

Full Paper

Labour-related Causes Controlling the Efficiency of Road Construction Operations in Sri Lanka: Engineers' Standpoint

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Abstract

The efficiency of workforce operations has a significant impact on how profitable a construction firm is. Studies from the past demonstrate that a variety of labour-related concerns have been affecting the construction sector in Sri Lanka and other developing countries, which has a negative impact on the efficiency of construction activities. Construction engineers are crucial resources who can play a key role in the development of decisions and regulations pertaining to construction labourers. This study intends to examine the influence of labour-related causes on the efficiency of construction operations in Sri Lankan road construction projects from the perspective of construction engineers. The significant labour-related causes were identified by a comprehensive scholarly review. Then, a questionnaire survey was conducted among 31 road construction contractors in Sri Lanka. The impact level of each cause was calculated using the Relative Importance Index (RII) method. A total of 26 causes were found to be critical, where labour skill shortage, labour discipline, labourers' poor ability of reading, understanding, speaking and writing, labourers' lack of thinking abilities and their communication problems were the top five ranking causes in the list. The validity and reliability of the study findings were established using statistical testing. The activities required in the construction site management processes were also evaluated in relation to the key variables identified through a number of industry consultative sessions. These consultative outcomes further confirmed the validity of the study results. The study findings will significantly aid in modernising current industry practices to boost output and efficiency. Even though the study findings are applicable and limited to the Sri Lankan road construction sector, some of those may still be considered in other developing sectors/countries.

Keywords: Construction management, labour efficiency, productivity improvement, road projects, Sri Lanka

Introduction

The construction industry has a significant impact on a country's infrastructure development and facilities, and it makes a substantial contribution to a nation's economic development and generates numerous employment opportunities [1]. Labour is the most valuable resource in the construction industry since it integrates all other resources in various construction projects [2]. Labour costs typically make up between 30% and 50% of the total project costs in a construction project [1]. Therefore, raising labour efficiency is crucial for the long-term success of the construction industry [2]. In many developing countries, the construction sector has been losing the efficiency and productivity of labour, which slows down the physical pace of construction projects [3, 4-6]. According to a number of studies [7-12], labour-related problems in general are the main cause of the low efficiency in construction operations.

Lack of skilled labour has been a problem for construction organisations, which has a detrimental effect on workers' performance and decreased construction production [2, 4-5, 10, 13-15]. The lack of work experience among employees has been identified as one of the major contributors to labour skill shortages in the construction sector [3, 5-6, 11-12, 16-17]. Along with a lack of work experience, it has been found that a lack of vocational training facilities available for labourers significantly affects their ability to perform manual operations of labour [6, 18-20]. Notably, many developing countries, including Sri Lanka, use unskilled labourers to carry out skilled work because they lack skilled labourers [1, 6, 10, 21-22].

Recent research from several nations, including Iran [1], India [7, 14, 16], Vietnam [11], Indonesia [23] and Qatar [24], found that the physical capabilities of labourers affected how well work operations were carried out in numerous construction projects. The ageing of the workforce is mostly to blame for the issues with labourers' physical capacities [10, 14, 18, 20, 25]. According to studies [20, 26], the increased workload for workers has an effect on their physical capacities.

The two main problems impacting labour productivity in the Indian construction industry have been found as workers' health conditions and drug/alcohol use [20]. Notably, it was discovered that significant drug and alcohol usage had a negative effect on the efficiency of Indonesian construction workers [23]. The health problems of the workers have a substantial impact on their ability to adapt to changes in the workplace [3]. Further studies in India [16] and Turkey [27] revealed that workers' psychological and financial problems had an impact on how well they performed construction-related

duties. Notably, workers' personal problems significantly affected the productivity of construction operations in several Indian construction sites [14].

It has been found that workplace discipline needs to be improved for construction workers who work on numerous projects in different countries [11, 16, 19]. The construction industry of both India [22] and Nigeria [10] reported that low labour commitment and morale have been the major problems for construction contractors. According to Hickson and Ellis [28], numerous unscheduled breaks, early departures and late arrivals have a significant detrimental effect on labour productivity in many Trinidad and Tobago construction projects. Additionally, previous studies have shown that Egyptian workers squander a lot of time talking, eating and drinking, which has a detrimental effect on labour productivity in the construction sector [5, 29].

