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A New Constructive Professional Training Guide on Health and Safety Practices for Construction Workers

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Abstract: Healthy work environments and processes lower the possibility of workplace accidents, financial costs and unnecessary project delays, all of which have a significant beneficial effect on worker morale. The construction sector of many developing countries understands the necessity for effective tools to guide construction workers in improving their work practices linked to health and safety aspects. Accordingly, this study intends to design a modern training guide/manual that could enable construction workers in a variety of job categories to enhance their work procedures, learning demands and responsibilities in relation to health and safety practices. The crucial factors/areas and Competency Elements (CEs) were qualitatively identified using comprehensive approaches. A series of industry consultation meetings/discussions were carried out with action-oriented communication approaches to develop training aims and learning outcomes based on the identified critical CEs. Expert reviews were conducted on the entire development process to validate the outputs. The study has produced a new training guide/manual that describes all the needed components of training to improve the cognitive and manual skills of construction workers, connecting with the key areas of the job roles and the legal framework, identification/assessment/control of hazards, conditions and risks in construction operations. The study has also produced a sample lesson plan which describes how the learning areas/contents are methodically linked to training objectives. The outcomes of experts' reviews assured the validity, reliability and generalisability of the developed training guide. The developed training manual/guide will be a functional tool that offers proactive and sustainable strategies to successfully integrate contemporary techniques/systems in construction projects, leading to standardising and reforming healthy practices associated with safety, quality and productivity. Despite the study findings can be directly applicable to the construction industry sector of Sri Lanka, other developing/developed countries and other developing industries/sectors can also achieve comparable outcomes towards upgrading their industrial processes.

Keywords: Construction industry, Developing countries, Health and safety, Productivity improvement, Training development, Skill enhancement

1. Introduction

Construction is one of the key industries that significantly contribute to the economic recovery of a nation [1-2]. The construction industry is made up of a number of different enterprises that work together as multidisciplinary teams [3]. By offering enormous investment prospects, it links with other industry sectors and increases employability [4]. Importantly, the construction industry sector accounts for a notable share of Gross Domestic Product (GDP) in many nations, particularly 5-9% of GDP in England, Japan and Oman [3].

Enhancement in the quality and productivity of construction site activities is a major concern for any construction organisation as it influences the marketable commodities connected to construction management practices towards the achievement of organisational goals [5]. On the other side, technological advancements fuel the industry's explosive expansion correlated with financial outcomes, competitiveness and the adoption of critical collaborator ideas for the growth and sustainability of the construction sector [5-6]. A major obstacle to enhancing the productivity of construction operations and handling the challenges/opportunities associated with technological advancement is the workers' poor competencies and work styles across a variety of job categories in the construction industry of many developing nations, like Sri Lanka [1, 7-8]. This has been the

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main cause of construction delays, cost overruns and quality-related issues for organisational firms [9].

Recent studies highlight that construction workers' poor cognitive and manual abilities in health and safety practices are significant among those competencies that affect the work quality and productivity in various construction operations [10-13]. Healthy construction practices and working conditions significantly improve worker morale by lowering the likelihood of workplace accidents, financial fallout and the need for time off. It is crucial that construction workers adhere to appropriate health and safety procedures at all times [10-12]. The construction sector has been pushed to face productivity related issues due to poor health and safety practices in a number of nations, including Australia [14], Egypt [7], India [15-16], Nigeria [17] and South Africa [18]. In numerous building projects in Australia [14], India [15, 19] and South Africa [20], a considerable number of instances were documented owing to mishaps and worker injuries. Notably, workplace accidents were found to be a major cause of construction delays in Sri Lanka [9].

In Sri Lanka, national plans for the socioeconomic growth of the country place high importance on construction projects [1, 4]. But, recent studies indicate that numerous construction firms in Sri Lanka have failed as a result of challenges or difficulties related to workforce operations with poor quality and low productivity levels over a long period of time [1, 4, 13]. Because the abilities of workers in the construction sector across many job categories are not up to the requirements, there are noteworthy repercussions on the productivity and quality of workforce operations in many construction projects in Sri Lanka [1]. Notably, Tertiary and Vocational Education Commission [21] emphasises the absence of efficient training initiatives that address health and safety related problems. Despite a few studies focused on enhancing the worker's skills and performance levels in construction in Sri Lanka [6, 22-23], those studies did not have a sufficient level of focus on health and safety practices in construction. Consequently, it is important for the construction industry and the training sector of Sri Lanka to understand the need for systematic skill development practices in order to specifically address the workers' poor abilities in health and safety practices. Notably, this study highlights comparable situations, challenges and needs when it comes to many other developing countries as well, including Egypt [7], India [15-16], Nigeria [17], South Africa [18], etc.

