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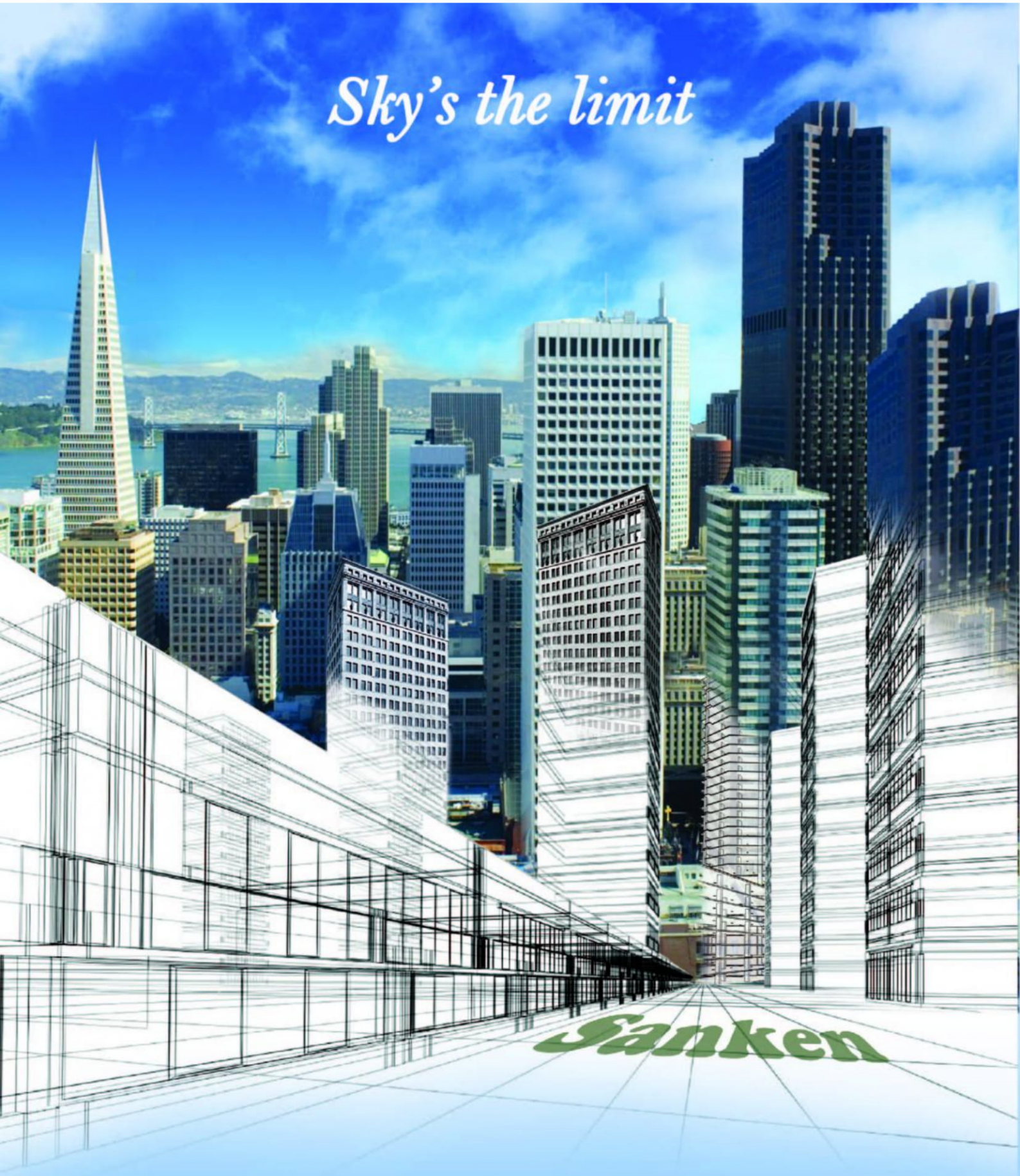

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MESSAGE FROM THE DIRECTOR GENERAL…

Construction Industry Development Authority which is the apex body in Construction Industry is mandated to regulate, register, formalize and standardize the activities of the Construction Industry as per the Construction Industry Development Act No 33 of 2014.

The Construction Industry plays a major role in national economic development, contributing more that 7% to the Gross Domestic Product (GDP).

The Construction Industry is rapidly booming requiring more resources in relation to material, manpower and technology. The most of the materials required by the industry are supplied from the natural sources. Excessive use of natural materials will create highly negative impact on environment, stressing the need for innovative approaches in meeting resources requirement of the Construction Industry in a sustainable manner. In order to find alternative materials and technologies increasing the productivity of the Construction Industry, it is required to carry out more research in the field of construction.

The purpose of publishing of this journal is to disseminate new research findings and innovative trends happening in the field of construction among the stakeholders of the Construction Industry to make them aware of the new research findings ensuring its increased application taking the industry into new heights. The journal will also create a platform for a professional dialogue on the subjects related to the construction leading to the exploration of new vistas creating sustainable approaches in meeting new and increasing demands emerging in the modern Construction Industry driving its growth momentum.

I take this opportunity to thank all the Authors for submitting their professional and visionary articles to be published in this valuable journal for the benefit of construction community.

I must appreciate the valuable guidance and visionary advice provided by the Hon. Minister, in preparation of this scientific journal. I also highly value the directions given by the Secretary and Ministry officials, facilitating the completion of this journal.

I also thank the editorial board for their commitment, dedication and professional contributions to make this journal a success.

My appreciation also goes to Chairman, Director (Development) and staff of the Development Division, publishing this journal on this important day of celebrating the achievements of the stakeholders of the Construction Industry.

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FEASIBILITY OF NON-CLASS TIMBER AS STRUCTURAL MATERIAL IN CONSTRUCTION INDUSTRY

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ABSTRACT

Timber is valuable and versatile raw material in Sri Lanka for construction. Timber species that have not been classified in BS 5268 despite their use as a structural material in construction are called "Non-Class Timber". State Timber Cooperation (STC), which classifies timber according to visual grading, demand and user experience, has categorized some of these species of Non-class timber under upper class timber. Structural engineers find it challenging to identify the type of timber that can best provide the required strength to the structures they design. Thus it will be very useful if timber could be classified based on their strength as well. The main objective of this research were therefore to classify timber based on their availability, workability, durability and user experience; to determine the strength of few selected local timber species; and to classify these species under the strength class provided in BS 5268. The study was limited to 14 timber species and their strength properties were determined by subjecting them to bending, compression and tensile stresses. All tests were done in according with BS 373: 1957 while maintaining the moisture content of the timber at 12%. The selected Non-Class timber species were thereafter classified according to their strength and the relationship between their anatomical behaviors and strength was identified.

Keywords: Non-class timber; Strength classes; BS 5268-2-2002, Qualitative analysis, Anatomical behavior

1. INTRODUCTION

Timber, a structural material commonly available in Sri Lanka, plays a vital role in the economic and industrial development of the country. In ancient days, it has been used in beams, for the fine decorations in buildings etc. (Jayewardene *et al.2014*). As technology developed with time, new and advanced timber products have come into being.

Non-class timber is the timber that has not been classified in BS 5268-2:2002 although they are already being used in construction because of their structural properties. In BS5268, teak and Kempus have been classified understrength classes, D 40 and D60 respectively. There are many non-class timber species available in Sri Lanka. STC has classified them as upper-class timber. They can also be classified based on their strength, under the standard classes given in BS 5268- their structural performance they are already used in construction. According to the BS 5268 -2-: 2002. Craftsmen, in general, decide on the suitability of a particular species of timber for use in construction by considering its visual grading based on the experience they have got in working with different species of timber. The properties of timber that can be considered whenselecting them for construction purpose are color, split and cracks, moisture content, resin pockets, ring width, weight, grain uniformity, knot size and frequency of wane, bow, spring, and twist. Although the non-class timber is commonly used in Sri Lanka as a construction material, the strength properties of this type of timber have not been determined. The quality of timber used in construction depends directly on factors such as density, Strength (bending, tension, compression,

flexural, shear), moisture content, and durability. STC has identified 400 timber species of timber among what are available in the country. Studies have been done on more than 227 of them. STC classifies timber under several classesbased on their visual grading, demand and user experience.However,it will be moreuseful if the timber could be classifiedbased on their strength as done in BS 5268-2-2002. For this purpose, standard bending, compression and tension tests have to be carried out on the timber in accordance with BS 373-1957.

In this study, a qualitative analysis of locally available non-class timber species based on their cost, durability, workability, availability and demand was done first. Thereafter, strength and physical properties of these timber species were determined and the timber was subsequently classified according to BS 5268 by using the results of standard tests specified in BS 338. Finally,therelationship between strength properties and anatomical features was investigated.

2. METHODOLOGY

2.1 Qualitative analysis

A qualitative analysis of the timber specimen was done first to find out the experience that local craftsmen have in using non-class timber. Timber has both major and minor characteristics.Color and grain directionare considered as the major characteristics of timber while weight is considered as minor characteristic of it. A questionnaire survey was conductedamong ten local craftsmencoming from Mathale, Anuradhapura, Galle, Mathara and Gampaha districts. The findings of the survey were used to validate using a five-point scale based on the following characteristics of timber.

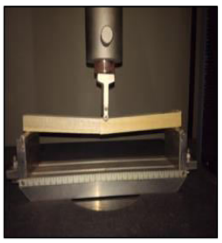
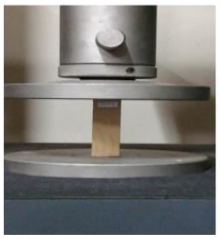
- Cost effectiveness
- Resist to insect attack
- Workability
- Availability
- Strength
- Shrinkage
- Durability
- Usagein community

Then qualities of timber were thereafter weighted and the total weighting that has to be assigned to each timber species was calculated.

2.2 Determination of strength parameters

To identify the strength properties of timber, compression, tension and flexural tests were done on these specimens. Their moisture content and density were also measured. All tests were done in accordance with BS 373:1957 ensuring that the moisture content of the timber specimenswasmaintain around 12%. A Universal Testing Machine was used for the tests. Force was applied on the samples up to the time of their ultimate failure. Table 1 presents the figures of tests, loading rates, grain directions, sample sizes and the equations used.

Table 1: Test Types and Parameters

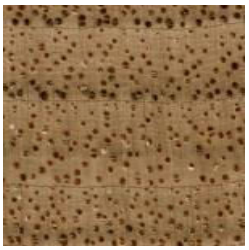
Material test	Three point bending test	Compression // to grain test	Compression ⊥ to grain test	Tension parallel to grain test
Figures				
Loading rate	0.025 (inch/min)	0.05 (inch/min)	0.025 (inch/min)	0.05 (inch/min)
Sample size	20mm x 20mm x300mm	20mm x 20mm x60mm	50mm x50mm x50mm	Have a different in shape at the mid span cross section is 6mm x 3mm
Equations	$\text{Strength} = \frac{\text{Servicibility load(N)}}{\text{Average area(mm}^2\text{)}}$ / Graded Strength $= \frac{\text{Strength (Nmm}^{-2}\text{)}}{\text{Safety factors}}$			
	$MOE = \frac{WL^3}{48\delta I}$			
Safety factors	Duration factor – 1.75 Depth factor - 1.17	Duration factor – 1.75	Duration factor – 1.75 Depth factor - 1.17	Duration factor – 1.75 Depth factor - 1.17

The measurements made were related to the characteristics strengths of the timber specimens tested. To convert them to their corresponding stress grades given by BS5268, they had to be multiplied by appropriate safety factors (K Factors).

2.3 Build up a relationship between anatomy and strength properties of timber

Timber species were selected based on the diameter of the vessel. The displacements perpendicular to grain of each timber specimen when place under compression was measured under a compression force varying from0.5 kN to 4 kN. The strength properties of the specimens with respect to their anatomical features were then plotted and the relationship between the strength parameters and the anatomical structures were analyzed. Only four main anatomical features were considered. The results of the tests done on compression perpendicular to grain were found to be significant.

Table 2: Pore (Vessel) patterns of timber

Type of Vessel	Ring porous	Diffuse porous	Semi ring porous
Porous arrangement in cell			
Description	Size of the porous increase with the growth ring caused by water deficiency	Pores in the early wood and late wood are approximately of the same size	Although the pores do not form clear rows, their size gradually decreases during their transition from early wood to latewood

(Muthumala, *2014*)

3. TEST RESULTS

3.1 Qualitative analysis

Table 3presents the results of the qualitative analysis done on the the results of local craftsman's experience that local craftsmen have in using different timber species. Test results revealed that the demand for timber does not depend solely on their strength.

Table 3: Qualitative analysis test results

Name of the tree	Total weighted marks	Demand rank
Margosa	4.4	1
Ketakala	4.3	2
Jack	3.75	3
Palu	3.65	4
Hora	3.65	4
Madan	3.5	5
Micro	3.45	6
Satin	3.45	6
Lunummidella	3.45	6
Pinus	3.4	7
Ehela	3.35	8
Grandis	3.35	8
Kumbuk	3.35	8
Tamarind	2.4	9

3.2 Strength characteristics of timber

Table 4 presents the test results pertaining to bending strength, compressive strength and tensile strength of selected timber species. The values given are for the grade strength stated in BS 5268 under the relevant classes. When using these values in structural calculations they have to be multiplied by the relevant "K factors".

The strength properties of timber tested deviated slightly the properties given in BS 5268. Therefore, "Deviation factors" had to be applied. These deviation factors allow for deviation up to ±25% from the values given for graded timber. Since these limits are allowable, the values obtained for the strength properties can be used when designing timber in accordance with BS 5268-2:2002 code.

Table 4: Approximate Mapping of Non-class

Name of timber	MOE (Nmm^{-2})			Bending strength (Nmm^{-2})			Compression parallel to grain (Nmm^{-2})			Compression perpendicular to grain (Nmm^{-2})			Tension (Nmm^{-2})			Suitable strength class (Nmm^{-2})
	Actual value	BS code value	Strength grade	Actual value	BS code value	Strength grade	Actual value	BS code value	Strength grade	Actual value	BS code value	Strength grade	Actual value	BS code value	Strength grade	
Margosa	7361	9500-6000	D30	10.23	9.0	D30	7.87	8.1	D30	4.83	5.2-4.0	D60	6.11	5.4	D30	D30
Ketakala	7377	9500-6000	D30	8.40	9.0	D30	7.64	8.1	D30	3.43	3.9-3.0	D40	12.03	10.8	D60	D30
Jack	6231	9500-6000	D30	13.09	12.5	D40	8.39	8.1	D30	6.27	6.0-4.6	D70	12.18	10.8	D50	D30
Palu	13581	15000-12600	D50	8.75	9.0	D30	12.78	12.6	D40	8.32	6.0-4.6	D70	12	10.8	D50	D50
Hora	12847	15000-12600	D50	17.55	16.0	D50	10.74	8.6	D35	6.08	6.0-4.6	D70	12.38	10.8	D60	D50
Madan	6550	9500-6000	D30	10.40	9.0	D30	8.98	8.6	D35	4.55	5.2-4.0	D60	5.15	5.4	D30	D30
Micro	13167	15000-12600	D50	16.44	16.0	D50	10.87	8.6	D35	4.03	4.5-3.5	D50	16.16			D50
Satin	10250	10800-7500	D40	14.95	12.5	D40	9.88	8.6	D35	7.05	6.0-4.6	D70	14.93	13.8	D70	D40
Lunumidella	6060	8800-5800	C16	5.28	8.7	C16	4.64	5.2	C14	1.75	2.1-1.6	C14	6.79	6.6	D35	C14
Pinus	6284	9100-6000	C18	7.15	6.8	C22	7.61	7.5	C22	2.88	2.9-2.4	C35	10.02	9.60	D50	C22
Ehela	9983	10800-7500	D35	11.45	11	D35	10.15	8.6	D35	5.31	5.2-4.0	D60	6.53	6.6	D35	D35
Grandis	8464	10800-7500	D40	13.28	12.5	D40	10.44	8.6	D35	2.53	2.8-2.2	D30	9.62	9.6	D50	D40
Kumbuk	6160	9500-6000	D30	12.33	11	D35	7.42	9.05	D35	3.60	3.9-3.0	D40	7.93	7.5	D40	D35
Tamarind	9881	10000-6500	D35	17.80	18.0	D60	9.07	8.6	D35	6.09	6.0-4.6	D70	8.94	7.5	D40	D35

$$Deviation\ Factor = \frac{(Particular\ Strength\ of\ timber\ according\ to\ BS\ 5268\ class - particular\ strength\ for\ particular\ non\ class\ timber\ specie)}{Particular\ strength\ of\ timber\ according\ to\ BS\ 5268\ class} \times 100\%$$

3.3 Strength Properties and Qualitative Analysis

Table 5: STC Classification vs BS classification

Name of timber	State Timber co-operation classification classes					
	Luxury class	Special class upper	Special class	Class I	Class II	Class III
Tamerind			D35 (9)			
Kumbuk			D35 (8)			
Grandis					D40 (8)	
Lunumidella					C14 (6)	
Ehela					D35 (8)	
Microcoris			D50 (6)			
Palu		D50 (4)				
Satin	D40 (6)					
Madan				D30 (5)		
Pinus						C22 (7)
Jack	D30 (3)					
Hora				D50 (4)		
Margosa		D30 (1)				
Katakala				D30 (2)		

(Note: Numbers given within brackets indicate the ranking obtained from qualitative test results)

According to Table 5, Ketakala listed as Class 01 Timber by STC has obtained a high ranking from the tests and Tamarindlisted as Special Class Timber by STC has a obtained a low ranking. The part of tamarind timber that is most commonly used in construction is its stem. This stem is very rare and is also very hard and thus has poor workability. Tamarind is therefore very rarely used in the local construction industry as timber. Thus, STC has placed it under a lower class when classifying it.

Figure 1 shows the flexural strengths and compressive strengths parallel to grain of different timber species arranged according to their demand. Flexural strength and compressive strength parallel to grain are the two stresses that have to be considered mostly when using for construction.

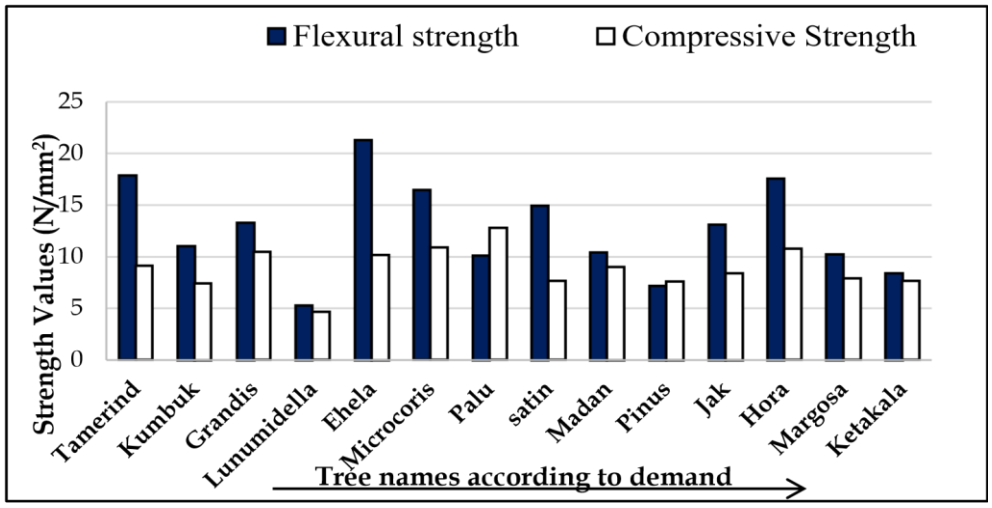


Figure 1: Strength variation vs. Demand

The qualitative analysis results and strength values reveal that the demand on timber is not dependent on its strength properties. This is due to the fact that although a particular species of timber may have very high strength and high density, because of its low workability there may not be much demand for it. Craftsmen therefore use timber with high workability in non-engineered construction.

3.4 Strength parameters variation with the anatomical characteristics

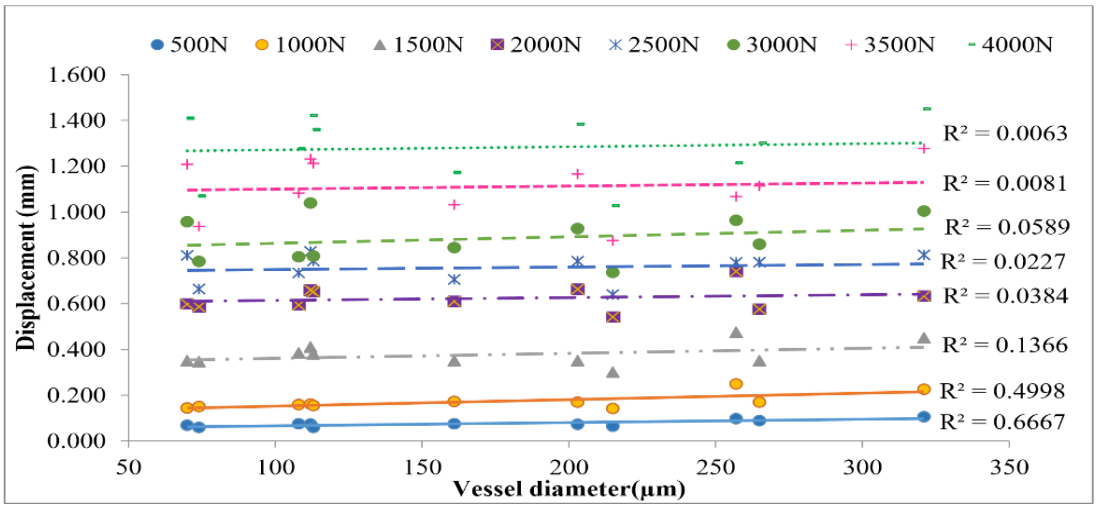


Figure 2: Displacement of timber samples under several loads

The test on compression perpendicular to grain was carried out on the timber specimen with a load varying 0.5kN to 4kN. It was revealedthat the displacement is almost proportional to the vessel diameter. Therefore, displacement and vessel diameter have a linear relationship at initial loading. As the load is increased, a nonlinear relationship will build up between the displacement and vessel diameter. Figure 02 shows the R2 values under each loading condition.

4. CONCLUSIONS

An experimental investigation was carried out to identify the utilization of non-class timber based on their strength properties. Aqualitative analysis of selected non-class timber species was done

by considering their cost, durability, workability, availability and demand. Their strength properties were also investigated to classify them under strength classes given BS5268 and identify the relationship between the strength properties and anatomical behavior of timber. Following conclusions can be drawn from the findings.

- Quality of non-class timber depends not only on strength but also on their workability, cost and availability. The qualitative analysis of Margosa, Katakala and Jack indicated that they have characteristics expected from good timber.
- "Deviation factors" of non-class timber lie within ±25% ofgraded timber. Therefore, species of non-class timber can be used directly or indirectly for various applications in the construction industry.
- Compression load is applying on perpendicular tograin direction, at the initial loading condition displacement of timber mainly depend on the vessel diameter. But when the load is increased it is not further depending on the vessel diameter. So it is required further study on these non-class timber based on their natural characterizes.

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REFERENCES

1. Deublein, M., Steiger, R. and Kohler, J., 2010, „Quality control and improvement of structural timber", *The Future of Quality Control for Wood & Wood Products:*Edinburgh the Final Conference of COST Action E53.

2. Jayawardana, C., Peiris, K. and Wijesinghe, S., 2014, Historical Timber Structures in Sri Lanka: A Reviewon Pekada, Kenimandala and Madol-kurupawa", *Engineer*, Vol. XLVII (04), 63-68.

3. Muthumala, C.K., 2014, *The Anatomical study of common local and imported timber species in Sri Lanka,* Report submitted to the State Timber Corporation, Colombo.

4. Prabodha J.P.T.H., De Silva Sudhira, De Silva Subashi and MuthumalaC.K., 2017, Application of Non-Class Timber in Construction Industry, Proceedings of the 8th International Conference on Structural Engineering and Construction Management, Kandy Sri Lanka (CD Rom Version), Paper ID: ICSECM/2017/143.

5. Ruwanpathirana, B.S., Rathnayaka, R.M.C.P., De Silva, S., 2015, Investigation of strength parameters and physical properties of non-class timber species in Sri Lanka, UG Research thesis, Department of Civil and Environmental Engineering, University of Ruhuna.

6. Ruwanpathirana, N., *Timber classification, (*viewed 07 April 2017, from http://www.timco.lk/stc/index.php?module=web&action=timberClassification.

7. Standard association of British, 1957, *British standard 373: Methods of testing small clear specimens of timber,* (BS 373: 1957), Standards British, London

BUILDING CONTROL: THE NEED FOR PROFESSIONALISM

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ABSTRACT

Construction industry in Sri Lanka is keen on ensuring the quality of buildings. It thus becomes important to comply with relevant standards to produce good quality products. Building Control (BC) covers features of building work including health and safety aspects, structural stability and energy efficiency as well as building rules and regulations in construction industry. Thus, the aim of this research was to propose a BC mechanism focusing on the Plan Approval Process (PAP) for Sri Lanka which will have the involvement of professionals.

