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Developing a New Construction Supervisory Training Programme Focusing on Productivity and Performance Improvement of Labour Operations

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Abstract: Good supervision practices bring out the best labour outputs in construction. The lack of competencies of construction supervisors yields significant impacts on the labour performance in the construction sector of many countries. This study intends to develop a new construction supervisory training programme and relevant practices for addressing the industry's evolving challenges related to the performance and productivity of labour with a long-term focus. The study methodology encompassed the applications of relevant generalised training models and a series of meetings, discussions and workshops conducted among academic and industry experts. The problem-focused and action-oriented communication approaches were used throughout the training development practices with the consideration of emerging characteristics of the industry. The developed training programme contains outcome-based learning practices in construction supervision that address the industry's challenges related to the performance and productivity of labour. The study has further presented the ways for the resource arrangements and the formation of ground rules to lay the platform for the training delivery with a long-term focus. The proposed training programme provides a common template that includes generalised processes for developing new training programmes and filling the gaps in existing training programmes based on the industry needs through proactive education and training strategies. The study outcomes provide a bridge that combines institutional and industry practices towards strengthening the industry's long-term focus on reskilling and upskilling to the new normal situations. Though the scope of the study was limited to the Sri Lankan context, the findings can contribute to creating a significant impact on construction education and training development practices in other developing countries in similar scenarios.

Keywords: Construction Supervision, Labour Performance, Productivity Improvement, Training Development, Sri Lanka

1. Introduction

The construction sector plays an imperative role in the economic growth of a country, and the construction industry has been the most demanding industry in many countries [1]. The construction industry generates substantial employment opportunities and contributes to achieving the national socio-economic goals [2]. Compared to other industries, the construction industry claims the largest component of the workforce for many years [3]. The productivity of labour operations has a major impact on the efficiency of organisations, leading to an influence on the GDP of a country [4]. Recent studies highlight that the construction industry in many developing countries has been facing productivity-related challenges [5-7]. Productivity improvement is essential for any profit-oriented organisation, whereas productivity depends on performance, and the performance covers both economic and operational aspects of the industry [8].

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Studies highlight that performance of labour is one of the most significant factors that affect the overall productivity of construction operations [7, 9]. Labour performance plays a significant role in transforming industry practices based on the adaptation of technologies and evolving challenges in new normal situations [7]. Poor performance of the labour generally causes time overruns, cost overruns and quality-related problems in construction projects [10]. The skills and experience of labourers are the major drivers of the performance of workforce operations [11]. A skilled workforce is considered a vital component of the continuity and success of the implementation of construction projects [12].

Works carried out by labourers are generally directed by the supervisory workers in construction projects. Studies highlight that the supervision of labour is one of the significant factors that have a high impact on the performance of construction labour operations in many countries [1, 5-7, 9]. Studies emphasise the need for effective supervision practices to avoid the wrong construction methods of labour operations [1]. The good leadership and decision-making skills of construction supervisors bring out the best abilities of labourers. But, these skills have been identified that need to be improved among construction supervisors working in many countries [5, 13]. The supervisors' poor site management and coordination skills were the major constraints on labour productivity in the construction industry in New Zealand [14]. Site coordination is important to bring together the labour and material resources in construction activities, especially to make optimum utilisation of resources [15].

Construction supervisors' interpersonal skills were studied by Onyekachi [5] through a survey carried out among 49 construction firms in Nigeria and identified that the supervisors' leadership, planning and communication skills need to be considerably improved. The survey also revealed that the relationship between the supervisors and labourers was very poor. A good understanding between the supervisors and labourers leads to higher motivation and labour engagement towards more productivity [5]. On the other hand, supervisors' poor planning skills were identified that significantly influence labour productivity in construction projects in India [1]. Proper construction planning improves work efficiency, effective materials management and cost reduction, which leads to avoiding unnecessary construction delays [16]. Supervisors' ethical behaviour has been identified that needs to be improved in the Iranian construction sector [17]. Ethical behaviour includes honesty, integrity, fairness and a variety of other positive traits. Ethical behaviour in supervision practices increases job satisfaction and organisational commitment among labourers towards performance improvement of construction operations [18].

Moreover, the construction supervisors' competencies in health and safety and quality inspection related practices have been determined that significantly affect construction productivity in the State of Queensland, Australia [19]. Notably, construction supervisors' poor abilities in quality controlling were reported in many construction projects in India [20]. Quality control practices reduce the risks of making costly mistakes in setting quality standards and improving the safety of the project [19]. Supervisors' poor skills in health and safety practices were the major problems for the contractors against productivity improvement in the construction projects in Egypt [9].

1.1 Sri Lankan Context

Considering the Sri Lankan context, the construction industry plays a prominent role in the national economy of the country [2]. A large number of infrastructure development projects are currently ongoing under different categories, such as transport, energy, water, environment and waste management, high-rise constructions, housing and township, industrial cities and tourist cities. Based on the statistics, the construction subsector has recorded impressive growth in the post-war era in Sri Lanka, and this expansion has created many opportunities and challenges for the industry [21].

Recent studies spotlight poor supervision as one of the major reasons for the low performance of workforce operations in many construction projects in Sri Lanka [7, 13, 22]. The lack of competencies of construction supervisors yields notable impacts on the performance of workforce operations [2]. Sri Lankan supervisors' poor cognitive skills in health and safety [3] and modern technologies [2] were determined that contribute to low productivity levels of construction operations in many Sri Lankan construction projects. Studies further spotlight the need for improving the cognitive skills of supervisors on the performance evaluation of labour skills in Sri Lankan construction projects [3, 7, 22].

Manoharan et al. [13] state that the vocational training institutions should focus more on improving the competencies of construction supervisors in site management, labour management, construction planning, performance evaluation on labour skills, material handling, construction methods and procedures, understanding the basic structural concepts, health and safety practices, leadership, decision making and communication.

