

THE EFFECT OF LABOUR PRODUCTIVITY ON SUCCESSFUL COMPLETION OF MAJOR CONTRACTS DURING THE COVID PANDEMIC IN SRI LANKA

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ABSTRACT

The COVID-19 outbreak is the greatest global health crisis in many years. It has had a dramatic effect on workforces and workplaces all around the world. The construction industry has been significantly affected by the COVID-19 pandemic and has been challenged to improve the safety and wellbeing of its workforce and control the collapse of construction productivity. The objectives of this study were to identify and rank the factors affecting lack of labour productivity in major contracts during the COVID pandemic and effect of labour productivity on successful project delivery in major contracts during the COVID pandemic in Sri Lanka and to recommend management strategies to combat them. A thorough literature search on recently published literature, industry experiences, reports, and other related documents was performed to collect and categorize the required data. 40 COVID-19 challenges were identified, and the results revealed that 19 factors including absenteeism at work site, travel restrictions, supply chain disruptions, cash flow delays and social isolation due to teleworking. 27 strategies were identified to overcome these challenges, and 14 results demonstrated including avoid material shortage at the site, conduct a risk analysis, create an end-end supply chain map, initiate flexible work schedules to promote social distancing, increase of hygiene of construction. The findings of this study will help the project managers and authorities in the construction industry understand the challenges of the pandemic and adopt effective strategies that will improve the health and safety of their workforce.

Keywords: Construction Cost; COVID 19; Labour Productivity; Time Overrun.

1. INTRODUCTION

In the development of the construction industry human resource is an important factor. So that understanding the effect of labour productivity is much more important to improve the construction productivity in building construction projects (Prabhu and Ambika, 2013). Identification and evaluation of factors affecting labour construction productivity have become critical issues facing project managers for a long time. Both positive and negative can be used to understand the critical factors affecting productivity, formulate a strategy to reduce inefficiency and improve project performance.

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Some factors which affect the labour productivity are lack of labour supervision, payment delays, lack of communication, shortage of materials, lack of training, rain, shortage of experienced labour, construction method and so on (Hickson and Ellis, 2014). Other than these factors, many other factors, which influence for the labour productivity have been found by the researchers.

The coronavirus, commonly known as COVID-19, is caused by the coronavirus 2, a serious acute respiratory disorder. On 31 December 2019, the first known infections from SARS-CoV-2 were discovered in Wuhan, China. As of January 2021, the virus had spread to more than 200 countries, affected 91.5 million people, and caused 1.96 million deaths (Hendrickson and Rilett, 2020).

The construction sector, like many other sectors, has been affected in a number of ways. Since the pandemic began, there have been fewer employment opportunities, partially due to the work disruptions that were caused by following constraints that were put in place 3 to stop the progression of the virus, and a shortage of personal protective equipment (PPE) that was caused by the more pressing need for it by healthcare employees. Due to an interrupted supply chain and employee shortages due to quarantines, many projects have been halted or postponed.

A shortage of workers is always a concern for the construction industry, but the pandemic has intensified it as a large percentage of construction staff has reportedly screened positive for the coronavirus (Karim, et al., 2013). As the propagation of COVID-19 is largely related to individual contact, encounters between construction employees have played a major role in the delays in reopening projects. Physical distancing policies intended to decrease the virus spread have affected the number of workers permitted to work in an area, how the staff handles their jobs, and how project managers foresee the working environment (Araya, 2021).

Although recent studies have focused on the impacts of COVID-19 on the construction industry, few insights have been provided for the construction workforce in particular. Therefore, this study aimed to identify the effect of labour productivity on the efficiency of the major contracts in Sri Lanka during this pandemic period and explore how improved labour productivity can increase project efficiency in the pandemic situation.

2. LITERATURE REVIEW

2.1 FACTORS AFFECT TO THE TOTAL PRODUCTION OF A PROJECT

Hickson and Ellis (2014) ranked the factors affecting construction productivity and stated that “labour productivity” is the most affecting factor for total construction production followed by “management strategies”, “technological factors” and “external factors”.

2.2 CHALLENGES FOR LABOUR PRODUCTIVITY DURING THE COVID-19 PANDEMIC

Pamidimukkala and Kermanshachi (2021) come up with a research paper “Impact of COVID-19 on field and office workforce in construction industry”. The authors have mentioned the challenges for labour productivity during the pandemic period and categorized as organizational, economic, psychological, and individual. They have presented four organizational factors for labour productivity during the pandemic period as; lack of safe working environment, challenges due to work-from-home practices,

managing a heavier workload and management team’s lack of leadership knowledge and skills.