A qualitative research approach was adopted to achieve the research objectives. A set of structured interviews were conducted with 15 professionals coming under five categories. Five subsequent expert interviews were used to validate the interview findings. A document review was conducted to collect additional information required. The findings were analysed using content analysis.

Through the research, the practices that are currently being followed in BC, parties involved in those practices and the role of the professionals in BC were identified. An improved mechanism was proposed for the building PAP after considering the current practices of BC and the degree of involvement of professionals in them so that corruption and malpractices in building work could be mitigated.

Keywords: *Building Control (BC), BC Surveyor, Professionalism, Plan Approval Process (PAP)*

1. INTRODUCTION

Building work is recognized as the erection of a new building or the alteration, extension, change of use, removal, demolition or re-erection of an existing building (Wilkinson, 2014). For a building to be adaptive, it has to be long-lasting, energy efficient, habitable and secure while providing safety and comfort to its occupants (Douglas, 1996). Building control (BC) is a process that ensures during the planning of the building and inspection and assessment of the completed work on site, the quality and the standard of the building work using a quality assurance procedure (Foolkes, 2015). BC will focus on the application and enforcement of building standards (Pedro, Meijer & Visscher, 2009). Therefore, as stated by Elson (2015), BC has to be well established if standards and regulations are to be maintained and continued with. According to Billington (1986), there are several stages in BC which have to be followed to ensure health and safety of the public, before approval or permit for the new construction is sought. Thus, a well-controlled and monitored Plan Approval Process (PAP) that will involve professionals who are knowledgeable about building codes, rules and regulations, which will be a part of BC, will be essential to reduce the number of constructions that fail to comply with the required standards.

Rumary (2015) has emphasized the need for a qualified professional if PAP is to be carried out effectively and responsibly. Conlon (2014) believes that good education and training is a sign of a

good professional. According to Morgan (2016), a building surveyor is a unique professional who is in a position to advice and comment on many issues related to sustainability, energy conservation and safety of buildings.

Although BC can have a positive effect on time, quality and cost of the final product of building work, in Sri Lanka it is fragmented and not well managed and can thus lead to corruption and malpractices (Fernando, Perera &Rodrigo,2017). Clement (2015) has argued that even in countries where BC functions are well maintained because of financial motivations there are inefficient and ethical issues when dealing with local authorities.

By improving the BC process, it will be possible to develop the construction industry in the country as a whole.

A large gap, however, exists between the theoretical performance of BC systems and its current industry practices(Lowe & Bell, 2000).There are several studies already done on different aspects of BC such as the training and development of building surveyors in Malaysia (Ali & Woon, 2012); private certification of BC (Pitt, 1984); legal aspects of BC (Sabri, Ujang, Arif & Aripin 2017), certification of BC in the Netherlands (Niemeijer, 1989)and professionals' perceptions of the effectiveness of BC measures in Nigeria (Wahab & Lawal, 2011). Yet, none of these studies explains in detail the need for professionalism in BC. This study aimed to identify the parties involved in the BC processes and drawbacks of the current BC processes and propose a suitable BC process which will have the involvement of professionals. The novelty of this study is therefore lies in the fact that it identifies the need for professionalism in BC.

2. LITERATURE FINDINGS

Concept of BC

BC, by getting the building work to adhere to relevant standards, ensures that the quality of construction work is such that it safeguards the health and safety of the public, as well as the structural stability and sustainability of the building (Everall, 2015). According to Douglas (1996), BC covers environmental aspects, functional aspects, legal aspects etc., of construction work. Dounis and Caraiscos (2009) believe that BC can provide long-term solutions to improve the energy efficiency of the built environment and decarbonise the energy infrastructure. Baiche, Kendrick and Ogden (2007) have discussed fabric efficiency standards under BC which can enhance the inner comfort and environmental quality of buildings by reducing overheating and improving natural ventilation. Facilitation of weather resistant designs and recognition of dangerous structures are other attainable objectives of BC (Oloyede, 2015). Davies (2001) also believes that the health and safety of the public as well as fire safety of building work can also be attained through BC.

According to West (2016), BC requires owners to comply with statutory requirements stipulated by local authorities and fulfil local housing needs, while adhering to national standards. Conlon (2015) states that under BC rules and regulations, building regulations relating to access and facilities in houses and design security measures adopted in new houses will also be inspected.

Buildings have to be monitored and fine-tuned to ensure the health of the building which will be a difficult task is there is no involvement of BC surveyors in the process (Finch, 1998).Yet, all over the world including in countries like UK, Canada and Australia, non-compliance with the BC process is evident (Baiche,Walliman & Ogden, 2006).

Regulatory Bodies

In most of the countries, BC comes under the purview of regulatory bodies (Meijer & Visscher, 2008). Building regulation has become a routine task for these BC bodies (Knight, 2015). The parties who are authorized to certify and approve plans, specifications, drawings and other relevant documents in regulatory bodies are identified as qualified persons (Howard,Barrett & Oldbury 1992). According to Baiche et al. (2006), regulations and standards in BC play a vital role by ensuring the conservation and upholding of the quality and performance of new and existing constructions.

Pedro, Meijer and Visscher (2010) have stated that local authorities should be held responsible for controlling and maintaining building regulations to guarantee that the construction quality and standards of the buildings constructed are suitable and appropriate to the locations where they are to be built. Local authorities develop partnerships with private companies to supply services for building controlling that will improve the standards (Aarons, 2014). Governments of some countries have even introduced new laws and regulations to privatize BC services (Gunduru, 2015; Thompson, 2014). Local Authority Building Control (LABC) is a regulatory body that has the power to impose standards in England and Wales and it has to ensure that building construction in those countries complies with the building rules and regulations (Clarkson, 1988).

BC Process

Planning policy and BC systems have a high impact on the effectiveness of the BC process. The BC process focuses on an application system that begins with the submission of planning application and continues up to the issuance of the BC completion certificate (Aarons, 2014). Pitt (1984) and Billington (1986) have stated that depending on the country or city and the type of the building, rules and regulations can differ making the PAP or BC to diverge accordingly. According to Yau (2009) in Hong Kong, BC process is being highly criticised due to delays in the processing of applications.

The main aim of the BC process is to maintain building standards to ensure health and safety aspects of buildings (Thompson, 2015). According to Elson (2015), BC has to be considered at the PAP stage to ensure the maintenance of and continuation with the standards and regulations. Thus, BC revolves around PAP, which will be discussed in this study.

Role of Professionals

Everall (2015) has stated that with population growth, the need for dwellings has gone up. To meet this growing demand for housing, more effective and efficient BC systems are needed (Pedro et al., 2010). Therefore, there is an increasing demand for professionals to maintain and continue with building standards. According to Smith (2016), BC profession includes a diverse range of job varieties and a flexible working environment within the office and on site.

A BC surveyor has to play a multi-disciplinary role in BC which requires him to have different competencies and skills to practice building rules and regulations in a well-disciplined and ethical manner. He also needs to possess a comprehensive understanding of the construction procedures, design concepts, building materials used in construction and the technology involved (Ali & Woon, 2013; Dickinson, 1999; Wood & McGahey, 1995).The combination of these technical and practical experience and skills will help a BC surveyor to effectively carry out his tasks.

According to Wilson (1988), the BC surveyor employed has to be an accredited member of a professional body such as the Royal Institution of Chartered Surveyors (RICS), Chartered

Institute of Building Engineers (CIBE) or Chartered Institute of Building (CIOB). “Maintaining the highest level of professional and ethical competence is an essential obligation on the part of the modern BC surveyor”, says Rumary (2015). Hence, the BC surveyors have to be conversant with the codes of practice and ethics to function as successful BC professionals.

Involvement of BC Professionals in the Process

According to Heaton (2009), the scope of work of a BC surveyor will include advising clients on building regulations and preparation of documentation that has to be submitted for approval; and checking building proposals. Thus, to ensure that a proposal complies with building regulations, the BC surveyor has to examine the plans, specifications, drawings, and other documents that have been submitted for approval and issue the plan certificate if they comply with the standards. During the early stage of plan submission, the BC surveyor has to advise applicants on construction safety matters and cost and time saving options that will guarantee a quality product that complies with the standards (Pitt, 1984).According to Wilkinson (2014), during the approval process, the BC surveyor has to give proactive advice and design solutions using his knowledge and competencies. Clarkson (1988) has emphasized that BC professionals should examine and comment on plans for new building work, alterations or extensions before approving same.

If the building work fails to meet building regulations, BC surveyors have the authority to reject plans. However, according to Mills (1987), in complex projects it is better for the BC surveyor to get involved in the pre-application stage to reduce the risk of delays and provide a better value for money. At the development stage, BC surveyors are obliged to carry out regular inspections and site visits to ensure that the building work is being properly carried out according to the approved plan. They have to inspect and test walls, foundations and drainage works for their standards (Tebbit, 2015). Furthermore, records have to be kept on each and every inspection and site visit made on project progress and checking of samples of new building materials. At the completion stage, BC professionals have to issue completion certificates after they have satisfactorily concluded inspections relevant to building codes and regulations.

During the implementation of a building project, the BC surveyor has to interact and communicate with clients, builders, construction professionals and parties such as historic building conservation officers and statutory bodies to exchange knowledge and provide advice. He has to be up to date with current regulations and legislation related to BC. If there is any non-compliance with the requirements, they have the right to take action against the builders. In Australia, BC professionals are highly employed in the government sector whereas in Hong Kong they are required to mainly focus on the dilapidation reports of newly built and historical constructions in the private sector (Ali & Woon, 2013). Therefore, by introducing a BC surveyor to the process, solutions for poor quality could be found and corruption and malpractices mitigated.

3. RESEARCH METHODOLOGY

The aim of the research was to propose a BC process suitable to Sri Lanka that will involve professionals. Thus, it was necessary to obtain professional opinions and thoughts, and closely identify the existing procedures related to PAP.

Qualitative methods are strong in measuring descriptive aspects and in the absence of numerical data they help to deeply understand and interpret conditions (Bayraktaro lu, Kutanis, Özdemir,

Alpaslan & Dil, 2006). Compared to quantitative techniques, qualitative techniques help to determine more objectively the reliability and validity of subjective data (Amaratunga Baldry, Sarshar & Newton, 2002). Therefore, qualitative approach was considered as being more appropriate for this study. Fifteen semi-structured interviews were carried out with five categories of professionals, i.e., town planners, architects, engineers, quantity surveyors and lawyers with three professionals coming from each category. The findings were validated by interviewing five planning officers, all of whom had more than fifteen years working experience in BC. The data collected were analysed using NVivo 11 content analysis software.

According to Yin (1994), triangulation is important to make data collection more accurate and correct. Hence, a document review was carried out finally as a means of triangulation to cross validate the information gathered from interviews and observations. As the document review had to focus on PAP, reference was made to several documents published by the Urban Development Authority and local authorities.

4. RESEARCH FINDINGS

Parties Involved in BC Implementation

In developing a BC process which involved professionals, it was first required to identify the degree of involvement of professionals in the current practices. Table 1 presents the personnel and the organisations identified from the semi-structured interview findings as being involved in BC.

Table 1: Parties involved in BC

Persons	Organizations
Local Authority • Chairman/ Commissioner • Planning Officer (UDA representative) • Technical Officer (TO) • Public Health Inspector (PHI) **Regional and Main (UDA)** • Town Planner • Architect • Engineer • Urban Commissioner • A member from each department or authority	• Urban Development Authority (UDA) • Municipal Council • Local Authority • Coast Conservation Department • Environmental Authority • Road Development Authority • Sustainable Energy Authority • Archaeology Authorities • National Housing Development Authority • Irrigation Department • Forest Department • Civil Aviation Authority • Board of Investment

According to Table 1, PAP in Sri Lanka comes mainly under three sub categories, main authority (Urban Development Authority), regional authority (Provincial Council) and local authority (comprising municipal councils, urban councils and regional councils). PAP of each authority is generally handled by a planning committee, which is named as the main planning committee, regional planning committee or the local planning committee respectively, depending on the name of the authority. A local authority consists of a commissioner/chairman, planning officer (UDA representative), technical officer (TO) and a public health inspector (PHI). The main organizations connected with the PAP were identified and the involvement of those organizations was found to differ depending on the type and scope of the proposed project.

From the literature review, it was revealed that the processes and the parties involved in BC differ from country to country (Pitt, 1984; Meijer& Visscher, 2008; Aarons, 2014; Billington, 1986). However, in all the countries, three main parties are involved in PAP: local authorities, private sector and approved inspectors. Building Regulations Advisory Committee has been recognised as the authorized party responsible for providing advice on the preparation of building regulations.

Existing BC Processes and Issues faced

Smith, Smith and Mitchell (2013), have evaluated the certification process in residential buildings in Australia. However, the applicability of that process in Sri Lanka is questionable. Thus, the existing PAP and the problems at each stage were identified through the interviews and the document review. The findings related to current issues and the factors affecting the effectiveness of the existing process are discussed under each stage of the process.

Step 1: Beginning of the process

All of the interviewees mentioned that the first step is for the applicant to obtain the required approvals in advance from the relevant authorities or departments, depending on the location of the development and submit them to the local authority along with the application for preliminary planning clearance. Therefore, at this stage the applicant has to deal with many issues because of the difficulties he faces in obtaining the clearances from the relevant authorities or departments. It was also identified that the work during this stage takes considerable time. Furthermore, ambiguities and errors in the documents, out-dated information provided in the documents and lack of understanding of the process and the type of documents required were also identified as issues that are currently faced during this stage.

Step 2: Submission of Preliminary Plans

Step two involves the submission of documents such as a copy of survey plan of the property, application, rough sketches, documents requested by the authorities depending on the requirement.

Step 3: Obtaining the Required Approvals

Under step three, if all the relevant documents submitted are in compliance with the relevant rules and regulations, approval will be granted to the building permit application. Moreover, interviewees mentioned that if there are any issues relating to the documents submitted or if the approval is not granted, the documents will have to be resubmitted for approval by the local authority. It was furthermore highlighted that a similar process has to be followed to obtain the documents that have to be submitted. Lack of knowledge on the PAP and poor quality of the documentation were highlighted as the reasons requiring resubmission.

Step 4: Submission of the Application for Planning Approval

Interviewees highlighted that currently the design has to be developed and certified by a qualified architect and the structural and technical requirements by a qualified engineer. It was further added that the certification ensures compliance with building regulations and standards and that non-compliance will make work to be of poor quality.

Step 5: Checking the Application and Other Documents

Checking the compliance of the design of the proposed project with building rules and regulations is done during this stage to ensure health and safety aspects. According to the

interviewees, a technical officer may have to conduct an audit to provide a substantiated opinion regarding the extent to which the design conforms to technical requirements. Moreover, the public health inspector is authorized to conduct site inspections to guarantee the health and safety of the new construction work. However, it was revealed that malpractices and corruption mostly occur during this stage which has become a huge issue.

Step 6: Approval by the Local Authority

One of the interviewees stated that in this step, the local authority enforces planning and building regulations on the development and provide a substantiated opinion regarding the extent to which the design conforms to technical requirements. Thus, if the documents do not comply with the rules and regulations, or if there are any issues related to the documents submitted, they will be referred to a special planning committee by the approving authority.

Step 7: Planning Committee

The interviewees explained that once the approving authority refers the documents to the planning committee, the latter after discussing and examining the issues or problems will either issue a building permit or reject the documents and request are submission. It was also mentioned that the planning committee may also provide advice to local authorities regarding the autonomy they have for granting building permits. The interviewees also stated that the opinions of other authorities and design auditors are also considered, and that if the relevant building authority is satisfied, a building permit will be granted to carry out the construction work.

Step 8: Issuing of the Building Permit

In this step, after the plan of a building or building works has been approved, the authority concerned has by issuing the building permit notify the owner of the building or the premises in which the building works are to be commenced or resumed that the relevant approval has been granted.

Step 9: Certificate of Conformity

The final step in the PAP is the issuing of the certificate of conformity. All interviewees elaborated that after the final site inspection, the local authorities issue a certificate of conformity certifying that the construction has been completed successfully. The interviewees also mentioned that depending on the quality of work, the authority may consider granting a certificate of conformity for the occupation of a building or any other development activities.

The interviewees mentioned that Irrespective of the stage of PAP, the probability of corruption and malpractices taking place is high in the BC process currently practiced because of the little involvement that professionals have in the process and also because of political interference. Therefore, the role of each professional in the process has to be identified as the professionals could make the process more transparent and efficient.

Role of the Professionals

After studying the existing process and its drawbacks, the role the professionals play in the process and the competencies they require to carry out their roles were identified. As there have been no studies previously done on this subject, there is novelty in this study.

Table 2 presents the findings on the roles played by the town planners, architects, engineers, technical officers and public health inspectors in BC and their competencies.

Table 2: Roles and competencies of professionals involved in BC currently

Categories	Roles	Competencies
Town Planner	Designing new towns and street lines by balancing the needs of communities, businesses and the environment	Continuing professional development in the areas of practice
	Checking whether the plans comply with rules and regulations	Ability to abide by ethical standards and codes of conduct
	Ensuring that suitable land becomes available for development	Communication skills
	Understanding the development patterns, trends and plans	Ability to make better decisions, creative thinking
	Making decisions on the checks required against the local area development plan	A keen knowledge in improving places and spaces for others
	Making decisions that positively affect how the people live	Negotiation skills
	Encouraging and supporting planners and others to deliver better outcomes from planning	Analytical skills that will produce innovative and useful solutions to planning problems
	Providing constructive and specific policies and solutions to the issues.	Capability to handle strategic planning
	Preparing a development plan	Problem solving skills
Architect	Making designs that match the area and the development plan	Ability to present and discuss proposals
	Maintaining an environmental and cultural sensitivity when designing a building	Ability to practice good ethical standards and codes of conduct
	Meeting planning requirements and building regulations pertaining to the designs	Ability to apply appropriate conceptual and practical methods to the designs
	Developing designs that comply with the rules and regulations of the country or an area	Ability to evaluate alternative solutions
	Undertaking activities in a way which contributes to sustainable development	Communication skills and computer literacy
	Using several approaches to problem solving and contributing to continuous improvement	Creative and innovative thinking, Problem solving skills
Engineer	Ensuring structural stability of the building work	Problem solving skills, decision making skills
	Introducing energy efficient techniques	Interpersonal skills
	Ensuring the health and safety of the building	Conflict avoidance and management
	Providing solutions by considering quantitative and qualitative analyses and appraisals	Ethics on good practice with respect to tolerance, confidentiality and honesty
	Contributing to the design and development of the building by providing engineering solutions	Knowledge and understanding to provide a good output
	Being updated with rapid evaluation	Communication skills and good team work

Categories	Roles	Competencies
	Implementing design solutions and contributing to their evaluation	Computer literacy
	Managing challenging problems related to the structure of the building	Ability to produce creative and innovative strategies and solutions
Technical Officer	Checking whether the plan is in accordance with guidelines, rules and regulations	Ability to practice good ethical standards and codes of conduct
	Checking the building plan and checking whether it fulfils the basic requirements of building codes	Communication skills
	Being able to interpret drawings, specifications, codes, standards and regulatory requirements, and carrying out site inspections	Good team work
	Supervising and inspecting sites	Decision making skills
	Checking the compliance of the designs with the building regulations	Problem solving skills
	Checking the technical requirements	Report writing and analysing skills
Public Health Inspector	Inspection and supervision	Report writing skills, technical knowledge
	Ensuring the health and safety aspects of a building	Practicing good ethical standards and codes of conduct
	Negotiating with parties when issues arise	Communication skills and good team work

According to Table 2, skills, ethics and knowledge on technical and legal aspects of buildings are the features essential to handle work effectively, be competent and survive in the industry. However, competencies and the roles of the parties involved have to be compatible with the tasks they are expected to carry out.

The main role of the town planner is the design of new towns and cities by balancing the needs of communities and the environment. As a result, the planning office has to issue a preliminary clearance after checking whether the particular building is suitable for the location. To carry out that task, town planners are expected to be knowledgeable about ethical standards and codes of conducts, have a keen knowledge on the places and possess space improving and managing and analytical skills so that innovative and useful solutions to planning problems could be found. They also need to possess negotiation, strategic planning, problem solving and good communication skills and be good at creative thinking.

The architect has to develop the designs complying with the rules and regulations of the country or the area while contributing towards sustainable development. Hence, they need to have up to date knowledge about building codes, rules and regulations. Moreover, their ability to ensure good ethical standards, and abide by codes of conduct may make the BC process better organized and more efficient. Some of the other competencies expected from architects in the design of the required product are creativity, innovative thinking, communication skills and the application of appropriate conceptual and practical methods.

The main role of the engineer in the BC process is to provide structural stability for the building work to ensure health and safety of the occupants. Furthermore, the engineer has to contribute to the design and development of the building by providing engineering solutions. He therefore has to be competent with conflict avoidance and possess management skills, communication skills,

knowledge and an understanding of construction work and structural stability. One essential competency that has to be practiced not only by engineers but also by all other professionals in the country is the adherence to good ethical practices.

The main role of the technical officer is the checking of the plan to see whether it complies with the building rules and regulations so that the approval could be granted for the building work. Thus, good ethical standards; communication skills; problem solving, report writing and analysing skills; were identified as the competencies required by technical officers to accomplish their tasks.

The most important role of the public health inspector is found to be the ensuring of the health and safety aspects of a building by inspecting it and supervising its construction. Consequently, a PHI will require as competencies report writing skills, ability to work in a team, communication skills, good ethical practices and technical knowledge to effectively carry out his duties and take up the responsibilities.

To maintain ethical standards, the professionals will require predominantly communication skills, analytical skills and knowledge on the subject matter. These competencies will pave the way for effective PAP in Sri Lanka while mitigating corruption and malpractices. An effective PAP will have the potential to ensure a good quality construction that will comply with the standards and contribute to sustainable development by satisfying environmental and cultural requirements.

Sri Lanka has so far been unable to maintain high standards, and deal with health and safety issues, technical issues, additional costs claimed as compensation, claims, unauthorized building work and malpractices. However, it is revealed that these drawbacks can be addressed if BC surveyors could get involved in the process.

The existence of buildings that do not comply with the required standards will have a huge negative impact on the society as well as on the country. In fact, adherence to building codes and standards will simply lead to sustainable and energy efficient building work that will ensure good living conditions for the inmates. Therefore, by getting the new professional, BC surveyor, involved in each stage of PAP, it would be possible to address the loopholes in the process.

BC Process Suitable for Pre-Contract Stage

Table 3 illustrates the process suggested for BC in Sri Lanka. It was developed after analysing the shortcomings of the current system, personnel involved and the competencies required at each stage.

Table 3: Proposed process for BC

Steps	parties Involved	Procedure Suggested
Step 1 Commencement of the process	Applicant	Introduction of a "**One stop shop"** concept in place of obtaining clearance from the relevant authorities
Step 2 Submission made for preliminary planning clearance	One organization (one stop shop)	Introduction of a "**One single submission**" for preliminary plan approval in place of submitting multiple clearance reports with the application
Step 3 Local authority approval for	Local authority	Granting of the approval if all the documents comply with the relevant

plan clearance		rules and standards
Step 4 Submission of the plan for approval	Town planner architect, engineer	A**ssigning the responsibility for the design and construction to the signatories** in place of getting the design certified by professionals.
Step 5 Checking of the application and other documents	Technical officer, public health inspector, third party reviewer	Introduction of the **appointment of a third party reviewer** to ensure effective results, in place of obtaining analysis reports from relevant government officials
Step 6 Approval (by the local authority)	Commissioner, technical officer, planning officer, public health inspector	Granting the approval if all the documents comply with the relevant standards.
Step 7 Planning committee approval (in a regional authority /UDA)	Town planner, architect engineer, urban commissioner, a member from the relevant authority	Providing the final decision on the approval/ rejection by considering the issues that have arisen
Step 8 Issuing of the building permit	Urban Development Authority /Regional Authority private company	Obtaining the building permit from one particular authority, and authorizing **private authorities** for continuous monitoring
Step 9 Issuing of the certificate of conformity	BC surveyor	Making the **BC surveyor** in charge of the certificate of conformity

In the proposed process for BC, the one stop shop concept is introduced which gets all relevant authorities at one table in the form of an integrated approach. As a result, relevant approvals are granted from one single place and instructions given to the applicant. This way, the quality and the transparency of the BC process can be improved while facilitating standardization and corporation among parties. Therefore, the collaborative involvement of professionals will ensure the quality of the process.

Malpractices and corruption are prevalent in the PAP during the stage in which the application and other documents are checked. Therefore, in order to mitigate such incidents, it is suggested to appoint a third party reviewer. This will also ensure the accuracy of the work done by the technical officer who checks the compliance of the design of the proposed building with the relevant standards and the public health officer who checks on the health and safety aspects of the building. A private sector party can be arranged in place of a technical officer or a public health officer to issue building permits. However, to ensure that private parties comply with standards and regulations, they need to be registered before they carry out site inspections.

