

THE SIGNIFICANCE OF LABOUR FACTOR IN INTEGRATING SUSTAINABILITY CONCEPT INTO CONSTRUCTION INDUSTRY PRACTICE

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ABSTRACT

Sustainable Development (SD) has become a major consideration due to low responsiveness of industries to the natural environment and related social problems. The construction industry is a main natural resource consumer and a major contributor to country's economy. Hence, the sustainable performance of construction industry is essential to achieve SD goals. The construction industry is a labour incentive industry and therefore, the way construction works are planned, scheduled and controlled depends directly on the labours performance. This research is aimed to evaluate the influence of labour factor in integrating sustainability concept into construction industry practice. The literature review identified the mostly used Sustainable Construction (SC) principles and revealed that Most of identified SC practices were influenced by the labour performance. This research is conducted with a quantitative approach using a questionnaire survey in two phases. Phase I was conducted with construction industry professionals, the sample size was 75, and Phase II was conducted with 50 construction labours. Findings revealed, labour having a significant role in implementing SC successfully. Lack of awareness was identified as the main reason for a negative impact from labour in SC. When integrating sustainable concepts into construction, labour management strategies should be also focused apart from the sustainable building materials and technologies to provide the best outcome for the client or society.

Keywords: Construction Industry, Environmental Sustainable Construction, Economic Sustainable Construction, Labour Performance, Social Sustainable Construction.

1. INTRODUCTION

More attention towards the environmental pollution, natural resource depletion and accompanying social problems has raised the significance of implementing and improving Sustainable Development (SD) and Sustainable Construction (SC) throughout the world (Chen et al., 2010). Most of the professionals agreed that sustainability highlights the need to simultaneously balance social, environmental and economic goals (Aarseth et al., 2017). Sustainable performance of Construction is essential in SD because, construction industry is a major resource consumer (Shen et al., 2007), applies a higher demand pressure on world natural resources goals (Djokoto et al., 2014) and responsible for the negative effects towards environment (Marques, et al., 2016). SC can be defined as “the creation and responsible management of a healthy built environment based on the prudent use of resources and ecological principles” (Kibert, 1994). Using SC methodologies, significant improvements can be achieved in terms of use of resources, harmful emissions, life-cycle costs and productivity, and building performance (Hakkinen & Belloni, 2011). Yet, due to construction methods practiced and building material used, it is very difficult to make changes in the construction industry (Adjarko et al., 2016). Mainly, resistances occurred due to the requirement of process change, involving the perception of possible risks and unforeseen costs (Häkkinen & Belloni, 2011).

Even though various technologies and methods were implemented authors have identified the importance of labour in the construction industry. As construction industry is a labour intensive industry, when integrating sustainable concepts into construction, labour management strategies should be also focused apart from the sustainable building materials and technologies (Mohd-Rahim et al., 2016). Labour can be defined as all

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workforces involve in the process that had to carry out to accomplish and to achieve the goal (Karim et al., 2013). Mostly and, especially in developing countries, construction labour factor is not considered as significant, even largest proportion of total project cost is labour cost (Kazaz et al., 2008). Further to the authors, usually site labours represent up to 40 % of the direct cost in large construction projects. The way construction works are planned, scheduled and controlled depends directly on the performance of labours (Mohd-Rahim et al., 2016). Further, Shen et al. (2007) have identified labour cost as a factor related to economical sustainability in the construction stage of a project.

As construction work planning, scheduling and controlling is depend on the labour, design stage and construction stage is affected by the labour. Sustainability implementation of a construction project is done in the design stage and construction stage. As these stages are influenced by labour, sustainability integration in design and construction is also influenced by labour performance. However, there are no researches carried out to identify the importance of labour in SC. Thus, this research is aimed to investigate the influence of labour factor in integrating sustainability concept into construction industry practice.

Accordingly, this paper first presents the findings of the literature review in relation to SC and construction labour involvement in SC. Next, the research method followed by discussions on the relationship between labour factor and SC through the findings are presented. The final section summarises the conclusions derived from the research findings and present recommendations. Influence of labour towards the majority of SC practices was confirmed and lack of awareness was identified as the major reason for low involvement of labour in SC practices. Importance of considering and improving labour performance to SC was recommended through this research.

2. LITERATURE REVIEW

The literature review identified the basics of SC, current application, aspects of SC and importance of labour factor to SC.

