IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

IMPACT OF COVID-19 ON COST OF CONSTRUCTION PROJECTS

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Abstract: Due to COVID 19 pandemic, many projects in the construction sector around the globe were affected adversely in various aspects. Many were stopped and many were put on hold. This research was to understand the intensity of impact of the pandemic on construction cost and to seek out methods on how these profound challenges can be managed?

The objectives of this research were (i) Studying the impact over construction sector and intensity of impact over cost and (ii) Identify ways to achieve cost control in the projects during such pandemic situation.

The methodology applied for this research includes (i) Literature review to comprehend and assess historic data and to understand the ideas regarding optimization of workspace in built environment, better ways to communicate and resolve problems, etc. (ii) Data collection by questionnaire survey to understand the impact in India. The targeted participants were people connected to construction industry i.e., Clients, Contractor, Consultant, and other Professionals from Built Environment sector. (iii) Case Study - to validate the responses received from survey, comparison was done with actual data collected from the case study of an ongoing project.

The data collected by questionnaire survey were critically analyzed, which revealed cost impact on the construction projects. And it also shows, the changes that are about to, or need to happen in construction sector which will develop/improve the usual practices, to achieve cost effective, cost efficient and optimized working conditions. The results received from survey responses were validated using actual data collected from a case study of an ongoing project.

The outbreak did not affect the construction industry severely but it experienced delays and rising cost. Due to current pandemic situation, the areas in a construction industry which got impacted the more were cash flow, work force and project schedule. The level of impact on the Manpower was the strongest and by survey and case study it`s been found the cost-impact due to increase in cost of Labour was about 20-50% due to the social distancing and social panic, availability of labors was scarce. The results will assist us to be ready to face such situation or crisis in future.

Index Terms **- Cost Impact, Cost Control, Construction Project, Cost Impact Analysis, COVID-19, Pandemic**

I. INTRODUCTION

The outbreak event of the virus identified as COVID-19 happened in December 2019 in Wuhan City, China stunned the world in many ways. The impact of coronavirus disease was clearly visible not only over the health of a people but also affected various aspects like supply chain, transportation, industrial production, and many more. Just like any sector the virus outbreak had its share of impact over the construction sector affecting various projects involved. When the current scenario was assessed, it could be easily seen that there will be a significant fluctuation (drop in) new orders and contracts, following the supply part as well. Though, this pandemic scenario did not stop the construction project completely, but it has hampered the development of project by impacting the schedule and cost of the project, disturbing the supply chain, etc.

In India, as for the largest receiver of FDI, Construction sector is considered at second position. (NIP, 2020). The government has started investing more into infrastructure development since 2008 and that of course giving a good boost to the development of the country. There has been further projection of advantages like improving the employment rate by 2.142-billion-person years.

NIP which included both economical aspect and also the social infra projects, have the sector wise break out which will show us the forecast of the sectors having the ability to generate high employment, develop livelihood and having potential to improve the development pace of a nation.

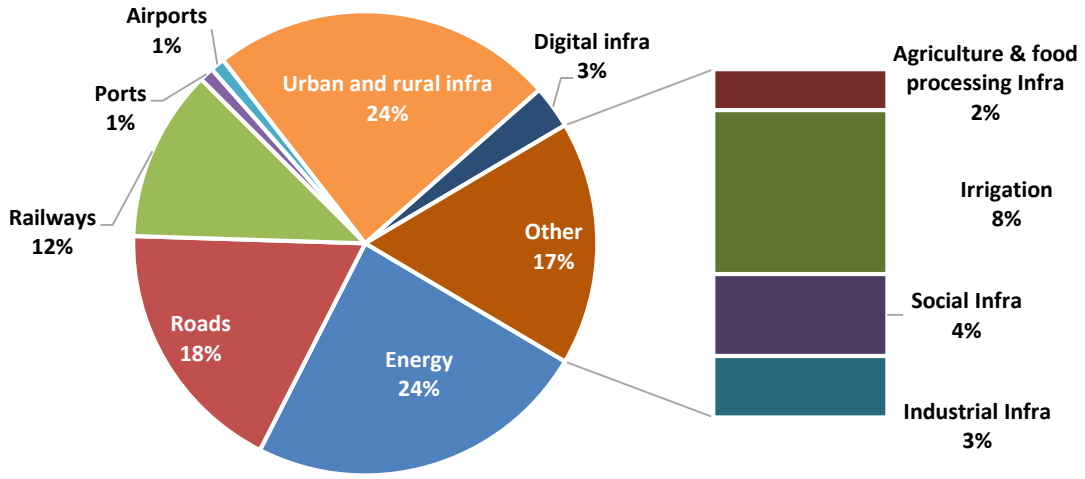


Figure 1 Sector-wise break-up of the NIP (NIP, 2020)

For FY 20-25 sectors like Power, Road Urban and rural infra, and Railways contributes about 80% of the Projected Capital Expenditure for infra projects in India. (See Fig.1)

But due to the pandemic, many construction projects were put on hold, some are called off, etc. This paper will give the insight about what got affected and how to overcome. The objectives of this research were (i) Studying the impact over construction sector and intensity of impact over cost and (ii) Identify ways to achieve cost control in the projects during this pandemic situation.