Overall, previous studies on labour-related issues affecting the efficiency and productivity of construction operations in various developing countries have been carefully analysed in the current study, as shown in Table 1.

Table 1. Past Studies that Investigated the Problems Associated with Labourers in the Construction Sector from Different Countries

Country	Studies
India	[2, 9, 12, 16, 20, 22, 30-35]
Indonesia	[23, 36]
Iran	[1,4]
Nigeria	[10, 37-40]
Palestine	[41]
South Africa	[18-19]
Sri Lanka	[6, 8, 15, 17, 21, 42]
Trinidad & Tobacco	[28]
Turkey	[25, 27]
Turkmenistan	[43]
Vietnam	[11]
Zimbabwe	[13]

Sri Lankan Context

A few studies have looked into the labour-related issues affecting construction productivity and efficiency in Sri Lanka [6, 8, 15, 44]. According to Widanagamachchi [44], the incapacity of Sri Lankan labourers to understand technical drawings, the transient nature of the job, the demanding environment and the lack of social

recognition are the main factors of their lack of motivation in construction projects. According to Praveen et al. [45] and Manoharan et al. [46], the biggest problems for Sri Lankan construction contractors are the labourers' poor material handling skills and the inability to understand drawings. According to Kesavan et al. [8], the main labour-related issues in Sri Lankan construction projects were labour shortages, interpersonal conflicts between workers, low motivation and morale among workers, slow mobilisation of workers, unqualified/inadequate experience among workers and labour injuries. Poor cognitive and job-specific technical skills of Sri Lankan labourers have been cited by the Construction Industry Sector Council of Sri Lanka as major barriers to raising labour productivity in the Sri Lankan construction industry [47–48].

Despite the fact that the previously mentioned studies concentrated on labour-related issues in the Sri Lankan construction sector, a comprehensive investigation conducted by Manoharan et al. [49] has presented a wide range of labour-related factors that significantly affect the performance and productivity of construction operations in Sri Lankan construction industry. Manoharan et al. [49] identified a total of 32 criteria based on the state of the practices in the Sri Lankan construction sector. The main labour-related components discovered by Manoharan et al. [49] are listed in Table 2. The current study has compared these components with other studies from other international contexts, as displayed in Table 2.

Table 2. Labour-related Causes Affecting Efficiency and Productivity of Construction Operations Presented by Manoharan et al. [49] - Mapping with Other Past Studies from Different Countries

Code	Causes	Past Studies from Different Countries												
		India	Indonesia	Iran	Nigeria	Palestine	South Africa	Sri Lanka	Tritad & Tobacco	Turkey	Turkmenistan	United Arab Emirates	Vietnam	Zimbabwe
L1	Lack of work experience	X		X	X	X		X	X	X	X		X	X
L2	Poor education background	X					X	X						
L3	Lack of knowledge in construction works	X					X	X				X		

L4	Poor ability of reading, understanding, speaking and writing	X					X	X											X
L5	Lack of thinking abilities	X					X	X	X	X									
L6	Physical ability and fatigue	X	X	X															X
L7	Health problems	X																	
L8	Use of alcohol and drugs	X	X																
L9	Lack of labour morale/commitment	X				X													
L10	Labour discipline	X	X					X											X
L11	Ageing workforce	X				X		X				X							
L12	Psychological problems	X										X							
L13	Economic problems	X						X				X							
L14	Personal problems	X																	
L15	Communication problems		X																
L16	Misunderstanding with other workers	X					X												
L17	Skill shortage	X	X	X	X				X	X				X					X
L18	Mixture of three levels (Skilled, Semi-skilled and Unskilled)	X			X	X			X										
L19	Late arrival, early quit and frequent unscheduled breaks										X								
L20	Unnecessary talks																		
L21	Work overload	X																	
L22	Work dissatisfaction	X			X	X			X					X					
L23	Inability to understand drawings										X								
L24	Inability to adapt to changes in new environments																		
L25	Improper material handling									X									
L26	Poor equipment/tool handling									X									
L27	Changing nature of career expectation	X	X															X	
L28	Skill drain/emigration									X									
L29	Less job interest due to family and society	X			X				X										
L30	Other ways of earning money											X						X	X
L31	Labour absenteeism	X	X																
L32	Labour strikes		X																

