STRATEGIES TO IMPROVE THE PRODUCTIVITY OF SITE LEVEL BUILDING CONTRACTORS IN SRI LANKA

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ABSTRACT

The construction industry is widely recognised as a laggard in terms of productivity improvement. Site level construction productivity is a major influential factor to reduce the overall productivity in the construction industry. The main reason behind this is the critical site level construction productivity problems faced by Sri Lankan contractors. Therefore, aim of the study is to identify the possible solutions to enhance the site level construction productivity of building contractors in Sri Lanka. Accordingly, a mixed approach was used for the research. Initially, an extensive literature review was carried out to identify the site level construction productivity influential factors which was followed by a preliminary survey to investigate the critical problems influencing the site level construction productivity of contractors in Sri Lanka. A questionnaire survey was carried out to identify the most critical site level problems faced by the building contractors in Sri Lanka. Finally, expert interviews were conducted to identify the possible solutions to enhance the site level construction productivity of building contractors. Findings revealed that the most critical site level problems include worker skills problems, worker motivation problems, unavailability of skilled labours, and material management problems on sites. Accordingly, introducing proper training programs, implementing incentive, rewards and appreciation schemes as per the workers' performance, training unskilled workers, educating site workers on proper usage of materials are the possible solutions for the identified four most critical problems.

Keywords: *Building Contractors; Construction Process; Construction Productivity.*

1. INTRODUCTION

Construction industry has become the world's largest and most challenging industry (Fulford and Standing, 2014). When considering the productivity of construction industry, contractors play a vital role through their direct involvement during the construction work and the contractors were identified as the most influential factor for the construction productivity in a country (Navaratna and Jayawardane, 2007). Further, contractors' productivity can directly influence to the overall economy due to the number of processes and activities involved in the building construction industry (Navaratna and Jayawardane, 2007). Therefore, giving considerable effort to improve the building contractors' site level construction productivity is an important phenomenon, however this has become challengeable due to the huge productivity gap at site level (Horner and Duff, 2001). There is lack of a research study to identify the possible solutions to improve site level construction productivity of building contractors in Sri Lanka. Accordingly, the aim of the study is to identify the possible solutions to enhance the site level construction productivity of building contractors in Sri Lanka. This was achieved through identifying significant site level construction problems faced by building contractors in Sri Lanka. Finally, reasons and solutions for each critical site level problem was identified.

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2. LITERATURE REVIEW

2.1. SIGNIFICANCE OF CONSTRUCTION PRODUCTIVITY TOWARDS NATION'S ECONOMY

Construction productivity can be defined as the usage of all resources for the production in an effective and efficient way (Dolage and Chan, 2014). Hughes and Thorpe (2014) identified the construction productivity as "the ratio of output to all or some of the resources". These resources basically include materials, labour, equipment, energy, space, information, finance, knowledge and time (Dolage and Chan, 2014). Hence, contractors can use all above resources in effective and efficient manner to increase the construction productivity. However, construction industry always tends to fluctuate with the general economy (Olomolaiye, *et al*., 1998). Hence, productivity of construction industry has become one of the most complicated and broadest aspects.

The construction productivity of a country largely impacts to the nation's economy (Naoum, 2016; Naoum and Hackman, 1996). Therefore, construction industry plays a key role through creating assets for the nation (De Silva *et al*., 2014). Ma, *et al*., (2016) stated that the construction industry always makes an indispensable contribution towards the prosperity of the economy. A greater proportion of Sri Lankan construction industry is also covered by the building construction sector (IMaCS and ICRA Lanka, 2011), hence contractors are often engaged in building construction activities. Site level construction productivity is significant for contractors due to the large involvement of resources at site level. Therefore, Sri Lankan building contractors can earn more profit through increasing their site level construction productivity.

2.2. SIGNIFICANT FACTORS AFFECTING THE CONSTRUCTION PRODUCTIVITY

Productivity is a complex issue due to the influence of numerous factors including labour, material, capital and equipment (Liberda *et al*., 2003). Further, most of the researchers attempted to identify the critical factors affecting the construction productivity in different countries (Lim and Alum, 1995). Accordingly, the following 60 factors were identified as the significant factors impact to the construction productivity.