1.1 The Study's Objectives and Significance

Considering the above-highlighted aspects, this study accentuates that there is a need for efficacious mechanisms to direct construction workers on improving their work practices related to health and safety aspects. The study emphasises the significance of addressing the industry's knowledge gap on what elements of outcomes are associated with work roles and legal approach, hazard identification, assessment and control and high risks and conditions prevailing in construction operations. More importantly, this knowledge gap expands on how protocols need to be developed to offer proactive and sustainable strategies for successfully integrating contemporary techniques and systems in construction projects within a methodical framework. As per these stated needs and significance, the study intends to,

- identify the critical areas and competency elements that direct the attributes of the health and safety related work roles and legal approach, hazard identification, hazard assessment, hazard control and high risks in construction operations.
- design/develop a modern training guide/manual for enabling construction workers from various job categories to enhance their work processes, learning demands and responsibilities in the health and safety aspects of construction project operations.
- standardise and reform the health and safety policies of the industry sectors of numerous developing countries towards successfully addressing the challenges and opportunities associated with quality, safety and sustainability of work outputs in the current and future stages.

2. Literature Review

Studies highlight that the cognitive abilities of construction workers in construction methods have a significant impact on the progress of many construction projects in India [24], Iran [25] and New Zealand [26]. Additionally, quality concerns have arisen during the construction operations of pre-stressed concrete bridges in Egypt as a result of lack of training facilities for workers in health and safety

procedures [7]. On the other hand, a significant number of occupational fatal injuries have lately been documented in the construction sectors of Australia [14] and India [2] due to the workers' poor cognitive skills in health and safety procedures. Importantly, the International Labour Organisation [27] reports that over 100,000 construction workers die annually from various occupational safety and health issues, accounting for roughly 30% of all fatal occupational injuries. According to Umar et al. [28], while looking at the construction industry in Oman, the majority of worker injuries have resulted from traffic accidents, followed by workers sliding/falling, and last being crammed between solid objects. According to Umar and Egbu [29], a larger percentage of accidents is caused by workers' errors than by issues with tools, materials, environment or management. It is important to note that work-related accidents lower employee productivity and cause businesses to spend more money on things like clean-up costs, replacement costs, delays, supervision costs and rescheduling and transportation costs [30]. Health and safety training practices will help to reduce accidents and injuries on construction sites, as well as shield the business from expensive legal battles with the management or organisation and stop workers from leaving the job site sick from their jobs.

Rami and David [14] examined factors affecting construction productivity in the State of Queensland City of Australia and found that the construction workers' competencies in practices related to health and safety and quality inspection require significant improvement. The safety of projects is increased, and the dangers of making costly errors in establishing quality standards are reduced when the quality control procedures are properly implemented [14]. On the other hand, Oseghale et al. [11] highlight that the poor knowledge of construction supervisory workers in health and safety procedures has been the main issue for contractors against productivity improvement in Nigerian construction projects. Moreover, similar issues have been found as an influencing factor on productivity in a large number of building projects in India [15] and Sri Lanka [4]. Additionally, this was emphasised as a critical concern for the failure of a noticeable number of construction organisations in the United Arab Emirates [31] and Zambia [32] more than a few decades ago.

When it relates to health issues of construction workers, Shahab and Audrius [33] highlight that workers' overtime and rework are notable factors. Similar perspectives were observed by Durdyev et al. [34] in light of construction industry practices in Turkmenistan. Working more hours could result in an increase in alcohol consumption and body mass index, which could cause a variety of other health issues. Working long hours might be harmful to the mental health of a worker [35]. Umar et al. [36] assessed the health status and physical discomfort levels of 30 construction workers from the Gulf Cooperation Council (GCC) countries and found that the major problems are with excess body weight, and 43.3% of them had blood pressure readings that were in the hypertension range. For instance, it was discovered that over 45% of them had been suffering from physical pain in their neck, shoulder, lower back, legs and knees for a number of months. According to Umar et al. [36], sleep habits have a big impact on how uncomfortable workers are.

The overall academic review of the potential past studies [27-36] revealed the significant work role characteristics and the knowledge elements associated with the hazards and risks. As per the listed critical areas/elements, in order to address the demand for modernising skill development processes, the education and training sectors of developing nations must integrate both industrial and institutional approaches [1-2, 7-8, 21, 37]. The importance of research components on improving training development practices is emphasised by Adi and Ni'am [38] as one of the key strategies that must be put into practice in order to improve the current practices and policies of an industry sector. In many developing nations like Sri Lanka, there are only very few studies that extensively explored the work-based training development techniques in the construction sector [6, 22-23, 39-41].