II. LITERATURE REVIEW

From literature review, the following derivations were made -

2.1 For the short-term responses-

- Support from bank in dropping the interest rates for loans and all which could be helpful for the builders to get support as the capital investment for the project.
- Governments response by cutting down tax.
- Disseminating hygiene practices in workplace, which will be great help not only as low-cost thing but also to defend the ill effects of this pandemic situation, affecting your project. (Fernando, 2020)
- Developing and producing guidelines aiding safety norms and for better labour health.
- In situation like this following two responses should be done-
    - To assess the contract clause to check severity of liabilities upon violation.
    - To actively take up actions to mitigate the liability by sensibly raising the correct legal code. (S, 2020)
- Introduce alternative approaches or different ways to take care of the processes without affecting the performance in the construction site.
- Dividing the teams into smaller groups so to minimize the spread of disease.
- Using alternatives like making meeting online instead of physical ones to avoid gathering.
- Even the contract can be nullified by stating the current scenario as force majeure, but proper statement should be provided to state how this situation affected the project and the severity (Johnson, 2020)
- To give proper training for work from home.
- Proper management and keeping things in check.
- Creating escape policy to safehold the sectors from have adverse effects. Proper and revised guidelines should be introduced for the contractors to achieve cost control and they should be made aware of it. (Ludvigson, et al., 2020)
- Proper recording of information, processing and management could give a better cost control.
- With the application of software with features to track the scheduling and to have control of labour cost and other expenses should be valued more.
- Seminars and training should be given to develop awareness of software and important guidelines like of ICTAD. (S.N., et al., 2017)

2.1 For the Long-term responses-

- To increase investment in health care system.
- To have global cooperation with support in public health sector and in stabilize global economic is crucial. (Fernando, 2020)
- Engineering optimized alternative methods while concentrating on the value design.
- Establishing a basic practice to develop better and efficient set of responses to avoid any impact of such similar scenarios on projects in future.
- Introducing new special clauses in contracts for proper response and aid in risky possibilities. (S, 2020)
- Implementation of response by adopting better policies and measures that may give relief to the affected one.
- To develop plans to boost the economy to avoid any crisis.
- Government should support and introduce sustainable business models in every sectors. (Nicola, et al., 2020)
- Introduce better government policies and active investments from the private firms. (Johnson, 2020)

III. RESEARCH METHODOLOGY

3.1 Methodology

The main aim of this research is to understand why and how severe is the cost impact in construction projects during the current pandemic condition. Also, to find methods to control cost. In this research, following three methods were used.

3.1.1 Literature Review

In this, initially literature review was done to understand how to assess the present condition of the market and to find out events like current situation for comparing the data. This data aids to project possible solutions and better ideas to optimize work environment for construction sites, better ways to communicate and resolve problems, etc.

3.1.2 Online Questionnaire Survey

To understand the severity of the impact of this situation on the sector, as a part of data collection and to have a wider picture online questionnaire survey was conducted. The questions were structured by assessing the gaps identified during the literature review. For the survey, the targeted participants were people connected to construction industry i.e., Clients, Contractor, Consultant, and other Professionals from Built Environment sector. By taking proper consent from the respondents, the data were collected and represented in graphical format i.e. bar charts and pie charts, which were then analyzed revealing cost impact on the construction projects. Also providing the insights regarding the changes that were about to happen in construction sector which will be improvement to the conventional practices. Thus, creating new methods to achieve not just cost-effective methods but also efficient and optimized working conditions.

3.1.3 Case Study

The results received from survey responses were validated using actual data collected from a case study for which an ongoing project which had started before the Pandemic was selected. This helps to compare and assess the progress of the project before and during the Pandemic.

IV. DATA COLLECTION AND RESULT DISCUSSION

4.1 Questionnaire surveys

4.1.1 The profile of the respondents

Respondent`s profile was one of the important factors that needs to be checked to get satisfactorily accurate responses. There was total 16 questions provided to the participants in which 6 questions for profile identifications, 8 questions regarding the survey topic and 2 optional questions. Total number of responses received for the survey was 41 i.e., total number of participants was 41. These were from various segments of construction industry. Key profile metrics regarding the profile of respondents were as following: -

4.1.1.1 Origin country of the participants

To identify the country of the participant as it will aid in understanding the impacts of the Pandemic situation not just of one area but from others too which will enable the responses to be collective and reliable.

Here, 78% of the responses were from India while the rest i.e., 22% were from UAE (United Arab Emirates). (See Fig.2)

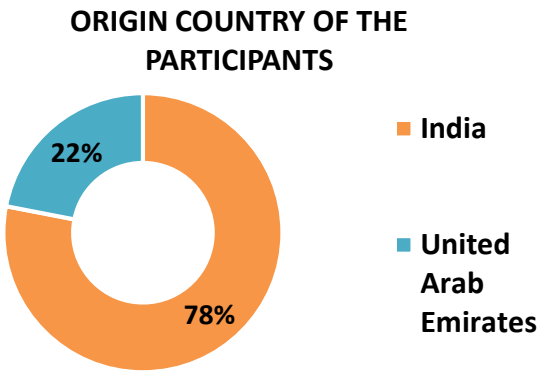


Figure 2 Origin country of the participants (Source-Google Survey)

4.1.1.2 Respondent`s years of work experience

This gave us dependability on the responses as they will assess the scenario and its impact better.