Reduced accessibility to updated tools and equipment needed to accomplish the tasks, uncertainty regarding future of workplace, supply chain disruptions and cash flow delays are identified as economic challenges for labour productivity.

Pamidimukkala and Kermanshachi (2021) mentioned two psychological challenges for labour productivity during the pandemic period as; social isolation due to teleworking and stress and burnout. They have identified four individual factors as; responsibility for personal and family needs when working, learning various communication tools and overcoming technical difficulties, feelings of not contributing enough to work and adjusting to new work schedules. Also, they have presented three moderating factors challenging for labour productivity during the pandemic period as, effect of COVID-19 on vulnerable groups (age), gender-based impacts and impacts on migrant workforce.

2.3 IDENTIFIED FACTORS AFFECTING LACK OF LABOUR PRODUCTIVITY DURING THE COVID-19 PANDEMIC

As a conclusion, the factors which affect lack of labour productivity in major construction projects during the COVID-19 pandemic are summarized in Table 1.

Table 1: Factors affecting lack of labour productivity during the COVID-19 pandemic

Researcher	Factors
(Halwatura, 2015)	Poor medical care for labours Lack of Labour supervision Late payments for the labours Low job security Communication problems between labours and staff members Lack of Accommodation facilities for labours Lack of incentives and respect for workers Schedule changes
(Palop, 2016)	Changes and errors in the original scope of work and the complexity of works Poor resource planning Schedule changes Morale problems at workplace Qualifications and educational problems
(Dixit, et al., 2017)	Rework Owner’s financial status Poor communication among the parties involved Material shortage at site Lack of skilful labours
(Muhammad, et al., 2015)	Poor weather conditions Crew

Researcher	Factors
	Labour disruption
	Entrance to the site
	Absenteeism at work site
	Congestive work area within the project site
(Prabhu and Ambika, 2013)	Lack of safety
	Lack of quality materials
(Hickson and Ellis, 2014)	Method of construction
	Working overtime
	Inspection delays by site management
	Lack of incentives and respect for labours
	Lack of periodical meetings with leaders
(Gopal and Murali, 2015)	Shortage of materials and tools
	Management Practices
	Environmental conditions
(Pamidimukkala and Kermanshachi, 2021)	Lack of safe working environment
	Challenges due to work-from-home practices
	Managing a heavier workload
	Management team's lack of leadership knowledge and skills
	Reduced accessibility to updated tools and equipment needed to accomplish the tasks
	Uncertainty regarding future of workplace
	Supply chain disruptions
	Cash flow delays
	Social isolation due to teleworking
	Stress and burnout
	Responsibility for personal and family needs when working
	Learning various communication tools and overcoming technical difficulties
	Feelings of not contributing enough to work
	Adjusting to new work schedules
	Effect of COVID-19 on vulnerable groups (age)
	Gender-based impacts

2.4 IDENTIFIED METHODS OF IMPROVING LABOUR PRODUCTIVITY DURING THE COVID-19 PANDEMIC

As a conclusion identified methods of improving labour productivity in major construction projects during the COVID-19 pandemic can be summarized as shown in Table 2.

Table 2: Methods for improving labour productivity during the COVID-19 pandemic

Researcher	Methods
(Hickson and Ellis, 2014)	Increasing labour supervision Arranging training Programs for labours Arrange periodical meetings with crew leaders Increase site safety and conduct site meetings to aware the labours about site safety Avoid material shortage at the site
(Dixit, et al., 2017)	Provide proper tools and equipment for labours and maintain Creating a schedule for works Proper resource planning in the site
(Thiyagu, et al., 2015)	Increasing of hygiene of construction Providing temporary shed for labour
(Jain, et al., 2016)	Measure the work done of the labours
(Warren, et al., 2009)	Increasing proficiency splitting Helping educated workers in their use of casual procedure
(Prabhu and Ambika, 2013)	Presuming quality camping conditions Timely payments to the labours without delays Good communication between labours and supervisors Minimizing work pressure Arranging suitable rest areas for labours in the site
(Halwatura, 2015)	Proper site management Arrange periodical meetings with crew leaders
(Pamidimukkala and Kermanshachi, 2021)	Redefine worksite safety Support personnel who work remotely Initiate flexible work schedules to promote social distancing Teach employees to recognize and manage stress symptoms Expand use of technology Educate the employees about COVID-19 policies and procedures, and train them to incorporate them Establish a system to maintain effective communication Allow longer timelines for project delivery Perform a contractor assessment to increase productivity Conduct a risk analysis Create an end-end supply chain map

3. RESEARCH METHODOLOGY

Initially a comprehensive literature survey was carried out by referring books, journals and other publications to identify the factors affecting labour productivity and labour productivity improving methods, which suits to pandemic period.