Ojha et al. [41] focused on the training practices used to assess how well construction workers adhere to health and safety procedures. Despite the fact that the results indicate that the majority of the organisations have been using traditional/conventional methods, which are typically lecture-based sessions and toolbox lectures, Ojha et al. [41] noted that the work-based learning method has a significant advantage over conventional approaches. Supporting the study outcomes of Ojha et al. [41], further studies also point out that workers'

cognitive and technical skills, self-confidence and comfort levels significantly increase as a result of work-based training approaches [40, 42]. On the other hand, work-based learning (WBL) activities have been implemented by Siregar [39] with 30 construction employees on building projects in the Indonesian city of Medan. Siregar [39] examined the following nine factors in five stages, taking into account the participation of the workers in WBL activities.

- Noting the explanation of instructors
- Asking questions
- Providing ideas/opinions
- Effective group communication and participation
- Receiving feedback from others
- Responding to feedback from others
- Paying attention to group members from other groups
- Exhibiting confidence
- Summarising what was learned

Siregar [39] noted poor worker engagement in all nine aforementioned elements at the beginning stage, but this involvement gradually improved till the end of the training. Between the stages, there was a noticeable improvement in the workers' involvement in communicating and taking part in group work. The feature of the workers providing a summary of the learning was the highest in all phases. Siregar [39] also found that workers' abilities and the degree of learning activities grew steadily and noticeably as the WBL process progressed.

With a specific aim of enhancing the effectiveness and productivity of construction practices, recent studies have presented some useful training tools, models and systems, which are construction labour training guiding tool [22], construction supervisory training guiding model [6], construction labour performance score system [43], construction labour grading scheme [43], guiding tool for designing different qualification levels of training programmes [23] and training guide/manual for continuous professional development of engineers [44]. Notably, Manoharan et al. [22, 43] emphasise that 30% of the weight needs to be considered for the labourers' competency element of following health and safety procedures in all types of construction site operations among other elements of competencies associated with the labour training exercises aiming to improve the performance of labourers in applying technologies/methods in site activities. On the other hand, Manoharan et al. [6] point up the need for the consideration of the same percentage (30%) of the weight to the competency elements of construction supervisors associated with health and safety procedures to apply productivity and performance improvement practices compared to other competency elements in the supervision of site works, including buildings, roads, highways, bridges, water supply and irrigation works. These models, tools and systems highlight the significance of improving the competency elements of various job positions in health and safety procedures in construction projects. Nevertheless, they do not contain specific detailed procedures and guidelines for implementing the training tasks related to health and safety practices. Accordingly, the literature review of the current study has verified the need for a new training guide that specifically addresses the work processes, learning demands and responsibilities of construction workers associated with health and safety aspects.

3. Research Methodology

The study methodology was implemented using the series of steps depicted in Figure 1. The qualitative approaches were mainly used to determine the critical elements/ areas/competencies that must be covered in the new training manual/guide as per the study objectives. A comprehensive literature review was conducted using pertinent scholarly academic articles and the current curricula of academic/training programmes offered in the technical and vocational education sectors of various nations. On the other hand, a series of expert consultations, workshops and interviews were carried out among institutional, academic and industry experts in order to understand the characteristics of the latest practices used in the construction industry sector of Sri Lanka and other developing nations. A total of 12 experts participated in these sessions, who were selected by assessing their work experience and recent involvement in training development practices for various industry sectors. Notably, four of them had vast experience in training development practices, whereas the remaining eight professionals had more than ten years of experience in health and safety practices in a wide range of project operations, especially in buildings, roads, highways, bridges, water supply, irrigation work, etc. The detailed profile of such experts is shown in Table 1. In the selection of experts, the required expert

categories, size, expertise and qualifications were considered on the basis of the recommended guidelines provided by recent potential studies [6, 22, 23] for training development practices connecting both institutional and industrial sectors. Additionally, the detailed profile of such experts was also validated through the consultation with three academic director-level specialists who lead various aspects related to quality assurance, accreditation, curriculum development and other relevant academic policies/by-laws in both the tertiary and higher education sectors.

The thematic analysis was used to qualitatively filter the data collected from the aforementioned methodologies since it is a recognised approach to analysing respondents' viewpoints, experiences or values. According to Caulfield [45], this qualitative method was utilised to look for themes, subjects, ideas and patterns that keep coming up in the data that had been collected. This qualitative thematic analysis approach looked at the requisite competency elements (CEs) for particular characters, and the codes were supplied as appropriate. Then, based on the developed themes to prevent CEs from being repeated, the corresponding codes between the groupings of competencies were established. The final collection of relevant CEs was produced by this qualitative analysis approach following a second evaluation of the themes and codes.