2.1. SUSTAINABILITY CONCEPT AND CONSTRUCTION INDUSTRY

While achieving today's social requirements, it is essential to provide favourable environmental conditions to future generations through considering activities of today (Beiriz & Haddad, 2011). According to Voinov (as cited in Aarseth et al., 2017) definitions of sustainability, consider the relationship between human and resources used by the human. Brundtland Report (as cited in Pitt, et al., 2009) defined SD as "meeting the needs of the present without compromising the ability of the future generations to meet their own needs".

Researchers have identified the importance of major three areas in sustainability. The proper interrelationships among society, the environment, and economy are essential to the sustainability (Hutchins & Sutherland, 2008). Among many definitions of sustainability, the need to simultaneously balance social, environmental and economic goals is highlighted by the most of experts in the field (Aarseth et al., 2017). Further, Hutchins and Sutherland (2008) have identified sustainability as the "interdependence of ecological, social, and economic systems", which is known as three pillars of sustainability. According to Construction Industry Research Information Association (CIRIA) (as cited in Pitt et al., 2009), achieving the right balance between these factors supports true sustainability. Therefore, the key areas of sustainability can be identified as environment, economy and social. Yolmaz and Bakou (2015) have identified the area to be covered in these three pillars of sustainability. According to authors, environmental sustainability is about passing the available resources to future. In doing so, considerations on ecological balance and unrenowable resources are essential. Further to the authors, production and consumption balance is controlled under economic sustainability and social sustainability is focused on the rights and freedom of the human.

Today's world, it has become a major necessity to achieve sustainable goals in all sectors of society (Zhang et al., 2011). Because of the significant and direct influence on the environment, economy, and society, the construction industry has become a main sector under SD (Farzanehrafat et al., 2015). The construction industry is considered as the one of the major consumer of non-renewable resources, an extensive source of waste (Wallbaum & Buerkin, 2003) and has a considerable social and economic effect with its ability to provide employment opportunities (Marques et al., 2016).

SC has been defined by many researchers with relation to the SD. SC is an approach to attain SD goals of the construction industry while considering environmental, socioeconomic and cultural issues (Shafii et al., 2006). The aim of SC is to minimise the negative influence to the natural environment (Airaksinen & Matilainen, 2011) and support to save the resources and protect the environment (Zhang et al., 2011). SC effectively involve in social cohesion and job creation, promotion of cultural tourism and regional economic development (Shafii et al., 2006).

2.2. INTEGRATING SUSTAINABILITY INTO CONSTRUCTION INDUSTRY

Sustainability practices can be achieved through combining sustainability in project using varies technical solutions, systems and regular practices (Aarseth et al., 2017). Finding environmentally and economically sound design and development techniques for buildings and infrastructure is important to constructions to be sustainable (Shafii et al., 2006). To achieve SC goals properly, various construction activities should be considered and analysed (Ensassi & Mayer, 2005). When implementing SC also, three pillars of sustainability are included. Table 1 shows the critical practices, which should be executed to achieve SC performances.

Table 1: Aspects Covered in Three Pillars of SC

Environmental SC	Economic SC	Social SC
Minimisation of resources consumption [1]	Value for money [8]	Safety and welfare of workers [5]
Reduction of waste [1][2][3][4]	Maximum output with minimum input [8]	Labour relations [5]
Maximisation of resources reuse [1]	Financial affordability [10]	Conflict management among stakeholders [6]
Use of renewable and recycled resources [1][4]	Employment creation [10]	Minimising neighbourhood disturbance [6]
Pollution prevention [1]	Improve competitiveness [10]	Health and safety in construction [5] [7]
Avoidance of environmental health problems [1]		Using local resources [6]
Improvement of indoor air quality [1]		Job satisfaction achievement [6]
Protecting your building materials [3]		Education and training /apprenticeships opportunities [7]
Sorting and disposal of waste [3]		
Planning your building supplies [3]		
Managing inefficient water use [4]		
Avoiding air pollution [4]		
Energy use [2][4]		

Sources: [1] Adjarko et al. (2016), [2] Shafii et al. (2006), [3] Building Research Establishment (2008), [4] Ensassi & Mayer (2005), [5] Talukhaba et al. (2005), [6] Farzanehrafat et al. (2015), [7] Akotia (2014), [8] Zhou and Lowe (2003), [9] Hill and Powen (as cited in Enshassi et al., 2016).