Studies highlight that the school curricula have not emphasised the importance of construction education at a sufficient level, and this has been contributing to the poor supervision practices in the construction industry [7, 13]. Further, the industry's requirements have not been addressed sufficiently in the existing vocational training programmes in the country [7, 12, 13]. The construction sector expects to obtain huge benefits from construction supervisory workers, and effective construction supervisory training programmes are of uppermost importance to enhance the performance, quality and productivity of workforce operations [21]. Tertiary and Vocational Education Commission of Sri Lanka [21] points out that there has been a tendency to offer higher-level training programmes without fulfilling the exact requirements of the construction industry in Sri Lanka. Further, Tertiary and Vocational Education Commission of Sri Lanka [21] highlights the need for effective construction supervisory training programmes that directly address performance and productivity-related problems through supervision practices. A similar requirement is reported by recent studies for the construction industry in other developing countries too to upgrade the current supervision practices towards addressing the industry's challenges in new normal situations [5-6, 13].

1.2 Importance of the Study

The studies that attempt to excessively investigate the construction supervision practices, construction education and training development are highly limited in many developing countries, including Sri Lanka [2, 5]. The background investigation of this study highlights the significance of improving the competencies of construction supervisors through upgrading the training development practices for facing the productivity-related challenges and opportunities of the industry in the new normal situations. Based on the above-stated needs, this study aims to develop a new construction supervisory training programme, which has to directly focus on outcome-based learning practices to achieve productivity and performance improvement in labour operations. The study further focuses on resource arrangements for the smooth delivery of the training programme in a generalised manner with a long-term focus. This may lead to providing better practices for upgrading the built environment to the new normal situations by reinforcing the educational and training systems, as well as finding better ways for adding new characteristics to the job roles of engineers and project managers within similar scopes.

2. Literature Review

Though the significant issues related to construction supervision practices were reported by several studies, only a few studies focused on the track of training development practices for improving the competencies of industry practitioners [12-13, 23-26].

Education and training play a prominent role in the creation and maintenance of a capable workforce in the construction industry [27]. Jadallah et al. [26] state that the training is effective when learning is promoted through theories developed within the field of education science that focus on how learners obtain, process and retain information. Jadallah et al. [26] further highlight the importance of considering the following questions during the construction training development practices.

- To what extent is educational theory integrated into construction training for current industry professionals? Which educational theories are most often integrated?
- Which construction training subjects most commonly include educational theory for current industry professionals?
- To what extent does the construction training literature discuss learning outcomes, quantified as the frequency of occurrence of Bloom's Taxonomy verbs?
- What is the distribution of Bloom's Taxonomy levels in the construction training literature?
- To what extent does frequent terminology used in the construction training literature match that of foundational education theory literature?

Ojha et al. [25] have conducted a review on the delivery methods and evaluation techniques of health and safety training practices among construction industry practitioners. The review

results highlight that most of the firms have been using the traditional methods which are usually lecture-based sessions and toolbox talks, though the work-based training method has a considerable advantage over the traditional methods. Sacks et al. [28] and Gao et al. [24] also highlight that a significant improvement in the technical skills, knowledge, self-confidence and comfort of construction industry practitioners was resulted due to the work-based training methods added in some training programmes. Considering the evaluation techniques used in work-based training, Ojha et al. [25] reveal that questionnaire surveys are used by most firms to assess the competencies of trainees. Ojha et al. [25] also point out the inefficiency of this approach which results in inadequate learning outcomes. The work-based learning activities were assessed by Siregar [23] in a training programme conducted on concrete works among 30 construction industry practitioners in Medan city, Indonesia. Siregar [23] reveals that, though poor involvement was reported among the trainees at the beginning stage, the competencies of trainees were gradually improved throughout the work-based training delivery. Siregar [23] recommends measuring the following nine aspects of the trainees in different stages of the training.

- Noting explanation of instructor
- Asking questions
- Showing self-confidence
- Communicating and participating in group tasks
- Sharing ideas/opinions among others
- Receiving the opinion/input of others
- Responding to the opinions of others
- Paying attention to fellow members of other groups
- Making a summary of the learning contents

Some studies [29-30] have developed a digital environment using virtual reality gaming technology to promote workers' interaction and situational awareness in workers' competency assessments. Considering the workers' training and assessment purposes, Jeelani et al. [31] and Pham et al. [32] recommend applying 360-degree panorama technology that utilises photography and videography to generate real surrounding views of the construction environment. But, Ojha et al. [25] state that the training sectors in many developing countries have not upgraded their current practices to use these digital technologies due to the requirement of high costs and technological advancement.

Though some studies recommended some practices for training development and delivery, there has been a scarcity of systematic training guide models for the construction industry. The literature review of this study mainly focuses on the significance of the following training guide models that can be very useful for effective training curriculum development.

- A competency-based training guide model for construction labourers [12]
- A curriculum guide model to the next normal in developing construction supervisory training programmes [13]

2.1 A Competency-Based Training Guide Model for Construction Labourers

Considering the need for applying better practices to labour with the scope of improving the performance and productivity of construction operations, a labour training guide model was introduced by Manoharan et al. [12]. This generalised guide model includes a set of labour training exercises (LBEXs) and labour training elements of outcomes (LBEOs), which were developed using comprehensive approaches. The labour training exercises were designed to be delivered to the labourers by construction supervisors at construction sites. The methods of training delivery were designed considering site operational practices, environmental challenges and organisational behaviour. The training assessment methods were designed considering the process, learning demand and responsibilities of the level of descriptor mentioned in the National Vocational Qualification (NVQ) framework of Sri Lanka. The application of the labour training guide model of Manoharan et al. [12] is limited to developing training programmes for the industry practitioners whose levels of competencies start from the unskilled stage to reach the master craftsperson stage. As a result, a set of workplace training activities, experimental exercises and skill assessments can be meaningfully performed by construction supervisors for the labourers at construction sites. The construction supervisors should be able to lead discussions and make accurate observations, as well as assist labourers to link the training tasks to their jobs. The competencies of supervisors may also be assessed based on their ability to train labourers.