Here, maximum respondents were having experience of 15-20 years. (See Fig.3)

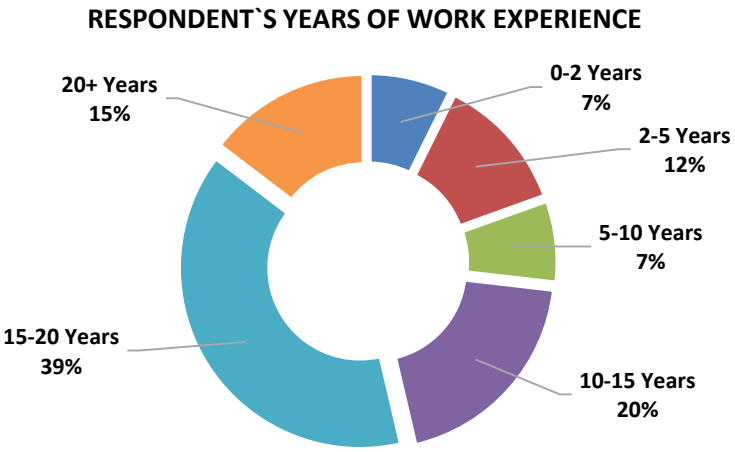


Figure 3 Respondent`s years of work experience (Source- Google Survey)

4.1.1.3 Respondent`s Designation

To understand the kind of work they were involved into. Here, top 3 responses were from Project manager, Senior Engineer and Site In-charge. (See Fig.4)

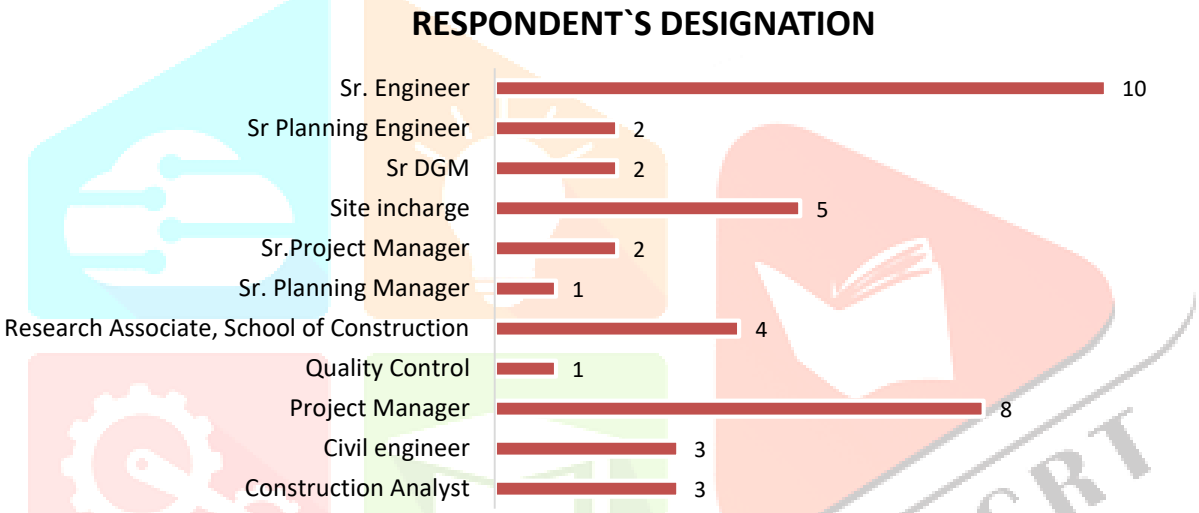


Figure 4 Respondent`s Designation (Source- Google Survey)

4.1.1.4 Respondent`s Occupation

To recognize the kind of projects they work on and their roles. Here, top 3 responses were Consultant, Contractor and Client. (See Fig.5)

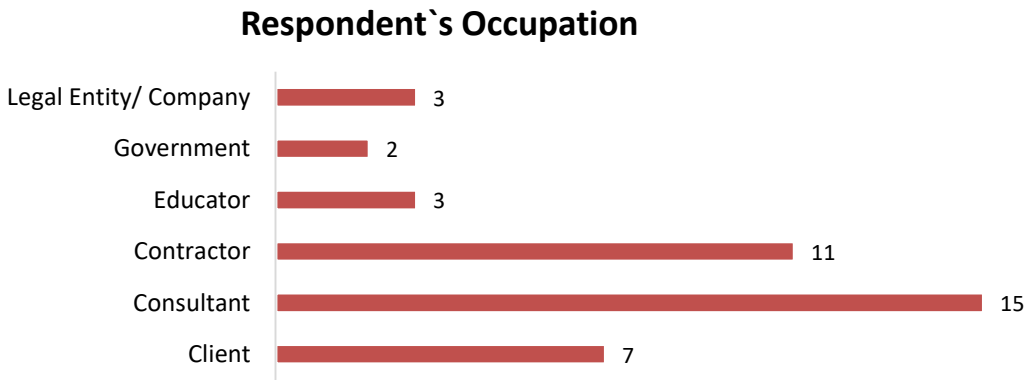


Figure 5 Respondent`s Occupation (Source-Google Survey)

4.1.2 Impact of COVID-19 on Construction Industry

In this section of survey, data collected were focused on overall impact of COVID-19 on the built environment. It covers 6 points as follows: -

4.1.2.1 Impact of COVID-19 on the progress of the project

To understand in what way the project gets impacted due to the Pandemic situation. Here, majority of response showed it was experiencing delays, followed by other responses like put on hold due to Govt. notice, spread of disease within company, etc. (See Fig.6)

