31]. It involves identifying hazards, evaluating potential consequences, and determining the likelihood of the occurrence of a fire in order to verify whether adequate risk management measures are in place [32]. In buildings, the process generally follows three stages: identification, analysis, and evaluation. Identification examines how, when, and why a fire might occur. Analysis estimates probabilities and consequences, forming a basis for decisions under uncertainty. Evaluation then applies the criteria to judge whether risks are acceptable [8]. Depending on purpose and data availability, assessments employ qualitative, quantitative, or hybrid approaches [33].

Fire risk analysis uses methods of varying complexity [34]. Fires are influenced by unpredictable factors ignition sources, locations, and combustible arrangements, that limit deterministic modelling and complicate probability estimation [35]. Multi-simulation methods generate probability distributions to support performance-based design and code exemptions, but require advanced expertise in fire dynamics [36]. Expert-driven approaches, such as the modified Delphi method, refine professional judgment through iterative surveys, while the Analytical Hierarchy Process (AHP) assigns weights to fire safety attributes to create structured criteria [37–39].

Industrial methods, including the Gretener method and Dow Fire and Explosion Index (F&EI), quantify hazards by assessing danger categories, exposure areas, and potential losses. Developed for chemical, oil, and gas facilities, they require detailed technical data and expertise [40], [26]. Probabilistic approaches, such as the Markov chain model, can evolve fire risk by incorporating spatial and temporal dependencies, but remain rare in building applications [41]. Computational models such as CRISP, FiRECAM, FIERA, RISK-COST, and CESARE-RISK evaluate fire protection performance using stochastic simulations, event trees, and hazard analyses [42]. Similarly, the Building Fire Safety Engineering Method (BFSEM) and FIRE program from Worcester Polytechnic Institute simulate fire growth, barrier performance, and suppression mechanisms [43]. These detailed tools are limited to small expert groups due to technical and computational demands.

Fire risk indexing methods assign numerical scores to safety parameters using expert judgment and historical data, producing composite values benchmarked against performance criteria [44]. Models such as CUrisk combine life safety and economic impact through sub-models assessing occupant response and fatality risks [45]. Overall, fire risk assessment methods fall into four categories: (1) checklists, (2) narratives, (3) indexing methods, and (4) probabilistic techniques [34]. Although these vary in precision, many are resource-intensive, data-dependent, and hard to verify. Complex models require specialized knowledge, reliable failure data, familiarity with codes and standards, and even proficiency in foreign languages, limiting their use to a narrow professional audience [46].

Modern software such as SafetyCulture (iAuditor), GoAudits, FireMate, Fire Hub, Collabit, Vision Pro, ClickFRA, Aurora, and Mobiess digitize compliance checks and reporting, offering risk scoring, offline inspections, and integration with international standards [47–48]. While these platforms improve hazard identification, they have drawbacks: high costs, subscription fees, training needs, reliance on the internet, and language barriers. Most align with UK, US, or Australian standards, creating mismatches with Sri Lanka regulations, while limited links with local authorities can reduce official recognition. Data requirements, such as accurate floor plans or technical documentation, hinder use in informal buildings.

Methodology

Methodology for novel tool development

The newly developed tool, designed to address the above-mentioned challenges, is structured around three core modules: Database, Interface, and User Interaction that collectively facilitate a systematic and evidence-based evaluation of fire safety compliance.

Module 1: Database (Knowledge Foundation)

The database module consolidates regulatory requirements, standards, and expert knowledge necessary for accurate fire risk evaluation. It draws primarily on the CIDA Fire Regulations Database, Sri Lanka's national fire safety standards, and the country's overarching regulatory framework. Where CIDA regulations are incomplete, British Standards on which CIDA is largely based are used to fill the gaps. In addition, the database integrates common industry fire safety practices and fire safety management standards such as BS 9999, which are not covered by CIDA or most prescriptive codes.

From these sources, 221 fire risk assessment attributes were identified:

– 126 "Standard" attributes directly derived from CIDA and British standards.
– 85 additional attributes addressing fire safety management and industry best practices.

These attributes were grouped under 12 critical risk factors, established through expert interviews in the author's previous research. The factors were mapped to the design, construction, and maintenance stages of a building's lifecycle, showing that fire risks vary in severity depending on context rather than occurring uniformly.