Data collection process was done through the questionnaire surveys. The data analysis part of the project was done through two different methods. The qualitative data collected through the open-ended questionnaire were analysed by the manual method. All the quantitative data collected through the closed ended questionnaire were analysed using MS excel software and the results were produced in tables in order to carry out the discussion part of this chapter through final result.

The empirical survey was conducted adapting questionnaire research approach. Due to the Pandemic situation in the country, access to working sites was restricted and data collection had to be done through google forms. This limited the sample size to 30 participants. The Relative Important Index (RII) was used to evaluate the ratings of the respondents and got the average deviation. The approach was recommended in past studies as the appropriate analytical approach to group rings of the variables in a given set. The analysis involved the computation of the RII, which is the representative rating point for the collective rings made for each variable in the subset (refer Eq. 01).

$$RII = \frac{\sum_{i=1}^5 W_i X_i}{A \times N} \quad \text{Eq. 01}$$

Where, RII - Relative Importance Index; W - Weighting given to each factor by the respondents and ranges from 1 to 5; X - Frequency of i^{th} response given for each cause; and A - Highest weight (5 in this case).

4. RESULT AND DISCUSSION

The data collected from the resource persons through the questionnaires were analysed by MS Excel software. When analysing gathered questionnaire data, every factor related to the research topic were analysed separately and they are presented below.

4.1 RANKING OF FACTORS AFFECTING TOTAL PRODUCTION OF THE PROJECT

Objective of this question is to identify and rank the factors affecting total production of a project. Received data were analysed and find the average deviation to find the significant factors and not significant factors affecting total production of the project. Findings are presented in Table 3.

Table 3: Ranking of factors affecting total production of the project

Factor	Relative Important Index	Average Deviation	Rank
Labour	0.96	0.23	1
Management	0.88	0.15	2
Technology	0.83	0.10	3
External	0.56	-0.17	4
Other	0.40	-0.33	5

4.2 REASONS OF AFFECTING COVID-19 PANDEMIC DIRECTLY TO THE PRODUCTIVITY OF A PROJECT

The objective of this question is to get opinions of the professionals on affecting of the COVID-19 pandemic on the productivity of a project. In the first part of the question, 28

out of 30 respondents have answered as the COVID-19 pandemic directly affect to the productivity of a project. Findings are summarised in Table 4.

Table 4: Reasons of affecting COVID pandemic directly to the productivity of a project

Factor	No of respondents	Total
Increase of material prices	R1, R11, R12, R16, R25, R27	6
Labours often get sick due to pandemic condition	R1, R24	2
Minimize the workforce of construction sites /Lack of labour	R4, R7, R8, R10, R13, R14, R15, R16, R17, R21, R23, R25	12
Material shortage/Supply chain disruption	R8, R10, R12, R13, R14, R15, R16, R17, R18, R21, R23, R25, R26, R28, R29	15
Have to keep personal distance	R9	1
Travel restrictions/Transportation problems	R9, R22, R24	3
Health Issues	R9, R22	2
Workers are afraid to work at sites	R12, R18, R28, R29	4
Delay in cash flow	R19, R25	2
Shutdown the construction sites temporally	R24, R25, R27, R28, R30	5
Lockdown the country	R26	1

According to the analysed data, “Material shortage/ Supply chain disruption” is the most affecting factor for the productivity of the project during the COVID pandemic. Respectively “Minimize the workforce of construction sites/Lack of labour” and “Increase of material prices” are the next significant factors affecting productivity of the project during the COVID pandemic.

4.3 RANKING THE FACTORS AFFECTING LABOUR PRODUCTIVITY DUE TO THE IMPACT OF COVID-19 PANDEMIC

Objective of this question is to identify and rank the factors affecting labour productivity of major contracts due to the impact of COVID pandemic. Affecting factors were identified through the literature review and designed the question to rank them according their significant due to the COVID pandemic. Findings are presented in Table 5.