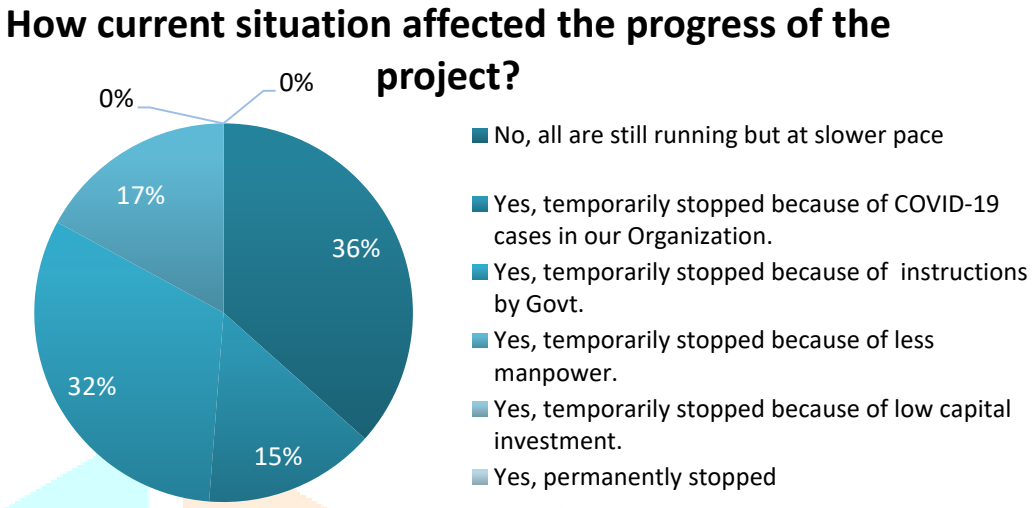


Figure 6 Impact of COVID-19 on the progress of the project (Source- Google Survey)

4.1.2.2 Impact of COVID-19 on the Organization

To know the severity of impact of the current scenario on the Organization. In this, majority response indicated the outbreak did not affect much to the organization.

4.1.2.3 Impact of COVID-19 on the Project/Work

To know the level of impact of the current scenario on the Project. In this, majority response indicated medium - high impact was there on the projects.

4.1.2.4 Impact of COVID-19 on Revenue

To know how the revenue / cashflow was impacted due to the pandemic situation. In this, majority response indicated the outbreak had strong impact on the revenue.

4.1.2.5 Impact of COVID-19 on Manpower

To know how much manpower got affected due to the COVID-19. In this, majority response indicated the strongest impact was on the manpower.

4.1.2.6 Areas affected in their Organization.

To understand, what areas in a construction industry had impacts due to current Pandemic situation. Here, top 3 responses were cash flow, work force and project schedule. (See Fig.7)

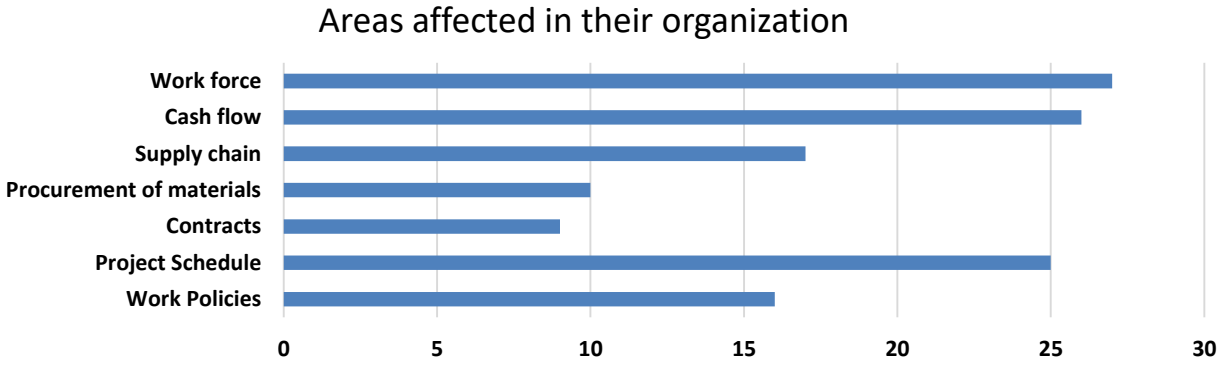


Figure 7 Areas affected in their organization (Source- Google Survey)

4.1.3 Cost-Impact of COVID-19 on Built Environment

In this section of survey, data that to be collected were set to focus on cost-impact of COVID-19 on the built environment. It covers 2 points as follows: -

4.1.3.1 Cost-Impact of COVID-19 on Built Environment

This was to understand how severe the impact of COVID-19 was, cost wise, on various essentials of a project. Here, majority of response shows-

- There will be drop on cost of Construction Materials by 0-25%. (See Fig.8)
- There will be rise on cost of Labour by 25-50%. (See Fig.9)
- There will be drop on cost of Other Materials by 0-25%. (See Fig.10)
- There will be no major effect on cost of Construction Equipment. (See Fig.11)

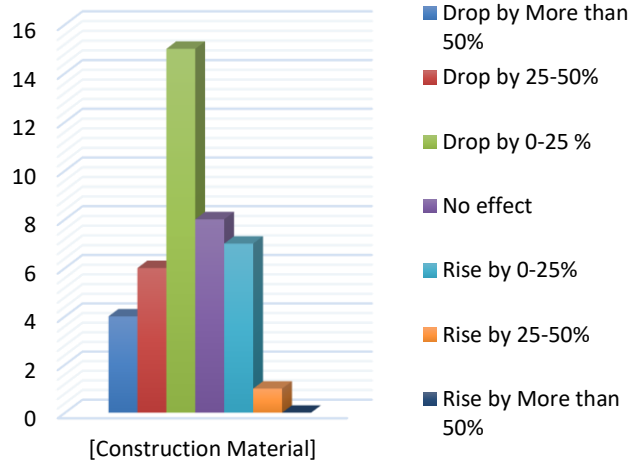


Figure 8 Cost-Impact on Construction Material (Source- Google Survey)