For Sri Lanka, the most significant drivers of elevated fire risk were identified as:

– Flawed building design
– Approval of unsuitable building plans
– Inadequate maintenance of fire safety systems

Other contributing factors include lack of comprehensive fire safety management systems, use of substandard or non-compliant materials and equipment, insufficient fire safety infrastructure, poor housekeeping & unsafe work practices, inadequate emergency planning and training, non-adherence to specifications, limited awareness of fire safety protocols, and improper installation of fire safety systems.

Finally, each attribute was weighted using the Relative Importance Index (RII) values of the 12 critical risk factors from prior research, ensuring that risk evaluation reflects the true significance of each attribute rather than simple compliance counts. These weighted attributes were then organized into five key fire safety domains: Means of escape, Structural fire protection, Fire detection systems, Fire protection systems, and Fire safety management.

Module 2: Interface (Operational Platform)

The interface module acts as a bridge between the knowledge base and the user interface, ensuring that building-specific fire risk evaluations are accurate and efficient. The system is built around 54 custom checklists, each aligned with one of Sri Lanka's officially recognized building categories, which are defined by height, floor area, and purpose group under CIDA fire regulations. These categories determine major differences in both active and passive fire safety requirements. For example, super high-rise buildings must have refuge areas, whereas high-rise buildings do not. Similarly, firefighting shafts are required in high-rise buildings, while medium-rise buildings require only protected shafts.

In another case, detention facilities up to 18 m of height with a floor area exceeding 800 m² must include landing valves, while hotels, hostels, or offices of the same height are exempt from this requirement.

A core function of the interface module is to map applicable standards and best practices to each building category. From an initial pool of 221 fire risk attributes, the system filters out non-relevant requirements and integrates additional management or technical provisions as needed. This process produces 54 building-category-specific checklists. An automated checklist selector then assigns the correct checklist based on the user's input about building height, floor area, and purpose group. Each checklist includes up to 221 weighted fire risk factors, with built-in Relative Importance Index (RII) weightings to ensure that results reflect the criticality of each risk factor, not merely the number of compliance items.

Module 3: User Interaction (Assessment Engine)

The final module enables a user-guided fire risk assessment through a structured, step-by-step process. After logging in, users encounter a warning interface requiring them to read, acknowledge, and confirm the operating instructions before proceeding. The second interface collects essential information for the final report, such as date, building name and address, number of employees, and operating hours, along with technical data including habitable floor area, building height, height category, fire growth rate, occupancy characteristics, required management level, and one- or two-way travel distances. This information allows the software to select the correct checklist from 54 predefined building categories.

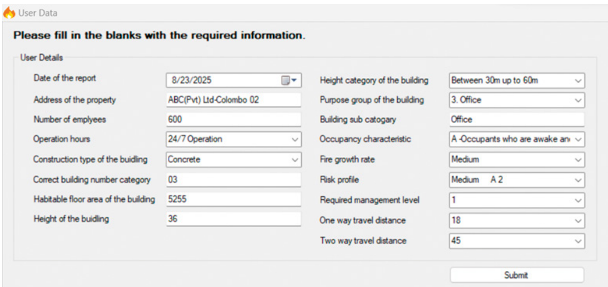

Figure 2. Basic input data of the new software
Source: Own elaboration.

The next stage is purpose group selection, where users choose both the category and sub-category from drop-down menus. Each selection is supported by an on-screen table and charts to help non-specialists make accurate choices. Once confirmed, the software automatically loads the customized checklist for that building type.

Each checklist contains attributes grouped into five key fire safety areas: means of escape, structural fire protection, fire detection systems, fire protection systems, and fire safety management, covering up to 221 attributes. Users progress through each section by answering a structured questionnaire:

1. Determine applicability – The software assumes all attributes are relevant, since the checklist is already category-specific. Users need only flag rare cases where a requirement does not apply (e.g., basement-specific measures for a building without a basement). These attributes, if not applicable, will be excluded from the final risk calculation.
2. Assess compliance level – For each applicable attribute, users assign one of four compliance levels, guided by detailed descriptions:
   – Level 1: Non-compliant (0 marks);
   – Level 2: Partially compliant (25 marks);
   – Level 3: Moderately compliant (50 marks);
   – Level 4: Fully compliant (75 marks), with comprehensive standard references.