Table 1: Factors Affecting the Construction Productivity

Factors Affecting the Construction Productivity	1	2	3	4	5	6	7	8	9
Poor site layout	x	x							
Incompetent supervision of subordinators			x	x					
Rework		x	x						
Supremacy of owner/consultant	x								
Incomplete drawing, specification etc.		x							
Material management on site				x	x				
Non-availability of information			x	x					
Worker skills			x						
Design changes			x						
Insufficient knowledge of new technology						x			
Lack of proper incentives to reward good performance							x		
Interruption of site programs						x			
Poor selection of project personnel						x			
Scarcity of material	x	x							
Subcontractor inefficiency	x								
Shortage of multi skilled project personnel						x			
Scarcity of tools and equipment	x	x							
Absenteeism	x	x							
Delay in running bill payment	x								
Lack of contract administration skills						x			

Lack of appraisal for promotion					x				
Lack of experience and training					x				
Low quality material used	x								
Management of tools, equipment and labour				x					
Poor knowledge of scientific techniques					x				
Worker turnover	x							x	
Financial-failure of owner	x								
Scope changes	x			x					
Ineffective delegation of responsibilities					x				
Uncertainties about career prospects within organization					x				
Lack of consultation for decision making					x				
Inspection delay	x	x							
Lack of proper planning and scheduling			x			x			
Difference in construction technique	x								
Slow responses to settle employees' grievances					x				
Unavailability of skilled labours	x								
Adverse weather conditions			x	x					
Worker motivation			x		x				
Lack of shared beliefs between headquarters and site office					x				
Design errors				x			x		
Discrepancies with technical information					x				
Tools/equipment breakdown					x				
Exclusion of site management from contract meetings					x				
Congested work areas			x	x					
Excessive quantity variation	x								
Unbalanced risk	x								
Lack of integration of the management information system					x				
Lack of opportunities to exercise skill/ knowledge					x				
Accidents	x							x	
Work overload	x								
Resentment about management policies					x				
Worker interference							x		x
Working overtime									x
Changing crew members									x
Changing foreman									x
Overcrowding						x			x
Public interruptions	x								
Issue of security	x			x					
Omissions									
Labour strike	x								

[1] (Hughes and Thorpe, 2014)
[2] (Makulsawatudom and Emsley, 2003)
[3] (Hewage and Ruwanpura, 2006)
[4] (Jergeas, 2010)
[5] (Naoum, 2016)
[6] (Naoum and Hackman, 1996)
[7] (Horner and Duff, 2001)
[8] (Lim and Alum, 1995)
[9] (Holt *et al*., 1998)

2.3. IMPORTANCE OF CONSTRUCTION PRODUCTIVITY IMPROVEMENT

Researchers and practitioners found several means to improve the various aspects of construction productivity in the global context (Jergeas, 2010). Number of researches had been conducted on improvement of construction productivity in world-wide as the productivity growth is highly significant to strengthen the market relationships (Myronenko, 2012). As per the analysis of Horner and Duff (2001) during the period of 1976 to 2001, there was a huge room for productivity improvement in the construction industry. Accordingly, many researchers had made efforts to improve the construction productivity (Oglesby *et al*., 1989). Jergeas (2010) identified that improvement in construction productivity needs to be achieved through efficiency, effectivity, increased innovation and technology diffusion. However, this is impossible due to the huge productivity gap at site level (Horner and Duff, 2001). Therefore, identifying possible solutions is significant to improve site level construction productivity of Sri Lankan building contractors to fill the construction productivity gap.

3. RESEARCH METHODOLOGY

Mixed approach was used for this study due to the utilisation of qualitative and quantitative approaches. Initially, an extensive literature review was carried out to identify the site level construction productivity influential factors. Thereafter, a preliminary survey through semi-structured interviews were conducted with the construction industry experts due to the unavailability of secondary information to identify the important factors which have high impact over the site level construction productivity of building contractors in Sri Lanka. Convenience sampling under non-probability sampling technique was used to select sample of respondents. Accordingly, preliminary survey was used to investigate the critical problems influencing the site level construction productivity of contractors in Sri Lanka. This preliminary survey was carried out among 5 experts in the construction industry. Further, Relative Important Index (RII) and content analysis techniques were used for data analysis of preliminary survey.

Table 2: Profile of Preliminary Survey Experts

Respondent	Area of Expertise	Experience
R1	Director, Chartered Quantity Surveyor	45 years
R2	General Manager, Chartered Engineer	24 years
R3	Director, Chartered Quantity Surveyor	25 years
R4	Project Engineer, Senior Quantity Surveyor	26 years
R5	Director, Chartered Quantity Surveyor, Project Manager, Arbitrator, Claims Manager	35 years

A questionnaire survey was carried out to identify the most critical site level problems faced by the building contractors in Sri Lanka. These questionnaires were circulated among a sample of 92 site professionals including the Project Managers, Quantity Surveyors and Civil Engineers, as representatives of the whole population of the building contractors in Sri Lanka from grade CS2 to C3. Accordingly, 49 responses were received and among those respondents 78% were Quantity Surveyors, 16% were Civil Engineers and the rest of 6% were Project Managers. RII technique was used for the data analysis of the questionnaire survey.