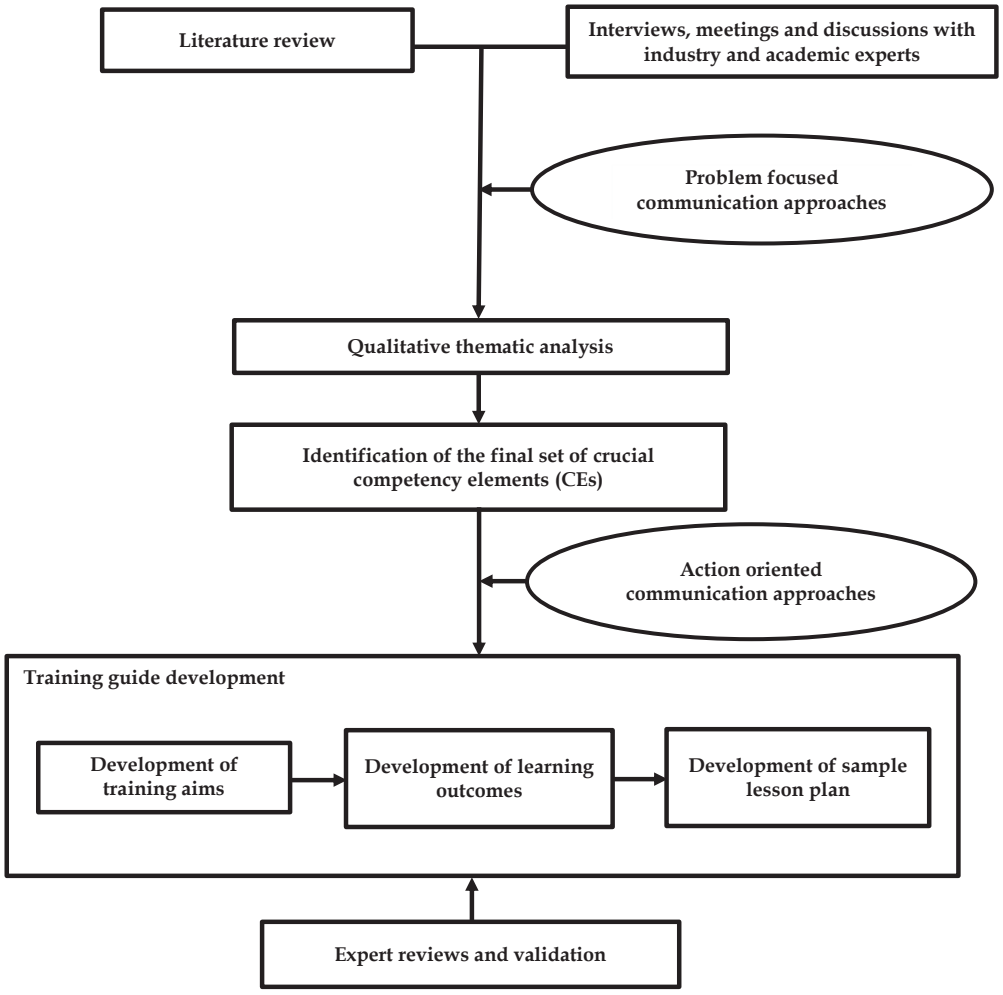

Figure 1 – Study Methodology to Design the Modern Professional Training Guide/Manual on Health and Safety Practices

Table 1 – Detailed Profile of Experts Participated in the Interviews, Meetings, Workshops and Discussions

Expert Categories	Total Number of Participants	Expertise and Qualifications
Academic specialists	4	• All the academic experts had more than 10 years of work experience in the academic field. • All of them had a minimum of 5 years of industry experience. • All of them had a minimum of 5 years of institutional administrative experience. • All of them had a minimum doctorate qualification in the civil engineering field. • Half of them had chartered engineering qualifications. • All of them had vast experience in teaching courses related to the areas of construction materials and technology, construction planning and management, industrial management, water resource engineering and hydrology, transportation and highway engineering, environmental engineering, geotechnical engineering, etc. • All of them had expertise in conducting industrial-based research and applications. • All of them were expertise in curriculum designing, training development and quality assurance practices in tertiary and higher education sectors.
Industry specialists	8	• All the industry experts had more than 10 years of work experience in their respective fields. • All of them had minimum master's level qualifications in the civil engineering field. • All of them had chartered engineering qualifications. • Half of them had Green-accredited professional qualifications. • Three of them were expertise in health and safety practices in building construction works. • Three of them were expertise in health and safety practices in road, highway and bridge construction works. • Three of them were expertise in health and safety practices in water supply and irrigation work.