The labour training guide model of Manoharan et al. [12] shows that the industry should have

attention to labourers' cognitive skills in understanding and applying domain levels to effectively handle technical related problems. The guide model also contains the training elements to improve various transferable and self-management skills of labourers. Improvements in these skills will be helpful for the labourers to develop their job performance since these specify how they relate to their job environment, how they respond to situations, and how they interact with other workers.

The training guide model of Manoharan et al. [12] also presents the relative weight of each LBEX and LBEO component, which shows how much importance needs to be considered in labour supervision for a specific labour task compared to other ones. Based on the relative weights of each LBEX and LBEO and the competency assessments of labourers, a labour performance score (LBPS) system and a labour grading scheme (LGS) were comprehensively developed by Manoharan et al. [33] with the necessary formulas. The LBPS system includes a comprehensive procedure to measure the performance of labourers. According to the LBPS values, the labourers can be graded through LGS. This may also lead to identifying different clusters of the labour force based on the job performance in the construction sector.

2.2 A Curriculum Guide Model to the Next Normal in Developing Construction Supervisory Training Programmes

A curriculum guide model developed by Manoharan et al. [13] through comprehensive approaches can be a functional tool for systematically developing new construction supervisory training programmes to address the new normal challenges faced by the industry. This guide model consists of a set of competencies of construction supervisors that allows applying better practices in construction supervision with a direct focus on improving the performance and productivity of labour operations in construction. It encompasses the elements of competencies for the construction supervisory training programmes with corresponding learning domains, competency assessment weights and mapping levels of training outcomes. The following 20 programme outcomes (POs) presented by Manoharan et al. [7] laid the platform for the development of the construction supervisory training guide model of Manoharan et al. [13].

- Demonstrate the ability of monitoring usage, storage, delivery and operations of construction materials and equipment (PO1)
- Demonstrate the ability of planning and managing the resources at the site effectively (PO2)
- Apply effective supervision methods to the labour operations at the construction site (PO3)
- Assist in developing budgets and estimates of construction activities effectively (PO4)
- Demonstrate the ability to overcome health and environmental-related challenges during the construction activities (PO5)
- Implement the possible practices for improving labour performance in construction projects (PO6)
- Carry out self-learning on modern theories, advanced technologies and practices related to construction works (PO7)
- Demonstrate brainstorming techniques to the labourers in construction (PO8)
- Demonstrate competency-based training techniques for the labourers in construction (PO9)
- Instruct basic theories and applications of the construction principles to the labourers in construction (PO10)
- Provide experimental learning exercises to the labourers in construction (PO11)
- Assess the performance of labourers in the construction field (PO12)
- Implement the possible labour rewarding mechanisms in the construction sector (PO13)
- Apply necessary mathematical applications to solve related problems in construction activities (PO14)
- Assist in conducting field investigations, surveys and tests required for feasibility studies of construction works (PO15)
- Maintain the records of the construction tasks and help in preparing the reports effectively (PO16)
- Demonstrate the ability to apply sustainable development and green practices to labour operations at the construction site (PO17)
- Communicate with construction workers effectively with team working capabilities (PO18)
- Analyse situations to face the challenges with positive thinking abilities (PO19)

- Guide the labourers for their lifelong career development in the construction sector (PO20)

The above-mentioned POs were comprehensively developed by Manoharan et al. [7] based on the identified critical factors affecting labour performance in construction and the improving practices on construction supervision proposed by industry experts. These 20 POs display how construction supervisors should perform their job tasks based on the industry's expectations. These 20 POs are accentuated by Manoharan et al. [7] as the common supervision practices in various types of construction projects, namely building, roads, highways, bridges, water supply, irrigation and dredging works.

Based on the above-mentioned 20 POs, Manoharan et al. [13] have systematically obtained 12 competency units (CUs) and 64 elements of competencies (ECs) for the construction supervisory training. Manoharan et al. [13] also presented the mapping levels of ECs and CUs with the 20 POs to effectively design the teaching-learning platform for construction supervisory training programmes. Using the principles of the Delphi survey technique, the weights of ECs were measured by Manoharan et al. [13] for each CU. The model shows the distributed weights of ECs among the learning domain levels, considering the applicability to the work-based activities. This weight distribution can be helpful for trainers to design appropriate methods of assessment with a clear understanding of what is to be assessed. This also leads to measuring how much a training programme targets the knowledge, skills and attitudes of the construction supervisors at different levels. Further, the training guide model of Manoharan et al. [13] also highlights the required competency elements of construction supervisors to train labourers at construction sites based on the labour training guide model presented by Manoharan et al. [12].

The application of the construction supervisory training guide model of Manoharan et al. [13] is limited to developing training programmes for the industry practitioners whose levels of competencies increase from technician level to management level. The expected level of qualification is occupational or vocational specific, including simulated work experiences and work-integrated learning. The guide model of Manoharan et al. [13] shows the detailed steps that need to be followed for the development of a new construction supervisory training, as given below.

- Step 1: Design the initial structure of the training programme based on the competency units proposed in the model. Each competency unit can be named with a course unit. The aims of each course unit can be developed based on the respective competency unit.
- Step 2: Decide the total number of credits of the training programme according to the requirements of the qualification level to be achieved. The total credits can be distributed among the course units based on the industry requirements. This credit distribution can be performed through experts' interviews and discussions.
- Step 3: Develop learning outcomes for each course unit based on the elements of competencies presented in the model.
- Step 4: Develop detailed content for each course unit based on the elements of competencies and the mapping results presented in the model. The learning contents, teaching and learning activities, hourly breakdown and resource arrangements can be designed accordingly. Assessment methods can be designed based on the distributed weights of the elements of competencies presented in the model.