Finally, expert interviews were conducted to identify the possible solutions to enhance the site level construction productivity of building contractors. These interviews were conducted among 10 experts who have vast knowledge on site level construction productivity.

Table 3: Profile of Final Expert Interview Survey

Expert	Expertise area	Experience
A	Project Manager	13 years
B	Senior Quantity Surveyor	10 years
C	Director/ Chartered Quantity Surveyor	40 years
D	Assistant General Manager- Estimation and Contracts leading contracting organization	10 years

Expert	Expertise area	Experience
E	Head of the Construction Department	15 years
F	Director of Quantity Surveying in a consultancy firm	10 years
G	Chief Quantity Surveyor in a contracting firm	30 years
H	Chief Executive Officer in a leading contracting organization	10 years
I	Chartered Quantity Surveyor	40 years
J	Chartered Civil Engineer	15 years

The interview was principally focused on the major problems highlighted through the questionnaire survey findings. The aim of the final expert survey was to investigate the reasons for the major problems and possible productivity improvement methods to mitigate those problems from the building contractors. Code based content analysis technique was used to analyse gathered data which facilitated in identifying the critical reasons and solutions for major site level problems faced by the building contractors in Sri Lanka.

4. RESEARCH FINDINGS AND DISCUSSION

4.1. SIGNIFICANCE OF SITE LEVEL CONSTRUCTION PRODUCTIVITY FOR CONTRACTORS

Preliminary survey findings revealed that site level construction productivity has 65% of profitability contribution for contractors and head office level has only 30% of profitability contribution for the contractors. Balanced 5% is covered through the external factors. Site level construction productivity is therefore more important for Sri Lankan contractors. Further, research findings revealed that efficient use of resources, increased profitability, improvement in operations and enhanced image of the company were the five main reasons behind the importance of site level construction productivity for contractors.

4.2. FACTORS INFLUENCING THE SITE LEVEL CONSTRUCTION PRODUCTIVITY OF CONTRACTORS

According to the preliminary survey findings, there are 26 significant factors out of 60 factors which have high impact over the contractors' site level construction productivity in Sri Lanka. Worker motivation is identified as the most influential factor in the site level construction productivity of contractors. However, there are 7 most significant factors identified through the preliminary survey. All those seven factors obtained greater than 0.90 RII value. It provides a clear indication about the significance of the identified five factors and shows the high level of severity over the site level construction productivity.

Table 4: Findings of Preliminary Survey

No	Factor	RII	No	Factor	RII
1	Worker motivation	1.0000	**14**	Scarcity of material	0.8800
2	Worker skills	0.9600	**15**	Subcontractor inefficiency	0.8800
3	Lack of proper planning and scheduling	0.9600	**16**	Shortage of multi skilled project personnel	0.8800
4	Unavailability of skilled labours	0.9600	**17**	Scarcity of tools and equipment	0.8400
5	Incomplete drawings, specification etc.	0.9200	**18**	Absenteeism	0.8400
6	Material management on site	0.9200	**19**	Delay in running bill payment	0.8400
7	Non-availability of information	0.9200	**20**	Lack of contract administration skills	0.8400
8	Incompetent supervisors of subordinators	0.8800	**21**	Lack of appraisal for promotion	0.8000
9	Design and changes	0.8800	**22**	Lack of experience and training	0.8000
10	Insufficient knowledge of new technology	0.8800	**23**	Low quality material used	0.8000
11	Lack of proper incentives to reward good performance	0.8800	**24**	Management of tools, equipment and labour	0.8000
12	Interruption of site programs	0.8800	**25**	Poor knowledge on scientific techniques	0.8000
13	Poor selection of project personnel	0.8800	**26**	Worker turnover	0.8000

4.3. METHODS TO IMPROVE SITE LEVEL CONSTRUCTION PRODUCTIVITY OF BUILDING CONTRACTORS

There were 4 main problems identified through the questionnaire findings as workers' skills problems, worker motivation problems, unavailability of skilled labourers, and material management problems. Accordingly, workers' skills problem has become the most influential problem at the site level for the building contractors in Sri Lanka. Therefore, as per the questionnaire survey findings following 4 factors can be considered as the significant productivity problems at site level according to its criticality.