Table 5: Ranking of the factors affecting labour productivity due to the impact of COVID pandemic

Factor	Relative Important Index	Average Deviation	Rank
Poor medical care for labours	0.71	0.09	8
Lack of labour supervision	0.67	0.05	12
Late payments for the labours	0.61	-0.02	21
Low job security	0.67	0.05	12

Factor	Relative Important Index	Average Deviation	Rank
Communication problems between labours and staff members	0.59	-0.03	23
Lack of Accommodation facilities for labours	0.72	0.09	7
Lack of incentives and respect for labours	0.53	-0.09	32
Schedule changes	0.67	0.04	15
Changes and errors in the original scope of work and the complexity of works	0.64	0.01	17
Poor resource planning	0.69	0.06	11
Morale / motivation problems at workplace	0.49	-0.13	37
Qualifications and educational problems	0.44	-0.19	40
Rework	0.57	-0.06	29
Lack of quality materials, tools and machinery	0.75	0.12	6
Lack of skill	0.54	-0.09	31
Poor weather conditions	0.49	-0.13	37
Labour disruption	0.57	-0.05	27
Absenteeism at work site	0.84	0.21	1
Congestive work area within the project site	0.65	0.02	16
Lack of safe working environment	0.70	0.07	10
Supply chain disruptions	0.83	0.20	3
Method of construction	0.64	0.01	17
Working overtime	0.53	-0.09	32
Inspection delays by site management	0.58	-0.05	25
Lack of periodical meetings with leaders	0.57	-0.05	27
Environmental conditions	0.47	-0.16	39
Travel restrictions	0.83	0.21	2
Challenges due to work-from-home practices	0.71	0.08	9
Managing a heavier workload	0.61	-0.01	20
Management team's lack of leadership knowledge and skills	0.58	-0.05	25
Uncertainty regarding future of workplace	0.63	0.01	19
Cash flow delays	0.77	0.15	4
Social isolation due to teleworking	0.77	0.15	4
Stress and burnout	0.60	-0.03	22
Responsibility for personal and family needs when working	0.55	-0.07	30
Learning various communication tools and overcoming technical difficulties	0.53	-0.10	34
Effect of COVID -19 on vulnerable groups (age)	0.51	-0.12	36

Factor	Relative Important Index	Average Deviation	Rank
Gender-based impacts	0.67	0.05	12
Impacts on migrant workforce	0.51	-0.11	35

According to the data received, 19 factors have identified as significant factors affecting labour productivity of major contracts due to the impact of COVID pandemic. “Absenteeism at work site” is identified as the most significant factor affecting to the labour productivity during the COVID pandemic. Respectively “Travel restrictions” “Supply chain disruptions”, “Cash flow delays” and “Social isolation due to teleworking” are identified as the top five factors affecting labour productivity of major contracts due to the impact of COVID pandemic.

Absenteeism may mean a loss of productivity of project, time overrun and cost overrun of a project. With the impact of COVID pandemic, many labours reported a decrease in work reporting in construction sites. The COVID-19 pandemic has seen government implementing restrictions on travel such as imposing travel bans or restricting or closing border checkpoints including ports. The travel bans have undoubtedly impacted the progress of many projects and disrupted the construction and projects sector. Material delays that stalled overall project progress and triggered major schedule disruptions were experienced due to the social distancing and quarantining requirements that resulted in a smaller workforce within supply chain organizations.

4.4 RANKING THE METHODS OF IMPROVING LABOUR PRODUCTIVITY DUE TO THE IMPACT OF COVID PANDEMIC

Objective of this question is to identify and rank the methods of improving labour productivity due to the impact of COVID pandemic. Affecting factors were identified through the literature review and designed the question to rank them according their significant due to the COVID pandemic (Refer to Table 6).

