

## CHAPTER FIVE

### Conclusion, Recommendation & Further Research

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#### 5.1 Introduction

This chapter is summarized the principal findings and provides conclusions and recommendations. Three stages were used to describe chapter.

- Conclusion & Summarize of findings
- Recommendation
- Future research directions

#### 5.2. Conclusions

Disruption is referred to loss of productivity while carrying out work. This is quite difficult to proof that even its shadow is visible. The main difficulty is that identify the sole disruption event from others. There are many sources behind disruption occurrence, however, some of them are lower significance of causing disruptions. Some are severely affected on project productivity. To claim those disruption events, contractor has to proceed with disruption analysis claim methods, but those methods require certain limits of records to initiate and calculate the amount. However, availability of contemporary record is now questionable.

According to the literature review, sources of disruption were identified under six sub-heading; a) Schedule acceleration, b) Change in work, c) Management characteristics, d) Project characteristics, e) Labour and morale and f) Project location/External conditions. On contractor's perspective, some of them above can be claimable which are directly passed the responsibility upon Employer or Engineer. By questionnaire survey, it was deeply reviewed and checked the significance level of occurrence in sources of disruption. Overtime concurrent operation was the highest significance level in schedule acceleration out of other factors of overcrowding and stacking of trades.

Highest significance in change in work category was additional quantities of work and delays. Learning curve, changes and engineering errors/omissions were second significance factors when rework of already installed work at the bottom level.

Management of project in a way to keep momentum of productivity level is a challenging task. Success depends on controlling of disruption occurrence while having management. Four factors were identified in literature survey as sources for disruption occurrence such as material/tool availability, management control, project team and dilution of supervision. Significance level of those factors were examined through questionnaire survey. It was recorded that dilution of supervision was the highest significance level in disruption occurrence other than material/tool availability, management control and project team.

Productivity varies with the project character and some of them are severely affected on project success. This aspect was examined through questionnaire survey and it was observed that joint occupancy and fast track construction are major significance level on disruption occurrence which ultimately cause productivity losses. Site access is minimum level of significance when project size, work type, workforce size and site condition are medium level significance in disruption occurrence.

Labour component of project play a significant role to complete project in timely and quality. However, there are many aspects of labour can be intervened with project productivity. Significance level of disruption occurrence was examined through questionnaire survey and it was identified that highest significance level are Quality of craftsman quality assurance/quality control practice, and wages. The lowest significance level of disruption occurrence on labour component is rework and errors. In addition, absenteeism, craft turn over, fatigue, morale and incentives are comparative higher significance level rather than rework.

One of determination factor for project success is that effect of external factors to the project. Some of them are severely affected on project productivity such as weather

and economic activity in the area. Others; area population, commuting time and availability of skilled labour are comparatively lower effect on project productivity. Substantiate a claim is required evidences to proof the claim event. This may be a record that everyone can accept without any doubt. In literature, those records were identified, however, availability of those record at site is still questionable. Therefore, questionnaire survey was used to identify the what extent availability of those record at site. Under this survey, it was observed that the most availability record at site is payment certificates next to labour sheets, and daily report. Contrastingly, at lower availability records at site are correspondence, change order log, separate cost account for specific change orders, record of change conditions caused by the owner, and man power histograms. In addition, physical progress curves, and RFIs are also comparative lower availability at site.

Contractor suffer monetary losses from productivity loss due to various disruption causes. However, it is very difficult to compute and analyze of this loss from out of disruption events. As per details of disruption claim analysis method were described in literature survey, main reason is that most of disruption analysis method are required contemporary records to evaluate claim. Questionnaire survey was identified that maintenance of the most records at site are lower level which ultimately face huge difficulty in analysis of disruption claim. At this stage, usage of disruption analysis method in construction industry during last five years is questionable. Therefore, questionnaire survey was conducted in order to identified industry usage of those methods. According to the responses, most of the methods are at minimum level. Measured mile study, baseline productivity analysis and system dynamics modelling are the lowest usage. Total cost method is highest practice in the industry whereas earn value analysis, comparison studies, industry-based methods and modified cost method are medium usage. Total cost method is popular due to it is just presentation of actual cost and request a claim in whole and other method is required various documents to proceed the claim as submission elements.