Importance of this Study

Overall, studies highlight how important it is for the construction industry in many developing countries to address a number of labour-related concerns in order to improve the efficiency of construction operations. When considering the Sri Lankan construction industry, consultations with representatives of the Sri Lankan Construction Industry Development Authority (CIDA) revealed that the construction industry lacks studies on the labour-related causes influencing road construction project operations, and also both the public and private sectors invest more in road construction as part of the nation's infrastructure development. On the other hand, the study is aware that construction engineers are important resources who can be instrumental in the formulation of decisions and policies related to construction labourers [29]. As a result, based on the standpoint of construction engineers, this study aims to quantify the influence levels of labour-related causes on the efficiency of construction operations in Sri Lankan road construction projects. This will support addressing labour-related difficulties associated with the modernisation of construction site procedures in a developing country like Sri Lanka.

Materials and Methods

The study employed quantitative approaches to assess the degree to which each component (included in Table 2) affected the efficiency of road construction operations from the perspective of construction engineers. In-depth approaches were also used in the study to verify the reliability and accuracy of the findings. The sections that follow cover these.

Questionnaire Survey

A total of 31 Sri Lankan road construction contractors were selected for the survey, and a construction engineer from respective firms responded to the questions on their current practices and methods for carrying out road construction projects. To determine the degree of each element's influence, the survey questions used a Likert scale with five ordinal measurements ranging from 1 to 5 (very low effect to very high effect). The questionnaire design and its contents were validated by cognitive interviews conducted with six construction engineering professionals. In particular, the questionnaire contained all the instructions and data required to ensure that respondents understood the purpose of the survey as well as the elements related to the significance of efficiency and sustainability in construction labour operations/practices.

Given the difficulties in determining the real sample size with the needed qualities, the snowball sampling technique was used to select the road construction contractors for this questionnaire survey. In order to increase the sample size, the snowball sampling approach started with a small group of known individual survey respondents. Accordingly, a total of 31 road construction contractors were identified, who had higher/middle level registration grades of the Construction Industry Development Authority (CIDA). Notably, CIDA is the authorised body in Sri Lanka that provides contractor registration with credentials suitable for the construction sector. Construction contractors are categorised into 11 grades under CIDA's national registration and grading system based on their financial soundness, technical competence and practical experience. 50 million Sri Lankan Rupees is the required minimum amount of funds to obtain grade C4, which is the middle level of CIDA registration. A detailed profile of the respondents is shown in Table 3 based on their CIDA grades and job experience in the road construction sector. Contractors with a C4 grade made up the majority of the workforce (42%). Notably, all the survey participants had worked in the construction industry for at least five years, where the majority of them (45%) fell into the category of work experience between five and ten years.

Table 3. Detailed Profile of Survey Respondents

Profile	Variables	Number of Responses	Percentage
CIDA grade of contractors (Financial limit of the projects - LKR in million)	CS2 / CS1 (X > 1500)	04	13%
	C1 (1500 >= X > 600)	03	10%
	C2 (600 >= X > 300)	07	23%
	C3 (300 >= X > 150)	04	13%
	C4 (150 >= X > 50)	13	42%
Experience in the construction industry	Less than 5 years	00	00%
	5–10 years	14	45%
	11–15 years	08	26%
	16–20 years	06	19%
	21–25 years	03	10%
	More than 25 years	00	00%

Quantitative Analysis

The level of influence that each listed cause/factor has on the efficiency of construction activities was determined using the Relative Importance Index (RII) method. Using Equation (1), RII values were computed as indicated by prior studies [1, 11, 50].

$$RII = \frac{\sum W}{A * N} \tag{1}$$

- W is the weight that response ranges have given each element (1 – Very low, 2 – Low, 3 – Moderate, 4 – High, 5 – Very high).
- A stands for the maximum weight permitted (A equals 5).
- The total number of responses is shown as N.