There are different aspects needs to be covered in SC. Further, the involvement of all participants in the construction projects is essential to make the SC implementation success.

2.3. INFLUENCE OF LABOUR IN INTEGRATING SUSTAINABILITY INTO CONSTRUCTION PRACTICE

As construction industry is a labour intensive industry, the performance of the people in the industry has a massive influence on the performance of the construction firms (Lill, 2008). Therefore, labour is a key factor to complete construction projects in a more successful manner (Mohd-Rahim, et al., 2016).

Hence, SC should not be only focused on the sustainable building technologies and construction material, but also labour management strategies (Lill, 2008). A sustainable design only can be implemented, if the workers engaging in the construction are properly aware of the sustainable practices and the awareness on sustainability can be given through the training for workers (Kakkar, 2014). According to Mohd-Rahim et al., (2016), even labour shortage has become a crucial risk for achieving sustainability in construction projects. Shen et al.,

(2007) have identified the factors affecting sustainability throughout the project life cycle and labour cost and employment are identified as a significant factor in project construction stage.

Similarly, when implementing SC, labour factor is with a high gravity, which should be carefully considered. Hence, in here the influence of labour factor to SC is described under three pillars of sustainability.

When considering the environmental SC, minimisation resource consumption, waste reduction, water efficiency were mainly identified as practices that affected by labour factor. Kibert (1994) has identified minimisation of resource consumption as the main requirement of SC. Workers' knowledge of the efficiency of handling natural resources is essential for the success of building sustainable buildings (Kakkar, 2014). Preventing and reducing the generation of waste are the most effective way of decreasing the environmental impact of construction waste (Esin & Cosgun, 2007). Teo et al. (as cited in Begum et al., 2009) mentioned there is a significant impact on waste levels from the behaviour of labour in construction because construction is a labour intensive industry. Further, according to Lingard et al., 2001 (as cited in Begum, et al., 2009) motivational influences on the behaviour of construction workers have an important influence on the extent that waste can be reduced.

When considering about the economic SC cost efficiency, construction cost, construction period (Attar et al., 2012), life cycle cost of construction and employment creation (Hill & Bowen, 1997) were identified as aspects that affected by labour. Cost efficiency is about minimising the project cost, life-cycle cost of construction and providing consumer's requirements at a satisfactory level (Akadiri et al., 2012). According to Akadiri, et al. (2012), when sustainability is applied to construction practice, efficiency is promoted and the cost will be reduced through ensuring availability of skills required and labour supply. Poor productivity of construction workers is one of the causes of cost and time overruns in construction projects (Attar et al., 2012). As per Yusof and Misnan, (cited in Mohd-Rahim, et al., 2016), the construction industry is influenced by the availability of skilled and productive labours as the construction industry is a labour intensive industry. Employment creation is a major point for labour-intensive construction industry (Hill & Bowen, 1997).

Importance of labour in social SC was identified under safety, health, and welfare of workers, labour relations and providing training. Nwokoro and Onukwube (as cited in Akotia, 2014) have mentioned that in promoting good health, satisfactory safety practices and certifying the right working environment, which is as well essential in attaining successful social sustainability. According to Attar et al. (2012), labour performances are mostly affected by the health and safety factors. Health and Safety in construction important to SC (Shaffi et al., 2006). Labour performances are affected by the quality of site management and supervision (Kazaz & Acikara, 2015). Further, Ghate and Minde (2016) have also mentioned labour supervision as a top factor affecting labour productivity. In order to that, according to Delmas and Pekovic (2012), interpersonal contact in a construction site is affecting to the job satisfaction and motivation and it will result in productivity increases. Further, to that, Ghate and Minde (2016) have identified training as another significant factor affecting the labour productivity.

When considering the available literature, a significant relationship between labour and SC could be identified. However, at the moment in SC implementation labour has not been identified as an important factor. Therefore, when rethinking design, constructions, and operations with a sustainable perspective, labour factor is also needed to be considered.

3. RESEARCH METHODOLOGY

According to Kerlinger (as cited in Kumar, 2011) research design is the plan, structure, and strategy that would be used to find the answers to research questions or problems. The research was done with the quantitative approach. The quantitative approach is used in evaluating relationships between two facts compared to the available theories or the findings of any previous research (Creswell, 1994; Fellows & Liu, 2015). As this research is about identifying the relationship between labours and SC, a quantitative approach was used for the in conducting the research.