The certificate of conformity is issued in the final stage certifying that the building work is in accordance with the relevant rules and regulations. A BC surveyor who is competent and has the ability to take responsibility has to be appointed for this task. It was revealed at the interviews that currently, the architect and engineer cannot be held liable for any modifications made by the client to the design or the technical aspects of the building under construction although they are responsible for the design and technical aspects of the construction during the pre-construction stage. Hence, no person/party can be held responsible for the design changes done after the

design has been approved. This, issue can be overcome by the introduction of the BC surveyor who can ensure that no health and safety regulations have been violated once the building has been completed.

5. CONCLUSIONS AND RECOMMENDATIONS

In Sri Lanka, owing to the loopholes in the existing BC procedure, corruption and malpractices can increase as the construction sector develops. A proper BC process will assure the quality and standards of a project and the involvement of professionals will lead to a successful project with good quality. Therefore, the need for professionalism in BC has become crucial. Furthermore, by getting BC professionals involved in the process, transparency of the process will improve, making it more effective and efficient. A model with nine steps was developed after analysing the existing BC process and the competencies required from the professionals at each stage, towards achieving the aim of the research which was to propose a BC process for Sri Lanka that will have professional involvement.

REFERENCES

1. Aarons, T. (2014).A balanced approach: The work of the Building Regulations Advisor committee. *RICS Building Control Journal*, *2014*(Nov/Dec), 8.
2. Ali, A.S., & Woon, C.J. (2012). Training and development of building surveyors in Malaysia. In *Proceedings of the RICS COBRA 2012 in Las Vegas, Nevada, USA*, (pp. 777-784).
3. Ali, A.S., & Woon, C.J. (2013). Issues and challenges faced by building surveyors in Malaysia.*Structural Survey, 31*(1), 35 – 42. Doi :10.1108/02630801311304404.
4. Amaratunga, D., Baldry, D., Sarshar, M., & Newton, R. (2002). Quantitative and qualitative research in the built environment: application of "mixed" research approach. *Work Study*,*51*(1), 17-31. doi:10.1108/00438020210415488.
5. Baiche, B., Kendrick, C., & Ogden, R. (2007). Air-tightness in the recent Part L of the Building Regulations: The case of buildings with metal envelopes. *Structural Survey, 25*(5), 355-374. Doi : 10.1108/02630800710838419.
6. Baiche, B., Walliman, N., & Ogden, R. (2006). Compliance with building regulations in England and Wales. *Structural Survey*, *24*(4), 279-299.doi:10.1108/02630800610704427.
7. Bayraktaroglu, S., Kutanis, R. Ö., Özdemir, Y., Alpaslan, S., & Dil, E. (2006). Methodology preference in information congresses: Qualitative research method. 5. In *Proceedings of the Congress on Knowledge, Economics and Management, Kocaeli, 1*, (pp. 594-601).
8. Billington, M. J. (1986). Building control: an update. *Property Management*, *4*(2), 116-119. doi:10.1108/eb006616.
9. Clarkson, T. (1988). Local authority building control. *Structural Survey*, *6*(1), 5-9. doi:10.1108/eb006268.
10. Clement, T. (2015). Keeping an open mind: The impact of market changes on local authority building control. *RICS Building Control Journal*, *2015*(Nov/Dec), 14-15.
11. Conlon, M. (2014). Only the best is good enough: Education and training are key to taking the profession forward. *RICS Building Control Journal*, *2014*(Sep/Oct), 4.
12. Conlon, M. (2015). A time of change: political change, international standards and training. *RICS Building Control Journal*, *2015*(April/May), 4.
13. Davies, H. (2001). Environmental benchmarking of Hong Kong buildings. *Structural Survey*, *19*(1), 38-46. doi:10.1108/02630800110384220.

14. Dickinson, R. (1999). The qualified and professional building surveyors in Malaysia. *The Surveyor*, *34*(1), 28.

15. Douglas, J. (1996). Building performance and its relevance to facilities management. *Facilities*, *14*(3/4), 23-32. doi:10.1108/02632779610112508.

16. Dounis, A. I., & Caraiscos, C. (2009). Advanced control systems engineering for energy and comfort management in a building environment—A review. *Renewable and Sustainable Energy Reviews*, *13*(6-7), 1246-1261.doi: 10.1016/j.rser.2008.09.015.

17. Elson, S. (2015). Changing liabilities: Tougher fines and sentencing for health and safety breaches are on the way under regulations reforms. *RICS Building Control Journal,2015*(April/May), 10-11.

18. Everall, P. (2015). Model Answers: The way that different councils are dealing with the increasing squeeze on services. *RICS Building Control Journal*, *2015*(Nov/Dec), 12-13.

19. Fernando, W.N.L., Perera, B.A.K.S., & Rodrigo, M.N.N. (2017). Introduction of a systematic process for building control in Sri Lanka. In *Proceedings of 6th World Construction Symposium: What's New and What's Next in the Built Environment Sustainable Agenda? in Sri Lanka*, (pp. 254-262).

20. Finch, E. (1998).Remote building control using the Internet. *Facilities,16*(12/13), 356-360. doi: 10.1108/02632779810235672.

21. Foolkes, A. (2015). Crossing Boundaries: The role of the building control body as part of the project team. *RICS Building Control Journal*, *2015*(April/May), 14.

22. Gunduru, O. (2015). Learning from disaster: A development in Izmir has been designed to mitigate earthquake risk and embrace sustainability. *RICS Building Control Journa*l, *2015*(Nov/Dec), 7.

23. Heaton, M. (2009). Building palaeopathology: practical applications of archaeological building analysis. *Structural Survey*, *27*(2), 119-137. doi:10.1108/02630800910956452.

24. Howard, M., Barrett, P., & Oldbury, D. (1992). Pest birds: The role of building design and maintenance. *Structural Survey*, *10*(1), 38 – 44. doi: 10.1108/02630809210031717.

25. Knight, P. (2015). Future proof homes: The eco credentials of new hoses in Kent. *RICS Building Control Journal*, *2015*(Nov/Dec), 9.

26. Lowe, R., & Bell, M. (2000). Building regulation and sustainable housing part 2: Technical issues. *Structural Survey*, *18*(2), 77-88. doi:10.1108/02630800010330121.

27. Meijer, F., &Visscher, H. (2008). Building regulations from an European perspective. In *Proceedings of COBRA 2008: The Construction and Building Research Conference of the Royal Institution of Chartered Surveyors*, London.(pp. 1-11). Retrieved from https://s3.amazonaws.com/academia.edu.documents/41951067/Building_regulations_from_an_European_pe20160203-30232-13idutj.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1537185368&Signature=VbRUJYiqlsxHe8NO4qxpzdRe3wA%3D&response-content-disposition=inline%3B%20filename%3DBuilding_regulations_from_an_European_pe.pdf

28. Mills, G.C. (1987). Building control with NHBC. *Structural Survey*, *5*(4), 335-339. doi: 10.1108/eb006264.

29. Morgan, M. (2016). New Wheels: Energy conservation and generation issues. *RICS Building Control Journal*, *2016*(June/July), 8-9.

30. Niemeijer, B. (1989). Urban Land-Use and Building Control in the Netherlands: Flexible Decisions in a Rigid System. *Law & Policy*, *11*(2), 121-151. doi:10.1111/j.1467-9930.1989.tb00023.x

31. Oloyede, A. (2015). An explosive situation. *RICS Building Control Journal*, *2015*(Feb/March), 19.

32. Pedro, J.B., Meijer, F., & Visscher, H. (2009). The Portuguese building regulation system: a critical review. *International Journal of Law in the Built Environment*, *1*(2), 156-171.doi: 10.1108/17561450910974759.

33. Pedro, J.B., Meijer, F., & Visscher, H. (2010). Building control systems of European Union countries: A comparison of tasks and responsibilities. *International Journal of Law in the Built Environment*, *2*(1), 45-59. doi: 10.1108/17561451011036513.

34. Pitt, P. H. (1984). Private certification of building control. *Structural Survey,2*(3), 212-215. doi: 10.1108/eb006186.

35. Rumary, E. (2015). Keeping up to date: the importance of continuing professional development for building control surveyors in the built environment sector. *RICS Building Control Journal*, 2015(April/May), 8.

36. Sabri, B., Ujang, N., Arif, A., & Aripin, A. S. (2017). Measures in curbing poor compliance to building control regulation among renovated terrace houses. *International Journal of Law in the Built*, *9*(3), 256-271. doi: 10.1108/IJLBE-06-2017-0018.

37. Smith, J., Smith, B., & Mitchell, G. (2013). Review and analysis of the residential building certification process in south east Queensland. *Structural Survey*, *31*(1), 21-34. doi:10.1108/02630801311304396.

38. Smith, P. (2016). Attention to detailing: Internal wall insulation offers opportunities for energy saving, but the choice of product requires care. *RICS Building Surveying Journal,2015/2016*(Dec/Jan), 20-22.

39. Tebbit, J. (2015). Cracking the code: Ten years on, pre-tested party wall and floor design patterns have proved their worth in ensuring new homes meet sound regulations. *RICS Building Control Journal*, *2015*(April/May), 16-17.

40. Thompson, A. (2014). Investing in the future: new training initiatives are aiming to encourage new entrant to local authority building control. *RICS Building Control Journal*, *2014*(Sep/Oct), 8.

41. Thompson, A. (2015). Safe and sound: The role of building control at the Glastonbury festival. *RICS Building Control Journal*, *2015*(June/July), 8-9.

42. Wahab, A. B., & Lawal, A. F. (2011). An evaluation of waste control measures in construction industry in Nigeria. *African Journal of Environmental Science and Technology*, *5*(3), 246-254. doi: 10.4314/ajest.v5i3.71933.

43. West, S. (2016). Opening up success: Flexible local rules will provide the solution. *RICS Building Control Journal*, *2016*(Feb/March), 8-9.

44. Wilkinson, S. (2014).Taking stock of emissions: the importance of assessing the uptake of sustainability measures in buildings over time. *RICS Building Surveying Journals*, 2014(July/Aug), 16-17.

45. Wilson, R. (1988). The LDSA and the benefits to builders and developers. *Structural Survey*, 6(3), 203-206. doi: 10.1108/eb006283.

46. Wood, A., & McGahey, G. (1995). The new face of building control. *Structural Survey*, 13(4), 21-22. doi: 10.1108/02630809510104867.

47. Yau, Y. (2009). On the proposed private certification of building works in Hong Kong. *International Journal of Law in the Built Environment*, *1*(3), 221-233. doi: 10.1108/17561450911001270.

48. Yin, R.K. (1994). Discovering the future of the case study method in evaluation research. *Evaluation Practice,15*(3), 283-290. doi: 10.1177/109821409401500309.

CONSTRUCTION ACCIDENTS AND UNSAFE BEHAVIOURS OF CONSTRUCTION WORKERS

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ABSTRACT

The construction industry is known to be one of the most accident-prone work sectors across the world. Construction industry being highly fragmented, marginalizes the efforts to maintain the status of the label; "safety first". Thus, accident rates are high at construction industry.

The research attempts to investigate the rate of accidents and its significant reasons aiming to recommend behavior-based safety framework for construction industry in Sri Lanka. Both secondary and primary data were tapped to gather required data. The secondary data were extracted from the records available in year 2014-2015 at the office of the commissioner for workmen's compensation and the industrial safety division of the Department of Labour (DoL) to analyse the rate of under reporting. The primary data were obtained through expert interviews to explore the gaps in reporting system and to identify mechanisms to reduce under reporting.

Results showed that highest rate of accidents (24%) have been reported in Construction industry. Further 15 unsafe acts and 14 influential factors that workers' tend behave unsafe manner were established.

The findings provide an insight of occupational safety practices in construction industry and it can be used as an eye opening flash for safety law makers and practitioners to revisit the existing regulations and practices

Key words: *construction accidents, construction industry, behaviour-based safety, construction workers*

1.0 INTRODUCTION

Most of the construction accidents are due to outdoor operations, work-at-heights, use of many different resources, poor working conditions, no steady employment, tough environments (e.g. noise, vibration, dust, handling of cargo and direct exposure to weather), complicated on-site plants and equipment operations coupled with workers' attitudes and unsafe behaviours (Choudhry & Fang 2008; Oswald et al., 2013; Forteza et al. 2017). At site level, construction activities are physically dispersed across various locations. Thus, supervising and monitoring safety issues in the workplace is much more challenging. Moreover, the rapidly changing nature of the construction industry exacerbates the situation especially in developing countries including in Sri Lanka.

Broadly, accidents can happen due to unsafe behaviours (human error) and unsafe conditions, or a combination of both. Many countries including Asian countries disclose that most of the accidents are due to unsafe acts or unsafe behaviors of workers. These unsafe acts and behaviors are operating without authority, working without personal protective equipment, wearing

dangling clothes, unsafe handling such as lifting, carrying and placing, and unsafe handling of hazardous material. Therefore, behaviours have always had a role in occupational safety. For instance, French and Geller (2012) recommended that, when designing and evaluating safety processes, attention needs to be in three basic domains; namely, environment, person, and behaviour. Behaviours are regarded the primary, and sometimes only, tools for survival, remaining today as the last tool when all else fails (Galloway, 2012). Galloway (2012) further explained that when proper tools or systems were lacking, workers should behave in a manner for self-preservation. Thus, promoting safe behaviour at work is a critical part of the occupational safety.

Good safety behaviour, together with management systems and operational procedures can minimise unsafe acts in order to reduce the potential for accidents (Institution of Occupational Safety and Health [IOSH], 2014). As a result, Behaviour Based Safety (BBS) has emerged creating a new era of research in the field of construction safety.

This research is focused to investigate construction accidents aiming to propose a BBS model to enhance safety in the construction industry.

2.0 LITERATURE REVIEW

2.1 Construction Accidents

Approximately 350,000 workers die every year while they are working (Rubio et al., 2005). Out of these recorded numbers, 60,000 cases occur in the construction industry. Therefore, a construction worker dies at every 10 minutes somewhere in the world, labelling the industry as one of the most hazardous and accident-prone industries worldwide. This fact is often proven by the statistics relating to construction accidents.

According to statistics in 2011-2012, there were 1.4 million lost working days were reported in the UK construction industry (HSE, 2013). Among them, 818 thousand were due to ill health and 584 thousand were due to workplace injury. The average fatal accident frequency rate in the Indian construction industry is 15.8 for 1000 employees (“Webindia123”, 2014). According to Labour department of the government of Hong Kong special administrative region (2014), the number of reported construction accidents in Hong Kong, in the year 2013, was 3332 with 37 fatalities. In Malaysia, 69 deaths, 83 non-permanent disabilities, and 12 permanent disabilities were reported in year 2013.

Though the construction output is less in Sri Lanka, the magnitude of the accident rate in the construction industry is still significantly high (De Silva & Wimalaratne, 2012). The annual accidents in the construction sites were 750-900, and among them, 50-60 were fatal (Amarasinghe, 2010). Furthermore, this annual figure represented more than 30% of accidents higher than in the other industries in Sri Lanka (Amarasinghe, 2009). Thereby, Sri Lankan construction industry is in a proven need to adhere to safety more than in any other industry with this high rate of accidents.

Another challenge the country faces today is unauthorized constructions that can cause massive accidents and giving a huge safety threat; not only for construction workers, but also all users. Most recent incident reported was the collapse of a seven storey building in Wellwatta. Under these circumstances, construction safety should go beyond its current focus on “safety first,” which replicates the “safety management at site level”. However, lack of attention on R&D has undermined the innovative approaches for enhancing safety.

2.2 Unsafe behaviour of construction workers

There is no globally accepted definition for unsafe behaviour. Most commonly, it has been defined in focus on unaccepted practices, which have the potential for producing future accidents and injuries. For instance, any conduct at the workplace, which deviates from accepted safety norms, can be unsafe for the worker as well as the other employees on site. Furthermore, ergonomically wrong movements such as working at improper speeds, exceeding the prescribed speed limits and improper posture for tasks, make the worker unsafe, for they can cause musculoskeletal disorders (Da Costa & Vieira, 2010). Aksorn and Hadikusumo (2007) explained that servicing equipment which is in operation, for instance, refuelling a machine without first turning off the engine could cause a severe accident. Also, not wearing PPE may increase chances of getting injured and lack of use of PPE has become a critical concern in workplaces (Cavazza & Serpe, 2009). Similarly, 15 distinctive unsafe acts of unsafe behaviour have been identified (Figure 1).

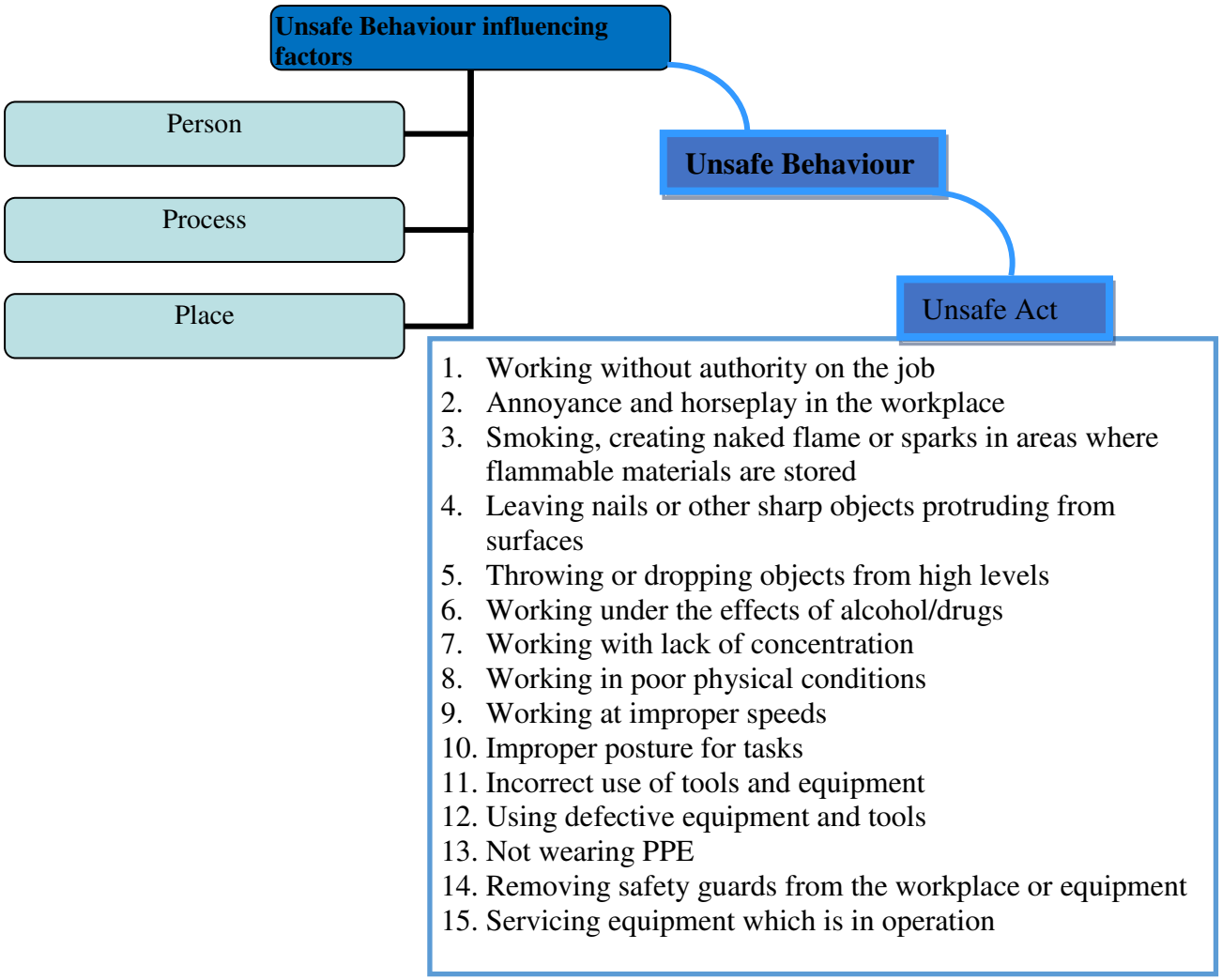

Figure 1: Unsafe Acts of Construction Workers

The factors that influence unsafe behaviour can be mainly categorized into three main constitutes as Person (Individual Dynamics), Process (Work Environment) and Place (Organizational Safety Culture). Fifteen influences were highlighted under those categories as follows;

- Person- age, educational level, experience, Alcohol/drug abuse, Psychological distress, income and attitude
- Process - hazardous operation, unsafe conditions and hazardous equipment
- Place - safety procedures & rules, Legislation related to safety, management commitment, safety communication, employee involvement in safety,

3.0 Research Methodology

A literature review was carried out to gain an in-depth understanding of the research problem. Literature synthesized construction accidents, unsafe behaviour of construction workers, factors influencing unsafe behaviour and the techniques to develop a predictive model in accordance with the research problem. Under the three main categories, a total of 15 factors influencing for unsafe behaviour and 15 unsafe acts by a construction worker were identified through an in-depth literature review.

The first phase of data collection was focused on investigating the rate of accident in Sri Lankan construction industry. For this purpose, all accident records maintained at the office of the commissioner for workmen's compensation in year 2014-2015 (January 2014 to January 2015) were collected as it was the latest completed data set that is accessible.

In the second phase of the data collection, a pilot study was carried out to validate the literature findings and further to identify specific variables that could be relevant under local practices. Interviews were held with five managerial level experts, each having more than fifteen years of experience the fields of occupational safety and projects management in the construction industry. Each interview was held for 30-45 minutes and followed three steps; (1) brief introduction to the research, (2) details of identified 15 unsafe acts and (3) 15 influential factors were provided. The factor 'Sex' was removed by the experts as the female workforce is negligible in the country.

A questionnaire was developed to gather unsafe acts performed the construction workers who work under C1 contractors. However, considering the time constraint, the C1 building contractors who have undertaken high-rise building projects which are meant to as highly complex and have a high potential for safety risks, within the Colombo district were selected as the population. Out of the 54 C1 contractors registered in CIDA, a total of 20 C1 Building contractors running projects within Colombo district were recognized by examining the contractors' list. Similar high rise building construction sites managed by the selected contractors were identified, and from each site, 20 construction workers were randomly selected using simple random sampling. Hence, the size of the target sample was 400. The respond rate of the survey was 71%.

4.0 Results and Discussion

The highest rate of accident (24%) is reported in the construction sites in Sri Lanka (refer Table 1) as similar in many other countries. Out of which, 39% are fatalities. The construction industry thus needs an urgent attention to rectify the situation. Strong leadership led by the safety manager is believed to be one of the pillars to control site safety. In this regard, employing a qualified and competent safety manager is a critical point to be addressed.

Table 1: Number of accidents in different industries/ economic sector

Economic Activity	Accidents		F		PTD		PPD		TD	
	No.	%	No.	%	No.	%	No.	%	No.	%
Construction	**72**	24	28	39	4	6	31	43	9	13
Printing	17	6	0	0	0	0	1	6	16	94
Hotels	17	6	1	6	0	0	1	6	15	88
Metal Fabrication	9	3	2	22	0	0	6	67	1	11
Mineral Processing and quarry	9	3	4	44	0	0	5	56	0	0
Manufacturing of:										
Tea	43	15	3	7	1	2	17	40	22	51
Wood & Wood Products	23	8	0	0	2	9	18	78	3	13
Garments	23	8	2	9	0	0	13	57	8	35
Plastic/ Polythene & Rubber Products	13	4	1	8	1	8	5	38	6	46
Fiber & Fiber Products	13	4	1	8	0	0	10	77	2	15
Others	57	19								
Total	**296**									

The significant influential factors for unsafe behavior are analyzed using mean rating of 1-5 scale. The findings are shown in Table 2. Unsafe conditions, hazardous operations and age are identified as the top most three factors for causing unsafe acts. 13.7% of the responsive sample was workers older than 50 years of age. Workers who were younger than 25 years of age accounted for 14.8% of the responsive sample. The mean age of the workers in the sample was 36.3 years.

Table 2: Unsafe Behaviour Influencing Factors

No	**Factor**	**Mean average**
1	Age	3.0
2	Experience	3.2
3	Alchohol/Drug abuse	2.0
4	Education	2.7
5	Attitudes to OSH	1.7
6	Psychological distress	1.8
7	Income	3.4
8	Hazardous operations	3.4
9	Unsafe conditions	3.6
10	Hazardous equipment	3.1
11	Procedures and rules for OSH	1.7
12	Management commitment	1.9
13	Employee involvement in safety	1.9
14	Communication	1.9

When years of experience were considered, 20.6% of the responsive sample had work experience more than 20 years. Similarly, 24.6% had work experience less than 5 years. The average work

experience of a worker of the responsive sample was 13.2 years. The education levels of the responsive sample varied from no formal education to the General Certificate of Education (GCE) Advanced Level/National Vocational Qualification (NVQ) level 3. 5.8% of the responsive sample had no formal education while 13% had only a primary education. 21% of the responsive sample reported to have an education up to GCE Advanced Level/NVQ level 3. More than 50% of the workers are exposed to unsafe conditions, hazardous operations, poor income levels, lack of experience and hazardous equipment.