These levels help users make informed decisions based on physical inspections and clear criteria, rather than interpreting standards themselves. This structured scoring method follows the point-based approaches recommended in fire safety literature [49-50]. After all sections are completed, the software applies embedded RII weightings to calculate a weighted compliance score, compares it with the theoretical maximum, and determines the compliance gap as a percentage. The user can then generate and download the final report.

By combining prescriptive checklists with risk-weighted scoring, this tool delivers a simple, structured, and scalable approach to fire risk assessment. It is especially valuable in Sri Lanka, where fire safety awareness is limited, professional expertise is scarce, and regulatory enforcement is still evolving.

Calculating the fire risk level and generating a detailed report

Once all data is entered and compliance levels are selected, the tool automatically calculates the overall fire risk level of the building. The report can be downloaded in PDF format. It then presents the results through a report and a visual dashboard, including bar charts, pie charts, and a fire risk level chart. The final report provides a detailed breakdown of compliance across various safety categories, as shown in Table 1, highlights both major and minor deviations, and categorizes the building's fire risk as very high, high, medium, low, or very low. This entire process enables users to complete thorough, standards-aligned fire risk assessments without the need for in-depth technical knowledge, while still producing highly accurate and actionable results.

Application of the tool

For the application of the tool, an old high-rise office building was selected. The building is 36 meters tall, has a total habitable floor area of 5,255 square meters, and is spread across 10 floors. A fire risk assessment was carried out by a consultant using a checklist method developed based on local and international standards. In this checklist, each item was given equal weight, and compliance for each point was determined at the consultant's discretion, without any intermediate levels of compliance. Based on the final total score, the building was classified as a medium-risk building, and the compliance levels for each area are given in Table 2.

Table 1. Summary of fire safety assessment indicators

Key Area	Fire safety standards/ Attribute	Average Compliance Levels	Marks	IRR	IRR Value / Weightage	Final Weightage score	Highest Marks if 100% compliance
			A	B	C	A × C	C ×75
Fire Protection	**Maximum area for sprinklers**	L3	75	1	0.913	22.8125	68.4375
-	**Clearance below sprinklers**	L1	25	5	0.838	20.9375	62.8125
-	**Concealed space**	L3	75	1	0.913	68.4375	68.4375
-	**Water supply for hydrant and hose reels**	L3	75	1	0.913	68.4375	68.4375
-	**Water Supply for Sprinkler System**	L2	50	1	0.913	45.625	68.4375

Source: Own elaboration.

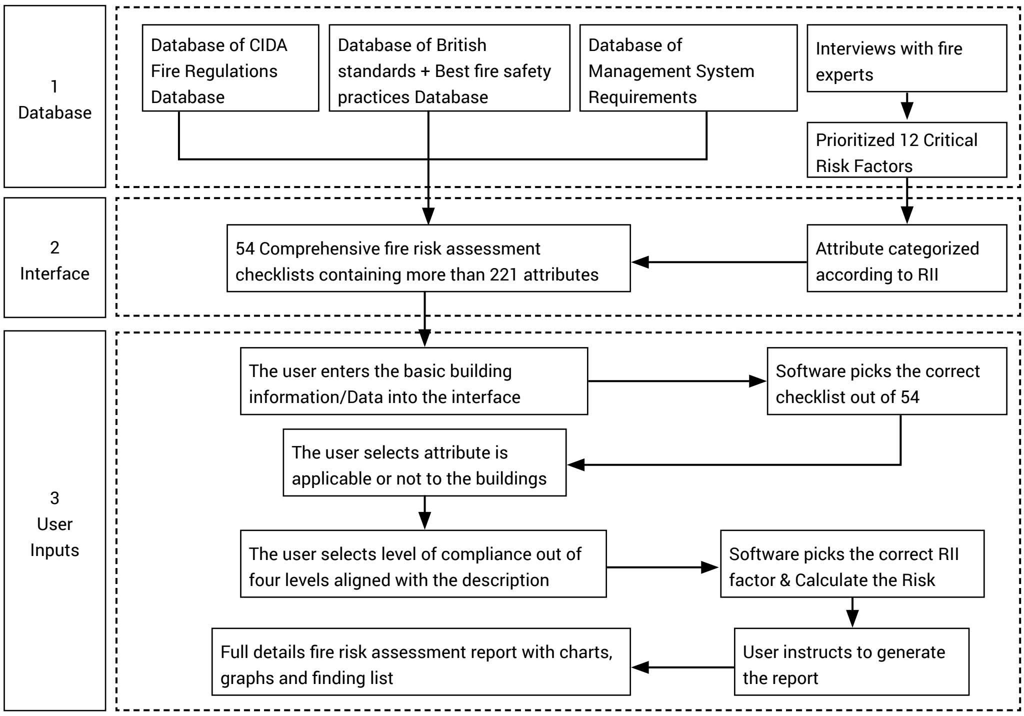

Figure 3. Process of functioning of the new software

Source: Own elaboration.