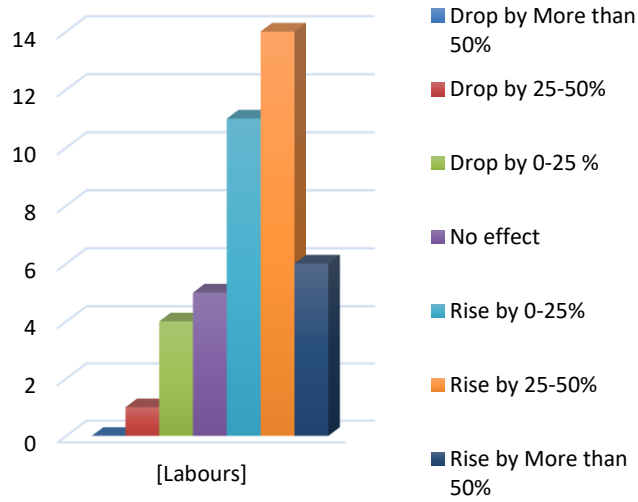


Figure 9 Cost-Impact on Labor (Source- Google Survey)

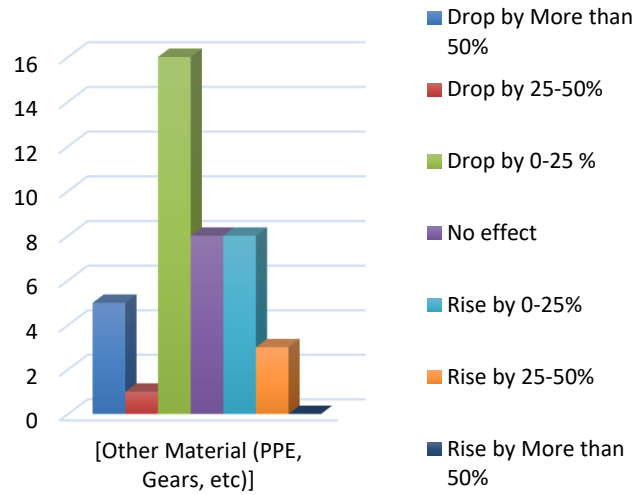


Figure 10 Cost-Impact on Other Material (PPE, Gears, etc.) (Source- Google Survey)

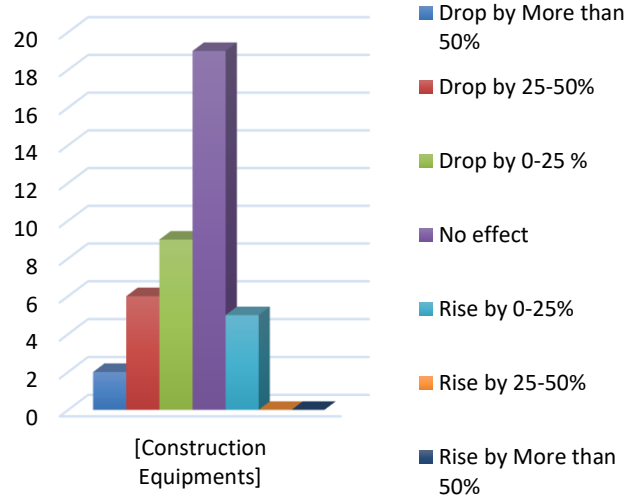


Figure 11 Cost-Impact on Construction Equipment (Source- Google Survey)

4.1.3.2 Immediate actions taken to mitigate any severe effect on the project.

To understand, what practical measures should be adopted or could be helpful to dodge any serious cost-impact due to current Pandemic situation. Here, top 3 responses were changing the work duration, Training employees for work from home and rescheduling the project operations at least the crisis was evaded without any serious affects to project. (See Fig.12)

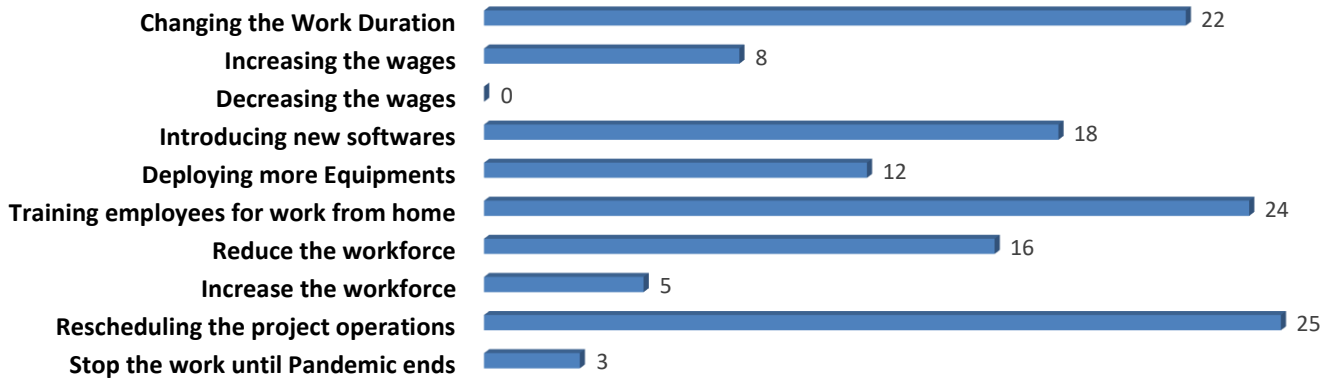


Figure 12 Actions taken to mitigate any severe effect on the project (Survey)

After carefully assessing the online questionnaire survey data, following critical points were highlighted: -

- The outbreak did not affect the construction industry severely but its experiencing delays and rising cost.
- The level of impact of the current scenario (See Fig.13)-
- On the Project was medium - high impact.
- On the Revenue the impact was strong due to shutting down of work, delay was there in delivering the project and no new contracts were issued or opened.
- On the Manpower was the strongest as the availability of labors were scarce.