Unsafe acts resulted from unsafe behaviours of the construction workers were analyzed as per the given scale (Table 3). Improper posture for tasks, not wearing PPE, and improper speeds for tasks have the highest mean ratings of occurrence.

Table 3: Unsafe acts of construction workers

Unsafe Act	Description	Mean occurrence
1	Improper posture for tasks	3.11
2	Not wearing PPE	2.40
3	Working at improper speeds	2.39
4	Incorrect use of tools and equipment	2.24
5	Working in poor physical conditions	2.07
6	Throwing or dropping objects from high levels	2.06
7	Annoyance and horseplay in the workplace	1.96
8	Working without authority on the job	1.81
9	Removing safety guards from the workplace or equipment	1.75
10	Working with lack of concentration	1.66
11	Using defective equipment and tools	1.53
12	Working under the effects of alcohol/drugs	1.31
13	Leaving nails or other sharp objects protruding from surfaces	1.31
14	Servicing equipment which is in operation	1.25
15	Smoking, creating naked flame or sparks in areas where flammable materials are stored	1.23

48% of the respondents reported that they use improper posture for tasks all of the time at work and 21% of the sample did not wear PPE to work at all. 18.4% of the sample reported working at improper speeds most of the time.

Both improper posture and speed for tasks can lead to acute trauma such as cuts or fractures due to accidents in the workplace (Da Costa & Vieira, 2010, EU-OSHA, n.d.). These two ergonomically wrong acts may be due to the lack of application of ergonomics in the construction industry in Sri Lanka. The limited knowledge of workers regarding ergonomics and related problems (Loo & Richardson, 2012) may also contribute to the high occurrence rate.

Not wearing PPE is the other most frequent unsafe act committed by the construction workers. This act is common among workers in the other industries as well (Ahmed & Azhar, 2015). The high frequency of occurrence of the unsafe act can most probably be due to the poor risk

perception of the workers and discomfort associated with wearing PPE, especially in a tropical country like Sri Lanka.

Incorrect use of tools and equipment frequently during work was reported from 13.7% of the responsive sample. Further, 5% of the workers reported that they work in poor fitness most of the time while 10.8% reported to be throwing or dropping objects from high levels most of the time during work. Annoyance and horseplay in the workplace was common among 14% of the responsive sample. Responses also revealed that 3% of the responsive sample works without authority on the job, 3.9% remove safety guards from the workplace or equipment, and 5.7% work with without concentration most of the time.

The least common unsafe acts among the sample were smoking/creating naked flame or sparks in areas where flammable materials are stored, servicing equipment which was in operation, and leaving nails or other sharp objects protruding from surfaces. According to the responses, 82.7% of the sample never created naked flame around flammable material. During work, 79.4% always withheld from servicing equipment which is in operation, and 79.1% of the sample never left sharp objects protruding from surfaces.

Thus, it is important to establish strategies to minimize influential factors of unsafe behavious aiming to control the resultant unsafe acts that can lead to accidents and injuries. The Figure 2 illustrates how those unsafe acts can be modeled with its influential factors and subsequent unsafe acts.

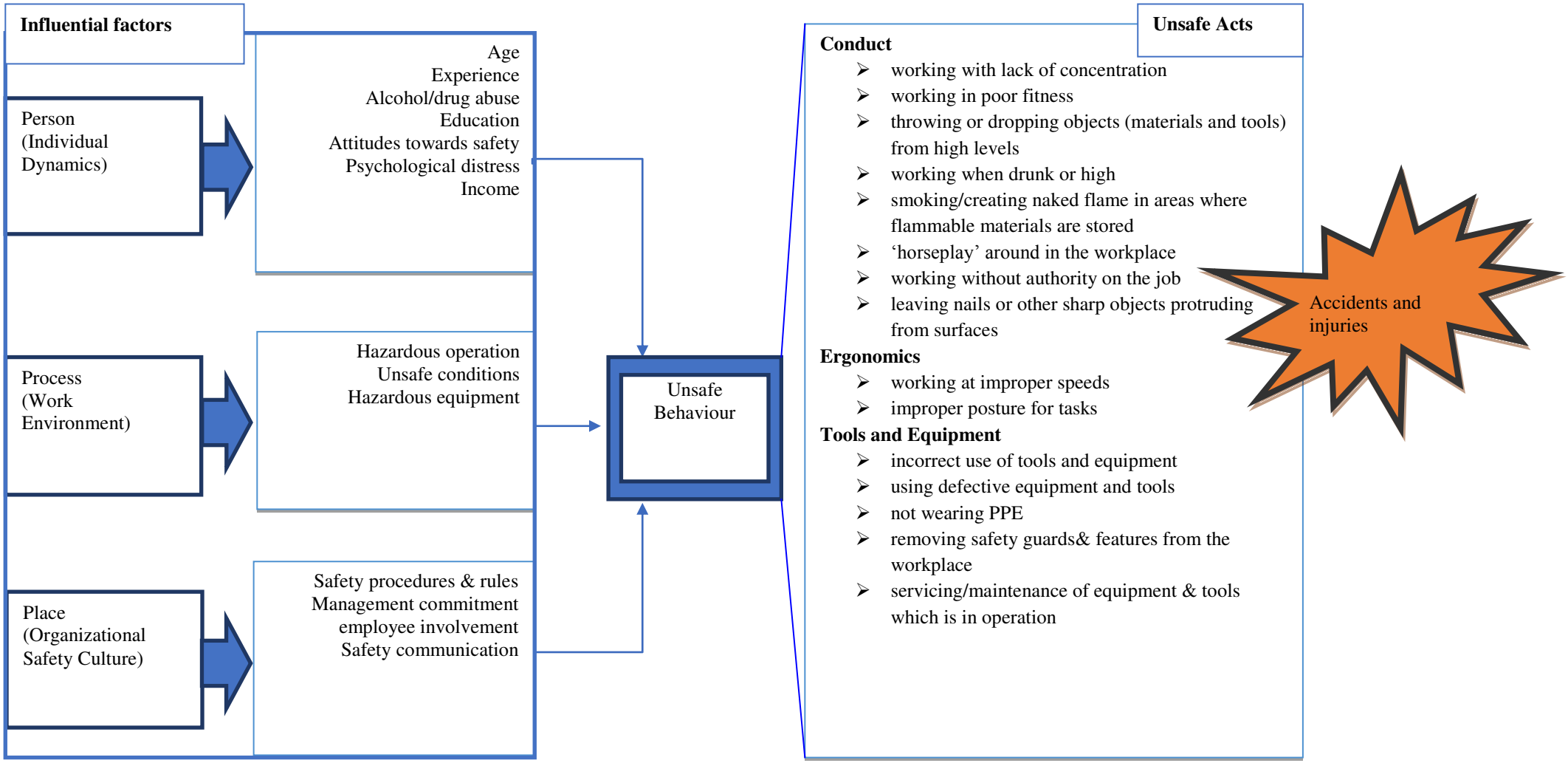

Figure 2: The model of unsafe behaviour of construction workers

5.0 Conclusions

Factories Ordinance No. 45 of 1942 is the country's legal entity that governs safety and health of the employees. Research found that the construction industry reported the highest number of accidents. Among them partial permanent disabilities (PPD) has recorded the highest incidents.

Research established fifteen distinctive unsafe acts performed by the construction workers on sites. Results revealed that the most common unsafe acts among the construction workers were using improper posture for tasks, ignoring to wear PPE, and using improper speeds for tasks. It was observed that poor management, communication and training are the main causes from which the unsafe acts. If workers do not understand why they need to use correct posture and speeds in tasks and wear PPE, they are more likely to refuse to comply with the need. Effective communication and consultation about the need for ergonomically sound posture and speed for tasks, and PPE at work, better training and reasonable adjustments to the workplace and PPE can reduce the occurrence of these unsafe acts.

Thus, these findings can be used as benchmarking information by the law makers to redesign strategies that can be used to uplift the image of the safety of employees. The law makers can further get more focus on behavior based safety in finding solution to enhance the site safety. Different aspects of managing construction safety have been introduced by fifteen behavioural influencing factors that are focused to individuals, process and workplace. Thus, when considering construction safety, both individual workers and the organization have roles to play. These roles need to be distinguished and established accordingly.

This may not reflect the changing nature of unsafe behaviour and influential factors over time. The cross-sectional data can be affected by the respondent's predisposition of any events that have happened in the past or by the mental position at the time of participating in the survey.

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6.0 REFERENCES

1. Ahmed, S. M., & Azhar, S. (2015). Addressing the issue of compliance with personal protective equipment on construction worksites: A workers' perspective. Retrieved from: http://ascpro0.ascweb.org/archives/cd/2009/paper/CPRT176002009.pdf

2. Amarasinghe, N.C. (2009), Importance of reporting accidents and illness, speech for National Safety Conference 2009 on "Safe Work Promotes Healthy Life", Colombo, Sri Lanka, 7 October. Amarasinghe, N.C. (2010, October), Deaths due to accidents in workplaces, Lankadeepa, p.1

3. Cavazza, N., & Serpe, A. (2009). Effects of safety climate on safety norm violations: exploring the mediating role of attitudinal ambivalence toward personal protective equipment. Journal of Safety Research, 40(4), 277-283.

4. Choudhry, R. M., & Fang, D. (2008). Why operatives engage in unsafe work behavior: Investigating factors on construction sites. Safety Science, 46(4), 566584.

5. Da Costa, B. R., & Vieira, E. R. (2010). Risk factors for work- related musculoskeletal disorders: a systematic review of recent longitudinal studies. American Journal of Industrial Medicine, 53(3), 285-323.

6. De Silva, N. and Wimalaratne, P.L.I., (2012). OSH management framework for workers at construction sites in Sri Lanka. Engineering, Construction and Architectural Management, 19 (4), 369-392

7. French, A.R. and Geller, E.S. (2012). Creating a culture where employees own safety Retrieved from: http://www.ifap.asn.au/Documents/Publications/SafetyWA%202012/safetywagellerapril_web2012.pdf.

8. Galloway, S.M., (2012, December). Understanding the roles of behaviour in safety. Retrieved from: https://ohsonline.com/Articles/2012/12/01/Understanding-theRoles-of-Behavior-in-Safety.aspx

9. Health and Safety Executive. (2013). Construction Industry. Retrieved from: http://www.hse.gov.uk/statistics/industry/construction/.

10. Institution of Occupational Safety and Health. (2014). Looking for higher standards: Behavioural safety improving performance. Retrieved from: www.iosh.co.uk/freeguides.

11. Loo, H. S., & Richardson, S. (2012). Ergonomics issues in Malaysia. Journal of Social Sciences, 8(1), 61.

12. Oswald, D., Sherratt, F., & Smith, S. (2013). Exploring factors affecting unsafe behaviours in construction. In Arcom Conference (pp. 335-344).

13. Rubio, M. C., Menéndez, A., Rubio, J. C., & Martínez, G. (2005). Obligations and responsibilities of civil engineers for the prevention of labor risks: references to European regulations. Journal of Professional Issues in Engineering Education and Practice, 131(1), 70-75.

14. Webindia123. (2014). Construction Sector accounts for highest accident rate: Experts. Retrieved from: http://news.webindia123.com/news/articles/India/20100526/1512790.html

FACTORS AFFECTING HEALTH AND SAFETY ISSUES IN BUILDING CONSTRUCTION SITES IN SRI LANKA

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ABSTRACT

With the rapid development in Sri Lanka, many infrastructure development projects are proceeding. As a result, a considerable number of people are being employed in construction sites. Therefore, frequency of occurring accidents is increasing. Investigation on an effective method to improve the safety and health practices and to reduce the occurrence of fatal accidents and non-fatal accidents in construction sites in Sri Lanka is an urgent need. Objective of this study is to identify the most influencing factors on the construction accidents.

It was found that a significant correlation of "conducting safety training on Personal Protective Equipment (PPE)" with "productivity target" ($p<0.05$), indicating safety training on Personal Protective Equipment (PPE) for every worker, who is working at site (for all direct, hired & sub contractors' workers) is an effective method to improve site safety practices while enhancing productivity. In addition, there was a significant correlation between "conducting safety training on PPE" and "supervisor's safety behavior" ($p<0.01$), between "conducting safety training on PPE" and "displaying safety boards at site"($p<0.01$) indicating that visual instructions and proper safety practices by supervisors, will be helpful to enhance the use of PPE by workers in building construction sites.

Key words: *Site safety, Health practices, Construction sites.*

1. INTRODUCTION

In any country, construction industry is considered as one of the main industries and identified as a dangerous place, with innumerable hazards and dangers that can cause illness, injury or death to a site worker. Therefore, the workers of construction industry are at greater risk than workers in other industries. Accidents on construction sites are still a major problem in this industry. The increasing level of health and safety legislation over the past two or three decades has placed a highest level of responsibility on site managers and supervisors for ensuring that the construction site is as safe as reasonably possible for those who work on it. Every accident leads to tragedies such as injury or death to person, damage to property and the environment and associates direct and indirect cost, as well as effort and effectiveness of the construction work. In addition, it leads to delay the construction process. Therefore, the negligence of safety leads to loss of productivity, accidents, poor health issues and several disadvantages to construction industry.

Although the risk is high in construction industry, it could be minimized by improving construction site safety. To achieve construction site safety, understanding on root causes for high risk of construction is very important. The root cause might be contractors' attitudes towards the construction safety or workers behavior towards the construction safety. In Sri Lanka there are considerable number of accidents occur in construction sites due to various reasons, such as carelessness, lack of disciplines, poor communication, lack of supervision, distraction, lack of

training. However, the site safety level is different in site to site due to many reasons: safety policies available for the organizations are different, financial allocation for site safety, facilities to train the workers, consideration by the client and engineers are different and allocation for the personal protective equipment (PPE) are different.
It is important to evaluate and control the health and safety by improving the health and safety practices in the construction sites, because the delays and total expenses following an accident are usually much higher than the original cost of establishing and maintain safety standards. Importance of safety is much appreciated thus it deals with several distinct concerns. Humanitarian concern should be taken into account because it causes death or adverse health effects. Site safety should be well maintained in good standards to convince the industry without any risk on professional, institutional and social perspective. Therefore, improvement of site safety is increasingly important in construction sites.

With the rapid development of the country, there are many infrastructure development projects. As a result, a considerable number of people are being employed in construction sites. Therefore, investigation on methods to improve the safety and health practices and reduce the occurrence of fatal accidents and non-fatal accidents in construction field in Sri Lanka is an urgent need. This research is based on identifying factors affecting safety performances and investigating on methods to improve the safety and health performances.

2. LITERATURE REVIEW

There are several types of factors affecting on safety in construction sites. The factors causing construction site accidents have also been addressed previously [1]. In general, construction accidents occur either due to poor knowledge on construction safety practices or lack of training, a lack of supervision due to an error of judgment, and carelessness of workers due to lack of experiences. Ahamed et al [1] show that the main causes of the fatalities in construction are due to falls, struck-by incidents, machinery, transport, caught in/between incidents and electrocutions. Accident in industries occurred while performing tasks by workers due to improper work methods, unsafe behaviors, hazardous machine, hazardous material and hazardous working environment. Investigations and analysis of accidents revealed that 90% of accidents are from unsafe acts or behaviors. The common unsafe behaviors found at industry are, operating without authority, working with moving machinery, working without personnel protective equipment, wearing dangling clothes, unsafe lifting carrying and placing, using hand instead of using tools, unsafe handling of hazardous materials.

Type of equipment and machineries, site condition, nature of the industry, management attitude and method, and human elements can directly influence the safety performance in construction industry [2]. Working at height, in adequate safety devices, poor management, lack of obedient on site, negligence of worker, and employing unskilled worker are also common in construction industry that cause to increase the risk of accident and making damage and injuries. Kartam et al. [3] stated that the causes of accident are related to worker turnover and wrong act, lack of safety performance, unsuitable or unclean materials, no maintenance tool, and weak supervisory and inspection.

In any kind of health and safety management programme, the initial step could be to identify the hazards or disaster situations in the work environment. Before improving the safety practices, it should initially identify how the accidents occur in the construction sites. Then necessary

precautions can be taken place easily. As an example, falling is a main cause of construction accidents. 'Fall' includes people falling from one level to another, falling of plant and material including collapse of a structure or a part of it [4]. The level of injury that can occur from the falling can be identified. The importance of safety training to improve the safety performance in the construction industry has been addressed in previous studies [5-6]. They have identified that effective training of construction workers could be one of the best ways in improving site safety performance. The factors affecting safety on construction sites were discussed in [7]. The impact of the historical, economical, psychological, technical, procedural, organizational and the environmental issues were considered in term of how these factors are linked with the level of safety. There is a close relationship between individual safety behavior and safety performance, and also age and experience of operatives and their level of safety performance, hazard payments and safety performance [7]. Effective training of workers can also significantly reduce unsafe behavior. Also the workers with good safety knowledge have a more positive safety climate than those with poor safety knowledge [7].

Langford et al. [8] identified the critical factors that influence the attitudes of construction workers towards safe behavior on construction sites. They studied these attitudes by using a research model that links three themes: safety management implementation strategies, attitudes of workers about safety and behavioral factors displayed by construction workers. This model was used to frame the responses of 126 directly employed construction workers in 10 companies. In has been identified the factors behind construction accidents as environmental and psychological (Table1) [8].

Table 1- Environmental and psychological factors behind construction accidents [8]

Environmental	psychological
Site condition	Care and attention by the individuals.
Site tidiness	Skill and experience brought to the job.
Availability resource and technology.	Safety training
Inter and intra group co-operation.	Accuracy of subjective risk evaluation.
Control and supervision of work.	Origins of safety norms.
Effectiveness of long term planning.	Perceived responsibly.
Role and position of the safety officers and safety representative.	
Payment structure.	

According to their findings, training of operatives and safety supervisors is important to safety awareness and improved performance. Moreover, it has also been found that knowledge and competence influence personal safety performance. They also suggested that companies must maintain and update their workers' skills and knowledge by training, skill updates and effective on site communication.

3. METHODOLOGY

3.1. Preparing questionnaire survey forms

A pilot study was conducted among ten personals using questionnaire. Safety practices, attitudes, behaviours and construction site safety were discussed. Two survey forms were developed for the construction workers and for the contractor by using the discussions about safety practices,

attitudes, behaviours and about site safety of the pilot study. The survey forms are based on the causes of accidents and the attitude and behaviour of workers towards the safety. Company details and relevant health and safety actions taken by management, were collected through the form of contractor. Survey form of the worker consists with questions which were related to historical factors, environmental factors and psychological factors (Table 2). Safety performances were measured as occurrence of accidents to a person, resulting various degrees of injury.

Table 2- Historical, Environmental, Psychological factors

Historical	Environmental	psychological
Operatives age	Safety training on PPE	Personal care of safety
Job experience	Safety training on site	Supervisors safety behavior
	Availability of resources (PPE)	Productivity target
	Displaying safety poster	

The response to each attitudinal question was measured on a five point scaling, under categories of 'strongly agree', 'agree', 'fair', 'disagree' and 'strongly disagree' (Table 3). Respondents were invited to discriminate favourably or unfavourably against statements of opinion, ordered under different headings.

On the other hand, safety performance is viewed within the context of accident occurrence: High performance, Moderate performance and Low performance. "Operatives who had no injury in the past" was considered as "High performance". "Operatives who had minor injuries in the past" was considered as "Moderate performance" while "Operatives who had major injuries in the past" was considered as "Low performance". All fractures, amputations, loss of eyesight and injuries resulting in the person being admitted into hospital for 24 hrs or more were considered as the main injuries.

3.2. Conducting site survey

Building construction sites from Galle and Colombo districts were selected to conduct the survey. All the workers who are working in the site including direct labours, hired labours, sub-contractors and workers with different trades were chosen for the questionnaire survey. Each questionnaire survey forms were completed by interviewing every personal. The survey was conducted at the time interval between 9.00a.m-12.00noon in each site. This time period was selected in order to make sure that workers were not tired for the purpose of interviewing. Seventy workers, employed in building construction sites, were interviewed through site visits. The operatives were answered to questions varied in their trade and they were selected randomly.

3.3 Survey data analysis

During the analysis, the attitudinal statements such as "Whether safety training programs help to improve your safety performance" was assessed by giving a score of 5 to those who strongly agree with the statement and was given a score of 1 to those who strongly disagree (Table 3).

Table 3- Point scale of attitudinal questions

Attitudinal question	"Whether safety training help to improve your safety performance"				
Answer	strongly agree	agree	fair	disagree	strongly disagree
Point scale	5	4	3	2	1

The measured safety performance was analyzed on a three point scale (Table 4) by the performance group that the respondents fall into. High, moderate and low performing were identified by the level of accident/s that each worker had in the past Average safety performance was calculated by averaging the safety performance (quantified by three point scale) determined for each age group and range of experience.

Table 4- Point scale of safety performance measurement

Safety performance	High performance	Moderate performance	Low performance
Point scale	3	2	1

Age of the workers was classified under 5 groups and given numeral as shown in Table 4. The age of workers, participated in the survey, is in the range between 20-57 years.

Table 5- Classification for age of workers

Classification number	1	2	3	4	5
Age group (yrs)	≤ 21	21-28	29-35	36-45	> 45

The correlations were determined with Spearman correlation among the research variables, that was selected from Environmental and Psychological factors (Table 2), by using SPSS (ver 21) (Statistical Package for Social Science) so as to identify the correlation between the research variables (Table 6) and safety performance. A relation with safety performance and a probability of occurrence of accidents with the age and experiences was also determined.

Table 6- Research variables

Identity	**Variables**
V1	Conducting safety training on PPE
V2	Personal care of safety
V3	Productivity target
V4	Safety training on site
V5	Provision of PPE
V6	Supervisors safety behavior
V7	Displaying safety posters

4. RESULTS AND DISCUSSION

Table 7 shows the significant levels of the correlations among the research variables.

Table 7- Significant level of correlations between research variable (i.e., factors) affecting safety performances

Variable	**V1**	**V2**	**V3**	**V4**	**V5**	**V6**	**V7**
V1	-						
V2	[b]	-					
V3	0.043*	[b]	-				
V4	[b]	[b]	[b]	-			
V5	0.297	[b]	0.003*	[b]	-		

V6	0.009**	b	0.155	b	0.089	-	
V7	0.045*	b	0.89	b	0.125	0.006**	-

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

b. Cannot be computed because at least one of the variables is constant.

It can be seen from Table 7 that, there is a correlation at significant level of 0.05 between "conducting safety training on PPE" (i.e., V1) and "productivity target" (i.e., V3). A correlation at significant level of 0.009 (p<0.01) was found between "conducting safety training on PPE" (i.e., V1) and "supervisor's safety behavior" (i.e., V6). A correlation at significant level of 0.05 was found between "conducting safety training on PPE" (i.e., V1) and "displaying safety posters" (i.e., V7). In addition, a correlation at significant level of 0.01was found between "supervisor's safety behaviour" (i.e. V6) and "displaying safety posters" (i.e., V7). There was a correlation at significant level of 0.05 between "provision of PPE to workers "(i.e., V5) and "productivity target" (i.e., V3).

4.1. Safety training on PPE and productivity target

It was found that there is the high correlation between "conducting safety training on PPE" and "productivity target" (significant level p=0.05). This indicates that workers have got knowledge and practice on training about PPE that gives at the construction site contribute to the production with more concerning safety. It can be seen from Table 7 that "conducting safety training on PPE" leads operatives to achieve higher production through performing safely at the site level rather than achieving goals without considering safety. It indicates that safety training on PPE allows to workers get knowledge about importance of the wearing safety equipment, how to use them and what are the advantages of the wearing PPE. Also safety training is very useful as it allows employees to predict future accidents or near misses. Individual responses of workers indicated that sub-contractors normally do not consider the wearing safety equipment, during their working hours. They are always trying to complete higher production throughout the day possibly because it will help them to daily salary increases. There was a misconception among sub-contractors that wearing PPE is reducing their working efficient.

4.2. Safety training on PPE and Supervisor's safety behaviour

It was found that the correlation between "conducting safety training on PPE" and "Supervisor's safety behaviour" was significant (significant at p=0.01) (Table 7), implying that the supervisor's safety behaviour is very important at site. The training on PPE at site helps to workers understands about what the supervisors or foreman are telling about safety matters. It's easy to explain to workers, who have some knowledge about safety, safety matters, health issues and accidents. Davies et al. [9] found that "frequent daily contact between workers and supervisors on safety and other job matters, is the most important to accident control efforts". Andriesson[10]concluded that "workers will work more safely with a supervisor who is seen as someone who respects their workers and their contribution". Safety training affects on workers to identify safety matters and also to improve the behaviour of the workers and supervisors. When a supervisor or foreman has positive attitudes on safety and health, workers also realize that safety is equally important as product.