Furthermore, comprehensive methods ensured the validity and reliability of the construction supervisory training guide model presented by Manoharan et al. [13]. Overall, the guide model presented by Manoharan et al. [13] will be very helpful for curriculum developers and evaluators to develop new curricula and design appropriate competency assessment methods with a clear understanding of expected training outcomes. The model also contributes to effectively planning the teaching, learning and assessment methods, considering the influences of the Covid-19 pandemic on the quality of training delivery.

Though the overall literature review of this study discusses some training development and delivery practices, it highlights the significance of the training guide model presented by Manoharan et al. [13] for the current study purposes. Notably, the construction supervisory training guide model of Manoharan et al. [13] includes the components that address all the questions recommended by Jadallah et al. [26] that need to be considered during the construction training development practices.

3. Research Methodology

A comprehensive study methodology was adopted to develop a new construction supervisory training programme based on the current study's purposes, as shown in Figure 1.

With the focus on the following training development processes, a series of meetings, discussions and workshop sessions were held in both on-site and online modes at the different stages with the participation of both academic and industry experts, including institutional directors, construction managers, engineers and technical officers. Notably, all the experts had a minimum of 5 years of work experience in the construction field. At the early stage, the experts' discussions focused on the critical literature findings and validated the importance of the training guide model of Manoharan et al. [12] for this study's purposes based on the current and future industry's needs and construction management practices.

The problem-focused and action-oriented communication approaches were used throughout the study for the following processes with the consideration of emerging characteristics in the industry's new normal situations.

- Development of the programme aims, title and entry requirements for the selection of candidates
- Selection of the institution for the training delivery
- Designing the initial structure of the training programme with the course units
- Credit distribution among the course units
- Development of the learning outcomes for each course unit
- Development of the detailed contents for each course unit
- Revision of the detailed curriculum of each course unit
- Curriculum review for the training programme

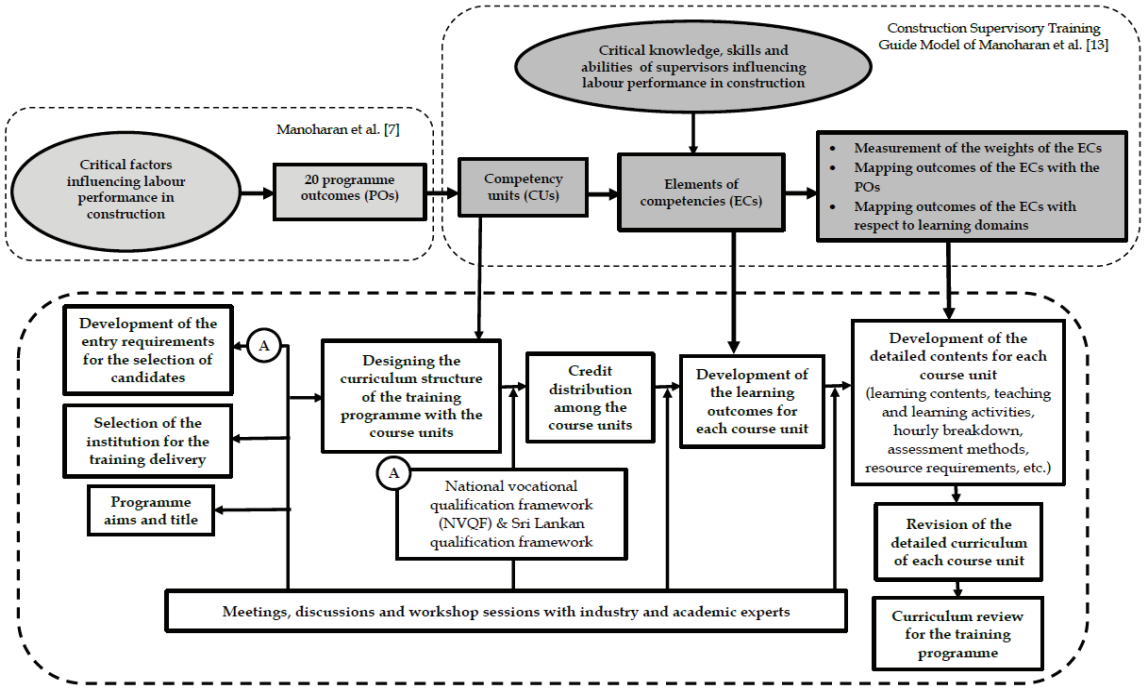

Figure 1 – Study Methodology for the Development of the New Construction Supervisory Training Programme

3.1 Development of the Programme Aims, Title and the Entry Requirements for the Selection of Candidates

The study focused to develop the new construction supervisory training programme to achieve the diploma level of the National Vocational Qualification Framework of Sri Lanka (NVQFSL). This qualification combines in-depth knowledge in a particular field with hands-on experience to develop the skills required in the workplace. The programme aims were developed based on the main purpose of this study, whereas the title of the training programme was designed as replicating the programme aims. The entry requirements for the selection of candidates were designed based on the conditions stated for Sri Lankan Qualification Framework (SLQF) Level 3 which is comparable to National Vocational Qualification Framework (NVQF) Level 5. The NVQF is a nationally consistent

framework developed by the Tertiary and Vocational Education Commission of Sri Lanka that ensures the credibility of qualifications and certifications awarded in Sri Lanka based on internationally benchmarked policies and processes [34]. The SLQF is the framework developed by the University Grants Commission (UGC) of Sri Lanka to recognise higher education qualifications offered in both public and private higher studies institutions in Sri Lanka [35]. The SLQF integrates the NVQF and includes pathways of lateral mobility between the vocational and the higher education sectors.

3.2 Selection of the Institution for the Training Delivery

A series of discussions were held among institutional directors, academic experts and industry professionals from the following institutional/professional bodies to select the training institution for the delivery of the training programme with the necessary approvals. A number of training providers were suggested by the experts for the delivery of this training programme. A SWOT analysis was performed through discussions among the academic and industry experts to select the most suitable training provider from the suggested list.