Through problem-based and action-oriented communication methodologies, training aims and a set of learning outcomes (LOs) were developed based on the identified critical CEs under different categories, with concerns about the present practices and the upcoming requirements of the construction sector of developing nations. A panel of experts assessed the entire training development process and the outputs, and the validity of the developed training guide/manual was assured using the review outcomes. Noticeably, the panel of reviewers consisted of two academic experts who had been involved in various education and training development activities, as well as four industry experts who had vast experience in health and safety practices in a variety of construction project operations. In particular, this review process was conducted using observations, documentation and interactive discussions with a specific focus on the eight aspects that are given below.

- meeting the industry's demands by defining the required knowledge, skills and attitudes (Component 1)
- encouraging improvements to the efficiency and transparency of industry and community based activities (Component 2)
- assessing the necessary data to forecast in order to prepare or conduct research (Component 3)
- offering the best strategies and tactics to address a variety of real-world issues mixed with some theoretical components (Component 4)
- offering efficient or novel methods to increase productivity in industrial processes (Component 5)
- improving work performance and the use of competency elements in various contexts (Component 6)
- integrating academic/theoretical, real-world and social elements into industry operations (Component 7)

- raising the bar for competencies in order to create progressive credentials and enhance the workers' careers (Component 8)

4. Results and Discussion

4.1 Key Work Role and Competency Element Characteristics that Guide the Health and Safety Characteristics in Construction Operations

Based on the data collected from the literature review and the interviews/discussions with the experts, the critical competency elements were qualitatively identified as the key attributes of health and safety practices under the different characteristics associated with work roles, hazards and risks in construction operations, as shown in Table 2.

Table 2 – Critical Competency Elements (CEs) that Direct the Attributes of the Health and Safety Practices in Construction Operations

Characteristics of the Elements associated with Job Roles	Characteristics of the Knowledge Elements associated with Hazards and Risks
1. Occupational health and safety regulations/methods in operating equipment and machinery*ab	1. Hazardous methods and materials*ab
2. Rights to refuse work activities during unsafe work conditions*b	2. Severities of risks*a
3. Health and safety related responsibilities of different work categories and authorities*ab	3. Effects of workplace illness*a
4. Emergency response plan*ab	4. Hierarchy of controls*a
5. First aid procedures in accidents*ab	5. Administrative controls*a
6. Emergency accident management procedure*ab	6. Personal protective equipment*a
	7. Health and safety information system*ab
	8. Physical and ergonomic occupational health risks*ab
	9. Risks of hazardous chemical and biological substances*a
	10. Risks in excavation and trench operations*b
	11. Risks in marking underground utility lines*b
	12. Risks in securing and stacking materials*ab
	13. Risks in hoisting and rigging*ab
	14. Risks in causing slips, trips and falls*ab
	15. Risks in the usage of ladders*b
	16. Risks in working on scaffolds-powered elevating systems*ab
	17. Risks in working with electrical energy sources*ab
	18. Sources of stored energy (thermal, hydraulic and pneumatic)*a
	19. Electrical equipment or installations*b
	20. Plugging in or unplugging low-voltage tools/cables*b
	21. Working at heights*a
	22. Operating machinery*ab
	23. Damaged and unprotected openings*b
	24. Making of guardrails and covers*b
	25. Usage of travel restraint system*b
	26. Usage of fall restricting system*b
	27. Usage of fall arrest system*b
	28. Usage of work belts, safety belts and safety nets*b
	29. Traffic protection plans, barriers and route controls*ab
	30. Vehicular control measures*ab

*a: Identified from the data collected from literature

*b: Identified from the data collected from the experts' interviews/discussions

*ab: Identified from the data collected from literature and the experts' interviews/discussions

4.2 The Training Guide

With the base of the contents shown in Table 2, this study has produced a fresh training guide/manual on strategies for enhancing the cognitive, manual and affective skills of construction workers in health and safety procedures. The training aims/objectives, principles, key learning areas, learning outcomes, teaching and assessment methods and lesson plans are all covered in detail in the proposed training guide, as per the following sections/paragraphs described below.

The major scope of the proposed training is to strengthen the workplace safety culture by raising the nature of the problem and the significance of preventing illnesses, injuries and deaths on construction sites, as well as to enhance the cognitive abilities and comprehension of construction workers on occupational health and safety matters that will push them to recognise common hazards on construction project activities and to understand how these hazards can be eliminated/prevented. Moreover, the training

guide highlights the significance of the following key areas to achieve the training aim.

- The role of parties in the workplace and the legal framework
- Identification, assessment and control of hazards
- Conditions and risks that can be frequently found in construction operations
- Commonly occurring high risks in construction projects (related to electrical and energy sources, falling from heights, mobile equipment and vehicles, material handling, and excavations and trenches)

As per the above-highlighted key areas, the learning outcomes were designed as described given below.