4.3. Supervisor's safety behaviour and Displaying safety posters

There is a significant correlations between the "Displaying safety posters" and "Supervisor's safety behaviour (i.e., specially supervisor's or foreman's announcing safety matters)" to workers (significant at p=0.01). This indicates that when supervisors announcing safety matters to workers, safety posters are more important, possibly because workers might not that much clever to understand things by listening to supervisors or foreman, or workers concentration may always be towards to the work to be completed. It's better to explain and understand safety matters with picture format, rather than text format.

4.4. Provision of Personal protective equipment (PPE) and productivity target

Table 7 indicates that there is a strong correlation between "provision of PPE" and "productivity target" (Significant at p=0.05). Safety helmet, gloves, safety boots, goggles and ear muffs are often available in sites. However, it has been identified that although PPE are available, most of the workers are not willing to wear PPE, possibly because of inconvenience of wearing them [11]. In addition, most of the workers did notwear PPE at the site due to several reasons: workers were in the opinion that PPE helps to do their work safely. It was easy to complete their targets safely with wearing PPE. However, some workers, mostly sub-contractors, expressed that working with PPE is quite difficult and it delayed to complete their target as well [12]. Therefore, they mostly did not wear their PPE during working period. To overcome this problem, introducing a fine for not wearing PPE would be effective.

4.5. Conducting safety training on PPE and Displaying Safety posters

It was found that the correlation between "Conducting safety training on PPE" and "Displaying Safety posters" was significant (significant at p=0.05) (Table 7), implying that the conducting safety training helps to read and understand safety boards and posters at site. In construction sites, there are workers with different educational levels. By considering each and every worker as same education level, by giving safety training on PPE to every worker helps to understand the safety matters and accidents by looking at the safety posters and safety sign boards. Safety training on PPE improves the ability of preventing accidents and work safely. Also workers can understand safety matters, accident types by looking at the safety posters when they have knowledge and training. So by giving safety training on PPE and by displaying safety posters in picture format rather than text in construction site, it can improve the safety performances and reduce the construction accidents.

4.6. Safety performances, age and working experience

Table 8 shows the safety performances with the age of workers. It can be seen that workers ages below 21 years have less safety performances, implying that they were more subjected to the construction accidents than other age groups. Further analysis shows that level of accidents tend to decline steadily after 35, to reach a low point of mid-forties. Then again workers, who are with age more than 45 years or more tends to occur accidents (Table 8).

There are several reasons to reduce safety performances and occurring accidents, when workers are getting old they have no lots of energy. Workers are getting weak. They cannot do hard working and carry heavy duties. However, at the construction sites, there are several easy and heavy duties. When older workers are doing heavy activities, they face to accidents. Literature

review indicates that workers over 60 years of age and under 20 years of age are over- represented among fatalities (Rameezdeen et al 2003). The results (Table 8) suggest that the older operative gets the more experienced with time in construction field, hence, they are more aware of safety requirements, eventually improve their safety performances. However, when workers are weak and age is more increasing, workers tend to occur accidents.

Table 8- Safety performance with Age

Age group (yrs)	Average safety performance
< 21	2.50
21-28	2.77
28-35	2.84
35-45	3.00
> 45	2.77

Table 9 presents the safety performance with workers experience. Workers, who have less than one year construction site experience, were more subjected to the accidents.

Also it indicates that, safety performance increases with increasing in the experience of workers. Therefore, experience was identified as one of the major concerns that affects to the safety and health issues of workers. Cherns [13] explained this phenomenon by contending that, as aging is a slow process, one can adjust to one's continually changing powers. Therefore, while one may continue to undertake the same work as one did when younger; one tends to do it in a different way. Thus, because of this ability to adjust, one can continue with a highly skilled activity which makes considerable demands on the perceptual and central mechanism well beyond the age at which we could ever hope to acquire such a skill from start. This implies that if contractors can find workers who have experience or provide them training, it would be effective for site safety practices and quality of the construction work. Therefore experience is one of the major concerns that affects to the safety and health issues of workers.

Table 9- Safety performance with experience

Experience range (years)	Average safety performance
Less than 1	2.63
Between 1 and 10	2.83
Between 10 and 20	3.00
More than 20	3.00

5. CONCLUSIONS

Site visits were conducted and questionnaire survey was carried out among 70 workers in different building sites to identify the most influencing factors that affect to the safety performances. Workers, whose age below 21, tend to occur accidents. Also workers, who has experience below 1 year tends to occur accidents, implying that giving more attention to workers whose age below 21 years old and whose working experience below than 1 year necessary to reduce accidents.

It was found that a significant correlation of "conducting safety training on PPE" with "productivity target" (p<0.05), indicating safety training on Personal Protective Equipment (PPE) for the every worker, who is working at site (for all direct, hired & sub contractors' workers) is an effective method to improve site safety practices while enhancing productivity.

There was a significant correlation between "conducting safety training on PPE" and "supervisor's safety behavior" (p<0.01), affecting to the improvement of communication and understanding safety matters between the workers and supervisors to improve health and safety matters..

The correlation was significant between "displaying safety posters"and "conducting safety training on PPE", between "displaying safety posters"and "supervisor's safety behaviour" (p<0.01), indicating that visual instructions will be more effective to improve health and safety practices in building construction sites.

There was a correlation at significant level of 0.05 between "provision of PPE to workers" and "productivity target", indicating availability of PPE affects to the construction site process to achieve production with more concerning safety.

REFERENCES

1. Ahamed M.S.S., Nafeel A.F.M., Rishath A.A.M., and Dissanayake P.B.G., " Site Safety of Sri Lankan Building Construction Industry"- *ICSECM 2011 - Kandy - Sri Lanka , 2011*
2. Pipitsupaphol, T. and Watanabe, T. (2000) "Identification of Root Causes of Labor Accidents in the Thai Construction Industry", *Proceedings of the 4th Asia Pacific Structural Engineering and Construction Conference (APSEC 2000) 13-15 September Kuala Lumpur*, pp193-202, 2000.
3. Kartam N., A., Flood I., &Koushki P. "Construction Safety in Kuwait: procedures, problem, and recommendation", *Journal of Safety Science 36, pp*. 163 – 184, (2000)
4. Rameezdeen. R., Pathirage. R., Weerasooriya. S,"Study of construction accidents in Sri Lanka", *Build-Environment-Sri Lanka-Vol.04*, Issue 01, 2003.
5. Huan X., and Hinze J., "Analysis of construction worker fall accidents", *Journal of Construction Engineering and Management, Volume 129(3)*, pp 262-271, 2003.
6. Aksorn T., and Hadikusumo B.H.W., "Critical success factors influencing Safety program performance in Thai construction projects", *Safety Science, Volume 46*, pp 709-727, 2008.
7. Sawacha E., Naoum S. and Fong D. ,"Factors affecting safety performance on construction sites", *International Journal of Project Management Vol. 17*, No. 5, pp. 309-315, 1999.
8. Langford D., Rowlinson S., and Sawacha E., "Safety behaviour and safety management: its influence on the attitudes of workers in the UK construction industry", *Engineering Construction and Architectural Management, Volume 7(2)*, 133-140, 2000.
9. Davies R and Stachi R, "Safety Organization and Activities of Award-Winning Companies in the Coal-Mining Industry". *US Department of Internal Information Circular 8224, Washington DC, US Department of Interior, USA*, 1964.
10. Andriessan, J., "Safe behaviour and safe motivation". *Journal of Occupational Accidents, 1, 363±376, 1978.*
11. Vitharana V.H.P, Subashi De Silva G.H.M.J., Sudhira De Silva. "Workers' Awareness of Risk Factors and Safety Practices in Building Construction Sites", *Society of structural Engineeris, Sri Lanka-Annual session 2013.*
12. Vitharana V.H.P, Subashi De Silva G.H.M.J., Sudhira De Silva, "Risk associated with noise and vibration exposures and their effects on health of workers in construction sites"- *ICSECM 2013 - Kandy - Sri Lanka , 2013.*
13. Cherns A, Accident at Work. Cited in Welford et al. (1976), Society Problems and Methods of Study. *Routledge and Kegan Paul Ltd, London, UK*, 1966.

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CRITICAL INVESTIGATION OF QUANTITY SURVEYORS FUNCTIONS WITH REGARD TO WORKPLACE TIME MANAGEMENT

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ABSTRACT

In the construction industry, work related stress due to excessive workloads; time constraints and deadlines are common. Quantity Surveyors (QS) in particular, experience work related stress when they find that they are unable to complete their work on time. However, no studies have so far been done on this work related stress that quantity surveyors often have to undergo. With time being life, irreversible and irreplaceable, this novel research investigates workplace time management by quantity surveyors through specific functions that will make them improve their performance professionally to help them ultimately achieve work life balance.

This study used a mixed approach starting with a preliminary survey conducted among 10 quantity surveyors who had vast experience in the field of quantity surveying. A questionnaire survey was thereafter conducted among 48 quantity surveyors followed by semi-structured interviews with 7 experts having specialised knowledge and experience in the relevant areas. The initial research findings identified the functions of quantity surveyors in terms of their roles and duties. The experts who took part in the semi-structured interviews agreed on the key functions that had been identified to be time consuming. MANOVA test was carried out to ascertain the influence of the sector, organisation, country of practice and managerial position on the duties of quantity surveyors. Content analysis was done to get the overall picture of the current situation. The study revealed that time pressure was less for quantity surveyors during post construction stage of a project as compared to its pre-construction stage and that their workplace time management is highly dependent on the type of project and employer since the functions expected of them can vary according to the requirements of the project and the employer. The critical duties of quantity surveyors that are time consuming were identified to be the preparation of final accounts and agreements; preparation of tender documents; and procurement and coordination of stakeholders.

Keywords: Critical; Functions; Investigation; Quantity Surveyor; Time Management; Workplace.

1. INTRODUCTION

The construction industry is generally considered as the backbone of the economy of a country (Khan, 2008; Enshassi, Mohamed and Karriri, 2010). In a country, the community and especially the other sectors would benefit when there is a high quality output from the construction industry (Senaratne and Sabesan, 2008; Olatunji, Sher and Gu, 2010; Pribadi, 2011). Therefore, the identification and analysis of the critical issues prevalent in the construction industry would be of value.

The nature of the construction industry makes its planning difficult, i.e., the dynamism of its environment prevents long and medium term planning (Ofori, 1990; Ambrose, 1996). This uniqueness of the construction industry has made construction project management a distinct discipline because of the challenges it poses in different contexts, i.e., technical, social, financial, political, and cultural contexts (Baccarini, 1996; Toor and Ofori, 2008). Many conflicts can arise in a project due to contextual factors impacting on project activities often making unusual events that has time constraints to occur (Passerini, 2013). Hoffmeister, Cigularov, Sampson,

Rosecrance and Chen (2011) have argued that in the construction industry, tight deadlines, working with and around other trades and the potential dangers of the job can create an atmosphere of tension and anxiety. A study made by Passerini (2013) indicates that in the construction sector, the different perceptions that exist about the deadlines and the different behaviours among the team members can affect the ability of teams to meet deadlines. Olatunji, Oke and Owoeye (2014) argued that out of the many problems faced by construction professionals, the time frame during which they have to execute construction works is the most important. The work carried out by construction professionals on overtime will have an impact on the quality of work they deliver (Hawkins and Klas, 1997). As a result, the availability of time and its management become the primary causes of stress in construction industry professionals (Brandon, 1992). Thus, it is important to focus on the challenges faced by professionals in the construction industry in managing their time.

Construction professionals include architects, builders, engineers and quantity surveyors (QS) (Olatunji et al., 2014). Quantity surveyors add value primarily to the financial and contractual management of construction projects at their pre-construction, construction and post-construction stages (Nkado and Meyer, 2001). Opawole, O.A.Awodele, Babatunde and Awodele (2012) have emphasized that the benefits of the specialized skills and knowledge in cost and financial aspects possessed by quantity surveyors are recognized in projects. Thus, the job performance of a QS will highly depend on how effectively he manages his time. This makes it important to identify and analyse the issues faced by QSs at their workplaces in managing their time which will have a bearing on their careers. Even the few research available on issues related to QSs do not discuss time management. Therefore, this research is novel as it investigates the time management issues faced by QSs at their workplaces due to their specific roles and duties.

2. LITERATURE SYNTHESIS

2.1 Time Management

Today, more than ever before, global competition is being driven by time (Gehani, 1995; Afful-Broni, 2013). Therefore, it has to be utilized then and there since it cannot be put on hold. In today's society, the ability to handle time is becoming more and more critical (Harung, 1998). Time management is a set of habits or learnable behaviours that can be acquired through increased knowledge, training or deliberate practice (Ahmad, Mohd, Yusuf, Shobri and Wahab, 2012). Claessens, Eerde, Rutte, and Roe (2007) were of the view that time cannot be managed because of its inaccessibility. It can, however, be influenced by the way a person deals with it (Rao, 2014). Poor time management has been associated with high stress and strain, emotional exhaustion, and health issues (Christopher, 2010). The increasing salience of time has been acknowledged in publications. Several authors (Britton and Tesser, 1991; HofFMacan, 1994; Christopher, 2010; Njagi and Malel, 2012) have discussed the need for better incorporation of time in theoretical models and research designs. Over the years, the focus of publications and training courses on time management have shifted from managers to a broad audience of working people (Claessens et al., 2007).

2.2 Time Management by Quantity Surveyors

The services provided by quantity surveyors are many (Olatunji et al., 2010). Toor and Ofori (2008) have stated that the day-to-day work of a quantity surveyor would involve the management of various activities and achievement of short-term goals of a project. Until recently, quantity surveyors have been involved almost exclusively in the latter part of the design-appraisal process although the traditional design process requires actual decision making to take place very much earlier (Keane, 2008). Kulasekara, Jayasena and Ranadewa (2013) have stated that

traditional quantity take offs and /bill generation is a very time consuming process which is prone to error and which requires considerable time when BOQs have to be revised to accommodate design changes. Female QSs find jobs in the construction industry as very stressful and demanding requiring long working hours (Poh, 2004) Site work is also time consuming and can infringe on social activities and family responsibilities.

Time management would become more difficult for QSs in the future for two reasons (Claessens et al., 2007). Firstly, in the future, they will be working under more complex and uncertain conditions. The choices they have to make regarding the alternative uses of their time will therefore be more complicated. This will make it difficult for them to master self-management. Secondly, the increasing size and sophistication of organisations will raise critical issues when managing time as in addition to satisfying their own needs they will be called upon to meet the increasing demands made by others.

2.3 Functions of Quantity Surveyors

Because of the changing needs of the clients and technological advances, traditional functions of quantity surveyors have come under threat (Nkado and Meyer, 2001). Also as a result of the dynamic nature of the industry, the functions of QSs have been evolving continually over the years (O'Brien, Mbachu, and Lomax, 2014). In the early days, QSs worked for the consultant, contractor or the client of a project (Shafiei and Said, 2008) whereas today, they work as project managers, arbitrators etc., and get involved in the insurance, financial, manufacturing, taxation and valuation industries (Hemajith, Perera, Amaratunga and Ginige, 2007).

In future, QSs will have to move into other sectors without confining themselves to the construction industry (Smith, 2004; Hemajith et al., 2007; Olanipekun, Aje and Abiola-Falemu, 2013; Stanley and Thurnell, 2014, Thayaparan et al. 2011). The construction industry will also want them to look beyond their traditional duties and get involved in whole life costing, sustainability, facilities management, investment appraisal and value management (Sacks and Pikas, 2013; Higham and Thomson, 2015; Wao and Flood, 2016; Karunarathna, 2006; Kanewala, 2003; Smith, 2009). QSs face complexities and competition from other professionals since they offer a variety of roles to project owners in construction (Wao and Flood 2016)

2. 4 Roles

C.J. Willis, Willis, Ashworth and Hogg (2007) have identified three types of roles for QSs- traditional, evolved, and developing roles based on studies made by Circa in 1960 and 2006 (Figure 1) .

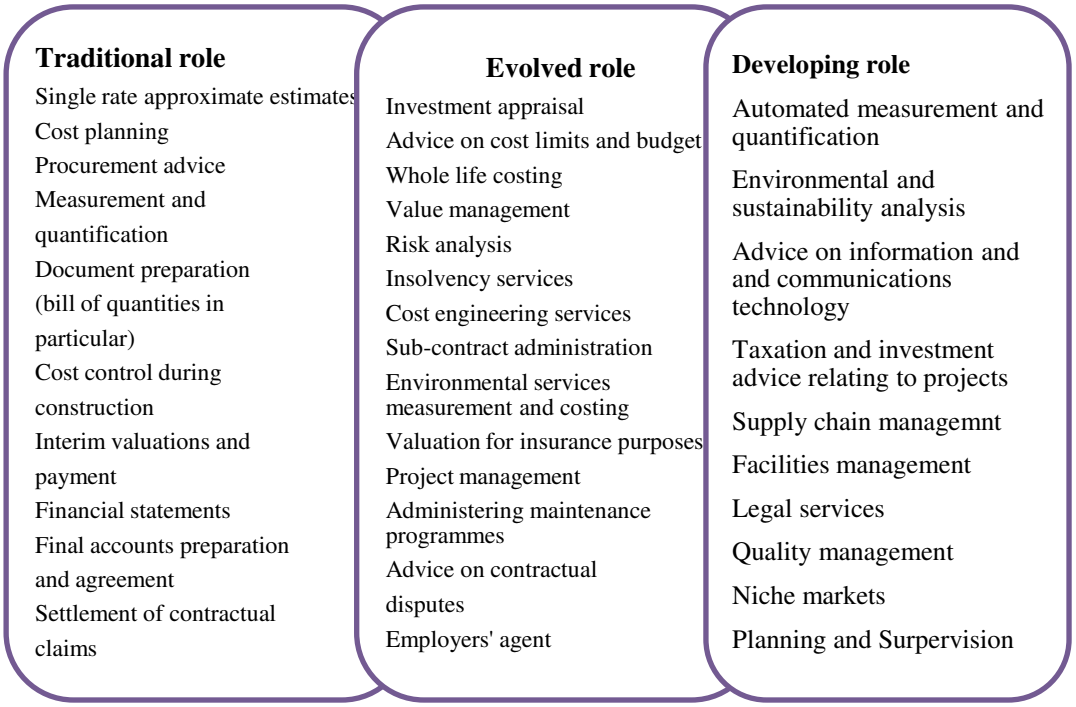

Figure 1: Classification of Quantity Surveyor's Roles

Source: C.J. Willis, Willis, Ashworth and Hogg(2007)

The distinctive technical role of the quantity surveyor has developed over the years as a result of the increasing complexity and diversity of client needs and market demands (O'Brien et al., 2014). Some of the technical and specialist roles expected from a QS according to Smith (2004); Crafford and Smallwood (2007); Lee and Hogg (2009); O'Brien et al. (2014) are found among the roles of building economists, value engineers, procurement consultants, cost managers, contracts administrators and commercial managers. The developing roles of QSs may include some functions of other disciplinary professionals, since QS is highly involving in project management and therefore he is capable enough to handle other responsibilities. Accordingly depending on the project, a team member including a QS who is capable of handling these functions will perform these roles.

2.5 Duties

Ashworth, Hogg and Higgs (2013) have wanted QSs to be involved with a project throughout its implementation and have identified their duties as traditional and non-traditional duties. Similarly, Jeyamathan (2005) and Fanous and Mullins (2012) have considered the duties that a QS carries out when he is working for a contractor as traditional duties. His duties when working for a consultant and which have evolved over the years with the development of the construction industry can be considered as non- traditional duties. O'Brien et al. (2014) differentiated the duties of a QS (who can be an individual or a firm that includes QSs and other professionals related to construction) according to the construction phase in which he is engaged in (Table 1).One may argue that some of the duties identified in table 1 are assigned to the 'Engineer' as per the Conditions of Contract and they are not Quantity Surveyors' duties. However to address this review of 'Engineer' in Conditions of Contract is helpful. For example Sub-Clause 1.1.2.4 of ICTAD/SBD/02 defines "Engineer" as the person appointed by the Employer to act as the Engineer for the purposes of the Contract and named in the Appendix to Tender. This may include a Quantity Surveyor or any other professional. The Quantity Surveyors

are provided with necessary academic knowledge and skill to perform the duties identified by various researchers as given in table 1 during their study period.

Table 1: Quantity Surveyors Duties According to the Construction Phases

Pre-construction Duties	Construction Duties	Post construction Duties
Tendering & winning jobs in a highly competitive market	Scope change & variation management	Agreeing final accounts
Estimating reliably when there is poorly documented design information	Cash flow monitoring & reporting	Obtaining practical/ final completions & Code Compliance Certificates
Cost data integrity and reliability of cost advice	Margin maintenance	Capturing and valuing costs associated with snagging requirements
Accuracy of budgeting & cash flow forecasting	Reconciling & estimate assumptions with onsite cost realities	Management of Defects rectification liability
Effective contract negotiation	Conflict management, negotiations & Dispute resolution	Retentions release
Appropriateness of contingency/ risk margins and allocations	Contract administration& Subcontract management	Cost analysis/ cost modelling
Prediction of market trends and their impacts on proposed project	Cost -to-complete forecasts	Liquidated & ascertained damages
Gaining and sustaining clients' confidence	Industry Capitalisation Overdraft/ credit facilities	Arbitration/dispute resolution
Adequacy of tender & contract documentations.	Cost accounting and control	Satisfying client - gaining repeat commissions
Resolving tags in tender evaluation	Interim valuations & payments	Documenting and sharing lessons learnt for use in future jobs
Keeping up with revisions in fast-paced design development.	Management of information release in fast-tracked & complex projects	

3. RESEARCH METHODOLOGY

Research methodology is the entire process comprising the theoretical underpinning to the collection and analysis of data (Fellows and Liu, 2008). This study began with a literature synthesis to understand the theoretical background of time management by quantity surveyors. However, no research could be found on time management by quantity surveyors. Thus, a preliminary survey had to be conducted among 15 quantity surveying experts to identify those duties of quantity surveyors that consume time. A mixed approach consisting of a questionnaire survey and a set of semi-structured interviews with experts were used for the collection of data. Since this research is on identifying and establishing the general opinion of the society objectively using the research question -"What are the critical duties of a quantity surveyor?" It has, in the absence of an in depth investigation, got a quantitative approach (Walsh, 2003; Zou, Sunindijo and Dainty, 2014). It may also be considered as having a qualitative approach as there it attempts to study an already existing issue. Therefore, this study had a mixed approach consisting of both quantitative and qualitative approaches.

The survey method was adopted to collect data from a sample as there was no control on the independent and dependent variables (Creswell, 2003). The sample was identified using convenience sampling, a non-probability sampling technique, through which quantity surveyors working in different working environments were identified for the sample (Tan 2002).

Although questionnaires were distributed among 100 quantity surveyors, the responses were received only 48. The questionnaire inquired about their perception on time management and on the effects of the sector, managerial position, country of practice and the type of organisation on it. Semi-structured expert interviews were conducted thereafter among 10 experts who had specialised knowledge and experience in quantity surveying, and time management. The expert opinions were used to validate the questionnaire survey results and to triangulate the data.

Since this research aims at identifying the critical duties of quantity surveyors which are affected by the type of organization, type of sector, country of practise and the type of managerial position, it can be considered as a *cause and effect type* of research through which *statistically significant differences in the levels between/among variable groups* need to be analysed (Bryman and Cramer, 1990; Naoum, 1998; Leedy and Ormrod, 2001). The level of measurement associated with the data can influence the type of analysis to be used (Vogt, 1999). Since the characteristics of the sample data is *ordinal type*, *non-parametric tests* can be applied on the data set. Accordingly, T-test, one-way ANOVA, Factorial ANOVA and MANOVA (Multivariate ANalysis of VAriance) can be used to distinguish the statistically significant groups or variables.

MANOVA using SPSS statistics software (to consider the effects of more than one independent variable on a combined set of dependent variables) was carried out to analyse the quantitative data collected from the questionnaire survey. A post-hoc test was conducted as a part of the second stage of MANOVA. This selection of MANOVA can be justified considering the research question, the type of data collected and the number of variables that had to be analysed (Keselman, Huberty, Lix, Olejnik, Cribbie, Donahue, Kowalchuk, Lowman, Petoskey, Keselman and Levin, 1998; Yin, 2013).

Qualitative data collected through the interviews were analysed using NVIVO software. Deductive approach was undertaken as the time and resources available were limited. The data were grouped based on the research question (to analyse the similarities and differences) and the qualitative research done could become a smaller component of a larger quantitative study (Krippendorff, 2013). Subsequently, thematic analysis was used to categorize data for the purpose of summarization and tabulation, a method that can assist in identifying, analysing and reporting patterns within data (Braun and Clarke, 2006) and considered as appropriate to any study that intends to make interpretations by offering a systematic element for data analysis (Alhojailan and Ibrahim, 2012).