- Construction Industry Development Authority (CIDA)
- Sri Lanka Association for the Advancement of Quality and Productivity (SLAAQP)
- Sri Lankan Accreditation Board (SLAB)
- Tertiary and Vocational Education Commission (TVEC)
- University of Vocational Technology (UoVT)
- Vocational Training Authority of Sri Lanka (VTASL)
- Wayamba University of Sri Lanka (WUSL)

3.3 Designing the Initial Structure of the Training Programme with the Course Units; Credit Distribution among the Course Units

The initial structure of the training programme was designed based on the competency units proposed in the training guide model of Manoharan et al. [13]. Each competency unit was named with a course unit. The aims of each course unit were developed based on the respective competency unit. Considering the requirements of the SLQF Level 3 (NVQ Level 5), a total of 30 SLQF credits (60 NVQ Credits) were assigned among the developed competency units. Here, 1 credit is considered equivalent to 25 notional learning hours. This is a student-centred system based on the student workload required to achieve the elements of competencies. This credit distribution was performed through experts' interviews and discussions. Several discussion sessions were held among industry experts and university academics to revise the structure of the training programme systematically.

3.4 Development of the Learning Outcomes (LOs) and the Detailed Contents for Each Course Unit

For each course unit, the learning outcomes (LOs) were developed based on the course aims and the elements of competencies (ECs) produced in the training guide model of Manoharan et al. [13]. The detailed contents were then developed for each course unit based on the developed learning outcomes (LOs) and the following contents produced in the training guide model of Manoharan et al. [13].

- Inclusion of the identified critical knowledge, skills and abilities of construction supervisors in the competency units
- Mapping outcomes of the elements of competencies (ECs) with the programme outcomes (POs)
- Weights of elements of competencies (ECs)
- The weight distribution of elements of competencies (ECs) with respect to learning domains

The learning contents, teaching methods, learning activities, hourly breakdown and resource arrangements were designed considering the above-mentioned contents. The assessment methods were designed based on the developed learning outcomes (LOs), and the assessment marks were distributed based on the weights assigned to the elements of competencies (ECs). A series of discussions were carried out among the subject specialists throughout these processes.

3.5 Revision of the Detailed Curriculum of Each Course Unit

An industry consultative workshop was conducted to revise the detailed course contents of the training programme at the selected institution. The participants were identified based on their experience in the construction field and their involvement in vocational training developments. More than 15 industry experts actively participated in this industry consultative workshop, where the majority of them were construction managers and engineers. In addition, more than 10 academic experts also participated in the workshop.

Based on the comments and suggestions received from the experts, the curriculum contents were revised.

3.6 Curriculum Review for the Training Programme

The newly developed construction supervisory programme was reviewed by a panel of experts, and the review process was performed through observations, documentary evidence, interviews and discussions. The reviewers were selected based on their type of experience in the construction field and their recent involvement in training development activities. The review panel consisted of two academic experts, two institutional directors and two industry experts. Notably, all of them had more than 10 years of work experience in their respective field. The review process focused on the following areas/categories.

- Title of the programme
- Background investigation and industry needs
- Level of qualification
- Duration of the training programme delivery
- Selection criteria for candidates
- Curriculum development methodologies
- Structure of the training programme
- Detailed curriculum of the course units
- Curriculum mapping outcomes
- Resource availability
- Implications of the programme

3.7 Calculation of the Weight Distribution of Assessments based on Learning Domains

According to Manoharan et al. [13], it was measured how much the proposed training programme targets the knowledge, skills/abilities and attitudes of construction supervisors at different levels using the following formula.

$$AWL\ \% = \Sigma\ (AWCL * NC)/\Sigma\ (NC) \quad ... (1)$$

where,

AWL is the assessment weight for each learning domain.

AWCL represents the assessment weight assigned to each course unit under the respective learning domain.

NC is the number of credits assigned to the respective course unit.

4. Results and Discussion

The developed training programme's title, abbreviation, aims, level of qualification, target group, entry requirements for the selection of candidates, duration of the training delivery, medium of the training delivery and the name of the training institution are shown in Table 1. The results obtained from the SWOT analysis for the training delivery at the selected institution are shown in Table 2. The necessary actions were proposed in order to reduce the effects of the weaknesses and threats highlighted in the SWOT analysis results. Table 3 describes the curriculum structure of the newly developed construction supervisory training programme.

Table 1 – Details of the Newly Developed Construction Supervisory Training Programme

Item / Category	Details
Title of the training Programme	Diploma in Construction Labour Productivity and Performance Management (DCLPPM)
Abbreviation	Dip (Constr Labour Prod & Perform Manag)
Training programme aims	The proposed training programme aims to; • Develop the course follower's (supervisory level workers) knowledge, skills and abilities in construction operations • Prepare the supervisors to be capable of applying better practices on labour skills for improving the productivity of labour operations in construction
Level of qualification	Sri Lanka Qualification Framework (SLQF) Level 3 which is equivalent to the National Qualification Framework (NVQ) Level 5
Target group	Construction supervisory level workers / Construction technical officers
Duration of the training delivery	One year (consisted of two semesters)
Medium of the training delivery	English
Name of the training institution	Faculty of Technology, Wayamba University of Sri Lanka
Entry requirements for the selection of candidates	The candidates can be shortlisted for a selection interview based on the following entry requirements. Passed the General Certificate of Education (Advanced Level) or equivalent qualification in Physical Science / Engineering Technology / Biosystems Technology / Biological Science / Commerce / Arts stream **OR** Passed a foundation course equivalent to SLQF level 2 after a minimum of 12 years of schooling followed by an aptitude test **OR** Passed a course equivalent to NVQF level 4 or accredited work experience or accredited prior learning followed by a cognitive bridging programme **OR** Any other qualification not listed above, but may be considered for the acceptance of the Board of Study **AND** passed 'Mathematics' and 'English' in General Certificate of Education (Ordinary Level) with a minimum 'S' grade **AND** at least one year of working experience in the field of construction