Table 6: Ranking of the methods of improving labour productivity during the COVID pandemic

Factor	Relative Important Index	Average Deviation	Rank
Increasing labour supervision	0.70	0.00	13
Arrange training Programs for labours	0.55	-0.15	24
Arrange periodical meetings with crew leaders	0.70	0.00	13
Increase site safety and conduct site meetings to aware the labours about site safety	0.72	0.02	11
Avoid material shortage at the site	0.85	0.15	1
Provide proper tools and equipment for labours and maintain them	0.79	0.09	4
Create a schedule for works	0.77	0.08	8
Proper resource planning in the site	0.77	0.08	8
Increase of hygiene of construction	0.79	0.09	4

Factor	Relative Important Index	Average Deviation	Rank
Provide temporary shed for labours	0.72	0.02	11
Measure the work done by the labours	0.50	-0.20	27
Increase proficiency splitting	0.54	-0.16	25
Help educated workers in their use of casual procedure	0.53	-0.16	26
Timely payments to the labours without delays	0.66	-0.04	19
Ensure the good communication between labours and supervisors and establish a system to maintain effective communication	0.68	-0.02	17
Minimize the work pressure	0.65	-0.04	20
Arrange suitable rest areas for labours in the site	0.68	-0.02	17
Proper site management	0.78	0.08	7
Support personnel who work remotely	0.69	-0.01	15
Initiate flexible work schedules to promote social distancing	0.79	0.09	4
Teach employees to recognize and manage stress symptoms	0.63	-0.07	22
Expand use of technology	0.69	-0.01	15
Educate the employees about COVID-19 policies and procedures, and train them to incorporate them	0.76	0.06	10
Allow longer timelines for project delivery	0.56	-0.14	23
Perform a contractor assessment to increase productivity	0.65	-0.04	20
Conduct a risk analysis	0.84	0.14	2
Create an end-end supply chain map	0.83	0.13	3

According to the data received, 14 methods have identified as significant methods for improving the labour productivity of major contracts during the COVID pandemic. “Avoid material shortage at the site” is identified as the most significant method for improving the labour productivity during the COVID pandemic. Respectively “Conduct a risk analysis” “Create an end-end supply chain map”, “Initiate flexible work schedules to promote social distancing”, “Increase of hygiene of construction” and “Provide proper tools and equipment for labours and maintain them” are identified as the top methods for improving the labour productivity of major contracts during the COVID pandemic.

COVID-19 has interrupted and will likely continue to disrupt sub-contractor scheduling as well as the supply of goods and materials. Prioritize critical shortages by supplier and buyer and identify the root causes, optimize VMI thresholds, unlock ERP, collaborate with suppliers and increase transparency, accountability, and ownership among buyers may help to avoid material shortage during the COVID pandemic. Conduct a risk exercise is an effective way to update the risk registers. This consists of considering a variety of ways that the project could unfold, including risks such as disturbances with supply chains; lack of cash flow of investors, subcontractors, and contractors; and permitting challenges. The benefits and costs of project closures and delays should be considered,

and priorities for responses and prevention initiatives should be assigned, based on the likelihood and severity of the potential threats.

5. CONCLUSION

The coronavirus, commonly known as COVID-19, is caused by the coronavirus 2, a serious acute respiratory disorder. The construction sector, like many other sectors, has been affected in a number of ways. This study aimed to identify the effect of labour productivity on the efficiency of the major contracts in Sri Lanka during this pandemic period and explore how improved labour productivity can increase project efficiency in the pandemic situation.

“Labour” is identified as the most affective factor to total production of a project. According to the analysed data, “Material shortage/Supply chain disruption” is the most affecting factor for the productivity of the project during the COVID pandemic. Respectively “Minimize the workforce of construction sites/Lack of labour” and “Increase of material prices” are the next significant factors affecting productivity of the project during the COVID pandemic. “Absenteeism at work site” is identified as the most significant factor affecting to the labour productivity during the COVID pandemic. Respectively “Travel restrictions” “Supply chain disruptions”, “Cash flow delays” and “Social isolation due to teleworking” are identified as the top five factors affecting labour productivity of major contracts due to the impact of COVID pandemic.

“Avoid material shortage at the site” is identified as the most significant method for improving the labour productivity during the COVID pandemic. Respectively “Conduct a risk analysis” “Create an end-end supply chain map”, “Initiate flexible work schedules to promote social distancing”, “Increase of hygiene of construction” and “Provide proper tools and equipment for labours and maintain them” are identified as the top methods for improving the labour productivity of major contracts during the COVID pandemic.

The results of this study will greatly benefit project managers and contractors by helping them understand the workers’ COVID-19 challenges and prioritize their plans so that they can provide safe working conditions that protect their employees and support them both mentally and physically to increase the project productivity. The outcomes can be useful to government entities also as they address the adverse impacts of the pandemic.

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