

An investigation of the resource finding issues in highway construction projects in Sri Lanka with COVID-19 pandemic situation

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Abstract : *The construction resources are most necessary for running the construction projects consistently up to their finishing stage and construction resource planning and management compulsory to ensure project goal in any project that the on time handover within budget. The whole construction industry of Sri Lanka was affected by advent of COVID-19 pandemic outbreak and the most construction projects had to face the difficulties of effective resources management. The research approach has been taken in to investigate the resource finding issues that arisen with COVID-19 pandemic in four highway construction projects which selected from four provinces in Sri Lanka. The study also focused to identify the effects to projects' delay, cost and quality. Through the literature review around topic background, seventeen resource finding issues related factors were identified under three categories that human, material and financial. Then, the importance level of identified factors were justified to this particular study through the responses gathered using questionnaire survey. The responses were taken from construction professionals (project managers, planning engineers, construction managers, QA/QC engineers, quantity surveyors and site engineers) who selected according to the researcher judgement from four contractor firms. Then factors were analyzed and ranked using Relative Importance Index (RII) and descriptive statistics, utilizing Excel and SPSS software. The results presented that the whole factors perfectly affected to resource finding issues and were discussed with qualitative findings to show their effects on projects' delay, cost and quality. Finally, concluded the identified effective solutions for continuing highway construction projects during COVID-19 pandemic period.*

Keywords : *Resources, Project objectives, COVID-19*

1. Introduction

The human resource, financial resource and material resource are the key construction resources which are consumed frequently by the construction projects and the construction management teams (client, consultant & contractor) normally confronted some challenges while resource management at the preliminaries or during construction period and they may probably come as one of environmental, social and health challenges, etc., or whole which cannot exactly be guaranteed.

At end of the year 2019, global people started to face the COVID-19 (Coronavirus) pandemic which was an immense health challenge highly affected the construction industry in recent times in Sri Lanka and other countries in the world. "The construction industry was one of the first industries that were impacted by COVID-19, and the workers have been subjected to an increased risk of unsafe" (Koh, 2020). The pandemic created a new unsafe and uncertain environment in construction industry in Sri Lanka and the normal construction works of many projects were disruptive to continuing energetically as previous.

Road construction projects are in a high-risk environment with their associated parties compared to the other construction projects running during the COVID-19 period (Julian Bailey, Nicolas Bouchardie, and Ignacio

Madalena, 2020). In Sri Lanka, highway construction projects faced a critical situation due to the raised barriers from the spread of the COVID-19 and the pandemic made an environment which having many resource related issues (shortages of existing resources or trouble in finding new resources required) against the completion or continuation of projects as planned. Enacting the regional lockdown, country lockdown, travel restrictions, social distancing and other isolation safety measures significantly affected handling the resources in the ongoing construction projects properly in Sri Lanka. So, this research approach taken into the highway construction projects considering its existing nature to investigate resource finding issues that generated with the COVID-19 pandemic. The study aim was to investigate the resource finding issues in four highway construction projects which were selected by covering four provinces during the COVID-19 pandemic situation in Sri Lanka and to discuss how those affect the delay, cost and quality of the project.

2. Literature Review

The continuing COVID-19 pandemic, which began in the Chinese city of Wuhan, has caused tremendous harm to the worldwide population and economy. The first incidence of COVID-19 in Sri Lanka was reported in late January 2020, involving a Chinese migrant, and the initial local case was detected at the second quarter of March. Since then, the Sri Lankan government has implemented a series of measures to decrease social distancing, including the closing institutes, the implementation of a work-from-home model to reduce crowds and, most recently, the regulation of an island-wide curfew in order to help reduce the risk of the pandemic on the Sri Lankan population (T.M.Wickramaarachchi et al., 2020). The COVID-19 outbreak has had a significant negative impact on key income-generating sectors. Because of its rapid growth, the COVID-19 outbreak could not be predicted or controlled. However, the COVID-19 pandemic significantly altered community lifestyle in Sri Lanka (Jayasingha, 2021).

A. Construction Projects Background with COVID-19

Michael A. Stover, Cynthia E. Rodgers-Waire and Thomas J. Moran (2020) even in the COVID-19 pandemic, contractors and other project-related parties are dealing with close problems like lack of raw materials and labour shortages, but it happened at unprecedented size and duration. The new existing situation like stay-at-home and government shutdowns/country lockdowns started considering the construction projects as "non-essential". Olanrewaju et al., (2021) state site productivity would be lowered by up to 50%, and the epidemic will cause a 40% increase in skilled labourers' shortages. Richard savino (2021) epidemic brought many construction projects to a halt for a brief period and it was a difficult stop that cost many jobs, revenue, and growth. While other industries are returning to work, the pandemic has presented additional barriers to some sectors, especially those in the construction industry.