Thus, due to current Pandemic situation, areas in a construction industry which was most affected were cash flow, work force and project schedule.

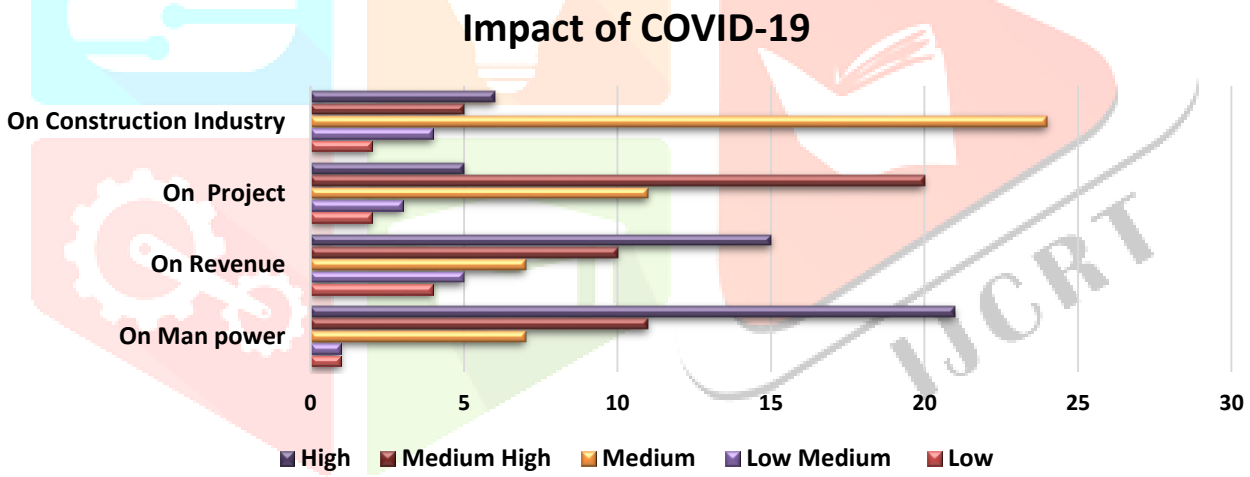


Figure 13 Impact of COVID-19 (Source- Google Survey)

The Cost-impact due to Covid-19 (See Fig.14)-

- There will be rise on cost of Labour by 25-50% due to the social distancing and social panic, availability of labors was scarce.
- There will be drop on cost of Construction Materials by 0-25% as the demand was low due to less work, the stock needs to be cleared before its damaged.
- There will be drop on cost of Other Materials by 0-25%.
- There will be no major effect on cost of Construction Equipment.

Factors that may affect the cost-

- Government policies and expenditure on infra projects.
- Employee retrenchment.
- Contract clause.
- Logistics.
- Competition- Less project more demand.
- Increase in operational fixed costs.
- Labour's salary and additional travelling cost.

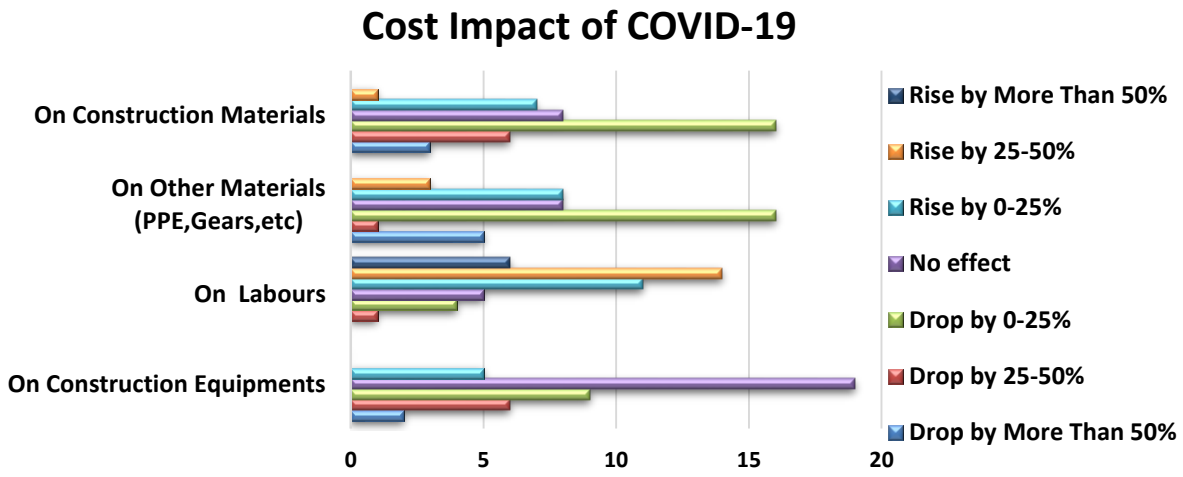


Figure 14 Cost-Impact of COVID-19 (Source- Google Survey)

Response that built environment should apply in this crisis-

- Changing the work duration.
- Training employees for work from home and rescheduling the project operations.
- Introducing and application of new software like BIM for better management.
- Developing ad adopting advance construction technology.
- To take special safety measures.
- Adding special contract clause in advance to get proper guidelines that needs to be followed during situations like this pandemic.

4.2 Case Study

For the case study a live project was selected which started before the pandemic and is still ongoing. The site taken for the case study was Construction of City Bus Depot/Terminal and Workshop undertaken by a prestigious construction company.

But due to the no public transport available and due to lockdown transit was not possible because of which physical site visit was not possible. Yet data required for analysis was taken well by verbal communication and also by studying the site monthly work status reports.