4. DATA COLLECTION AND ANALYSIS

4.1. Preliminary Survey Findings

By studying the available literature, a comprehensive list of roles and duties of quantity surveyors was prepared according to the type of organization involved (client, consultant andcontractor) and the type of construction phase (pre-construction, construction and post-construction), This list was then given to the respondents to comment upon all of whom concurred with the list. The respondents were requested to identify the critical activities of a QS according to the type of organization they worked for. The critical duties so identified are presented in Figure 2 below.

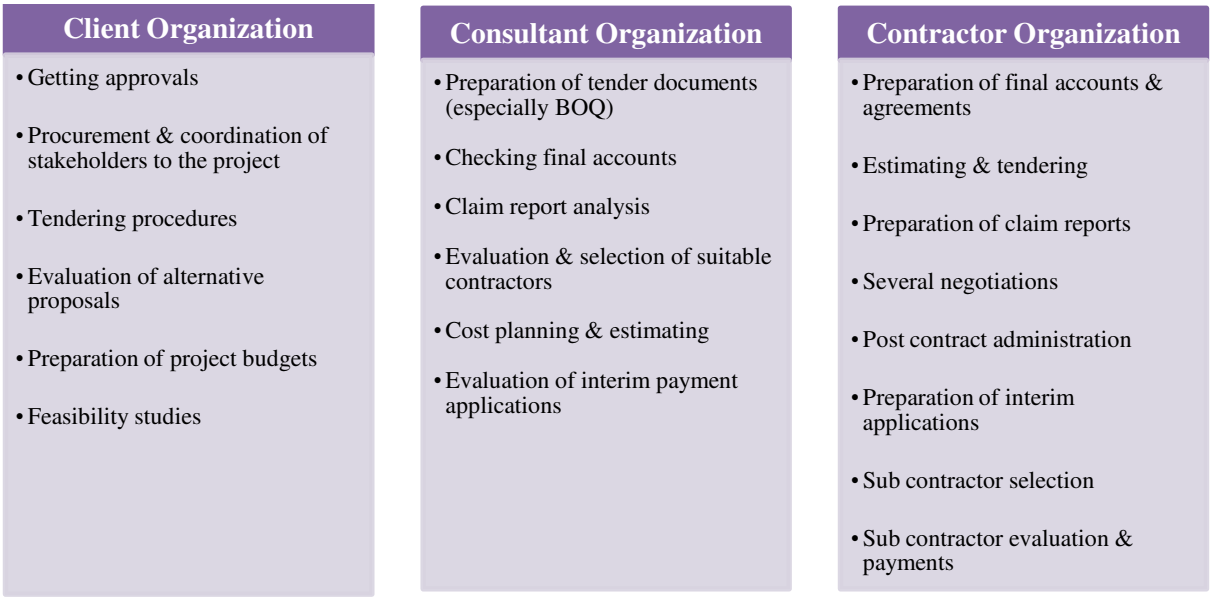

Figure 2: Critical functions of Quantity Surveyors

Pressure on time experienced by QS will also vary according to the phase of the project in which he is involved. A majority of respondents disclosed that pre-construction activities consume more time and all of them were of the view that post-construction activities do not consume so much time. Accordingly, it can be concluded that time pressure gets reduced when the QS moves from pre - construction to post construction phase. Time management by quantity surveyors may also can get affected by the type of sector their company belongs to, i.e., private sector or government sector. Therefore, types of organization, construction phase and employer will have a significant impact on the roles and duties of a quantity surveyor thereby having a direct effect on his time management. Therefore, these aspects need to be analysed in the detailed study.

4.2. Questionnaire survey and semi structured Interview outcomes

The second and third primary data collection tools were the questionnaire survey and the expert interviews. The structure and the design of the questionnaire used were based on the literature synthesis and preliminary survey findings. Semi-structured interviews carried out among practitioners having expertise on the research topic were used to validate the findings of the questionnaire survey. The quantitative data obtained from the questionnaire survey were analysed using MANOVA and the qualitative data obtained from the expert interviews were analysed using the NVIVO software tool to understand the relationships among the variables.

Profile of the Respondents

Because of the time and cost constraints, questionnaires could be distributed only among 90 QSs who comprised the sample and who were from both Sri Lanka and overseas. The number who responded was 48 and the response rate therefore was 53.34%. The profiles of the questionnaire survey respondents are given in Figure 3 based on their working experience, and their managerial positions in Figure 4.

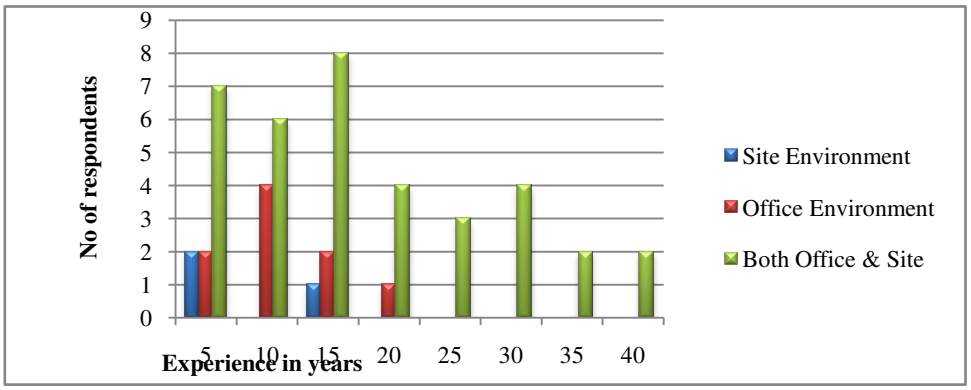

Figure 3: Profile on QS's work experience

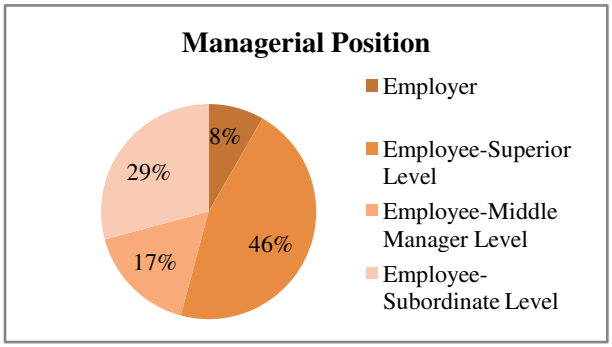

Figure 4: Respondents' profile based on managerial position

It is evident that the cluster of each of the different profiles is significant in size to validate the analysis. Semi-structured interviews were with 7 experts who had specialized knowledge and experience in time management, human resource management and project/site management in the field of quantity surveying. Their profiles are given in Table 2.

Table 2: Profile of Expert's Interview Respondents

Respondents	Type of Firm	Nature of Work	Experience	Overseas Exposure
Respondent A	Private Contractor	Chief Quantity Surveyor	20 years	Yes
Respondent B	Private Consultancy	Employer- Chief Quantity Surveyor (Specialist in Contract Administration)	15 years	Yes
Respondent C	Private Contractor	Chief Estimating Director - Electrical Engineer	10 Years	Yes
Respondent D	Private Client	Chief Quantity Surveyor (Specialist in Project Management)	20 Years	Yes
Respondent E	Private Contractor	Chief Quantity Surveyor	15 Years	Yes
Respondent F	Locally reputed government university	Time Management Expert - Career Advisor	15 Years	Yes
Respondent G	Private Contractor	Human Resource (HR) executive	15 Years	Yes

Results of the Manova Test

The literature review and the preliminary survey identified the duties and roles of a quantity surveyor working in a typical organization. From the preliminary survey, some of these duties were identified as critical activities which consume considerable time as compared to other duties. In this section, those critical activities are analysed to see whether the time taken by them could be optimised to help quantity surveyors to manage their time as a whole. Both quantitative and qualitative data have been used to ensure comprehensiveness of the study.

The duties identified as critical were statistically verified using MANOVA to measure the significant differences among the various duties. It provided the level of significance for a combined set of dependent variables (i.e. duties) against the independent variables (type of sector and managerial position). Table 3 illustrates the results of the multivariate tests.

Table 3: Results of MANOVA test for critical duties

Multivariate Tests for Duties across Type of Organization					
Effect	**Wilks' Lambda Value**	**F Value**	**Hypothesis df**	**Error df**	**Significance (p)**
In Client Organization					
Type of sector	0.714	1.007	12.000	66.000	0.453
Managerial position	0.527	1.325	18.000	93.823	0.191
In Consultant Organization					
Type of sector	0.668	1.228	12.000	66.000	0.283
Managerial position	0.523	1.344	18.000	93.823	0.180
In Contractor Organization					
Type of sector	0.638	0.976	16.000	62.000	0.493
Managerial position	0.711	0.471	24.000	90.511	0.981

The significant multivariate effect on the duties of QS in a client organization, the combined dependent variable, according to the type of sector is: Wilks' $\lambda = 0.714$, F (12, 66) = 1.007and p = 0.453 (>0.05). As the variance (Wilks' λ) is close to 1 in all of the cases, there can be no significant variance among the duties. Since the significance value (p) for the sector and the managerial position are greater than the benchmark value of p (0.05), there can be no significant effect on the critical duties of quantity surveyors according to the type of sector and managerial position. It can be concluded that the time taken to perform the given duties will be independent of the sector (client, consultant or contractor) and the managerial position (employer, executive, middle manager or junior level employee).

Separate univariate ANOVAs were also performed after the MANOVA as a "step down analysis" on each duty to identify whether the type of sector in which the quantity surveyor is employed, and/or his managerial position will have an effect on each of his critical duties. Table 4 below provides in respect of each duty, the F values and the corresponding significance values (p) for each type of sector and managerial position. Post hoc test was also performed to obtain the estimated marginal mean value for each duty by considering the overall means of the different types of sectors and managerial positions.

Table 4: Results of univariate test for critical duties

Quantity Surveyor's Duties		Estimated Marginal Mean	Type of Sector		Managerial Position		Rank
			F	Significance	F	Significance	
Duties in Client Organization							
D.1.1	Getting approvals	3.368	1.724	0.192	1.940	0.139	
D.1.2	Feasibility studies	3.000	0.584	0.562	0.401	0.753	
D.1.3	Evaluation of alternative proposals	3.193	0.758	0.476	0.738	0.536	
D.1.4	Preparation of project budget	3.203	0.062	0.940	1.107	0.358	
D.1.5	Procurement and coordination of stakeholders	3.527	0.880	0.423	0.307	0.820	**6**
D.1.6	Tendering procedures	3.117	1.010	0.374	0.232	0.874	
Duties in Consultant Organization							
D.2.1	Preparation of Tender document	3.722	0.186	0.831	0.652	0.586	**2**
D.2.2	Evaluation of Bid & Selection of suitable Bidder	2.828	1.516	0.233	2.062	0.121	
D.2.3	Evaluation of Interim payment application	2.132	0.330	0.721	0.065	0.978	
D.2.4	Cost planning and estimating	2.718	0.359	0.701	0.529	0.665	
D.2.5	Claim report analysis	3.278	0.916	0.409	0.765	0.521	
D.2.6	Checking final account	3.608	0.099	0.906	0.589	0.626	**5**
Duties in Contractor Organization							
D.3.1	Estimating & Tendering	3.682	0.246	0.783	0.239	0.868	**3**
D.3.2	Preparation of interim application	2.815	1.985	0.151	0.322	0.809	
D.3.3	Sub contract selection	2.498	0.579	0.566	0.365	0.778	
D.3.4	Subcontract evaluation & payment	2.228	0.215	0.807	0.258	0.855	
D.3.5	Preparation of claim report	3.657	0.214	0.808	0.435	0.729	**4**
D.3.6	Preparation of final account and agreement	3.997	0.546	0.584	0.156	0.925	**1**
D.3.7	Post contract administration	3.163	0.318	0.730	0.453	0.717	
D.3.8	Several negotiations	3.017	0.578	0.566	0.961	0.421	

As can be seen, there is no statistically significant impact on the duties of quantity surveyors by the type of sector and managerial position. Since the level of significance (i.e. *p* value) for each activity is greater than the benchmark *p* value (0.05), the duties will not be affected by the type of sector and managerial position. Statistically, this is known as the non-rejection of the null hypothesis, i.e., *H_0, the categorical variable does not have any significant effect on the dependent variable*. Since there is no influence from the categorical variables (type of sector and managerial position) on the critical duties, it can be concluded that each activity can be analysed independently ignoring the net effect from the categorical variables. Furthermore, it has to be noted that the F value of each selected duty is less than the critical F value: $F_{(6, 41)} = 2.3359$ (obtained from F Table). Since both conditions need to be fulfilled simultaneously (significance level and F value), none of the duties were affected by the independent variables. However due to time constraints, only some of the duties could be analysed in detail. Thus, the critical duties that had a high estimated marginal mean (over 3.500; population mean) were ranked for further analysis. The responses received from the questionnaire survey were also considered for further analysis.

Preparation of final accounts and agreements

The preparation of final accounts and final agreements is one of the key functions of a QS serving in a contractor organization which has to submit the final and full claim of the contractor. It was ranked at the top with a marginal mean of 3.997. Final account is the last negotiation between the two parties to a contract. It can take time to negotiate and finalize the amount due to the contractor and prepare the final agreement. Since it is ranked first, the contractor's QS can have time issues. This was confirmed by Respondent E when he said that although *the final account comes last, they have to work on it from the beginning and that it involves several negotiations based on the organization's internal processes.*

Preparation of tender documents

The most time consuming activity of a QS working in a consultant organization is the preparation of tender documents, especially the BOQ, with an estimated marginal mean of 3.722. Since commercial contracts are initiated with the tender document which deals with the selection of the contractor, contract agreement, post contract activities etc., the tender document prepared by the consultant QS has to be accurate and reliable. It also requires considerable time to obtain required information from other team members which is beyond the control of the QS. Thus, it can consume more time compared to other activities of the organization. This was confirmed by Respondent A when he said, *". Preparation of the tender is very time consuming, and especially the BOQ and it depends on the complexity of the project".* Respondent E however said, *"Preparation of the tender document is a task for the consultant with no specific time frame. There has to be mutual agreement on it between the employer and the QS".*

Estimating and tendering

Estimating and tendering comes under contractor organization and is ranked second with a marginal mean of 3.682. It is one of the primary functions of a contractor's QS, which has to be done properly to ensure the survival of the organization. It involves several outsiders and management participation. Since quotations for specialized work from domestic subcontractors are generally received at the last moment and top management also indicate the required mark-up only at the last moment, the rates can be finalised only at the end. Also in most cases, the rates will have to be hand written on the original tender document and not printed taking considerable time. However, the work has to be completed on time to avoid late submission and the rejection of bids. Therefore, all delays in estimating and tendering get added up and the QS will be

pressed for time. This was emphasised by Respondent E who said, "*When estimating, quotations would be received at the last moment and we have to be prepared for that. If we do not get quotations, we generally use the previous quotations after making adjustments".*

Preparing claim reports

The preparation of claim reports is one of the critical duties of a contractor's QS during the post contract stage. Its estimated mean is 3.657. There is a procedure laid out in contractual documents for submitting claims which has to be followed to receive compensation for any damages. There are pre-defined time limits to submit the claim notice, contemporary records and substantiation documents, detailed claims etc. that place time pressure on the quantity surveyor. Respondent D supported this by saying, ". *Claims should go on time complying with the clauses relating to time targets, for example, the contractor may need to submit a claim notice within 28 days."*

Checking final accounts

Checking final accounts is also a critical activity that requires time from a QS working in a consultant organization. It has got a marginal mean of 3.608. As the final account contains the full and final amount that has to be paid by the employer, it has to be scrutinized and evaluated carefully to achieve value for money for the client. It may involve still more time if negotiations with parties to the contract become necessary. This statement was upheld by Respondent E when he said, *"Negotiations connected with the checking of final accounts can take time, and will be based on the type of contract, i.e., whether private or government. If it is a private sector contract, there can be discounts which will take several months to materialise".*

Procurement and coordination of stakeholders to the project

The procurement and coordination of stakeholders to a project is one of the principal duties of a QS in a client organization. There may be several consultants and contractors (especially in major complex projects) who have to be coordinated by the client's QS, as he/she will be knowledgeable about the many aspects of the project. Therefore, in comparison to other activities of a client organization, this may require time with a marginal mean of 3.527. This was emphasised by Respondent B by saying, *". All coordination need to be done by the client's QS without any support from the consultant".* However, Respondent E, *was of the view that the procurement and coordination process depends on the policies of the organization and on the type of procurement.*

Value engineering

Although only one respondent considered value engineering as a critical activity of a consultant organization, after considering its impact on time management, it was considered for the detailed analysis. It requires several technical features together with cost aspects to identify the alternative options without sacrificing the performance. The ultimate purpose of this function is to achieve value for money to the client without lowering the quality. However, this is not a traditional role of a QS and is used now mostly in unique and complex projects. A QS in a contractor organization may also be able to perform value engineering under variation proposals. The time taken for this function may differ based on the complexity and the value of the project and the proposal.

Preparation of Turnaround documents

This function was also considered by a respondent as a critical activity of a consultant organization and like value engineering, it was *also* considered for the detailed study. It refers to the maintenance of proper documentation. For a consultant QS, corresponding with the client and

the contractor will be one of the most significant and time consuming activities. Therefore, appropriate maintenance of documents can be considered as a time consuming activity not only in the case of a consultant's QS but also in the case of a contractor's QS.

Preparation of cost value reconciliation (CVR)

Preparation of cost value reconciliation has been marked by one respondent as a time consuming activity in a contractor organization and was considered for the detailed analysis similar to value engineering. CVR aims at involving the management of the finances of a project by comparing the cost with value. It provides a running account of the profitability of the project and indicates those areas where the actual costs exceed the projected costs, or provide the lowest value. This may be identified early to enable corrective action or prevent repetition. Therefore, it has to be in place throughout the project duration and will have an impact on time management.

Getting the required approvals

One respondent considered getting approvals from the authorities as a critical duty of a QS in a contractor organization. In Sri Lanka, a contractor's QS will have to obtain several approvals especially for safety procedures and environmental protection. A reasonable justification was offered by Respondent E for this situation by saying, *"Getting approval is time consuming since in Sri Lanka depending on the requirement, it will be difficult to get the required approvals from the relevant authorities".*

The preliminary survey revealed that QSs working in the state sector experience more pressure on time compared to private sector QSs because of the auditing requirements. However, questionnaire findings indicate it to be not so. About 43% of the respondents have said that QSs working for private clients need to perform additional duties which affect their time management. However, only 17% have said same about QSs working for the government when the latter functions as the client. Since both the preliminary and questionnaire survey findings say otherwise, it was taken up at the expert interviews for further study. Respondent E justified it by saying that *in private sector, there is respect and trust for the quantity surveying profession and for financial matters they like to get the services/advice from the QS although it may not be part of the QS's work.* About 28% of the respondents were of the view that the type of client has no influence on the QS's time management. However, the type of employer along with his requirements has been selected as one of the dominant causes of poor time management and analysed in the preliminary survey. Therefore, it can be concluded that QSs may be required to perform additional functions for both government and private clients based on parameters like project requirements, legislation requirements, professional standards etc.

5. RESEARCH FINDINGS

Time management is an art of living as it can be perceived as "self-management" that involves personal skills and attitudes to make smart decisions on how to allocate time among several tasks and succeed in life (Kleiner, 1989). Nevertheless, many contextual factors can impact on construction project activities often resulting in unusual events which can have time constraints (Passerini, 2013). Since as emphasised by Khan (2008) and Enshassi et al. (2010), the construction industry is usually considered as the backbone of a stable global economy, time management issues whichis the most critical constraint in construction projects have to be resolved to ensure the growth of the country.Although Keane (2008) argued that among the construction professionals, it is the QS who frequently appears to be under time pressure. Therefore, this study attempts to investigate workplace time management of QSs through their roles and duties.

5.1. Key functions that create time management issues

The key functions that give rise to time management issues include the preparation of final accounts and agreements; preparation of tender documents, especially the BOQs; estimating and tendering; preparation of claim reports; checking of final accounts; procurement and coordination of stakeholders of projects; value engineering, preparing turnaround documents, cost value reconciliation and getting the required approvals from the relevant authorities.

The results of the preliminary survey reveal that QSs working in the government sector have more pressure on their time than the QSs working in the private sector since in the government sector they have to follow procedures that are already written down and maintain proper documentation for auditing purposes. However, one interviewee believed that there are no differences between the two sectors, as a QS in the private sector will also be required to follow government procedures when the client is a government institution. Therefore, he was of the view that it is the type of the employer but not the type of the sector that matters.

On the contrary, the questionnaire survey revealed that QSs working for a private client will have to carry out additional duties that may have an impact on his/her time management. Experts believed that it is because of the respect with which the private clients treat the quantity surveying profession and also the trust they place in it. They prefer to get service/advice from a QS when it comes to financial matters, even though this work may not fall directly or indirectly within the scope of work of QSs. It may not be part of the QS's work. Thus, it can be concluded that QSs working either for a private or a government client may be required to perform additional jobs as required by their respective clients and the projects they handle and this additional work can have an influence on their time management.

Moreover, the preliminary survey results indicate that time pressure is less in post construction stage when compared to pre-construction stage depending on the *type* of project, organization standards, employer's requirements, type of procurement and working environment.

6. CONCLUSIONS AND RECOMMENDATIONS

This study covers professional QSs practicing globally. The research findings acknowledge the importance of time management by construction professionals, especially the QSs.The results of the questionnaire survey confirmed the information obtained from both the literature and the preliminary survey. The information provided by the experts who were interviewed also confirmed the results of the questionnaire survey. This triangulation of information confirmed that the information obtained was reliable and valid.

In managing time in the day to day life, an individual will have to first list out the activities that he is required to complete. The literature findings revealed the traditional, evolved and developing roles of the QSs and their duties during pre-construction, construction and post construction stages of a project. These roles and duties that were identified were verified using the information provided by experts during the preliminary survey. The critical functions that may have an effect on time management were thereafter verified through the research findings.

Since successful time management is a form of personal achievement, it is the individual who has to take the initiative at personal level for time management. However, he will be able to succeed, only if his working environment is conducive towards his initiatives. Therefore, the top management of an organisation has to ensure a positive and corporative working environment which will support the employees in their time management initiatives. The superiors can create this environment by maintaining flexible relationships with subordinates who will then be able to

convey the issues they face in achieving their time targets. This study has been able to address the existing knowledge gap in workplace time management by quantity surveyors which will benefit the industry and the QSs in their careers.

REFERENCES

1. Afful-Broni, A. (2013), "Time management behaviour among academic and administrative staff of the University of Education, Winneba", *Journal of Education and Curriculum Development Research (JECDR),* Vol. 1 No. 3, pp. 67 – 78. Retrieved from http://www.projournals.org/JECDR

2. Ahmad, N.L., Mohd, A.N., Yusuf, Shobri, N.D.M., & Wahab, S. (2012), "The relationship between time management and job performance in event management", *in In International Congress on Interdisciplinary Business and Social Science 2012, Procedia - Social and Behavioral Sciences - 65,* pp. 937 – 941.

3. Alhojailan and Ibrahim, M. (2012), "Thematic analysis: a critical review of its process and evaluation", *Proceedings of the WEI International European Academic Conference,* pp. 8-21. Available at: www.westeastinstitute.com /wp-content/uploads/2012/10/ZG12-191-Mohammed-Ibrahim-Alhojailan-Full-Paper.pdf [Accessed: 10 August 2014].

4. Ambrose, S.B.Y.I.N.B. (1996), "A review of changes in the UK construction industry", *European Journal of Marketing*, Vol. 30 No. 3, pp. 47 - 64. Retrieved from http://dx.doi.org/10.1108/03090569610107427

5. Ashworth, A., Hogg, K., and Higgs, C. (2013), *Willis's practice and procedure for the quantity surveyor*, Wiley, Hoboken.

6. Baccarini, D. (1996), "The concept of project complexity a review", *International Journal of Project Management*, Vol. 14 No. 4, pp. 201 - 204.

7. Brandon, P.S. (1992), *Quantity surveying techniques: New directions,* Blackwell Scientific Publications, United Kingdom.

8. Braun, V. and Clarke, V. (2006), "Using thematic analysis in psychology", *Qualitative Research in Psychology*, Vol. 3 No.2, pp. 77-101.

9. Britton, B.K., & Tesser, A. (1991), "Effects of time management practices on college grades", *Journal of Educational Psychology,* Vol. 83 No. 3, pp. 405 - 410.

10. Bryman, A., & Cramer, D. (1990), *Quantitative data analysis for social scientists,* Florence, KY: Taylor & Frances/Routledge.