The higher RII value indicates that the corresponding component significantly affects how well construction operations are carried out. For the linked factor/cause to be deemed critical, it needs to have a minimum RII value of 0.7. For the purpose of evaluating the validity and dependability of the results, the Coefficient of Variation (CV) values were calculated for each of the causes/factors stated. According to Statistics Canada [51], a CV value of less than 0.3 ensures the dependability of the outcomes for each specified cause/factor.

Additionally, a number of industry consultation meetings were held with construction experts from various working categories, and the results were discussed to determine what mitigation measures should be included in the site procedures. These discussion outcomes were also used to validate the findings. Notably, more than 20 industry experts participated in these sessions, including directors, team leaders, project managers, engineers and quantity surveyors, where problem-based and action-oriented communication approaches were mostly employed.

Results and Discussion

According to construction engineers, Table 4 shows the levels of the impact of labour-related causes on the efficiency of road construction operations. When the RII ratings of the stated causes were taken into account, 26 of those 32 causes were found to be critical (more than 0.7 of RII value). Skill shortage, labour discipline, poor ability of reading, understanding, speaking and writing, lack of thinking abilities, communication problems, lack of knowledge in construction works, use of alcohol and drugs, lack of labour morale/commitment, work dissatisfaction and lack of work experience were identified in the top ten labour-related causes affecting the efficiency of road construction operations in Sri Lanka. This section contrasts the outcomes when Sri Lanka and other foreign contexts are taken into account alongside those major elements, while also detailing the reasons for their current position, how they relate to other causes/factors and the steps that need to be taken in the industry's operations.

Table 4. Influence Levels of the Labour related Causes Controlling the Efficiency of Construction Operations in Sri Lankan Road Construction Projects

Codes of Factors	Mean	RII	SD	CV	Ranking	Level of Impact
L17	4.26	0.85	0.17	0.20	1	High
L10	4.18	0.84	0.16	0.19	2	High
L4	4.15	0.83	0.15	0.18	3	High
L5	4.15	0.83	0.15	0.18	3	High
L15	4.13	0.83	0.16	0.19	5	High
L3	4.05	0.81	0.14	0.17	6	High
L8	4.00	0.80	0.14	0.18	7	High
L9	4.00	0.80	0.16	0.20	7	High
L22	4.00	0.80	0.16	0.20	7	High
L1	3.95	0.79	0.14	0.18	10	High - Moderate
L16	3.85	0.77	0.13	0.17	11	High - Moderate
L14	3.82	0.76	0.14	0.18	12	High - Moderate
L13	3.79	0.76	0.12	0.16	13	High - Moderate
L2	3.77	0.75	0.14	0.19	14	High - Moderate
L7	3.77	0.75	0.11	0.15	14	High - Moderate
L6	3.74	0.75	0.12	0.16	16	High - Moderate
L31	3.69	0.74	0.13	0.18	17	High - Moderate
L11	3.67	0.73	0.13	0.18	18	High - Moderate
L18	3.67	0.73	0.12	0.16	18	High - Moderate
L19	3.67	0.73	0.12	0.16	18	High - Moderate
L21	3.64	0.73	0.11	0.15	21	High - Moderate
L12	3.62	0.72	0.15	0.21	22	High - Moderate
L25	3.62	0.72	0.13	0.18	22	High - Moderate
L23	3.59	0.72	0.14	0.19	24	High - Moderate
L20	3.54	0.71	0.12	0.17	25	High - Moderate
L26	3.51	0.70	0.14	0.20	26	High - Moderate
L29	3.46	0.69	0.12	0.17	27	Moderate
L27	3.41	0.68	0.11	0.16	28	Moderate
L24	3.33	0.67	0.11	0.17	29	Moderate
L30	3.28	0.66	0.11	0.17	30	Moderate
L28	3.18	0.64	0.12	0.19	31	Moderate
L32	2.97	0.59	0.21	0.35	32	Moderate