Table 1 Case Study Project Details

Project Detail	
Project	: Construction of City Bus Depot/Terminal and Workshop
Project Cost	: Rs. 9,70,48,890.13
Project Duration	: 18 months (Including monsoon)
Starting Date	: 11/12/2019
Area of site	: 21,015 sq. m.
Building type	: 1) Depot Building: R.C.C. Building. G+1 without basement.
	2) Workshop Building: R.C.C. Building. G+1 without basement.

During the progress of work, there wasn`t any obstructions or hindrance to delay the work. Instead, was going well and effectively. When the pandemic hit India, there was slight panic mode among people, yet with safety the work was going on. Then on 25th March 2020, government ordered complete lockdown for safety protocol and contain the spread of virus. From that till 26th April 2020 the project was put on hold hence the construction works were stopped for that period.

After taking special permission and taking all the safety checks, the project resumed its work on 27th April 2020. But then other issues started to show up in the form of scarcity in manpower. Due to the panic created during the pandemic, labors (who come from various parts of India) went home and there was not much available. Hence the site resumed for few days by deploying the existing construction equipment and doing the possible work like backfilling and few casting works. But after a week it was put on hold again and the works were completely stopped. Finally, the work on site resumed in May 2020 by hiring another agency whose labors were available.

Here the first sign of delay was seen during the pandemic due to the lockdown and the lack of labour. In the chart below tracking of work is shown for PCC and RCC work.

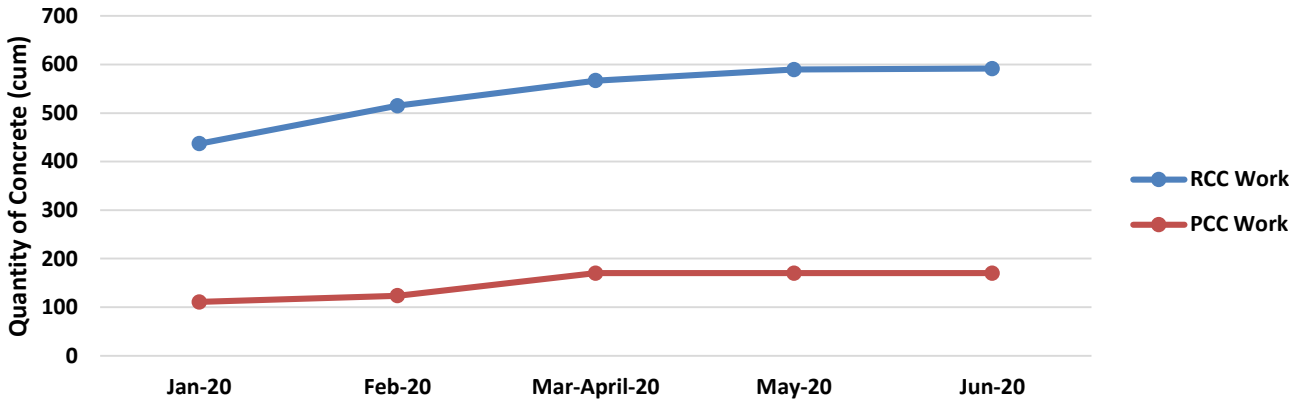
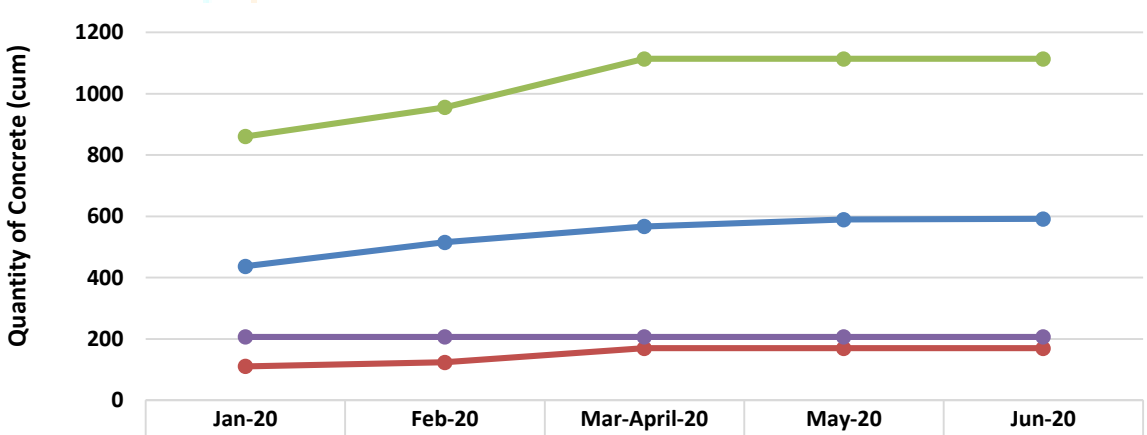


Figure 15 Tracking the progress of work (Source- Site work logbook)

To understand the work`s pace, two operations i.e., PCC work and RCC work were traced out by the progress reports. This helped us in understanding the progress of work in the current scenario. The following was the comparison of planned schedule against actual work done.



	Jan-20	Feb-20	Mar-April-20	May-20	Jun-20
RCC Work Done	436.82	515.252	566.89	589.51	591.49
PCC Work Done	110.72	123.73	170.01	170.01	170.01
Total RCC Work	860.24	955.58	1113.66	1113.66	1113.66
Total PCC Work	206.64	206.64	206.64	206.64	206.64

Figure 16 Tracking the progress of work (Source- Site work logbook)

During the period of low manpower availability, the construction equipment was deployed to do the majority of the possible works which helped to catch up with the planned schedule to some extent.