The design of this research includes; a literature survey, a questionnaire survey in two (02) phases, data analysis and providing recommendations. Data collection was done using questionnaire survey in two (02) phases with construction industry professionals and construction labours. The questionnaires were prepared based on identified factors through the literature synthesis. A sample of the first phase of data collection consists of 75 various professionals in the industry who are involved in labour manging at construction projects with 55%

response rate. Second phase sample is 50 labours and it has 100% response rate due to manual data collection. Data from both phases were analysed using statistical methods. Details of two samples were indicated in Figures 1 and 2.

“Percentage sum of the factor” was the used statistical methods for analysis. MS Excel software application is used for the data analysis. “Percentage sum of a factor” was calculated according to Eq. (01) and Eq. (02). Eq. (01) was used for the construction industry professionals’ questionnaire analysis and Eq. (02) was used for the construction labour questionnaire analysis. In calculation was used to analyse the perception of respondents regarding the considered factors. As perception cannot be quantified, total agreeing percentage and disagreeing percentage were calculated without giving weightage to variables. Then, factors were ordered according to the percentage agreed to the argument.

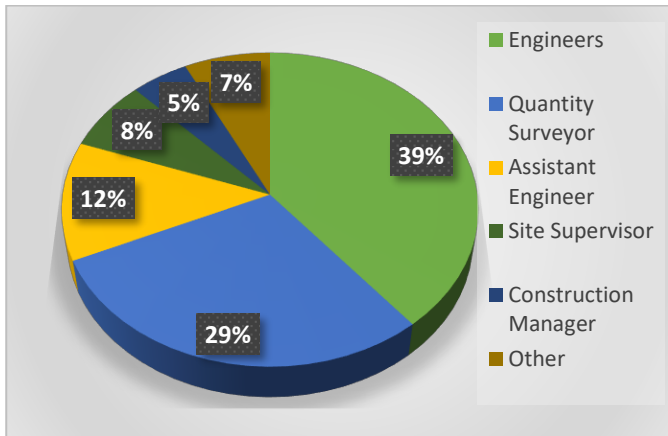


Figure 1: Sample of Phase 02

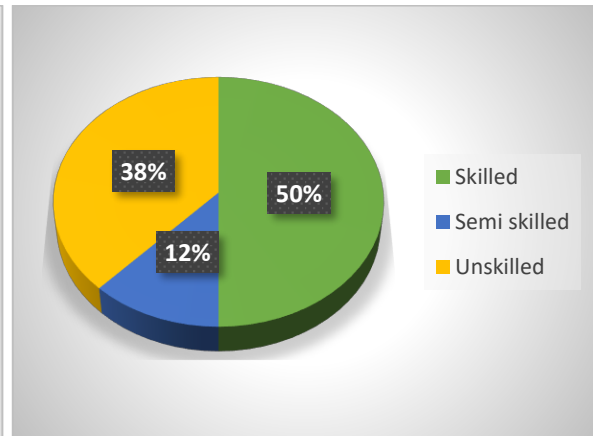


Figure 2: Sample of Phase 01

The equations used in the calculations are as below.

$$\text{Percentage sum of factor (Phase 01)} = R_1 + R_2 - R_3 - R_4 - R_5 \quad \text{Eq. (01)}$$

Where,

- R_1 = Responses percentage for “Very Often”
- R_2 = Responses percentage for “Often”
- R_3 = Responses percentage for “Rarely”
- R_4 = Responses percentage for “Very rarely”
- R_5 = Responses percentage for “Never”

$$\text{Percentage sum of factor (Phase 02)} = P_1 + P_2 - P_3 \quad \text{Eq. (02)}$$

Where,

- P_1 = Responses percentage for “Yes”
- P_2 = Responses percentage for “Somewhat”
- P_3 = Responses percentage for “No”

Through the analysis, most important labour related factors influencing the SC were identified and recommendations were provided to improve the SC aspects.

4. RESEARCH FINDINGS AND DISCUSSIONS

Under the professional survey, findings reveal the current application of SC as very low and the application is also not up to satisfactory level. Lack of government regulations to promote SC and lack of government support have negatively affected on SC implementation. Most of the professionals in the construction industry are knowledgeable about the SC. Therefore, there should be a negative contribution from other stakeholders in the industry hindering SC implementation. Hence, industry professionals should use their knowledge to implement SC and other stakeholders in the construction industry should actively involve in these activities.