4.2.1 The Role of Parties in the Workplace and The Legal Framework

At the completion of the training, the construction workers will be able to

LO1.1: Apply occupational health and safety regulations based on the types of construction activities/methods and the type of equipment and machinery operations.
LO1.2: Perform the duties with proper communication and understanding of the rights to refuse the work activities when identifying unsafe work conditions.
LO1.3: Perform the duties with proper communication and understanding of the responsibilities of the health and safety officers, representatives, inspectors and joint committee members.
LO1.4: Perform the duties with proper communication and understanding of the responsibilities of the Ministry of Labour, insurance authorities and other relevant designated entities /associations.
LO1.5: Pay attention to the emergency response plan and/or other instructions /regulations, including first aid in accidents, emergency incident/accident management procedure, maintenance of incident/accident log, etc.

4.2.2 Identification, Assessment and Control of Hazards

At the completion of the training, the construction workers will be able to

LO2.1: Identify hazardous methods and materials with a proper understanding of the principles and significance.
LO2.2: Evaluate risks based on their severities.
LO2.3: Describe the hierarchy of controls, including elimination/substitution, engineering and administrative controls and personal protective equipment, as they relate to dangers in construction operations.
LO2.4: Describe the effects of workplace illness, injuries and fatalities on co-workers, families, communities and societies.

4.2.3 Conditions and Risks Frequently Prevailing in Construction Operations

At the completion of the training, the construction workers will be able to

LO3.1: Use systematic/proper methods in removing debris, securing materials and stacking materials.
LO3.2: Identify typical occupational health risks that are present on construction sites related to physical, chemical, biological and ergonomic aspects.
LO3.3: Describe how occupational illnesses brought on by exposure to hazardous chemical and biological substances in construction operations.
LO3.4: Explain how health and safety information system mandates within the workplace practices.
LO3.5: Demonstrate how to identify typical workplace situations that cause slips, trips and falls on the same level in construction operations, especially slippery surfaces due to spillage of wet or dry substances, changes in elevation (curbs), uneven surfaces, protrusion dangers, unsecured mats, inadequate illumination, debris and items stored in walkways, cords and cables in pedestrian walkways, smoke, steam and dust.
LO3.6: Describe typical construction scenarios in which ladders could be used safely.
LO3.7: Follow the necessary instructions prior to operating or working on scaffolds-powered elevating work platforms and suspended access equipment.

4.2.4 Common High Risks in Construction Projects

4.2.4.1 High Risks Related to Electrical and Energy Sources

At the completion of the training, the construction workers will be able to

LO4.1.1: Identify potential electrical energy sources that might be present during construction, including power cords, overhead power lines, exposed wires, generators, and broken insulation on power/electrical cables.

LO4.1.2: Identify typical construction situations that may result in direct/indirect electrical contact, particularly overhead, buried, encased, and exposed conductors.

LO4.1.3: Describe strategies to reduce the risk of electrical contact in the situations, including proximity, signage, work area evaluation and post-contact measures.

LO4.1.4: Identify sources of stored energy, including thermal, hydraulic and pneumatic components.

LO4.1.5: Control themselves from involving tasks where only qualified individuals are allowed to undertake work on electrical equipment or installations, with the exception of plugging in or unplugging low-voltage tools or extension cables.

LO4.1.6: Describe the potential repercussions of working on electrical tools without making sure the potential energy sources.

LO4.1.7: Pay attention to the specific measures and procedures needed before beginning any work involving lockout and tag out.

4.2.4.2 High Risks Related to Falling from Heights.

At the completion of the training, the construction workers will be able to

LO4.2.1: Identify the risks that may occur when working at heights, particularly unprotected edges, guardrails that are missing, damaged or insufficient, unprotected openings in floors, roofs or other work surfaces, falls into water or another liquid and falls into or onto operating machinery or hazardous materials.

LO4.2.2: Identify typical techniques for reducing fall hazards, particularly in work related to guardrails and covers of sufficient strength that are fastened over work surface openings.

LO4.2.3: Pay attention to the occupational health and safety measures before using a travel restraint system, fall restricting system, fall arrest system, work belts, safety belts, and safety nets in construction operations.

4.2.4.3 High Risks Related to Mobile Equipment and Vehicles At the completion of the training, the construction workers will be able to Pay attention to the risks associated with working near mobile equipment, especially being struck by mobile equipment or the load, being trapped between or crushed against mobile equipment or another surface and electric shock and electrocution due to electrical contact with buried or overhead power lines.

LO4.3.1: Describe various strategies for reducing the risks associated with working near mobile equipment, including following traffic protection plans, barriers, and route controls, making eye contact with operators and signalers and signalling intentions, being aware of blind spots, using one example of mobile equipment and vehicles used in construction operations, using pedestrian routes and avoiding equipment routes and pathways.

LO4.3.2: Follow specific instructions prior to performing the procedures when involved in the setup and removal of vehicular control measures.