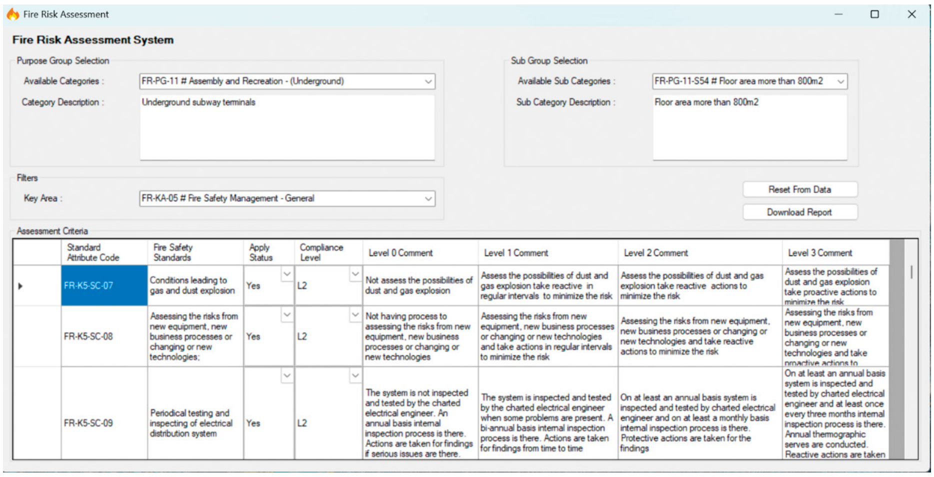

Figure 4. Example of selection purpose group and level of compliance

Source: Own elaboration.

To verify and validate the newly developed checklist-based software, it was applied to the same building. After entering the building type, height, and floor area, the software automatically generated the appropriate checklist for the building, as shown in the interface below. Additionally, the software has already been applied to over 50 buildings by selected fire experts, whose feedback confirmed that the tool is user-friendly, easy to operate, ensures all necessary points are reviewed according to building type, and delivers results that are more accurate than conventional checklists. In addition, the author has applied the developed tool to multiple building types, with the resulting fire risk assessment findings published in peer-reviewed journals [51].

Below is a summary of the results obtained after applying the newly developed fire risk assessment software to the above high-rise office building, along with a comparison to the results from the traditional checklist-based assessment previously conducted for the same building by a fire consultant.

Table 2. Summary of Fire Safety Assessment Indicators

No.	Average compliance [%]	New software result [%]	Normal checklist result [%]
1	Means of escape	35.64	46
2	Structural fire precautions	36.66	45
3	Fire detection and alarm system	33.33	50
4	Fire protection systems	39.22	46
5	Fire Safety Management System	48.81	N/A
6	Passive fire protection system	36.15	46
7	Active fire protection system	36.27	48
8	Local standards	43.56	N/A
9	British and best industrial practices	42.07	47
10	Fire risk level of the Building	Medium	Medium
11	Detailed Report including deviations, graphs, charts	Available	Not Available

Source: Own elaboration.

Results and Discussion

A major constraint of quantitative fire risk assessment is the lack of reliable failure data to support accurate calculations. Inconsistent risk acceptance criteria further hinder the establishment of a uniform assessment basis [30]. Although the newly developed fire risk assessment tool offers a practical solution across all 54 building categories in Sri Lanka, the country still lacks the statistical records required for fully quantitative methods.

Building fire safety under prescriptive codes traditionally combines active and passive protection systems [52]. Effective strategies require the installation and proper maintenance of both [52]. However, many approaches underestimate risk by overlooking system maintenance deficiencies [27], while most assessment tools ignore whether fire safety management programs are implemented. Research shows that strong fire safety management programs significantly improve building performance [53].