In conclusion, there are many factors behind the productivity lose in construction industry and some of them are severely affected on project. Complex nature of

individual identified of each disruption event and its effect to the project productivity loss, it is very difficult task to prepare proper claims. Even though, if it is identified, there is not adequate records at site to substantiate the case. During last five years, industry failed to maintain records at certain level that it requires from claim proceedings. Furthermore, it is hard to submit a claim, yet there are many comprehensive disruptions claim analysis methods are available. Hence, detailed disruption analysis methods of measured mile study, baseline productivity analysis and system dynamics modelling are at significant lower level usage in the industry. However, simple method of total cost method is practiced widely in order to process disruption claims.

### 5.3. Recommendations

It is a fact that Contractor is not paid for productivity losses, even though faults upon the Engineer or Employer. Based on the research findings, I propose following recommendations as mitigation measures.

- Project manager should establish daily planning systems one day before construction at site and incorporate daily views of supervisors and engineers in to that when the site is at acceleration programme, otherwise occurrence of disruptions and mitigation actions are very hard to control.
- Scope monitoring with original scope, recording of instruction of Engineers and delay events should be undertake by contract division and pass the responsibility upon especially project manager, quantity surveyors. They should provide early warnings and keep record the relevant records as per situations.
- Establish a team base system for particular work. For instances, earth work team, base construction team, asphalt team. This team comprises with site engineer, technical officers, supervisors and labours. They will specialize on particular work while they are handling same work again and again. Afterward, they will circulate among projects. This will be benefitted to industry to

improve productivity level. Further, performance based assessment of their working and appreciation with monetary values are motivation factors to success this method.

- Establish an independent group with associate with site staff to grab the independent information to find out work norms. This will helpful to early identification of disruption events.
- Involvement of head office is essential to get their third comments and independent views. This will be great opportunity to find out early advices from their experiences.

#### 5.4. Further research

This research identified that the industry is not ready to maintain proper record keeping system within their project implementations. This gap is still questionable, therefore, following suggestions are made for carrying out another research to find out best ways to improve industry.

- Identify a suitable method for record tracking system to capture contemporary record in record version. This can be check list to fill by site officers to verify that they have maintain the record properly.
- Identify a suitable method to document maintenance system when claim arise and it can be easily referred at claim submission stage.



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## Appendices

### QUESTIONNAIRE SURVEY

#### ANALYSIS OF DISRUPTION CLAIM IN CONSTRUCTION INDUSTRY DURING LAST FIVE YEARS

Dear Sir/Madam,

I am sandun K.K., following M.Sc. in Construction Law and Dispute Resolution, in Department of Building Economics, University of Moratuwa. My research based on above topic is conducted under the supervision of Dr. Gayani Karunasena, Senior lecturer, Department of Building Economics, Faculty of Architecture, University of Moratuwa. The result of this survey would be essential for the successful completion of my dissertation.

Completion of the questionnaire would take approximately 15 minutes and all the questions can be answered with minimum effort. Further, I personally assure that all information obtained would be treated to the strictest confidential and only intended for the use of the analysis in this study. All the data will be considered on aggregated basis and no individual data will be published.



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I would be much obliged to you if you could kindly allocate some time to read this questionnaire and participate by being one of my respondents to help me in this research. Your contribution is highly appreciated.

Thank you.

Yours faithfully,

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...../...../2015

### General Information

1. Name of Respondent: .....
2. Position within organization: .....
3. Name of the organization: .....
4. Organization:

Civil Engineering Construction ☐

Building Construction ☐

5. Years of Experience in claim preparation:

0 - 5 years ☐

10 - 15 years ☐

5 - 10 years ☐

More than 15 years ☐

Please state the actual numbers of disruption occurrence during last five years						
No	Years	2011	2012	2013	2014	2015
1	How many disruption events were occurred during a year?					

“**Loss of productivity** is defined technically as “Disruption” while increasing cost of performance caused by a change in the contractor’s anticipated or planned working conditions, resources, or manner of performing its work”

Causes for disruption are sources for disruptions.

**Finding out the significant** of disruption events frequently occurrence of and its significant in construction industry during last five years.