Findings regarding labour influence on SC can be discussed in three sections as; environmental SC practices, social SC practices, and economic SC practices. Table 2 includes the results of Phase I of the research. Identified SC practices have been ranked according to the agreed percentage to the argument in Table 2. Results of Phase II of research are summarised in Table 3. It shows the ranking of identified SC practices according to the labours' responses. There are some differences could be identified between results of Phase I and Phase II.

When considering the environmental SC practices under professional survey, labours' lack of awareness regarding environmental impact of construction, labours do not sort out the waste when disposing, high energy wastage due to labour activities, labours' less involvement in reducing energy consumption, labours' less involvement in minimising resource consumption, labours' less involvement in minimising waste generation at construction site are identified as top factors that affecting SC. Poor handling of the material, lack of construction knowledge unproductive and idle labour were identified as main three causes of waste generation.

Table 2: Summary of Percentage Sum of Factors under Phase I

Summary of Percentage Sum of Factors under phase 01- Professional survey		
SC Practice	Percentage sum of factor	Rank
Labour related environmental practices of SC		
Labours are not aware about environment impact of construction	90.25%	1
Labours do not sort out the waste when disposing	90.24%	2
Energy wastage due to labour activities is high	75.61%	3
Labours do not try to reduce energy consumption at accommodation	75.61%	4
Labours do not try to reduce energy consumption while working	75.60%	5
Labours do not try to minimise resource consumption at site	65.86%	6
Labours do not try to minimise waste generation at construction site	65.86%	7
Labours are not using water efficiency	60.98%	8
Labours are a reason for waste generation at construction site	56.09%	9
Labours do not try to protect building materials while working and storing	53.66%	10
There is a water wastage occurred due to labour activities	51.22%	11
Labour related economic practices of SC		
There is a high cost impact of poor labour performance to cost of construction	85.37%	1
There is a time impact of poor labour performance to time of completion	85.37%	2
Labour performance is affected to life cycle cost of construction	75.61%	3
Labours do not contribute to get maximum output from minimum input	60.98%	4
Labour related social practices of SC		
Labour performance has influenced by treating all employees in same manner	56.10%	1
Labour efficiency has increased due to safety facilities	41.46%	2
Providing local employment opportunities has affected to labour performance	36.59%	3
Labours are not provided with training and education opportunities	31.71%	4

Yet, some different results were obtained through Phase II. "Awareness of the importance of minimising resource consumption" and "awareness of the importance of reducing waste generation in construction" got positive responses showing most of the labours have some knowledge regarding the importance of them. Further, "labour practices in minimising resource consumption at the site" and "labour involvement in minimising waste generation at construction site" has got very low values comparing to the awareness. This difference shows that labours knowledge is not enough to implement the practices in site. "Sorting out waste when disposing of" is a top factor. Similar to the professional survey findings, labours also accepted that it is the least involved activity by labours. Further, there is a big difference between "percentage sum of the factor" under two surveys for factors such as "labours try to reduce energy consumption", "labours try to minimise resource consumption", "labours try to minimise waste generation", "labours are using water efficiency". It explained that even labours are doing these practices they are not up to the expected level. It shows that there is a need to be improved.

Lack of awareness can be considered as a main reason for the low involvement of labour in these activities. Further, even labours have knowledge regarding some areas, it is not practically applied. Therefore, there is a

need to improve the awareness of labours. Hence, there is a gap between expectation and behaviour of the labours in some SC principles.

Table 3: Summary of Percentage Sum of Factors under Phase II

Summary of Percentage Sum of Factors under phase 02- Labour survey		
SC Practice	Percentage sum of factor	Rank
Environmental SC practices		
Labours are aware about importance of minimizing resource consumption	88.00%	1
Labours are aware about importance of reducing waste generation in construction	88.00%	2
Labours do not sort out the waste when disposing	44.00%	3
Labours are using water efficiency	32.00%	4
Labours try to protect building materials while working and storing	28.00%	5
Labours are involving in minimizing resource consumption at site	12.00%	6
Labours try to minimise waste generation at construction site	12.00%	7
Labours are reducing energy consumption while working	0.00%	8
Economic SC practices		
Adequate job opportunities are available to labours	88.0%.	1
Social SC practices		
Labours are following the safety instructions and using safety equipment	100.0%.	1
There are health care facilities at site	100.00%	2
Labours are satisfied with the safety facilities at the site	72.00%	3
Labours are not provided with training and education opportunities	72.00%	4
Labours are satisfied with the welfare facilities at the site	48.00%	5
There is no better relationship between labours and management	16.00%	6
Labours are not satisfied with their job	8.00%	7