Delay of completion, breakdown of supply chain and materials, change public attitude about the construction site, economic uncertainty locally and globally, job turnover of professionals, less productivity of projects, labor shortage, uncertainty of continuing site works, less funding for the future and demand reduction identified as challenges to the construction industry in Sri Lanka during COVID-19 pandemic (WN Kawmudi et al., 2021).

B. Construction Resource Background with COVID-19

1) *Human Resource*: The construction sector was experiencing a record scarcity of trained workers in prior to the epidemic, and that problem was increased because COVID-19 has halted some projects and slowed others. Although companies have begun calling back workers who were let off but some have declined, claiming a desire for unemployment benefits, virus fears, or family obligations (Shelley D. Hutchins, LEED-AP, 2020).

2) *Material Resource*: The ongoing coronavirus pandemic has caused considerable disruptions

in supply chain and material shortages in the construction sector, resulting in both lengthy delays and higher costs for numerous projects. Series of COVID-19-related influences, such as lockdowns, workplace restrictions, and border closures, caused significant disruptions in the manufacturing and distribution of construction materials, as well as both domestic and international supply chains (Ben Cotter and Katie Zhang, 2021).

3) *Financial resource*: During the COVID-19 epidemic period, one of the key issues for principal contractors, subcontractors, and suppliers in the construction business has always been project cost and cash flow maintenance. Construction projects' shutdown during COVID-19 prevents the projects from collecting income, but the projects must still account for many of its overheads (Thorpe, M, 2020). The cost of the projects was severely impacted after installing the on-site health and safety facilities and other safety measures. It has been critical to have access to cash that was the key challenge for construction parties during the COVID-19 pandemic period (Sierra, 2021). The developing countries face significant construction financial challenges, which complicate the impact of COVID-19, such as fluctuations in foreign exchange rates, inflation, interest rate changes, and material price fluctuations (Ben Cotter and Katie Zhang, 2021).

C. Construction Projects' Delay with the COVID-19

The human resource management in construction sites, is highly joined together with the working condition and it always affects the output. The better working condition means that the employees working safely. COVID-19 epidemic changes the proper working condition needed for effective resource arrangement in the construction sites. Due to the hazardous conditions that existed throughout the COVID-19 period, employees frequently failed to report to work and absenteeism was increased (All Answers Ltd, 2018). Labourers and other staff members are infected by COVID-19 and

quarantined frequently. So, the increase in labour shortage highly caused to delaying the construction works of many projects in Sri Lanka. Some construction sites have been stopped purposing to resume again later (Sampath Udayanga E.A.D , 2022).

ILO (2021) with the shortages of raw materials and other inputs, contractors, subcontractors and employees, the pandemic and its disruption of global supply lines have increasingly impacted construction activity. The manufacturing and distribution of some materials have been halted and construction projects were closed for extended periods. Project handover dates have been tentatively postponed.

D. Construction Projects' Cost with the COVID-19

Andy Choi (2021) states the many organizations faced and are still facing major financial difficulties. Contractors lacked the financial resources even though they were required to cover staff wages and keep their firms running during the COVID-19 pandemic period. The construction industry's profit margins were severely impacted by an unforeseen rise in material costs, with some businesses even losing money. Delay is one of the most critical factors that affect the cost of construction project during the COVID-19 and the price of construction materials frequently rise with time delay, while the supply of construction materials declined. Dealing with unexpected extra expenditures has always been a difficulty for contractors. The onset of the COVID-19 pandemic had a detrimental impact on many contractors' financial background since it was unexpected.

John G. McConville CCP (2020) mentioned due to the social distancing maintenance, small groups of workers available, and endless safety measures, caused to loss of productivity in construction projects that will result in more cost and the COVID-19's influence will result in increased indirect cost for the safe COVID-19 conformity and employing additional site safety

employees to monitor worker social distance and daily temperature checks at the site's entrance, masks, gloves, face masks, hand sanitizing dispensers, additional worker changing room facilities and isolated dining

facilities are required to enable social distancing techniques, more buses and vans or trucks need to facilitate isolated worker group transportation from residencies or accommodations to the worksite. Olanrewaju et

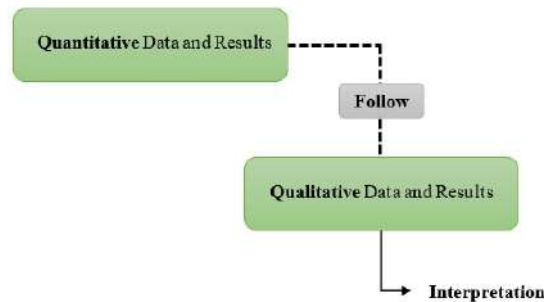


Figure 1. Explanatory process of research design

al., (2021) the costs of COVID-19 prevention health and safety requirements will increase project costs by more than 20%.