The new tool addresses this gap by incorporating more than 85 checkpoints on fire safety management and system maintenance, aligned with CIDA regulations and BS 9999 standards. As shown in Table 2, traditional checklist methods fail to capture these critical parameters. By integrating management and maintenance factors, the tool provides a more realistic measure of a building's true fire risk. Using structured on-site inspections, each fire safety attribute is compared against codes and standards, with compliance levels clearly defined so assessors need not interpret requirements. Unlike traditional tools limited to specific codes or building types, this system applies to all 54 building categories and reports on compliance with Sri Lanka, British, and European standards as well as areas of non-conformance.

Overcoming the weaknesses of traditional checklists

Traditional methods treat all attributes equally, distorting results [3]. Experts stress that risk weighting is essential [50]. The new tool applies Relative Importance Index (RII) weightings from the author's research to improve scoring accuracy [6]. It also replaces binary "comply/do not comply" checks with four compliance levels. For example, if seven of ten exits have panic bars, older methods mark full compliance, overstating safety. The new tool assigns partial scores (Level 1–4), giving nuanced results. Low-compliance situations, such as only three compliant exits, are no longer oversimplified.

Improved accuracy and validation

Compared with traditional methods (Table 2), the new tool reports slightly higher risk levels (lower compliance), reflecting precision rather than stricter scoring. This results from including management attributes, applying RII weightings, and using graded compliance levels. Both approaches show similar trends, but the new tool is more reliable. Validation through expert review, manual calculations, and user feedback confirmed ease of use and high accuracy.

Addressing professional gaps in Sri Lanka

Sri Lanka has fewer than 30 certified fire engineers (Institution of Fire Engineers, U.K.) and only a small number of related professionals, far too few for a population over 20 million. Comprehensive risk assessment normally requires expert knowledge, leaving building owners and maintenance engineers without adequate guidance.

This tool bridges that gap. Factory engineers, facility managers, and safety officers can perform assessments with only basic data, height, floor area, and purpose without specialized training. By improving awareness of standards and management practices, the tool both delivers accurate risk evaluations and encourages proactive compliance.

Benefits and broader impact

- User-friendly and cost-effective – requires no specialist knowledge.
- Applicable to any building type – covers all 54 CIDA categories.
- Additional management and industrial best practice attributes not addressed by CIDA fire regulations – 85 attributes not covered by regulations
- Raises safety awareness – helps users understand standards and management practices.
- Supports resource-limited contexts – addresses the shortage of fire engineers.
- Validated and scalable – consistent with expert assessments.

Overall, this tool merges the strengths of prescriptive codes and risk-based methods, offering a structured, precise, and practical solution for identifying, quantifying, and prioritizing fire risks of buildings in Sri Lanka.

Conclusion

The rapid growth of complex and high-rise buildings in Sri Lanka, coupled with a 26% increase in fire-related incidents between 2015 and 2020, has intensified risks to life, property, and the environment. Statistics indicate that there were 2,703 major fire incidents nationwide, with annual cases in Colombo alone rising from 113 in 2013 to 182 in 2018. These alarming trends highlight the urgent need for a practical and effective fire risk assessment approach. However, the limited number of qualified fire engineers and the lack of reliable local data have constrained the ability to conduct robust quantitative assessments. Existing international tools are often expensive, data-intensive, and misaligned with local standards, while conventional qualitative checklists provide little attention to design, maintenance, and management factors.

To address these challenges, this study developed a locally adapted, systematic, and user-friendly fire risk assessment tool designed for use by non-specialists such as facility managers, building owners, and inspectors. Through expert interviews, twelve critical fire risk factors relevant to the Sri Lanka context were identified. A comprehensive checklist of 221 attributes was formulated – 136 based on local fire regulations and applicable British Standards, and 85 covering management and maintenance areas not addressed in national regulations. These attributes were categorized into five core domains: means of escape, structural fire precautions, fire detection systems, fire protection systems, and fire safety management. Using the Relative Importance Index (RII) derived from the twelve critical factors, each attribute was weighted, and a four-tier compliance scale was introduced to ensure consistent and transparent evaluation across 54 official building categories.

The developed tool provides a structured, evidence-based method for assessing fire safety performance in diverse building types. It enhances awareness, promotes regulatory compliance, and empowers non-specialists to perform reliable assessments without the need for costly, complex systems. Future integration with real-time data collection and AI-driven analytics is expected to further strengthen proactive fire risk management and contribute significantly to safeguarding lives, property, and the built environment in Sri Lanka.

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