Then economic SC practices were also analysed. Most critical economic sustainability-related factors affected by labour performances are the cost of construction and time for completion and life cycle cost of construction. Therefore, improving labour performance is important to the contractor to complete projects successfully. Labours' contribution to get maximum output from the minimum input is considerably low. According to labours, there are adequate job labours have adequate job opportunities in the construction industry. When considering the cost of construction, wastage and not protecting material are reasons to increase the cost. Therefore, achieving environmental goals of SC will be a support to achieve economic goals of SC.

According to the findings most critical social factor affecting labour performance is "treating all employees in the same manner". Therefore, it is important to treat all employees in the same manner. The relationship between management and labour has an important role in it. Management staff has a responsibility for maintaining that relationship. Further, labour performance has increased due to providing safety facilities and safety facilities and equipment are available to use of labours. According to results of both phases labours are not provided with training which highly effective on the labour performances.

Therefore, when considering all SC principles, environmental and economic principles of SC are affected by labour performances, while social principles of SC are affecting to the improvement of labour performances. According to the findings following suggestions could be provided to the better integration of sustainable concepts into the construction. Suggestions are mainly focused on the construction industry professionals and should be implemented by construction industry professionals and contracting organisations.

There are areas that awareness of employees should be improved. Awareness programmes should be conducted to increase the labours knowledge regarding these different aspects and importance of those. Areas that are needed to be improved could be identified as sorting out the waste when disposing, reducing energy consumption and reduce energy wastage, minimising resource consumption, minimising waste generation at a construction site, using water efficiency and reduce water wastage and protect building materials. As there is a gap between current labour performance and expectation, guidance and close supervision are essential.

Moreover, labour should be instructed on strategies which can be practically used in minimising resource consumption and waste minimisation.

In conducting awareness programmes, day to day guidance should be improved. Displaying guidance within the construction site is an effective method to transfer messages to labours. Regular seeing will give more impact and motivation to labours.

Rewarding the labours can be used as another method to improve labour performance. It can be done on daily, weekly and monthly basis. Contractors should provide these opportunities to labours. Lack of knowledge of construction methods can be overcome through this. A better relationship is essential to improve labour performances. Therefore, construction site staff should make a better relationship with labours. Staff also should be aware of the importance of relationships and strategies to manage the labours. According to the findings, labour performance has a considerable impact on increasing competitiveness in winning contracts or projects. But there is no method to evaluate the performances of the labours. Therefore, labour performance evaluating method should be implemented. This concludes the recommendations of the research.

5. CONCLUSIONS

This research was aimed to investigate the influence of construction labour factor in integrating sustainability concept into Sri Lankan construction industry practice. Through the literature, it was identified that there is a significant involvement in labour with SC. The argument was confirmed by the research. The study reveals that SC in Sri Lanka is not satisfactorily applied and therefore, there is a need improve the SC in Sri Lanka. As most of the professionals are knowledgeable about SC, the involvement of other personnel in construction was evaluated. When considering the influence of labour, environmental and economic principles of SC are affected by the labour performances, while social principles of SC are affecting to the labour performances. Better labour performances are resulting in achieving environmental and economical sustainable goals. Fulfilling social SC requirements will be helpful to achieve better labour performances. Lack of awareness regarding environmental impact was identified as major cause of improper actions of labour. High energy consumption, wastage of resources, not minimising the resource consumption were identified as major issues relating to environmental requirements of SC. Further to that labour performances are highly affected to the cost of construction, time for completion and life cycle cost of construction. Improving labour performance is essential to achieve cost and time targets of construction. Labour performance could be improved by providing safety equipment and facilities, treating labours in the same manner and through training. In order to that, improving labours' awareness, guidance and close supervision are suggested to improve labour performance. Completing social principles of SC will also improve the labour performance. As discussed in the previous sections of this paper, there is the significant role of labour factor in SC and proper management of labour factor will be more beneficial to achieve SC goals of the construction industry.

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