Table 5: Findings of Questionnaire Survey

No	Factor	Very often	Often	Moderately	Rarely	Never	RII	Rank
1	Worker skills	29	15	5	0	0	0.898	1
2	Worker motivation	17	22	10	0	0	0.829	2
3	Unavailability of skilled labours	20	18	9	1	1	0.824	3
4	Material management on site	11	26	10	2	0	0.788	4

Significant reasons for those critical problems and solutions to mitigate those problems by enhancing the site level construction productivity are discussed in below.

4.3.1 IMPROVING WORKERS' SKILLS

As stated by 8 experts, introducing proper training programs is the main solution for workers' skills problem. Further, experts noted that providing proper training for employees under supervisory level and levels above that is possible due to the availability of suitable institutes to train those people. However, it is difficult to find institutes with training programs for bottom level site workers. Therefore, it is vital to introduce proper training programs for labourers around the country to overcome this problem. Experts C, E and H mentioned that they face with challenging circumstances due to the workers without required skills to carry out the site work. Site workers practice to work by following others, whereas that person may also not a skilful person. Accordingly, unavailability of skilled labour can be minimised through these strategies.

- Implement proper training programmes

As per the findings, Sri Lankan government had implemented "Silpa Saviya" programme focusing the people of "Uda Gammana" project areas which is targeted for 15000 trainees with the aim of recruiting them to the construction industry within 1 year period. However, there are only 9500 trainees. Most of bottom level people are unable to bear expenses during the training period. Thereby, this "Silpa Saviya" program pays stipend of Rs. 10000 per month and give Rs. 5000 worth tool box for trainees. However, this program is still not successful due to the lower level of assistance from the contractors. Therefore, the contractors' assistance is essential for the existence and improvement of this programme.

- Employ workers longer period with the company

Experts B, E, and G noted that the second solution to the workers' skill problem is sustaining the workers longer period with the company. There is a responsibility for the top management to treat workers well and keep them with the company by creating a good attitude in employees' mind towards the organisation where workers will gain experience and skills that they required to carry out their job tasks. Expert G stated that if employees work in a same organisation for a longer period will assist them to adapt to the culture of the organisation and then they become loyal to the organisation.

4.3.2 IMPROVING WORKERS' MOTIVATION

Improving workers' motivation is significant for optimising the site level construction productivity. According to the questionnaire survey findings worker motivation problem is the second highest site level construction productivity problem which must be overcome by the Sri Lankan building contractors.

- Pay rewards, incentive and appraise the performance of workers

Findings asserted the noteworthiness of having a proper rewarding system at site level. If contractors can identify the highly-performed team of workers per month or twice a week, workers motivate to provide their fullest effort in carrying out the job tasks. Further, implementing an incentive scheme is also effective in enhancing the worker motivation. Hence, workers try to earn more by enhancing their performance to fulfil their day-to-day requirements.

- Provide facilities for site workers

Findings proved that top level management does not much care about the labourers' necessities including food, accommodation, transportation which will result in decreasing the productivity. Therefore, providing required facilities for workers is significant towards the achievement of higher productivity level.

4.3.3 ENHANCING AVAILABILITY OF SKILLED WORKERS

Unavailability of skilled workers was ranked as third highest existing problem at site level construction productivity of contractors in Sri Lanka. The main reason behind this would be the people's trend towards earning money through easy modes. Further, experts mentioned construction industry as a "3D" industry which means "Dirty", "Dangerous" and "Difficult industry". Therefore, construction industry is not attractive compared to the other working environments and not an ease method of earning money. The bottom level construction site jobs involved with hard working and highly hazardous environment. Therefore, nowadays people do not interest in doing construction site jobs.

- Increase the age limit to get licence for three-wheeler and taxi driving

Nowadays young people tends to buy three-wheelers and easily become three-wheeler drivers. CCI, NHDA, NCASL, and CIDA effort to increase the age limit up to 35 years to get three-wheeler driving licence. According to the experts, age limit of 25 years is also good if the policy can be implemented. Then young people will try to learn something till 25 years old without driving three-wheelers or taxis at very young age which will support to eliminate the unavailability of skilled workers issue up to a certain extent.