11. Christopher, D.B. (2010), "Development of the time management environment (Time) scale", *Journal of Managerial Psychology,* Vol. 25 No. 6, pp. 649 - 668. Retrieved from http://dx.doi.org/10.1108/02683941011056978

12. Claessens, B.J.C., Eerde, W., Rutte, C.G., & Roe, R.A. (2007), "A review of the time management literature", *Personnel Review*, Vol. 36 No. 2, pp. 255 – 276. Retrieved from http://dx.doi.org/10.1108/00483480710726136

13. Crafford, G.J. and Smallwood, J.J. (2007), "Clients' views on quantity surveying competencies", *Acta structilia: Journal for the physical and development sciences*, Vol. 14 No.1, pp. 33-55.

14. Creswell, J. W. (2003), *Researcg design: Qualitative, Quantitative and mixed method approaches* (3rd ed.), USA: SAGE Publications.

15. Enshassi, A., Mohamed, S., & Karriri, A.E. (2010), "Factors affecting the bid/no bid decision in the Palestinian construction industry", *Journal of Financial Management of Property and Construction*, Vol. 15 No. 2, pp. 118 - 142.

16. Fanous, A. and Mullins, A. (2012), "Surveying the field: changes in quantity surveying", available at: www.smashwords.com/books/download/215763/1 /latest /0/0/surveying-the-field-changes-in-quantity-surveying.pdf [Accessed 17 August 2014].

17. Fellows, R.F., & Liu, A.M.M. (2008), *Research methods for construction* (3rd ed.). United Kingdom: Wiley.

18. Gehani, R.R. (1995), "Time-based management of technology", *International Journal of Operations & Production Management,* Vol.15 No. 2, pp. 19 – 35. Retrieved from http://dx.doi.org/10.1108/01443579510080391

19. Harung, H.S. (1998), "Reflections: Improved time management through human development: Achieving most with least expenditure of time", *Journal of Managerial Psychology,* Vol. 13 No. 5/6, pp. 406 - 428. Retrieved from http://dx.doi.org/10.1108/02683949810219909

20. Hawkins, F., & Klas, L. (1997), "Time management as a stressor for helping professionals: Implications for employment", *Journal of Employment Counselling*, Vol. 34 No. 1, pp. 2 – 6.

21. Hemajith, S.D.M., Perera, B.A.K.S., Amaratunga, D. and Ginige, K.N. (2007), "Quantity surveyor as the technical appraiser in the Sri Lankan financial industry", *Proceedings of the 3rd Annual Built Environment Education Conference of the Centre for Education in the Built Environment*, pp. 1-12, available at: www.disaster-resilience.salford.ac.uk/

22. Higham, A. and Thomson, C. (2015), "An evaluation of construction professionals sustainability literacy in North West England", in: *Raidén, A B and Aboagye-Nimo, E (Eds), Proceedings of 31st Annual ARCOM Conference, 7-9 September 2015*, Lincoln, UK, Association of Researchers in Construction Management, pp. 417-426.

23. HofFMacan, T. (1994), "Time management: Test of a process model". *Journal of Applied Psychology*, Vol. 79 No. 3, pp. 381 – 391.

24. Hoffmeister, K., Cigularov, K.P., Sampson, J., Rosecrance, J.C., & Chen, P.Y. (2011), "A perspective on effective mentoring in the construction industry", *Leadership & Organization Development Journal,* Vol. 32 No. 7, pp. 673 - 688. Retrieved from http://dx.doi.org/10.1108/01437731111169997

25. Jeyamathan, S.J. (2005), *Identifying and analysing duties and skills of quantity surveyors in Sri Lanka* (Unpublished bachelor's dissertation). University of Moratuwa, Sri Lanka.

26. Kanewala, S.D. (2003), *Modelling the competencies required by professional quantity surveyors in Srilanka* (Unpublished bachelor's dissertation), University of Moratuwa, Sri Lanka.

27. Karunarathna, A.M.A.P. (2006), *Five years look ahead: Quantity surveyors' expectations in Srilanka* (Unpublished bachelor's dissertation), University of Moratuwa, Sri Lanka.

28. Keane, W.M.M.D.K.M. (2008), "How a quantity surveyor can ease cost management at the design stage using a building product model", *Construction Innovation*, Vol. 8 No. 3, pp. 164 - 181.

29. Keselman, H.J., Huberty, C.J., Lix, L.M., Olejnik, S., Cribbie, R.A., Donahue, B., Kowalchuk, R.K., Lowman, L.L., Petoskey, M.D., Keselman, J.C., and Levin, J.R. (1998), "Statistical practices of educational researchers: An analysis of their ANOVA, MANOVA, and ANCOVA analyses", *The Review of Educational Research,* Vol. 68 No. 3, pp. 350-386.

30. Khan, R.A. (2008), "Role of construction sector in economic growth: empirical evidence from Pakistan economy", *Proceedings of the First International Conference on Construction in Developing Countries*, pp. 279-290.

31. Kleiner, J.M.B.H. (1989), "New developments in effective time management", *Management Decision*, Vol. 27 No. 5, pp. 28 – 34. Retrieved from http://dx.doi.org/10.1108/00251748910132485

32. Krippendorff, K. (2013), *Content analysis: An introduction to its methodology,* Thousand Oaks, CA: Sage Publications.

33. Kulasekara, G., Jayasena, H.S., & Ranadewa, K.A.T.O. (2013), "Comparative effectiveness of quantity surveying in a building information modelling implementation", *In The Second World Construction Symposium 2013: Socio-Economic Sustainability in Construction, Sri Lanka*, pp. 101-107.

34. Lee, C.C.T. and Hogg, K. (2009), "Early career training of quantity surveying professionals", available at: www.irbnet.de/daten/iconda/CIB_DC24200.pdf [Accessed: 17 June 2014].

35. Naoum, S.G. (1998), *Dissertation Research and Writing for Construction Student*, Oxford: Butterworth-Heinemann.

36. Njagi, L.K., & Malel, J. (2012), "Time management and job performance in selected parastatals in Kenya", *Australian Journal of Business and Management Research*, Vol. 2 No. 5, pp. 19 – 29.

37. Nkado, R., & Meyer, T. (2001), "Competencies of professional quantity surveyors: A South African perspective", *Construction Management and Economics,* Vol. 19 No. 5, pp. 481 - 491. Retrieved from http://dx.doi.org/10.1080/01446193.2001.9709624

38. O'Brien, P., Mbachu, J. & Lomax, S. (2014), "Current and future challenges facing New Zealand quantity surveyors: Priority issues and potential solutions", *In Proceedings of the 4th New Zealand Built Environment Research Symposium (NZBERS), Auckland, New Zealand*, pp. 1-17.

39. Ofori, G. (1990), "*The construction industry: Aspects of its economics and management"*, Singapore University Press, Singapore.

40. Olanipekun, A.O., Aje, I.O. and Abiola-Falemu, J.O. (2013), "Effects of organisational culture on the performance of quantity surveying firms in Nigeria", *International Journal of humanities and social science*, Vol. 3 No.5, pp. 206-215.

41. Olatunji, O.A., Sher, W., & Gu, N. (2010), "Building information modelling and quantity surveying practice", *Emirates Journal for Engineering Research*, Vol. 15 No. 1, pp. 67 - 70.

42. Olatunji, S.O., Oke, A.E., & Owoeye, L.C. (2014), "Factors affecting performance of construction professionals in Nigeria", *International Journal of Engineering and Advanced Technology (IJEAT),* Vol. 3No. 6, pp. 76 - 84.

43. Opawole, A., Awodele, O.A., Babatunde, S.O., & Awodele, O.O.P. (2012), "Review of correlation of quantity surveyors' education in Nigeria to skill requirements for administration of civil engineering projects", *Journal of Education and Practice,* Vol. 3 No. 16, pp. 109 - 117.

44. Passerini, D.W.K. (2013), "Uncovering knowledge-based time management practices", *International Journal of Managing Projects in Business*, Vol. 6 No. 2, pp. 332 – 348. Retrieved from http://dx.doi.org/10.1108/17538371311319052

45. Poh, F.Y.Y.L.Y.P. (2004), "Encouraging more female quantity surveying graduates to enter the construction industry in Singapore", *Women in Management Review,* Vol. 19 No. 8, pp. 431 - 436. Retrieved from http://dx.doi.org/10.1108/09649420410570234

46. Pribadi, R.D.W.K.S. (2011), "Licensing construction workforce", *Engineering, Construction and Architectural Management*, Vol. 18 No. 5, pp. 431 - 443. Retrieved from http://dx.doi.org/10.1108/09699981111165158

47. Rao, M.S. (2014), "Timeless tools to manage your time", *Industrial and Commercial Training*, Vol. 46 No. 5, pp. 278 – 282. Retrieved from http://dx.doi.org/10.1108/ICT-09-2013-0059

48. Sacks, R. and Pikas, E. (2013), "Building information modelling education for construction engineering and management. I: Industry requirements, state of the art, and gap analysis", *Journal of Construction Engineering and Management,* Vol. 139 No.11.

49. Senaratne, S., & Sabesan, S. (2008), "Managing knowledge as quantity surveyors: An exploratory case study in Sri Lanka", *Built-Environment - Sri Lanka*, Vol. 8 No. 2, pp. 41 - 47.

50. Shafiei, M.W.M., & Said, I. (2008), "The competency requirements for quantity surveyors: Enhancing continuous professional development", *Sri Lankan Journal of Human Resource Management*, Vol. 2 No. 1, pp. 17 - 27.

51. Smith, P. (2004), "Trends in the Australian quantity surveying profession: 1995-2003", *Proceedings of the International Cost Engineering Council 4th World Congress,* pp. 1-15, available at: www.icoste.org/korev2004a.pdf

52. Smith, P. (2009), "Trends in the Australian quantity surveying profession: 1995 – 2008", *Proceedings of the 13th Pacific Association of Quantity Surveyors Congress,* pp. 1-15, available at: www.icoste.org/korev2009a.pdf

53. Stanley, R. and Thurnell, D. (2014), The benefits of, and barriers to, implementation of 5D BIM for quantity surveying in New Zealand, *Australasian Journal of Construction Economics and Building,* Vol. 14 No. 1, pp. 105-117.

54. Tan, W. (2002), *Practical research methods,* Jurong: Prentice Hall.

55. Thayaparan, M., Siriwardena, M., Amaratunga, D., Malalgoda, C., and Keraminiyage, K. (2011),"Lifelong learning and the changing role of quantity surveying profession",*In: Proceedings of the 15th Pacific Association of Quantity Surveyors Congress; 2011 Jul 23–26; Colombo, Sri Lanka*.

56. Toor, S.R., & Ofori, G. (2008), "Leadership for future construction industry: Agenda for authentic leadership", *International Journal of Project Management*, Vol. 26 No. 1, pp. 620 - 630. Retrieved from www.elsevier.com/locate/ijproman

57. Walsh, K. (2003), "Qualitative Research: Advancing the Science and Practice of Hospitality", *Cornell Hotel & Restaurant Quarterly*, Vol. 44 No. 12, pp. 66-75.

58. Wao, J.O. and Flood, I. (2016), "The role of quantity surveyors in the international construction arena", *International Journal of Construction Management,* Vol. 16 No.2, pp. 126-137. doi: 10.1080/15623599.2016.1142251

59. Willis, C. J., Willis, J. A., Ashworth, A., & Hogg, K. I. (2007), *Willi's practice and procedure for the quantity surveyor (12th ed.)*, UK: Blackwell Publishing Ltd.

60.Yin, R.K. (2013), *Case study research: Design and methods (5th ed.)*, New York: Sage Publications.

61. Zou, P. X. W., Sunindijo, R. Y., and Dainty, A. R. J. (2014), "A mixed methods research design for bridging the gap between research and practice in construction safety", *Safety Science*, Vol. 70, pp. 316–326.

POSITIVE AND NEGATIVE IMPACTS OF NON-STANDARD PRACTICES IN CONSTRUCTION PROJECTS: CASE OF QUANTITY SURVEYORS

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ABSTRACT

The construction industry is perceived to be extraordinary and unique. With the increase of project size and complexities, mal practices are drastically mounting. The project performance and the productivity have been impacted consequently. Adhering to the standardized practices would assist the industry to upkeep the expected performance and maintain the productivity. Nevertheless, the construction industry has been considered as a vulnerable industry to non-standard practices instigating many impacts on the project. Thus, this paper directs towards investigating and mitigating the Quantity Surveyors (QSs) non-standard practices in the construction industry.

The study revealed several non-standard practices undertaken by QSs prevail in the construction industry. These practices could vary, remain, unchanged or escalate through the project life cycle of briefing, design and development, tender preparation, construction stage, handing over and defects liability period. Several causes of the non-standard practices were identified with their positive and negative impact and the possibility of immediate rectification. The positive impacts were identified as minimized conflicts and disputes among project team, time saving, and cost saving. A wide range of negative impacts were acknowledged because of the non-standard practices, which directed the need of identifying the mitigation actions to overcome the non-standard practices.

Key words: *Construction projects, Negative, Non-standard practices, Positive, Quantity Surveyor*

1.0 INTRODUCTION

Construction industry is an extraordinary industry compared to other industries (LaBarre& El-adaway, 2013) due to the main parameters making the construction industry unique from other industries are involvement of multiple tasks, skill mixes, climatic conditions and work environment. According to Cakmak and Cakmak (2014), construction industry has been a very complicated and aggressive environment in which individuals with different ideas, abilities and different levels of wisdom on construction process collectively work. Construction industry involves many participants out of which Quantity Surveyors (QSs) play an important role like other professionals (Shafiei & Said, 2011). Moss (2012) stated that QSs play a vital role in terms of making decisions in construction projects, which usually involve large sums of money and information produced through continuous communication with other participants at the stages of planning, design and construction. The construction industry participants possess different perceptions with related to various aspects, which makes conflicts an inevitable element in the industry (Khekale & Futane, 2015). Furthermore, the authors highlighted that conflicts will take the face of disputes if not properly managed.

According to Henry and Arthur (1993), a conflict can rise as a doubt or questioning, disagreement, unsuited behaviour, controversy or unfriendly interaction and on the other hand disputes can origin from one of the range of events considered as a conflict.

A study by Kumaraswamy and Yogeswaran (1998) provided a good reference of many common sources of construction disputes, which expressly deals with contractual matters, including variation, payment, availability of information, extension of time, quality of technical specification, unrealistic client expectations and determination, administration and management. Further, the study highlighted the most critical sources creating claims as unclear or inadequate documentation, variations initiated by the Employer/Engineer, late instructions, inclement weather, measurement related issues, and time extension assessment. These facts imply that not following standard methods in carrying out the job roles of construction professional could create conflicts, disputes, which would affect the project performance.

According to Adnan, Hashim, Mohd, Yusuwan and Ahmad (2012), construction industry is perceived to be one of the most vulnerable industries to non-standard practices. Further, authors stated that construction industry comprises of large capital investments, consists of many participants, involves a number of documentation work, provides large scale opportunities to obtain rent as well as investments that usually cannot be diverted after implementation. The study highlighted that non-standard practices can be found out or taken place during all the phases of a construction project, which include planning and design, pre-qualification and tender, project execution and operation and maintenance (Adnan et al., 2012).

Given the impact of non-standard practices in construction projects and the important role-played by the QS in construction industry, the requirement to investigate the impact of non-standard practices of QS in construction projects emerged. The paper is organized as follows. First, a literature review including QSs involvement in project life cycle, common non-standard practices and causes are presented. This is followed by the justification of the methods used for data collection and research findings.

2.0 LITERATURE REVIEW

2.1 Construction projects

The construction of a building would differ to another, in terms of unique design, purchasing practices and challenges faced from the site settings, the work that must be carried out, equipment, materials, stakeholders, and different procurement processes (Enshassi, Choudhry &Ghandour, 2008).However, Adnan, Hashim, Mohd and Ahmad (2012) expressed the opinion that construction industry is often named to be a place with malpractices due to its size. Despite these arguments, Rahman, Karim, Danuri, Berawi and Yap (2007) stated that the main reason causing issue in constructions is human led factors. Rumane (2013) defined construction project as, “a plan or program performed by people who have been assigned resources to achieve an objective within a finite duration” (p.5).Every project undergoes a series of phases, which is not restricted only to construction industry (Bennett, 2003). Further to the author, six (06) stages described, which are briefing stage (pre -project phase), design and development phase, tender preparation and contractor selection phase, construction phase, project close out and handing over phase, and operational phase.

2.2 QSs involvement in construction project life cycle

Construction industry involves many parties as clients, designers, construction professionals and operational teams (Olanrewaju & Anahve, 2015). According to Zakaria, Mohamed, Ahzahar and Hashim (2015), construction needs many workers and traders on the other hand to achieve the project success, a professional team are mandatory. A QS plays a vital role among the parties as

"a professional in the construction industry who has the ability to analyze both cost components and practical physical construction works of a project in a successful way so as to be able to apply the results of his analysis in solving problems peculiar to each project" (Badu & Amoah, 2004, p.1). According to Mackie and Cooper (2012), QSs currently contribute in all the stages of construction projects. Ashworth, Higg and Hoggs (2013) presented the QSs traditional and evolved role in their study, which has been demonstrated in Table 1.

Table 1: Quantity Surveyors Traditional and Evolved Role

Traditional role	Evolved role
• Single rate approximate estimates • Cost planning • Procurement advice • Measurement and quantification • Document preparation • Cost control during construction • Interim valuations and payments • Financial statements • Final account preparation and agreement • Settlement of contractual claims • BOQ preparation	• Investment appraisal • Advice on cost limits and budgets • Whole life costing • Value management • Risk analysis • Insolvency services • Cost engineering services • Subcontract administration • Environment services measurement and costing • Technical auditing • Planning and supervision • Valuation for insurances purposes • Project management • Facilities management • Administering maintenance programmes • Advice on contractual disputes • Planning supervisor • Employer's agent • Programme management • Cost modelling • Sustainability advisor

Source: Ashworth et al. (2013)

2.3 Professionals standardized practices in construction industry

Standardized practices are detailed documents, which comprise of predefined steps developed by members and followed by them as procedures involving a series of steps (Krichbaum, 2008). Further, standardized practices are developed to reduce variations between processes and avoid unproductive movements, which in return leads to reduction in waste, simplifies conflict resolution, minimize claims and increases productivity in a particular work or a group of works. The author further highlighted that the term standardized reflects, designed or constructed according to an official standard or in a standard manner.

According to Cato (2001), process, which change continuously is hard to improve, but with standardized practices more room for continuous improvements is provided. By incorporating, standardized ways or practices to carryout work, a baseline will be created, which could utilize for continuous improvement (Royal Institution of Charted Surveyor [RICS], 2012). To eliminate conflicts involved in process, it is important to have an in-depth understanding on the steps that needed to be followed to complete the work, which would not be possible, if different parties use various means to complete a work (Cato, 2001). According to Krichbaum (2008), introducing

standardized practices, professional's role will be made ease, as a standardized document will provide a baseline or guideline, which they could refer in any circumstance (Krichbaum, 2008). Section 2.4 elaborates guidelines available for construction work.

2.4 Guidelines for construction works

A product or process acceptance would depend on the guideline as it provides the basis for such decision (Cato, 2001). Many Authors highlighted that by using construction guideline, conflicts could be avoided between project members, making easier to work with them. According to Hatheway (1992), guideline is a "formalization presented by a technical society or governmental agency as basis for voluntary adherence as the basis for acceptance of work product; requires additional thought and evaluation by the practitioner to implement on single project work" (as cited in Cato, 2001,p2).

RICS standards and guidance cover all areas of the Quantity surveying practice and embodies best practices (RICS, 2017). Further, RICS is the leading professional body that provides the international standard guidelines for the construction industry. RICS has published more than 30 guidelines for the construction work (RICS, 2017), which includes,

- Value Management and Value Engineering - 1st edition guidance notes
- Commercial Management of Construction
- RICS Valuation - Professional Standards UK January 2014 (revised April 2015)
- NRM 3: Order of cost estimating and cost planning for building maintenance works
- The Informed Infrastructure Client
- NRM 2 - Detailed Measurement for Building Works
- Measured Surveys of Land, Buildings and Utilities
- International BIM implementation guide
- RICS Property Measurement (incorporating International Property Measurement Standards)

Further, International Federation of Consulting Engineers had published FIDIC documents, international standard forms of contracts for works and for clients, consultants, sub-consultants, joint ventures and representatives, together with related materials such as standard pre-qualification forms (FIDIC,2017). Construction Industry Development Authority (CIDA) in Sri Lanka had published guidelines such as Standard Bidding Documents (SBD), Condition of engagement, and ICTAD formula method for Sri Lankan construction industry. Moreover, Government Procurement Guideline, and Procurement Manual are other common guidelines used in the industry. Standard Method of Measurement (SMM), Civil Engineering standard method of measurement (CESMM), Sri Lankan Standards (SLS 573) and Building Schedule of Rate (BSR) are mainly used as guidelines for preparing Bill of Quantities.

2.5 Non-standard practices of construction professionals in construction projects

The construction industry is considered as a place with malpractices (Ashworth et al., 2013). The authors emphasized non-standard practices should be avoided and highlighted that society has already become specialized in carrying out non-standard practices, which are opposed to standardized practices.

However, Adnan et al., (2012) considered construction industry as an environment, which facilitate non-standard practices due to the high competition, focus on price and low margins. Non-standard practices had created a huge impact on the industry reputation (Jordan, 2005). In a survey carried out by Fails Management Institute (FMI), 63% of respondents who participated in

the survey considered the industry to be heavily influenced by non-standard practices (Fails Management Institute [FMI], 2004).

Rahman et al. (2007) stated that due to the non-standard practices adopted in projects the completed project could be considered as unwanted, inappropriate, overlay complicated components, overcharged or delayed and end up with claims and conflicts. According to Annual Report of Malaysia Work of Ministry (2005), through a report held on Malaysian construction industry, 17.3% of 417 government projects were at stake and some were as a cause of non-standard practices carried out by the project participants (as cited in Adnan et al., 2012). According to Adnan et al. (2012), many reasons lead in making professionals to follow non-standard practices such as lack of a proper legislation, huge competition, economic slumps, and lack of ethical education from academic and professional institutes, cultural mismatch and complexity in construction works.

2.6 Non-standard practices of Quantity surveying that lead to cost and time overruns in construction projects

The common non-standard practices highlighted are concerned with tendering practice, poor quality of construction work, safety culture, payment issues, corruption and records maintenance (Adnan et al., 2012). Non-standard practices in construction industry are not limited to a country it is too universal as the industry. The findings of researches carried out based on many countries as in USA (Jackson, 2000; FMI, 2004), Australia (Vee & Skitmore, 2003), South Africa (Pearl, Bowen, Makanjee, Akintoye, & Evans, 2005) and Hong Kong (Fan & Fox, 2005) provide evidence for this.

According to Al-Khalil and Al-Ghafly (1999) and Assaf and Al-Hejji (2006), the biggest cause for delay is awarding the project to the lowest bidder. In addition, delays in progress payment, issues in planning and scheduling by contactor (Assaf& Al-Hejji, 2006), improper site management and supervision by contractors (Assaf& Al-Hejji, 2006; Faridi& El-Sayegh 2006) are other causes for delays. Assaf and Al-Hejji (2006) discuss the reasons for delays from the contractors and consultant view point. Accordingly, issues about payment is considered as the biggest issue for delays by contractors whereas, clients consider poor contractor management as the biggest issue. The impact on payments on project delays had been previously highlighted by the study conducted by Assaf, Al-Khalil and Al-Hazmi (1995) and Kaming, Olomolaiye, Holt and Harris (1997). According to Koushki, Al-Rashid and Kartam (2005), lack of experience in terms of construction is a critical component of factors causing for delays. Increase of quantities is another major issue forwarded by Yogeswaran, Kumaraswamy and Miller (1998) as a cause for construction delays.

According to Peeters and Madauss (2008), cost is a major factor creating issues in terms of project success. The authors highlighted that inaccurate estimate of cost of project as the biggest factor creating cost overruns. This view was forwarded initially by Aibinu and Jagboro (2002) and Akinci and Fischer (1998) stating that poor cost planning as a critical factor leading the project towards cost overruns.