The results of this study show that labour skill scarcity in Sri Lanka has a detrimental impact on the efficiency, productivity and quality of work operations in road construction projects. Construction contractors have faced similar difficulties in a number of countries, including Egypt [5], India [2, 12, 16], Iran [4], Nigeria [10], South Africa [18–19], and Zimbabwe [13]. The biggest contributor to the skills gap among construction labourers may be the lack of focus placed on construction education in

school curricula, particularly in the Sri Lankan context [47, 52]. Many road construction projects in Sri Lanka use untrained labourers as skilled labourers since there is a shortage of experienced labourers there. This makes it difficult for employees to advance their careers and get essential work experience, and it also produces subpar work outputs. According to the consultation with Sri Lankan Industry Sector Skills Council (ISSC), labour training resources are in need of improvement for the Sri Lankan construction industry. ISSC also asserted that many Sri Lankan public sector training initiatives fall short of meeting the needs of the sector [47]. Other areas where ISSC stands out include the Sri Lankan construction labourers with poor cognitive and job-specific technical skills.

Maintaining work activities inside a structure or framework requires worker discipline. The vast majority of Sri Lankan labourers are uneducated and unaware of the expectations that must be met for achieving higher productivity. The experts in the field emphasise the dearth of employee handbooks, standard operating procedures and employment agreements in many road construction projects in Sri Lanka. Therefore, the efficiency of road construction operations is greatly impacted by poor labour discipline. Other developing nations, such as India [16], Indonesia [23], South Africa [19] and Vietnam [11], all had similar problems.

According to the results, the majority of labourers working on Sri Lankan road construction projects perform poorly on the job, since they have low speaking, reading and writing abilities. This has made it very difficult for the workers to deal with the problems at work. The ability of labourers to learn new things that are pertinent to job operations has a significant impact on the development of their cognitive, transferrable and self-management skills. The aforementioned lack of early education among Sri Lankan labourers may be the root reason for their poor skills. Similar difficulties have been found in earlier studies on labour forces engaged in construction projects in India [12, 16], South Africa [18–19], Turkey [27] and Zimbabwe [13].

For labourers to make informed decisions, understand the consequences of their actions and handle problems at work, critical thinking abilities are crucial. These are essential life skills for communicating, connecting and changing perspectives. Industry advisors claim that mental impairments, a lack of confidence, social conditioning, work pressure and personal concerns are the key factors affecting how well construction labourers can think and perform the task. For construction site workers to improve their cognitive skills, the experts emphasised the value of regular brainstorming sessions and

meditation practices.

Cognitive skills are necessary for workers to think, read, learn, retain information, pay attention, solve problems, remember tasks and make decisions. The current study findings demonstrate that labourers' subpar cognitive skills have a significant detrimental impact on their work efficiency in a variety of road construction projects in Sri Lanka. According to industry consultation experts, Sri Lankan labourers' cognitive skills in a variety of technical tasks (especially concreting, bar bending, plastering, tiling, welding, electrical works, and equipment management) need to be considerably improved. According to Manoharan et al. [53], construction training institutions must pay particular attention to the cognitive skills of workers in those categories. According to Praveen et al. [45], construction delays were mostly caused due to the labourers' poor understanding of plans and material management in Sri Lanka.

The study highlights poor communication abilities as one of the major barriers to labourers' participation in teams and collaborative work in many road construction projects in Sri Lanka. The consultation with industry experts revealed that this has caused worker misunderstandings, errors on the job, rework and construction delays in many road construction projects in Sri Lanka. Inadequate communication facilities result in poor work qualities in construction operations, hence the experts emphasise the necessity of linking quality control units with the communication strategies of construction enterprises. The study also emphasises how important it is for construction labourers working on road projects to comprehend safety communication protocols in order to prevent unexpected injuries while performing work-related tasks. Occupational injuries significantly increased construction delays in a number of Sri Lankan construction projects [15].