E. Construction projects' quality with the COVID-19

Ryan Buma (2021) Shortage of material receiving and shortage of labourers' attendance to the construction site, effect decreasing the output on time. Low productivity of jobs in projects directly affected delaying the constructions during the COVID-19 pandemic period is one of the challenges to quality satisfaction. Standard materials help to gain the strength of work done and keep the work decent. The local and foreign materials for the quality construction achievement but the direction was going away due to the COVID-19 disease. Material suppliers and other parties related to the supply chain got many problems from the pandemic situation and essential materials handling were difficult in the construction sites. Shutting down of the material production and running supply chain was the problem encountered to continue the quality construction works in the construction projects (Richard savino, 2021).

3. Methodology

The research was designed by mixed method (both qualitative and quantitative) to address the research qestions of this study. The mixed method approach was followed by an

explanatory process which initially conducted quantitative data collection and analysis and then, discussed with qualitative findings in second phase as a follow-up to the quantitative results.

A. Research Area

The study was carried covering four (04) provinces (Western, North-western, Central and Eastern) where the large scale highway construction projects under construction during COVID-19 pandemic period in Sri Lanka and one construction project was identified and selected from each province.

B. Target population

Professionals of construction management teams of selected contractors in each selected highway construction projects from specified four provinces in Sri Lanka were targeted.

1) Sampling Frame: Registered and graded (CS2) main contractor firms which possess the qualified professional teams of road construction industry in Sri Lanka under the Construction Industry Development Authority (CIDA) were considered to this study. Specifically, highway construction projects were selected considering two criteria due to prevailing COVID-19 pandemic situation in Sri Lanka.

Table 1. Criterion background used to select the projects

Availability	Ongoing highway construction projects during COVID-19 pandemic period
Size	Large scale highway construction projects

2) *Sample Size*: The fifty (50) of individuals were expected to cover from the selective professional (project managers, planning engineers, construction managers, QA/QC engineers, quantity surveyors, site engineers) job roles through the selected projects.

3) *Sampling Method*: Purposive sampling method was used to select the suitable individuals according to the researcher judgement which under the non-probability technique.

Table 2. Responses rate of questionnaire

Respondents	Responses
Project Manager	03
QA/QC Engineer	03
Quantity Surveyor	06
Construction Manager	06
Site Engineer	18
Total	36
Expected responses	50
Responses (%)	72

C. Data Collection

Both quantitative and qualitative data were gathered by questionnaire survey and interviews respectively from the sample selected through the data source. The 05 scale "Likert format", close-ended type questionnaire was dispatched through online media (email and Whatsapp) focusing the construction management teams selected from the highway construction projects running during COVID-19 situation and thirty-six (36) responses were

received. Then, focused, Open-ended type semi-structured interviews were conducted through the telephone calls with selective four (04) professionals from each projects.

D. Data Analysis

Analyzed both quantitative and qualitative data for getting clear view to the research questions as well as objectives of the research. Relative Importance Index (RII) analysis and descriptive statistics were used to analyze and interpret the collected quantitative data and then, the statistical analysis were followed by qualitative analysis. Two software applications (Excel and SPSS) were used to analyze the responded data statistically.

1) RII Method in Data Analysis:

$$RII = \frac{\sum Wn}{A*N}$$

W - Constant that weighted each response

A - Highest weighting

n - Frequency of responses

N - Total number of the respondents

4. Results

A. Data Analysis of Questionnaire

Fifty (50) responses from construction professionals' were expected to cover by questionnaire survey and thirty-six (36) responses were received. It was 72% to the expected responses of the study. Gathered data through the questionnaire survey regarding seventeen (17) factors that negatively affected finding the resource under the three (human resource, materials resource and financial resource) categories during COVID-19 pandemic period were analyzed using RII analysis and descriptive statistics by utilizing Excel and SPSS softwares.

Human resource related factors were labeled as; **(HR1)** Prophylactic absenteeism of professional staff and labourers are greater than the normal situation, **(HR2)** Job turnover of professional staff is higher comparing to the normal situation, **(HR3)** Job turnover of skilled,

Table 3. RII values of human resource related factors

Factor ID	5	4	3	2	1	RII	Rank
HR1	24	12	0	0	0	0.933	1
HR2	6	26	4	0	0	0.811	4
HR3	7	29	0	0	0	0.839	3
HR4	24	12	0	0	0	0.933	1
HR5	8	28	0	0	0	0.844	2

non - skilled labourers' and other related parties (drivers, store keepers etc.) are higher than normal situation, **(HR4)** Amount of hiring skilled and non-skill labourers are greater comparing with previous and **(HR5)** Amount of hiring professional staff is greater comparing with previous.