4.2.4.4 High Risks Related to Material Handling At the completion of the training, the construction workers will be able to

LO4.4.1: Identify the risks involved in handling materials, which are things falling from elevated places, loads swinging close to workers, stacking of materials, and releasing of tie-downs or straps on materials all posing a risk to workers.

LO4.4.2: Identify measures to reduce the risk of being struck or crushed by objects, especially avoiding suspended loads, adhering to warning signs, securing tools and materials from accidental movement and good housekeeping.

LO4.4.3: Pay attention to the safety instructions to be followed when engaging in work or using equipment that involves hoisting and rigging.

4.2.4.5 High Risks Related to Excavations and Trenches At the completion of the training, the construction workers will be able to

LO4.5.1: Identify typical risks that come with working in or near excavations and trenches, including soil collapse, soil or equipment/material rolling into the excavation or trench and trenching or digging around subsurface utilities.

LO4.5.2: Follow the instructions related to colour-coded flags for marking underground utility lines prior to engaging in excavation and trench operations.

LO4.5.3: Determine the useful methods for controlling the hazards related to the work operations of excavations and trenches.

LO4.5.4: Pay attention to the sloping and shoring requirements for the various soil types and conditions for working in and around excavations and trenches.

4.2.5 Guidelines on Teaching, Assessment Methods and Sample Lesson Plan

Theoretical lectures, interactive discussion sessions and field exercises need to be delivered to cover the learning contents. A hybrid method consisting of both online and face-to-face sessions is preferable. Assessments can be designed based on the training contents towards the achievement of all the learning outcomes (LOs) mentioned above (LO1.1-LO1.5, LO2.1-LO2.4, LO3.1-LO3.7, LO4.1.1-LO4.1.7, LO4.2.1-LO4.2.3, LO4.3.1-LO4.3.3, LO4.4.1-LO4.4.3, LO4.5.1-LO4.5.4). A sample lesson plan for the training delivery is shown in Table 3. The model lesson plan also includes a sample hourly breakdown that can be taken into account for the delivery of training content, as shown in Table 2. This hourly breakdown was initially made by assessing the structure of some popular continuous professional development (CPD) courses that are successfully running in the industry. However, the contact hours in the training delivery can be varied by examining other important elements, such as the learning environment, size of the trainees, the attention spans of the trainees, quality assurance procedures and institutional policies.

The study recommends conducting a survey to assess the feedback of the trainees at the end of the pilot delivery of the proposed training programme with the intention of taking the required steps to further enhance the quality assurance of the training delivery components matching with the long-term based sustainability. Accordingly, the following seven feedback elements are recommended.

- The trainer(s) explain/s the ideas and emphasises key points effectively.
- The trainer(s) use/s examples and connect/s them to the practical experience.
- The trainer(s) prioritise/s the interest of trainees in learning content in an engaging manner.
- The trainer(s) is/are well-prepared.
- The trainees are actively encouraged to participate in training tasks by the trainer(s).
- The trainees receive individualised attention from the trainer(s) based on their learning needs.
- The trainer(s) provide/s performance evaluation and made suggestions for improvement.

The validity and reliability of the proposed training guide/manual were assured by expert reviews in accordance with the objectives of the study. Additionally, the expert reviews showed that the proposed training guide/manual properly outlines the competencies required for workers on construction sites to methodically and effectively handle the challenges associated with health and safety aspects in order to improve the performance and productivity of construction operations. Further, the training guide clarifies for the teaching materials what subject components should be taught, what training outcomes should be anticipated and what competencies should be evaluated. The proposed training guide is eager to be an ideal tool for the construction industry of a developing country like Sri Lanka, specifically to quickly satisfy the needs and expectations for successfully addressing evolving challenges in the new normal conditions of the sector, according to the statements provided by the review panel. The evaluation of the training manual based on the eight components (included in the methodology section) produced results that were satisfactory or above level for each category/component in the reviewers' input, as shown in Table 4. Overall, the review outcomes emphasise the applicability and generalisability of the proposed training guide in various types of projects, including buildings, roads, highways, bridges, water supply and irrigation works, towards ensuring the sustainability of the long-term based policies and practices of the construction industry.