- Implement Indo-Sri Lanka Economic and Technology Cooperation Framework Agreement (ETCA)

Experts C and J stated that "ETCA agreement" is one of the best methods to eliminate the problem of unavailability of skilled labour. According to the agreement, free labour movement can be done between India and Sri Lanka. Further, experts stated that productivity is very high when considering the Indian labourers compared to the Sri Lankan labourers. However, some people are afraid to implement this "ETCA agreement" due to the concern of arising cultural problems. According to the opinion of experts, recruiting the foreign labourers to work in construction industry and send them back to their motherland after completion of the project is a good solution if Sri Lankan people does not willing to engage in the construction industry.

- Commence Construction Service Force (CSF)

Initial requirement of CSF is to train 25,000 workers and keep them as a force. Then, those skilled workers can be used to fulfil the requirement of skilled labourers at construction sites. However, the government has a rule stating that not to start new units. Government always try to reduce public sector and try to expand the private sector. It is compulsory to produce skilled labourers to work with new technologies. According to the opinion of experts, traditional skills are not supported to work in current construction industry. Therefore, experts stated that though the government has certain rules, doing something to produce skilled labourers is a timely requirement of the country.

- Conduct "RPL" (Recognition through Prior Learning)

According to the findings, the government had implemented RPL program for identified people who has some knowledge about the industry. Hence this programme initially, trains those selected group of people and issues them with a certificate after a proper evaluation. The second stage involves with this is NVQ (National Vocational Qualification) Level 3. RPL passed person has to pay Rs. 5000 or 6000 to carry out NVQ Level 3 which is one of the best ways to qualify the workers with the required skills. However, this is unsuccessful because most of the people do not have sufficient money to get NVQ Level 3. Therefore, it was identified that bottom level people are unable to get a proper training without a payment. Therefore, all the experts stated the

importance of government involvement to provide aids to the people who are interested in getting qualifications such as NVQ level 3, which will be an effective strategy to mitigate the problem of unavailability of skilled workers.

4.3.4 CONDUCTING PROPER MATERIAL MANAGEMENT PRACTICES AT SITES

Material management is compulsory due to the availability of the limited resources. Findings revealed that unawareness of ground level people about the wastage and proper way of handling the materials as the main reason behind this problem.

- Educate site workers about the proper usage of material

Nine experts stated that providing the awareness for site workers on effective and efficient usage of material is a responsibility of the management. Normally, site level workers do not have good educational background. Therefore, they do not have proper knowledge on how to use material in an efficient and effective way for their work. Accordingly, educating them is compulsory to enhance the site level construction productivity.

- Conduct workshop or training programmes for site workers

Conduct workshop or training sessions for site workers about the efficient and effective usage of material is identified as the second solution for the material management problem. Findings asserted that site workers are less knowledgeable about procuring material for sites. Supplying material at required time from required quantity and quality is a timely requirement for sites. If site staff is talented, then they can lead labourers and manage material well without any wastage.

- Material reconciliation can be implemented in sites

According to the findings, material reconciliation is a good monitoring system to be implemented. Monitoring materials assists to identify the wastage and misuse of materials. Contractors should give consideration about unwanted usage of material at sites. Experts mentioned that workers at the sites tend misuse materials and if site workers know that material monitoring system is implemented, then they are afraid to misconduct. Accordingly, material reconciliation is compulsory to enhance the productivity.

5. CONCLUSIONS

This research focused on site level construction productivity of building contractors in Sri Lanka. Research findings acknowledged the importance of site level construction productivity for building contractors. Findings proved that there are most critical site level problems faced by building contractors in Sri Lanka, thus it necessitates the implementation of possible solutions to improve site level construction productivity. An expert survey was carried out to the experts in the field of construction industry to identify the capabilities of the government when implementing the solutions for the identified existing critical problems.

Findings asserted that the government can introduce proper training programs to increase the level of productivity. Training programmes for unskilled labourers can also be implemented with the assistance of building contractors. Further, implementing incentive, rewards and appreciation schemes according to the performance of the labourers, educating site workers on proper usage of materials, can be implemented by the building contractors. However, the findings revealed that it is difficult to implement rewarding system by the government due to the high cost involved and the changes in the political environment. Therefore, the building contractors should motivate workers by conducting effective appreciation scheme, rewarding and incentive system to get maximum output from the workers. Further, it is important for the building contractors to concerning about workers' basic facilities as it has high impact over the site level construction productivity. Moreover, implementing "ETCA" agreement will be useful to fulfil the skilful workers' requirement in the building construction industry in Sri Lanka. However, proper material management practices can be implemented effectively through using proper system to educate site people, and proper material monitoring and procurement system. Further, effective supervision of material usage and material storing systems are important in improving the site level construction productivity of building contractors.

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