Table 2 – Results of the SWOT Analysis and the Proposed Actions for the Training Delivery at the Selected Institution

Item / Category	Details
Strengths	• Curriculum contents significantly meet the exact industry expectations. • Well-developed programme outcomes, detailed course followers' profile, curriculum structure, elements of competencies, contents and curriculum mapping outcomes • Inclusion of the well-developed labour training exercises, delivery methods, productivity measurement tools and the concepts included in the labour training project component • Inclusion of the well-developed application packages with innovative practices to achieve the performance and productivity improvement of the workforce at construction sites • Developed tools for the systematic monitoring process on the delivery of training against the expected level of outcomes obtained in curriculum mapping • Active involvement of the institutional directors, academic experts and industry professionals in the training programme development • Positive feedback from industry experts and reviewers on the curriculum and the development methodology of the training programme • Providing the self-sustainability to all stakeholders • Availability of the resources in the training institution for the delivery of the training programme
Weaknesses	• Lack of awareness • Apathetic behaviour and poor practices from some companies/organisations • Lack of readiness to apply new practices from many companies/organisations • The financial crisis of many construction firms
Opportunities	For construction supervisors • Opportunity to achieve the SLQF 3 / NVQ 5 qualification within one year (part-time) • Opportunity to apply innovative practices in their worksites • Opportunity to get experience in training labourers, assessing labour skills and implementing labour rewarding mechanisms in construction sites • Opportunity to become the NVQ assessors • Opportunity to involve in performance assessments and productivity measurements practices in their worksites • Recognition / rewards / promotions opportunities within a short period of time • Clear path for their future career development For labourers in construction • Training facilities through labour operations in construction sites • Opportunity to improve the knowledge, skills and abilities required in construction activities • Significant improvement in labour performance • Recognition / rewards / promotions opportunities within a short period of time • Clear path for their future career development For companies / organisations • A systematic procedure for labour skills assessments and rewarding mechanisms in construction sites • Application of a well-developed performance score system and worker grading scheme in construction sites • Significant improvement in the performance of workforce operations in construction • Significant improvement in the productivity of construction operations with the evidence and the way to profitability for the companies/organisations For the training institution • Teaching and training opportunities for the university staff • Opportunity to reach out to the general public, thereby increasing awareness of the academic/training programmes of the faculty/university • Support for the infrastructure development of the faculty/university that can be a step closer to the self-sustainability • Professional development of the academic / supportive staff members. • Industrial links/connections For the construction sector / country • Significant increase in the industry's focus on reskilling and upskilling in the long-term for the evolving next normal situations of construction practices • Significant improvement in enhanced quality, relevance, performance, effectiveness, efficiency and transparency in the industry activities. • Upgrading the current industry practices with the direct concept of productivity and performance improvement, and to the economic and social development of the country through making provision for a nationally consistent, technical and vocational education and training • Preparing construction supervisors to be capable of applying better practices on labour skills for improving the productivity of labour operations in construction
Threats	• Covid-19 pandemic's influence on the usual activities of the industry • Lack of involvement of construction supervisors and labourers due to heavy workload / different site practices / organisational behaviour / other interventions.
Proposed Actions for Addressing the Weaknesses and Threats	• Awareness programmes can be conducted highlighting the significance of the training programme and the importance of the contents for improving the current practices of the industry. The necessary videos and materials can also be developed and published highlighting the above-mentioned matters. The course promotion activities should be performed against the identified weaknesses. • Each step should be taken in the training delivery and promotion activities following the health regulations and guidelines provided by the governmental organisations. The necessary components of teaching, learning and assessment can be delivered using online tools. • Continuous monitoring should be given to the involvement of construction supervisors and labourers. The necessary observations and feedback can be taken considering their workload, site practices and organisational behaviour. The necessary changes can then be considered in the developed practices and applications.

Table 3 – Curriculum Structure of the Newly Developed Construction Supervisory Training Programme

Course Code	Name of Course Units	No. of Credits (SLQF)	Course Aims (To enable the students to)
DCLPPM 112	English Language Proficiency for Effective Communication in Construction	2	Achieve a satisfactory level of proficiency in the English language essential for employability in the construction projects
DCLPPM 122	Mathematical Theories and Applications on Construction Labour Operations	2	Solve real problems using mathematical concepts with the scope of improving the performance and productivity levels of construction activities
DCLPPM 132	Skills Development of Workers for Performance Improvement in Construction	2	Work with the required soft skills at the construction sites and provide effective training to the labourers in developing their skills with the scope of productivity and performance improvement in the construction activities
DCLPPM 142	Labour Management, Productivity Measurements and Performance Assessments in Construction	2	Assess the performance and productivity level of labour operations in the construction works and report it to the organisation
DCLPPM 153	Application of Fundamental Theories of Science and Technology in Construction Labour Operations	3	Apply fundamental theories of science and technology in the labour operations at the construction sites with the scope of productivity and performance improvement in the construction activities
DCLPPM 214	Application of Fundamental Concepts of Engineering and Technology in Construction Labour Operations	4	Apply the basic concepts of engineering and technology related theories on the labour operations in the construction sites with the scope of productivity and performance improvement in the construction activities
DCLPPM 222	Supervision Practices in Building Construction Works	2	Monitor the labour operations in the building construction and apply effective supervision practices for the productivity and performance improvement in the construction activities
DCLPPM 232	Supervision Practices in Road, Highway, Bridge, Water Supply and Irrigation Works	2	Monitor the labour operations in the road/highway construction, bridge construction, irrigation, water supply, drainage and sewerage works and apply effective supervision practices for the productivity and performance improvement in the construction activities
DCLPPM 242	Construction Material Usage and Technologies used in Labour Operations	2	Develop their material handling abilities in the construction activities with the scope of productivity and performance improvement in construction
DCLPPM 251	Green Practices in Construction Labour Operations	1	Develop their performance on the applications of green practices in the construction activities with the scope of productivity and performance improvement in construction
DCLPPM 262	Planning and Management Practices for Construction Supervision	2	Apply effective project planning and management practices in the construction activities with the scope of productivity and performance improvement in construction
DCLPPM †16	Training of Trainers Project on Labour Training Exercises	6	Train the labourers in the construction projects through demonstrations, guidelines and other relevant activities/tasks to improve the performance and productivity level