Table 3 – A Model Lesson Plan for the Delivery of Training

Day	Topics / Contents / Activities	Number of Hours		Learning Outcomes (LOs)
		Lectures	Interactive Discussions / Field Exercises	
Day 1	The role of parties in the workplace and the legal framework	2	2	LO1.1-LO1.5
Day 2	Identification, assessment and control of hazards	2	2	LO2.1-LO2.4
Day 3	Conditions and risks that can be frequently found in construction projects	2	2	LO3.1-LO3.7
Day 4	Commonly occurring high risks in construction projects: High risks related to electrical and energy sources	2	2	LO4.1.1-LO4.1.1.7
Day 5	Commonly occurring high risks in construction projects: High risks related to falling from heights	2	2	LO4.2.1-LO4.2.3
Day 6	Commonly occurring high risks in construction projects: High risks related to mobile equipment and vehicles	2	2	LO4.3.1-LO4.3.3
Day 7	Commonly occurring high risks in construction projects: High risks related to material handling	2	2	LO4.4.1-LO4.4.3
Day 8	Commonly occurring high risks in construction projects: High risks related to excavations and trenches	2	2	LO4.5.1-LO4.5.4
Day 9	Assessments/Evaluations (8 hours)			
Number of Contact Hours in Total = 40 (Lectures – 16 Hours; Field Exercises and Interactive Discussions – 16 Hours; Assessments/Evaluations/Certification – 8 Hours)				

Table 4 – The Evaluation of the Training Manual as per the Views of Expert Reviews

Items	Percentage of Reviewers Responded for Each Level of Satisfaction				
	Very Dissatisfied	Dissatisfied	Neither Satisfied nor Dissatisfied	Satisfied	Very Satisfied
Component 1	-	-	-	-	100%
Component 2	-	-	-	12.5%	87.5%
Component 3	-	-	-	25%	75%
Component 4	-	-	-	37.5%	62.5%
Component 5	-	-	-	25%	75%
Component 6	-	-	-	12.5%	87.5%
Component 7	-	-	-	12.5%	87.5%
Component 8	-	-	-	-	100%

5. Conclusions

The study has produced a modern training roadmap that the construction training sector of developing nations like Sri Lanka might employ for upgrading the industry's current practices related to health and safety matters. The proposed training guide includes application-based learning materials that can help construction site workers in various working positions to perform their duties with ease and in a constructive manner with a clear focus on productivity, safety and quality of work operations. Overall, the proposed training manual generally follows learning principles to make sure that construction workers understand why they must learn specific content and its relevance to them and their workplace. It also links learning tasks with the construction workers' personal experiences in

scenarios that simulate actual application in the workplace and offers ways for construction workers to engage with a variety of activities that allow opportunities for participative learning.

The training guide presented in this study displays a detailed cross-section of the needed application of the apprenticeships in a comprehensive package, which specifies what advanced characteristics are required to be added to the industry practices, what competence elements need to be specifically assured among construction site staff, how the existing attributes of the job role patterns need to be upgraded and how the monitoring and control systems should function for the advancement and enhancement of health and safety within sustainable strategies. This stated package replicates the ingenuity and peculiarity of the proposed training guide compared to other available training guides.

Through the execution of expert reviews, the validity, reliability and generalisability of the proposed training guide were assessed and positively resulted. Importantly, the expert assessments noted that the proposed guide offers a novel template/roadmap for raising the bar for health and safety practices and policies within a methodical scope through preventative training techniques. Importantly, the expert reviews stated that the proposed guide can be a functional tool in laying a strengthful reinforcement to the work processes, learning demands and responsibilities of construction workers associated with a general understanding of the occupational health and safety policies and regulations. The consequences outlined in the proposed guiding tool are expected to be achieved by implementing those at the organisational and industry levels. The expert reviews further recommended applying the proposed guiding tool as a modern blueprint for designing/developing new constructive continuous professional development (CPD) programmes by engineering institutions with practical methods to handle the industry's rising issues and possibilities through proactive training tactics. The findings will also encourage engineering academic institutions to include new courses or competency aspects in undergraduate and postgraduate degree programmes during the development or revision stages of curricula. Moreover, the study findings might also help other technical disciplines and emerging industry sectors with a similar focus to introduce CPD training programmes.

Overall, the proposed training manual strengthens a link that perfectly connects institutional and industry practices. Despite the fact that the applicability of the findings of this study was restricted to the Sri Lankan setting, other developing and developed nations can also employ comparable practices to attain equivalent outcomes in their industrial processes. The findings of the study might also have an effect on how other developing industrial sectors run their current operations in order to reinforce the guiding principles and operational practices of their human resources. The study recommends that future studies concentrate on training delivery outcomes connected with the mix of institutional and industrial features, taking into account the traits of different job categories in different trades or business sectors in different situations. The report also makes recommendations for further research into how the proposed training guide will affect measurements of construction operations' productivity and quality levels. Future studies can therefore broaden the scope and effects of the industry's emphasis on reskilling and upskilling techniques across a variety of domains in order to find more effective strategies for addressing the new opportunities and challenges associated with productivity and technological improvement.

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The authors make no mention of any potential conflicts of interest.

Data availability statement

On reasonable request, the corresponding author will provide the information supporting the study's conclusions.

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