To resolve the low manpower problem, another agency was hired who had labors available locally. But they demanded for more wages. So, it was costlier than the previous agency. The following table and figure will show the charges-

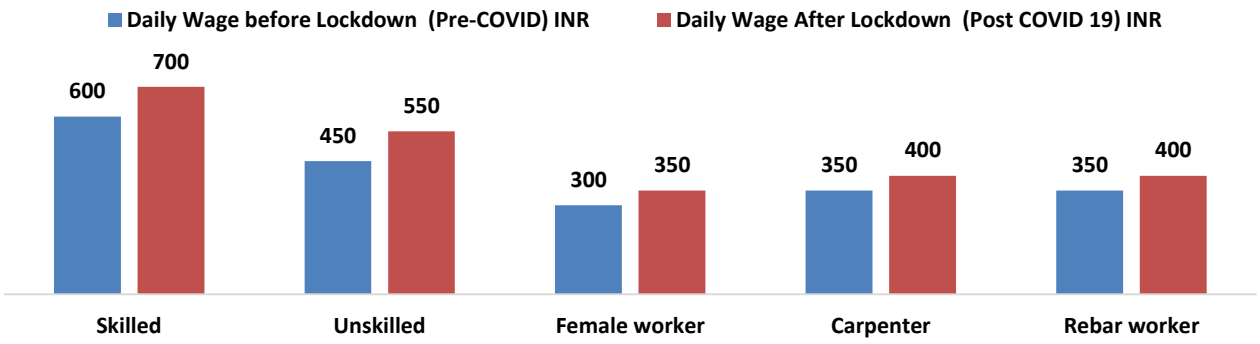


Figure 17 Change in Labour`s wage (INR) (Source-Survey)

As the contract cost was fixed, the rise of labour cost had to be borne by the contractor himself. The below table-2 shows the rise of wages (in percentage) –

Table 2 Change in Labour`s wage (INR) (Source-Survey)

Types of Labour	Daily Wage before Lockdown (Pre-COVID19) INR	Daily Wage After Lockdown (Post-COVID19) INR	Change percentage
Skilled	600	700	16.67 %
Unskilled	450	550	22.22 %
Female worker	300	350	16.67 %
Carpenter	350	400	14.29 %
Rebar worker	350	400	14.29 %

Critical Highlights –

- Need to increase usage of advanced constructional equipment.
- Addition of clause in contracts for the extremities (like current scenario) to clarify the ways to deal with these additional costs.
- Keep training and awareness sessions to make the labors and employees aware and capable to deal with tough situations.
- Enabling lean construction techniques to reduce the other costs.

V. RECOMMENDATIONS FOR COST CONTROL

- Seeing the possible cost-impact on projects due to COVID-19, the need to make cost control was necessary. So, following are recommendations provided for cost control: -
- Enabling approaches like lean construction to max to reduce the overall project costs.
- Proper management and application of advanced cost management tool.
- Reduction of fixed cost.
- Department like HR, procurement, EHS, QMS, etc. should continue works from home whenever possible, that will enhance productivity too.
- Lower the overhead cost.
- By reducing labors and deploying advance construction equipment
- Effective use of advance construction technology.
- Using lean techniques that can reduce the number of people required for each work.
- Delay or decrease wages/salary when cashflow gets affected.
- Serious austerity measures but with proper planning.
- Better planning of labour and inventory management.
- By inserting specific conditional clauses in contracts which must be mutually agreed upon by client and contractor so as to deal with the cost increase during such circumstances.
- Use optimized combination of manpower & machines, increase extent of mechanization, Multiple project rescheduling with suitable application of project crashing, Optimized resource allocation by adopting suitable approach of resource levelling or resource smoothing, improving supply- chain management, improving labour productivity by giving incentives etc. are the few ways for reducing cost of construction projects.
- As cost cannot be handled directly, cost occurred will be added as Risk cost to the project total cost in this pandemic situation. Cost accounting needs to be managed properly and thereafter necessary measures of cost control by rescheduling project, use of alternative construction techniques involving lesser manpower and value engineering can help in better cost management.

VI. CONCLUSION

It is true that the current pandemic situation has shocked the world to its core, bringing every movement, work, operation, education to a standstill. Even it is showing signs of a global economic crisis as aftermath. And it is no time to just wait for it to happen, but it is time that we should be taking necessary actions and proactively make it happen and mitigate the crisis from ever happening.

The results and recommendations show the changes that are about to or need to happen for which construction sector needs to develop/improve the usual practices to achieve cost effective, cost efficient and optimized working conditions. This will assist in future as well, for us to be ready to face whatever the situation or crisis come up.

In India, there are plenty of qualified/skilled people available in engineering and in various other fields. At the same time, it is our duty to maintain our responsibility as a true citizen to give back to our society in crises.

Also remember, this pandemic is the not the end for the construction industry but a new beginning for a strong and brighter future.

VII. ACKNOWLEDGMENT

Success of any work depends upon the dedication, sincerity, and hard work. It also requires some ingredients such as motivation, encouragement, guidance, and time. I am taking this opportunity to express my gratitude to each one who supported me in this research work.

It gives me immense pleasure in expressing my sincere thanks and profound gratitude to all the faculty of RICS SBE, Mumbai for their valuable guidance and continuous encouragement that gave me tremendous knowledge and support throughout the research work period.

I am very grateful to Mr. Arjun Amipara, Civil Engineer for providing his views and continuous support without which the work would be incomplete. I warmly acknowledge and express my special thanks for his efforts and invaluable contribution towards my research.

I am in debt to all those people who have directly or indirectly provided me support & guidance mentally to complete the research work successfully.

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