		Please state the significant of each causes by ticking (√) in the applicable places from 0 to 5.																								
No.	Disruption sources	2011					2012					2013					2014					2015				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
		Not significant	Slightly significant	Significant	Very significant	Extremely	Not significant	Slightly significant	Significant	Very significant	Extremely	Not significant	Slightly significant	Significant	Very significant	Extremely	Not significant	Slightly significant	Significant	Very significant	Extremely	Not significant	Slightly significant	Significant	Very significant	Extremely
1	Schedule acceleration																									
1.1	Overcrowding																									
1.2	Stacking of trades																									
1.3	Over time Concurrent operation																									

Please state the significant of each causes by ticking (✓) in the applicable places from 0 to 5.																										
No.	Disruption sources	2011					2012					2013					2014					2015				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
		Not significant	Slightly significant	Significant	Very significant	Extremely	Not significant	Slightly significant	Significant	Very significant	Extremely	Not significant	Slightly significant	Significant	Very significant	Extremely	Not significant	Slightly significant	Significant	Very significant	Extremely	Not significant	Slightly significant	Significant	Very significant	Extremely
2	Change in work																									
2.1	Additional quantities of work																									
2.2	Learning curve																									
2.3	Changes																									
2.4	Delays																									
2.5	Engineering errors and omissions																									
2.6	Rework of already installed work changes to the plans and specifications																									
3	Management characteristics																									
3.1	Material and tool availability																									
3.2	Management control																									
3.3	Project team																									
3.4	Dilution of supervision																									
4	Project Characteristics																									
4.1	Project size																									
4.2	Work type																									
4.3	Workforce size																									
4.4	Joint occupancy																									
4.5	Fast track construction																									

Please state the significant of each causes by ticking (✓) in the applicable places from 0 to 5.																										
No.	Disruption sources	2011					2012					2013					2014					2015				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
		Not significant	Slightly significant	Significant	Very significant	Extremely	Not significant	Slightly significant	Significant	Very significant	Extremely	Not significant	Slightly significant	Significant	Very significant	Extremely	Not significant	Slightly significant	Significant	Very significant	Extremely	Not significant	Slightly significant	Significant	Very significant	Extremely
4.6	Site access																									
4.7	Site condition																									
5	<b>Labour and Morale</b>																									
5.1	Quality of craftsman																									
5.2	Quality assurance/Quality control practice																									
5.3	Rework and errors																									
5.4	Absenteeism																									
5.5	Craft turn over																									
5.6	Fatigue																									
5.7	Morale																									
5.8	Wages																									
5.9	Incentives																									
6	<b>Project Location /External conditions</b>																									
6.1	Weather																									
6.2	Area population																									
6.3	Commuting time																									
6.4	Availability of skilled labour																									
6.5	Economic activity in the area																									



**Finding out the significant maintenance of site documents which can provide as evidence of disruption claim or apply with disruption claim analysis calculations in construction industry during last five years.**

**Please state the significant of each causes by ticking (✓) in the applicable places from 0 to 5.**

No.	Maintenance of Site records	2011					2012					2013					2014					2015				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
		Not significant	Slightly significant	Significant	Very significant	Extremely	Not significant	Slightly significant	Significant	Very significant	Extremely	Not significant	Slightly significant	Significant	Very significant	Extremely	Not significant	Slightly significant	Significant	Very significant	Extremely	Not significant	Slightly significant	Significant	Very significant	Extremely
1	Labour time sheets																									
2	Man power histograms																									
3	Physical progress curves																									
4	Schedule updates																									
5	RFIs																									
6	Daily reports																									
7	Correspondence																									
8	Payment certificates																									
9	Change order log																									
10	Separate cost account for specific change orders																									
11	Record of change conditions caused by the owner (e.g. Overtime, Interference, Weather, Delay, Overcrowding, loss of learning etc.)																									



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Finding out the significant usage of disruption claim analysis methods in order to calculate disruption entitlement under disruption events in construction industry during last five years.

Please state the significant of each causes by ticking (✓) in the applicable places from 0 to 5.

No.	Usage of Disruption claim methods	2011					2012					2013					2014					2015				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
		Not significant	Slightly significant	Significant	Very significant	Extremely	Not significant	Slightly significant	Significant	Very significant	Extremely	Not significant	Slightly significant	Significant	Very significant	Extremely	Not significant	Slightly significant	Significant	Very significant	Extremely	Not significant	Slightly significant	Significant	Very significant	Extremely
1	Measured Mile Study																									
2	Baseline Productivity Analysis																									
3	System Dynamics Modeling																									
4	Earned Value Analysis																									
5	Comparison Studies																									
6	Industry-Based Methods																									
7	Total cost method																									
8	Modified cost method																									



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