Number Suffix: [Semester] [Subject Index in hexadecimal] [No. of Credits] ; † indicates both semesters

The most significant component of the proposed construction supervisory training programme is the inclusion of the course unit titled 'Training of Trainers Project on Labour Training Exercises (DCLPPM †16)', which was designed based on the construction labour training guide model of Manoharan et al. [12]. This course unit consists of outcome-based learning practices on the competencies required for construction supervisory workers to provide necessary training to the labourers working at construction sites. The labour training components can be delivered by the course followers at the selected worksites through necessary demonstrations, guidelines and other relevant activities/tasks with the focus on improving the performance and productivity level of labour operations. The methods of delivery, performance evaluations, assessment of labour skills and labour

rewarding mechanisms were effectively designed considering the current industry practices and future needs. The course unit facilitates the systematic and smooth implementation of the labour performance score (LBPS) system and the labour grading scheme (LGS) introduced by Manoharan et al. [33] at construction sites. As a result, there will be an opportunity for labourers to develop their future careers. This will build on the successful and sustainable implementation of better practices at construction sites. The course unit also assesses the construction supervisors' competencies in applying productivity measurement tools in construction tasks. This leads to comparing the progress of labour training delivery with the improvement of productivity level in the construction works towards obtaining the satisfaction of both the labour and organisations at the end of training.

Considering the calculation of the weight distribution of assessments based on learning domains, the study resulted that 35% of the training components attempt to assess the cognitive skills of construction supervisors, whereas 45% of the training components focus on improving the supervisors' skills/abilities, and the remaining 20% of the training target the attitude of supervisors. Considering the cognitive skills, the assessments mainly focus on how the trainees define the terms and apply methods to solve problems. Considering the construction supervisors' skills and abilities, the assessments have a major focus on the applicability of sensory information, readiness to act, imitating the displayed behaviour, and converting learned responses into habitual actions. When it comes to the attitude of the construction supervisors, the feelings and emotions of the supervisors in work-related duties are mainly considered towards enabling active participation.

The main implications of the study findings contribute to polishing the characteristics of the job roles of engineers and project managers. Importantly, the proposed training programme and its applications/practices lead to the ways for adding new attributes to the continuing professional development of engineers and project managers, especially directing the supervisory procedures within the direct scope of increasing the performance and efficiency at construction sites/projects. Accordingly, the construction engineers and project managers will be able to identify the obstacles to better performance and productivity at construction sites/projects. Further, they can incorporate contemporary technologies and frameworks into current industry practices to enhance the efficiency and productivity of workforce operations. In addition, the following new characteristics can also be added to the job roles of construction engineers and project managers.

- Monitoring the procedures for conducting performance reviews and productivity evaluations in the construction industry
- Comparing the results of the productivity and performance improvement strategies to the objectives and expectations of the organisation
- Performing resource arrangements, awareness campaigns and promoting labour training initiatives to increase connections between industrial and institutional businesses on a national and worldwide level

4.1 Discussions with Past Studies

Past studies highlighted the poor competencies of construction supervisory workers working in many countries, especially their skills in leadership [5], decision making [13], communication (Onkeyachi, 2018), ethical behaviour [17-18], site management and coordination [14-15], construction planning [1, 16], health and safety [3, 9, 19], quality inspection [19, 20], construction methods and procedures [2, 13], labour performance evaluation [3, 7, 22] and understanding the basic structural concepts [13]. The developed course units and their aims ensure that the proposed construction supervisory training programme addresses all these poor competencies of construction supervisors highlighted by the above-mentioned studies. The study findings also address the needs related to training development practices highlighted by past studies [5-6, 21, 36-37] to upgrade the current supervision practices in new normal situations. Hence, the proposed training programme and its templates will be very useful to the construction industry and training sector in many other countries.

Considering the training development practices, the study findings ensure that the questions recommended by Jadallah et al. [26] that need to be considered during the construction training development practices were almost addressed in the newly developed training programme. Considering the training delivery methods, the proposed training programme includes a mix of lecture-based and work-based training sessions, supporting the requirements in the construction training delivery highlighted by Ojha et al. [25]. Past

studies [24, 28] reported a significant increase in the knowledge and skills of construction industry practitioners resulting in some training programmes due to the work-based training methods. Similar results are expected during the delivery of this newly developed construction supervisory training programme. Further, the course unit 'Training of Trainers Project on Labour Training Exercises (DCLPPM †16)' included in the proposed training programme may allow applying the digital technologies related to photography and videography recommended by past studies [29-32) in its near-future stages of the academic delivery.

4.2 Resource Arrangements for the Systematic Delivery of the Developed Training Programme

Considering the smooth delivery of the developed new construction supervisory training programme on a long-term basis, the by-laws were developed by the institution, including the following details.

- The role of the board of study
- Admission requirements and selection procedures
- Course registration procedures
- Evaluation procedures
- Final grades based on the marks range and grading scale
- Procedures for releasing the results
- Criteria for awarding the certificates
- Other necessary information

By following the ground rules of the Sri Lankan Qualification Framework, the training programme was commenced after getting the approvals for the curriculum and by-laws of the training programme from the Faculty Curriculum and Academic Development Committee (FCADC), Academic Development Scholarship and Ethics Committee (ADPSEC) of the University and the University Senate sequentially. With these approvals, the experts' review on the proposed curriculum ensured the validity and reliability of the proposed programme at its initial stage. Importantly, the overall review report shows that the proposed programme specifies the competencies required for the construction supervisors to improve the performance and productivity of workforce operations in various directions. The training programme was identified by the reviewers as the first diploma programme in the Sri Lankan construction sector, which was systematically developed with the direct scope of improving the performance and productivity of work outputs. The reviewers highlighted that the proposed training programme is willing to be an ideal programme for the Sri Lankan construction sector, especially to meet the timely needs/expectations of the industry through effective practices. The reviewers' report further stated that the training programme provides a template for developing new training programmes with effective and innovative practices to address the emerging challenges of the industry through proactive education and training strategies. Moreover, the reviewers' report stated that the proposed programme leads to the ways for adding new attributes to have an influence on the job characteristics of engineering and project management practices.