According to the Table 3 based on RII values of factors of human resource related category, there are two most significant factors of human

Table 4. Descriptive statistics of human resource related factors

Descriptive Statistics			
	N	Mean	Std. Deviation
HR1	36	4.58	.500
HR2	36	4.06	.532
HR3	36	4.19	.401
HR4	36	4.67	.478
HR5	36	4.22	.422
Valid N (listwise)	36		

resource related factors that pallelly affected the resource finding issues are (HR1) and (HR4) and (HR2) is the least significant factor.

Table 4 shows all of the responses are in between strongly agree and agree in the category of human resource related factors. (HR4) factor got the highest mean value and it is the most negative factor affected the human resource handling during COVID-19 pandemic

period. The standard deviation of the (HR4) factor is (0.478) and it means that the responses of (HR4) factor were not highly spread. The factor (HR2) has taken the comparatively lowest mean value and it is least affected negative factor that human resource handling during COVID-19 pandemic period. The standard deviation of the (HR2) factor is (0.532) and it means that the responses of (HR2) factor were not highly spread.

B. Data Analysis of Interviews

Table 5. Responses rate of interviews

Respondents	Responses
Project Manager	01
Planning Engineer	01
Quantity Surveyor	01
Site Engineer	01
Total	04
Expected responses of interview	04
Responses (%)	100

Interviewees stated that project time has been delayed during the COVID-19 pandemic period as never happened in the previous time on highway construction industry in Sri Lanka. The absenteeism of the staff members and labourers were highly increased during the pandemic period due to the travel restrictions, COVID-19 infection, group quarantine of infected parties, fear of the next wave and other social influences regarding the pandemic. They mentioned also that some quarantined people were not reported to the work again after finishing the quarantine period. Additionally, some interviewees mentioned some staff member and labourers have left their job in the projects and shifted to the different jobs because well caring about family members and relations during spread intensity of the COVID-19 pandemic period. So, finding new labourers and staff members to the site again were quite hard

and more time consuming work during prevailed pandemic period.

Participants stated that unexpected cost of project has been increased during the COVID-19 pandemic period as they never experienced in the previous time on highway construction industry in Sri Lanka. Health issues on manpower were increased in highway construction projects with COVID-19 virus outbreak and sufficient staff members and labourers have not been reported continuously to the construction project. So, tried to hire additional staff and labourers to the project as a solution for continuing the construction works even the virus outbreak. The new hired people were tested for COVID-19 by Rapid Antigen Test (RAT) frequently by transporting to the medical centre as the order of come to the site and they were provided all sanitary facilities (masks, sanitation liquids, hand wash, isolated accommodation and transportation etc.) to maintain healthy and safe environment in the worksite. They stated that the daily, weekly and monthly expenses of the projects were gradually increased when hiring the more manpower and facilitating safety precautions them during COVID-19 pandemic period. Planning the cost of safety measures and daily expenses were more difficult in the COVID-19 pandemic period and cost of medical and sanitary facilities raised with frequency of doing Polymerase Chain Reaction (PCR) test and RAT.

5. Discussion and Conclusion

The (HR1) and (HR4) factors were identified by both analysis as the most negatively affected two factors pallelly to handling the human resource to the highway construction projects during the COVID-19 pandemic and qualitative findings shown that the above factors were highly affected the projects' cost and time delay. Other two categories also analyzed same way and the results presented clearly that the whole factors highly affected resource finding issues in highway construction projects in Sri Lanka with COVID-19 pandemic situation. The most affected factors of other two categories were

also discussed with qualitative findings which gathered from the four interviewees of selected projects to show the effect on the time delay, cost and quality of the project. After evaluation the quantitative results with qualitative findings, the aim of the research has been achieved successfully.

The effect of (HR1) factor upon projects' delay can be decreased in some considerable degree, if the all labourers can be retained to the full by providing high level of safe working environment within the premises ensuring their sanitary facilities intensively. For that, isolated accommodation facilities with entertaining background to gain their mind happy from stress afar COVID-19 and essential goods and meals need to be supplied. Then they will stay safe and work happy even the out-side situation is worst. The continuous additional indirect costs of projects can be controlled by that practice because of providing additional transportation is limited and COVID-19 testing requirements are less. The effect of (HR4) has raised when the labour shortages happen, so that can also be minimized on project cost if the (HR1) is controlled. Then the cost overrun can be controlled on safety measures that need to be taken on frequent labour hiring. The minimization of human related issues will be beneficial to decrease the additional cost and continue the highway construction projects as much as possible without longest delaying effectively with COVID-19 situation in Sri Lanka.

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