The term 'labour morale' or 'commitment' refers to a worker's sense of responsibility for the goals and expectations of the organisation. This has a significant effect on increasing labour efficiency in the construction sector. However, the bulk of Sri Lankan labourers lacks sufficient enthusiasm for the duties they are assigned. By contrasting Sri Lankan labourers with the leading foreign labour forces in the skill-based ranked list, namely the Arabian, Chinese, Korean and Malaysian labour forces, Manoharan et al. [54] highlight the urgent need for the construction industry to improve the work commitment of Sri Lankan labourers. According to the consultations with industry consultation experts, secondary education and vocational training institutions in Sri Lanka need to focus on enhancing the soft skills and attitude domain components in

their curricula. The construction firms must also ensure that the working environment supports a higher degree of labour participation.

This study reveals that a significant problem for Sri Lankan construction contractors has been labour absenteeism. Notably, it contributed to project delays in the construction industry in Sri Lanka [15]. According to expert discussions, the main reasons for labour absenteeism in numerous road construction projects in Sri Lanka were found to be the workers' poor levels of job interest, motivation, dedication and work satisfaction. The experts found that the main causes of the decreased motivation, lack of job interest, and work unhappiness among Sri Lankan labourers are salary delays, lack of proper incentives, lack of labour rewarding mechanisms, improper promotion opportunities, lack of job security for labourers, lack of welfare facilities for workers and other means of income.

According to this study, the level of labourers' workload has an impact on how effectively they work during road construction operations. The workload of labourers affects their attitude and behaviour, which also causes poor mental focus, low motivation and difficulties focusing on work-related tasks [55]. As a result, interactions with coworkers and managers could become tense. An excessive workload also affects employee morale and motivation, which contributes to work fatigue [55]. The experts' conversations revealed that irrational project schedules and job sequencing are the primary contributors to the excessive workload of labourers in Sri Lankan road construction projects. A well-organised project timetable boosts output and guarantees that resources are allocated effectively, which reduces costs and expedites the procedure. The experts' conversations further revealed that delays in subcontractors' work, disputes over subcontractors' schedules and delays in obtaining permissions and clearances from required authorities are the main causes of unrealistic project schedules. Additionally, discussions among experts revealed that a lack of employed skilled labourers and managers' poor time management abilities are other factors leading to the high workloads of labourers.

Overall, the CV values of each cause provide assurance for the reliability and precision of these findings. With the exception of 'labour strikes (L32)', the CV values of all of the causes fell within the acceptable range, according to the range of CV values given in the Labour Force Survey Guide Canada 2020 [51]. The influence levels of L32 may substantially vary among projects because only a few projects may be impacted by labour strikes. L32 is also the last item on the list. The low mean value might also have

an effect on the high CV value of L32. Therefore, it cannot be claimed that the CV value emphasises the lower level of precision for L32. The outcomes of the conversations with construction industry experts also confirmed the veracity of the study findings.

Conclusion

The study has determined the significant labour-related causes that have a significant impact on the advancement of construction operations in Sri Lankan road construction projects based on the perspectives of construction engineers. The impact levels of the causes show how carefully each aspect of workers must be taken into account if road construction operations are to become more efficient and productive. The significance of these traits and how they impact various construction project methodologies were also covered in the study. The results of this study have been compared to those of earlier studies that took Sri Lankan and other global contexts into consideration. The validity and reliability of the study findings were further confirmed using comprehensive procedures.

Overall, the study has identified critical areas to which site management should pay attention for boosting the efficiency and productivity of construction operations. In order to enhance the cognitive, interpersonal and task-specific abilities of construction labourers, the study also emphasises the urgent need to upgrade the nation's vocational training programmes. This study concludes that future studies should focus on finding ways to improve labour skills in the construction sector. It is expected that the overall study findings will considerably affect site management procedures and guidelines in favour of the long-term sustainability of the construction sector. Though the study findings can be directly applicable and limited to road construction practices in Sri Lanka, some of those might also be put to the test in comparable settings in other developing countries.

Conflict of Interest

No potential conflict of interest was reported by the authors.

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Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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