The Board of Study was then formed based on the approved by-laws of the training programme. The Board of Study is the advisory committee which makes recommendations for the improvement and smooth function of this training programme in the following aspects.

- Designing and improvement of the syllabus
- Improving the quality of teaching
- Conducting examinations
- By-laws governing the training programme with the adherence to the university by-laws and policies

The budget preparations were performed based on the rules and regulations developed by the Financial Committee of the University. The academic staff members were selected to conduct the academic activities of the training programme based on the learning outcomes of each course unit and the field of expertise/qualifications of the academic staff members. A total of twelve academic staff members were appointed with some involvement of industry experts for the academic delivery of the training programme. In addition, the supporting appointments, namely management assistants, technical officers, lab attendants and work aids, were also made for the smooth delivery of the training programme. The course promotion works were performed for the awareness, as listed below.

- The official website of the training programme was launched.
- New profiles/accounts were created for the training programme on social media.
- The introductory and awareness videos were created and published on social media.

- Newsletters were designed and published on websites and social media.
- The brochures and posters containing the necessary information about the training programme were delivered to construction companies, training institutions & relevant authorities/departments/associations.
- Advertisements were published in the newspapers and other relevant websites.
- Awareness workshops were conducted online and on-site for construction firms and vocational training institutes.

A total of 196 applications were received for Intake 1. According to the by-laws, all the applications were reviewed based on pre-requisite qualifications. A total of 181 candidates were shortlisted for the selection interviews. Based on the decision made by the Board of Study, a total of 70 top-ranked candidates were selected to follow the proposed training programme for Intake 1. A panel consisting of 7 academic staff members interviewed the candidates based on a marking scheme designed to assess each candidate under the following matters.

- Entry requirements
- Showing the ability of smooth completion
- Showing the ability of good involvement in academic activities
- Showing the financial ability for the payment completion
- Subject knowledge / interest
- Communication skills / Discipline / Attitude
- Work experience / Work-related skills / Capability of conducting labour training exercises

The overall observations on the resource arrangements confirm that the platform was laid for the continuous delivery of the proposed training programme. This strengthens the smooth run of the training programme with a long-term focus, also showing the way for further improvements/upgrades in future stages.

5. Conclusions

The study has presented a template for developing a new construction supervisory training programme that specifies the competencies required for the construction supervisors for improving the performance and productivity of workforce operations in construction projects. The study methodology was comprehensively adopted through a sequence of processes with the use of some generalised training models and systems. The proposed training programme includes application-based learning content and proactive-based methods that are very significant for the construction supervisory workers to carry out their work tasks with a productive-based approach, and it will also be very helpful for them to find job opportunities and get career promotions in a timely manner. The training programme specifies how much it targets the knowledge, skills/abilities and attitudes of the construction supervisors. This displays the summarised picture that describes what the industry expects from the competencies of construction supervisors.

The study highlights the significance of the inclusion of the course unit titled 'Training of Trainers Project on Labour Training Exercises (DCLPPM †16)' in the proposed programme, which consists of the competencies required for construction supervisory workers to provide necessary work-based training to the labourers at construction sites with the focus on improving the performance and productivity level of labour operations. This makes the labourers involve themselves in skill improvement practices at their workplaces, resulting in career development opportunities and other benefits for them towards building on the successful and sustainable implementation of better practices in the industry. This may lead to driving improvement of the overall quality of the workforce capacity involving professional, technical and vocational competence in the industry.

The study has further made the resource arrangements to lay the platform for the smooth run of the proposed training programme with a long-term focus. The outcomes of the SWOT analysis process provided the way to take required actions against the weaknesses and threats to the delivery of the training programme. The developed ground rules strengthen the systematic delivery of the training programme at the institutional level. The sequential process of obtaining the approvals confirms the experts' observations on the curriculum of the training programme and its by-laws at the different stages. The types of resources used and the way the resource arrangements were made in different stages of this study describe how the mechanism needs to work for the effective delivery of the training components. The study also spotlights the effective practices in conducting course promotion and awareness

activities among the industrial workers for a training programme. The mechanisms used in the selection of the candidates emphasise the importance of unbiasedness for a generalised process. The overall process of training delivery, resource flow and training reinforcement practices can be further strengthened using digital technologies in the near-future stages of the proposed training programme.

The overall study outcomes are expected to highly contribute to the construction industry sector for upgrading the current practices with the direct concept of productivity and performance improvement to the new normal situations. The study findings allow educational institutions and industry training providers to challenge existing skills development practices and training methods in construction management. The proposed training programme can be a common template that includes generalised processes for developing new training programmes and filling the gaps in existing training programmes to address the industry's productivity-related challenges through proactive education and training strategies. The study outcomes provide a bridge between institutional and industry practices towards increasing the industry's long-term focus on reskilling and upskilling to the new normal situations of construction practices.

Though the scope of the study was limited to the Sri Lankan context, the study findings can contribute to creating a significant impact on upgrading the standards of the current practices and structural systems in the technical and vocational education sectors of other developing countries too. The findings may also contribute to making significant changes in supervision and workforce practices in the construction projects of developing countries for their productivity gains and technological advancement in construction practices. The study recommends future studies focus on the quality assurance practices in the training delivery, as well as monitoring systems for the systematic comparison process on the productivity measurements with the training outcomes.

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