According to the study carried out by Ali and Kamaruzzaman (2010), fromfactors contributing to cost overrun, inaccurate estimations of initial cost is the top ranked factor. The studies carried out by Durdyev, Ismail and Bakar (2010) supported this opinion, emphasizing that planning and improper estimation as the critical factor causing project cost overrun. Kumaraswamy (1997) stated that ambiguities in contract documents also cause conflicts. This opinion is supported by Cakmak and Cakmak (2014) in his study. Conlin, Langford and Kennedy (1996) stated that payments act as causes for construction disputes. Out of the seven types of construction disputes contract terms, payment issues and variations were ranked as first three causes(Heath, Hills &

Berry, 1994). According to Yates (1998), disputes in contract documents include variations and unclear contract documents. Sheridan (2003) highlighted on the major disputes settled through adjudication, which comprise disputes regarding "valuation of variations, valuation of final accounts and failure to comply with payment provision" (p.61). Causes or claims was ranked by Enshassi, Choudhry and El-Ghandour (2009) in their research and Table 2depicts the ranked causes where QSs are involved,

Table 2: Causes of claims

Causes of claims	Index	Rank
Awarding bid to the lowest bidder	0.744	1
Different description of the item in the bill of quantities than what was mentioned in the specifications	0.623	6
Payment requests are not entertained within the stipulated time	0.617	7
Drawings and bill of quantities are not fitting the construction site	0.02	10
Ambiguous and incomplete drawings and bill of quantities	0.599	12
Awarding process took longer period after the bid opening	0.593	14

Source: (Adopted from Enhassi, Choudhry & El-Ghandour, 2009)

A survey conducted by Ali (2015) identified, lack of attention in maintaining records and managing document as a cause of claims. Zaneldin (2006) based on his study ranked the causes of claims, which is presented in Table 3.

Table 3: Causes of claims

Causes of claims	Important index (%)	Rank
Change or variation order	55.0	1
Delay in payment process	48.9	4
Variation in quantities	44.7	8
Estimating errors	39.1	15
Bad communication between parties	37.7	18

Source: (Adapted from Zaneldin, 2006)

The studies conducted by authors Vee and Skitmore (2003) and Pearl et al. (2005) identified that many non-standardized practices and ethical conflicts in construction industry as to corruption, negligence, inducement, dilemmas, bid cutting, underestimating the bid, collusive tendering, high pricing of bid, allocating cost unevenly, revealing bids of contactors to other contractors, withdrawal of tender, and payment game.

Adnan et al. (2012) identified the consequences of non-standard practices, which are unfavourable to construction and engineering companies such as lost tender expenses, tendering ambiguities, amplified costs, economic damage, intimidations, criminal suits, fines, blacklisting and reputational damages. The form of non-standard behaviours that could take place in construction industry were highlighted by Fan, Ho and Ng (2001) and Vee and Skitmore (2003) as to unfair conduct, carelessness, dilemmas, sharing information illegally within companies, fraud and bribery.

Concerns on professional's non-standard practices has been gained insight among public and an increasing demand persist among the current literature on standard practices and behaviours of professionals in construction industry (Adnan et al., 2012).

3.0 RESEARCH METHODOLOGY

The study adopted qualitative approach to fulfill the research aim. Data collection method deployed was expert interviews, which was carried out using semi structured interview guideline. Since, open-ended questions could be directed to participants through semi-structured interviews, a platform for knowledge, opinion and experience sharing was created. Semi structured interviews were conducted with fifteen (15) industry experts who have experience of more than ten (10) years in the construction industry representing QS, Engineers and Architects. The collected data were analysed using code-based content analysis using N-Vivosoftware

4.0 DATA ANALYSIS

4.1 Non-standard practices

Through the process of data collection, it was identified that some non-standard practices carried out by both prevailing consultant and contractor QS during each stage of project life cycle in Sri Lankan construction industry and presented in Table4.

Table 4: Non-standard practices of QS during each stage of project life cycle

Briefing Stage	• Not issuing letters and notes • Not maintaining records • Use own methods for doing project feasibility analysis
Design and Development	• Not issuing letters and notes • Cost planning is done using different method based on experience • Not maintaining records
Tender Preparation Stage	• BOQ of a similar project is taken and editing is carried out to suit the new project • BOQ descriptions are not written in accordance to method of measurement • Not issuing letters and notes • Not taking accurate quantities in BOQ preparation • Not reading drawings and specifications accurately when BOQ preparation • Not reading drawings and specifications accurately when BOQ pricing • Use another project input proportions for current project • Materials, labour and services required are prepared based on the experience • Not following the tender document properly in bidding process
Construction	• Not issuing letters and notes • Interim payment application is created including more than the actual work done at site • materials, labour and services required are prepared based on the experience • Not maintaining records • Preparing rate breakdown using previous rate breakdown details without calling for quotations • Without attaching supporting documents, submitting interim payment application (ex- RFI, CVI, Test report) • Not involving contractors when taking site measurements • Approve Interim payment application that include more than actual progress • Release advance payment prior to the advance payment bond and performance bond • Amounts in a variations are approved by mutual understanding between parties
Handing over	• Not issuing letters and notes

	• Not maintaining records • Without attaching all the supporting documents, submitting final IPA • Amounts in a variations are approved by mutual understanding between parties • Issuing retention money without taking over certificate • Test reports are obtained without doing the tests

Several non-standard practices such as not issuing letters and notes, and not maintaining records are recurring in every stage of the project life cycle. Whereas, some non-standard practices result rise or escalate the project life cycle. As depicted in Table 4, more than thirty non-standard practices were identified in different stages of the project life cycle. To facilitate them as most common and least non-standard practices, one third or more than one third of the total number of respondents was considered as most common non-standard practices (bolted in Table 4), whereas if the number is below one third it is identified as least common non – standard practices.

. The identified most common non-standard practices are,

- BOQ descriptions are not written in accordance to method of measurement
- Interim payment application is created including more than the actual work done at site
- Not taking accurate quantities in BOQ preparation
- Not reading drawings and specifications accurately when BOQ preparation
- Not reading drawings and specifications accurately when pricing the BOQ
- Cost planning is done using different methods based on experience
- Use another project's input proportions without preparing it to current project
- Not maintaining records
- Materials, labour, equipment and services required are prepared based on the experience
- Not following the tender document properly in bidding process
- Preparing rate breakdown using previous rate breakdown details without calling for quotations
- Without attaching supporting documents submitting interim payment application (ex-RFI, CVI, Test report)

4.2 Causes for non-standard practices

The drivers leading in non-standard practices were subjected to investigation following the identification of common non-standard practices undertook by QSs. The findings have been presented in Figure 2 based on the causes identified by the respondents.

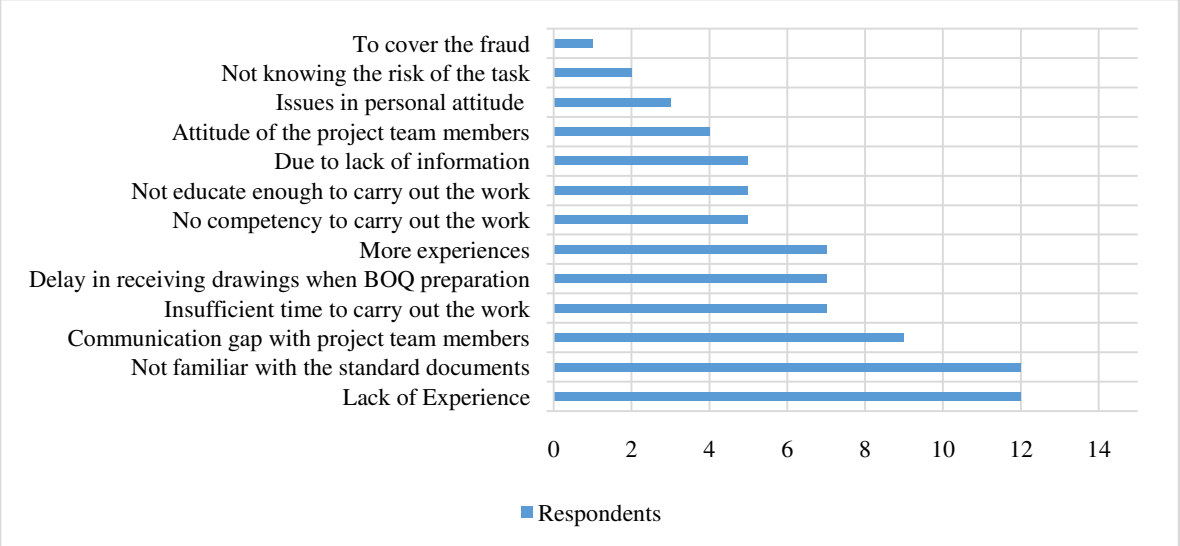


Figure 1: Causes for non-standard practices

Lack of experience, not familiar with the standard documents and communication gap with project team members were three (03) of the most referred causes out of thirteen (13) number of causes identified. The causes of the non-standard practices need to be immediately recognized and corrected to lessen the burden the projects owners and other stakeholders need to bear in terms of low productivity and performance.

However, identifying the impact of non-standard practices is of utmost important before addressing the issue. Hence, the impact of non-standard practices was subjected to investigation and twelve (12) number of impacts were identified which has been illustrated in Figure 3.

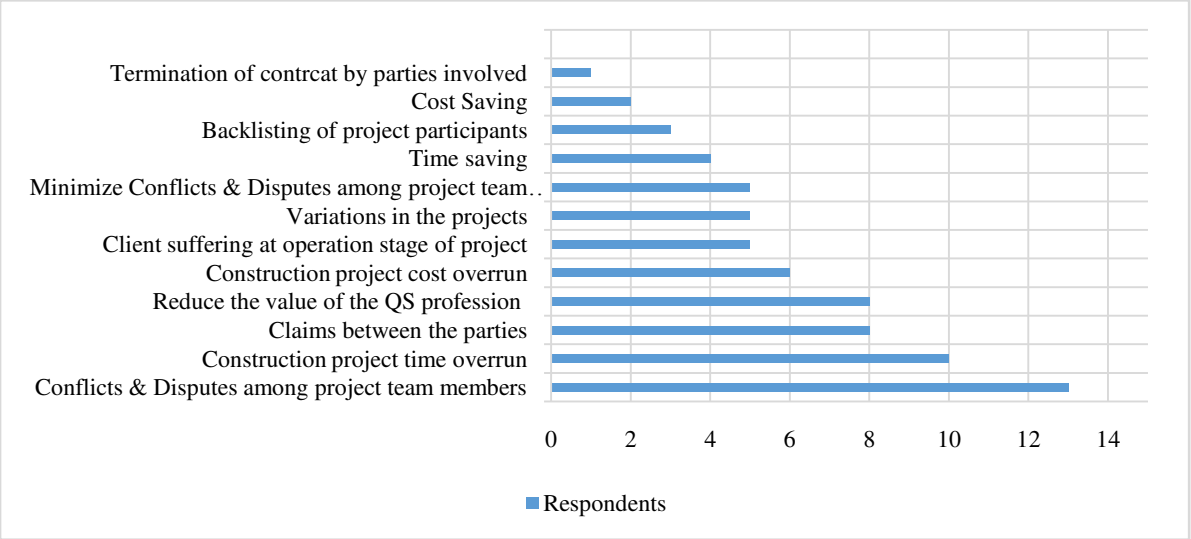


Figure 2: Impact of non-standard practices

Conflicts and disputes, time overrun and claims which were identified from literature as issues in construction industry wererecognised as impacts of non-standard practices of QSs and further was referred frequently by the respondents. However, respondents identified impacts from two perspectives as to positive and negative impact and has been presented in Table 4.

Table 4: Impact of non-standard practices

Negative Impact	Positive Impact
• Conflicts and disputes among project team members • Construction project time overrun • Reduce the value of the QS profession • Claims between project parties • Construction project cost overrun • Lead to variations in the project • Backlisting of the project participants • Termination of the contract	• Minimize the conflicts among project team • It's lead to cost and time saving at some circumstances

QSs non-standard practices could impact the construction project in two different ways. In some cases, it could negatively affect the construction project and on the other hand, it can be positively impact to the construction work. It was identified that some conflicts could be resolved in a non-standard way more easily than following standard ways and acting with mutual understanding could save money between parties involved rather than following a standard protocol. Hence, positive impacts were noted by several respondents.

Most of the experts who highlightedthe positive impact agreed that it depends with the project scale. Therefore, it is important to provide mitigation actions to minimize the negative impacts of identified non-standard practices. The mitigation actions proposed by experts are,

- Provide proper education on guidelines during higher educational level
- Practice ethical behavioursduring the period of education
- Prepare document for areas, which is not having the standard methods yet
- Update the guidelines to more user friendly
- Use differentprocurement methods rather than traditional methods
- Give clear idea about the task and advise on the impact if failed
- Start the construction project in a formal way
- Build friendly environment between project team members
- Attending to Continuing Professional Development activities(CPD)
- Sharing research output to the construction industry

Construction industry beinga place, which is been prone to non-standard practices need to resolve the situation by focusing on non-standard practices and the impacts caused by undertaking such practices.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The uniqueness of the construction industry has been emphasized due to the mix of talents, skills, attitudes associated with various participants. Architects, Engineers, Quantity Surveyors and contractors form a very important part in managing the construction process. In order to give best value for the client these professionals have to work together. The smooth flow of construction management and process require a good combination of standardized practices among the professionals in the design team. The conflicts among the construction professionals will literally affect the construction quality and performance. To handle the problems, the responsibility lies in hands of construction professionals, to carry out the work in accordance to a standard.

From the study, it revealed more than twenty-five non-standard practices of QSs, while engaged in construction projects. However, these practices could vary based on the stages of construction projects as briefing, design and development, tender preparation, construction and handover stage. Several practices adhered in a certain stage could prevail in another stage or a non-standard practice adhered in a stage may escalate to other stages. The non-standard could vary or remain in common based on pre-construction and post construction stages or between Consultant and Contractor QSs. Recognizing the non-standard practice next, the analysis was moved to arrive at findings on identifying the causes and impacts of the non-standard practices of QSs. It was identified that many causes could give rise for a non-standard practice and addressing the causes are of vital importance.

Identifying the non-standard practices and its causes, the study moved on to investigate the impact of the non-standard practices. It was identified that the impact could take two faces as positive impact and negative impact. Though the existence of non-standard practices is evident, the practices cannot be opting out of Sri Lankan construction industry. Recognizing the practices that could cause negative impacts and incorporating strategies to mitigate the negative impact is best mechanism that needs to be deployed to handle the situation. Due consideration need to be provided to reduce non-standard practices, which impact the construction project in negative way. Though it cannot be avoided entirely, recognizing the impact of the non-standard practices intended to be followed by a person would be a best mechanism to mitigate the non-standard practices.

6.0 FURTHER RESEARCH

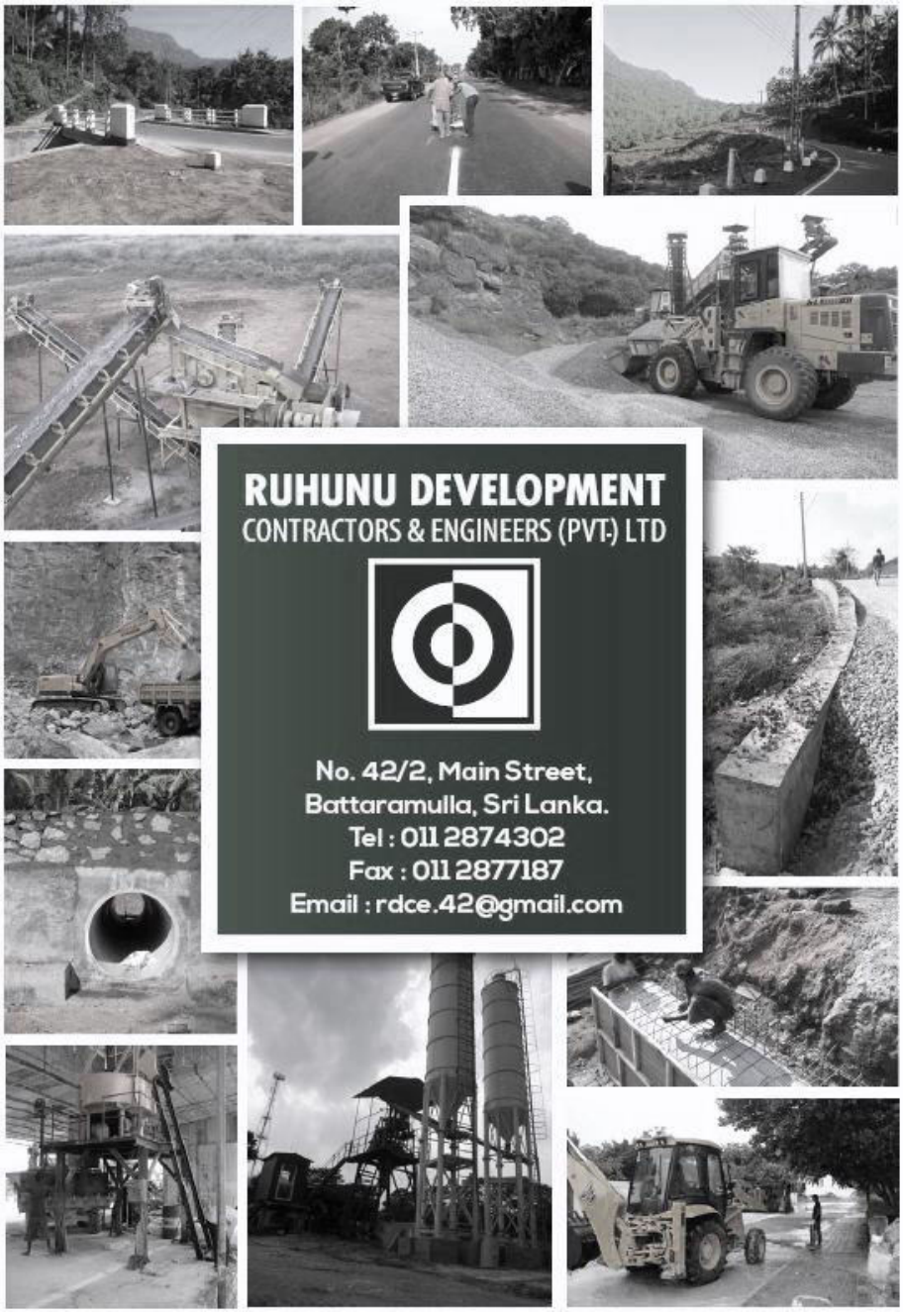
The study contributes to knowledge by identifying the non-standard practices and providing migratory actions to overcome the resulted impact in construction projects. Since the State sector procurement procedure is not the same as that of the private sector, a comparison study will be suggested as a future research.

7.0 REFERENCES

1. Adnan, H., Hashim, N., Mohd, N., & Ahmad, N. (2012). Ethical issues in the construction industry: Contractor's perspective. *Procedia-Social and Behavioral Sciences*, *35*, 719–727.
2. Aibinu, A. A., & Jagboro, G. O. (2002). The effects of construction delays on project delivery in Nigerian construction industry. *International Journal of Project Management*, *20*(8), 593–599.
3. Akinci, B., & Fischer, M. (1998). Factors affecting contractors' risk of cost overburden. *Journal of Management in Engineering*, *14*(1), 67–76.
4. Ali, A. M. E. F. (2015). A study on Causes and Management of Claims in the Sudanese Construction Industry. *M.Sc. Thesis, Construction Management*.
5. Ali, A. S., & Kamaruzzaman, S. N. (2010). Cost performance for building construction projects in Klang valley. *Journal of Building Performance*, *1*(1).
6. Al-Khalil, M. I., & Al-Ghafly, M. A. (1999). Important causes of delay in public utility projects in Saudi Arabia. *Construction Management & Economics*, *17*(5), 647–655.
7. Ashworth, A., Hogg, K., & Higgs, C. (2013). *Willis's practice and procedure for the quantity surveyor*. John Wiley & Sons.
8. Assaf, S. A., & Al-Hejji, S. (2006). Causes of delay in large construction projects. *International Journal of Project Management*, *24*(4), 349–357. https://doi.org/10.1016/j.ijproman.2005.11.010
9. Assaf, S. A., Al-Khalil, M., & Al-Hazmi, M. (1995). Causes of delay in large building construction projects. Journal of Management in Engineering, 11(2), 45–50.
10. Badu, E., & Amoah, P. (2004). Quantity Surveying Education in Ghana. *The Hgana Engineer*.
11. Bennett, F. L. (2003). The management of construction: A project life cycle approach. Routledge.
12. Cakmak, E., & Cakmak, P. I. (2014). An analysis of causes of disputes in the construction industry using analytical network process. *Procedia-Social and Behavioral Sciences*, *109*, 183–187.
13. Cato, P. S. (2001). Best practices-what does that imply. *Society for the Preservation of Natural History Collection Newsletter*, *15*(1), 1–11.
14. Conlin, J. T., Langford, D. A., & Kennedy, P. (1996). The Sources, Causes and Effects of Construction Disputes: A Research Project. *CIB REPORT*, 69–75
15. Durdyev, S., Ismail, S., & Bakar, N. A. (2010). Factors causing cost overruns in construction of residential projects; Case study of Turkey. *Asian Journal of Management Research*, *1(1)*, 3–12.
16. Enshassi, A. A., Choudhry, R. M., & El-Ghandour, S. M. (2008). Owners' perception towards causes of claims on construction projects in Palestine. *Arab Gulf Journal of Scientific Research*, *26*(3), 133–144. https://doi.org/10.1080/15623599.2009.10773123
17. Enshassi, A., Choudhry, R. M., & El-Ghandour, S. (2009). Contractors' perception towards causes of claims in construction projects. *International Journal of Construction Management*, *9*(1), 79–92.
18. F. M. I. (2004). The 2004-2005 U.S Construction Industry Traning Report.
19. Fan, C. N. L., & Fox, P. W. (2005). Ethical Issues in the construction industry. *Construction Industry Institute*.
20. Fan, L., Ho, C., & Ng, V. (2001). A study of quantity surveyors' ethical behaviour. *Construction Management and Economics*, *19*(1), 19–36.

https://doi.org/10.1080/014461901452058
21. Faridi, A. S., & El-Sayegh, S. M. (2006). Significant factors causing delay in the UAE construction industry. *Construction Management and Economics*, *24*(11), 1167–1176.
22. FIDIC. (2017). Retrieved from http://fidic.org/
23. Hatheway, A. (1992). AEG News. *Standard,guidelines and protocols: Keeping our house in order*, 35(1):26-18.
24. Heath, B., Hills, B., & Berry, M. (1994). The nature and origin of conflict within the construction process. *CIB report*, 35.
25. Henry, B., & Arthur, L. M. (1993). ADR Principles and Practice. London sweet & maxwell.
26. Jackson, B. J. (2000). The perceptions of experienced construction practitioners regarding ethical transgressions in the construction industry. Colorado State University.
27. Jordan, J. (2005). Texas Construction.
28. Kaming, P. F., Olomolaiye, P. O., Holt, G. D., & Harris, F. C. (1997). Factors influencing construction time and cost overruns on high-rise projects in Indonesia. Construction Management & Economics, 15(1), 83–94.
29. Khekale, C., & Futane, N. (2015). Management of claims and disputes in the Construction Industry. *Impact Factor*, *4*(5).
30. Koushki, P. A., Al-Rashid, K., & Kartam, N. (2005). Delays and cost increases in the construction of private residential projects in Kuwait. Construction Management and Economics, 23(3), 285–294.
31. Krichbaum, B. D. (2008). Standardized Work: The Power of Consistency. *Retrieved March*, *12*, 2008.
32. Kumaraswamy, M. M. (1997). Conflicts, claims and disputes in construction. *Engineering, Construction and Architectural Management*, *4*(2), 95–111.
33. Kumaraswamy, M. M., & Yogeswaran, K. (1998). Significant sources of construction claims. *International Construction Law Review*.
34. LaBarre, P. S., & El-adaway, I. H. (2013). Project benchmarking: tool for mitigating conflicts, claims, and disputes through improved performance. *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, 1-7. doi:10.1061/(ASCE)LA.1943-4170.0000140
35. Mackie, P., & Cooper, A. (2012). Quantity Surveying and Cost Management: Delivering Professional Solutions to the Property Industry. Rex Procter & Partners, www. rpp. co. uk.
36. Moss, J. (2012). The Future of Quantity Surveying. Moss Construction Cost Management Inc. www. mosscost. com.
37. Olanrewaju, A., & Anahve, P. J. (2015). Duties and responsibilities of QS's in the procurement of building services engineering. *Procedia Engineering*, *123*, 352–360.
38. Pearl, R., Bowen, P., Makanjee, N., Akintoye, A., & Evans, K. (2005). Professional ethics in the South African construction industry-A pilot study. In *The Queensland University of Technology Research Week International Conference* (pp. 4–8).
39. Peeters, W., & Madauss, B. (2008). A proposed strategy against cost overruns in the space sector: The 5C approach. *Space Policy*, *24*(2), 80–89.
40. Rahman, H. A., Karim, S. B. A., Danuri, M. S. M., Berawi, M. A., & Yap, X. W. (2007). Does professional ethic affects construction quality. In *Quantity Surveying International Conference* (pp. 4–5).
41. RICS Royal Institution of Chartered Surveyors. (2017). Retrieved from http://www.rics.org/lk/knowledge/professional-guidance
42. RICS. (2012). *Assessment of Professional Competence 2006 APC Requirements and competencies.* Retrieved July 6, 2013, from http://www.rics.org/ Global/APC_ Requirements_and_Competencies_Guide.pdf
43. Rumane, A. R. (2013). *Quality tools for managing construction projects*. CRC Press.
44. Saad, A., & Engineers, M. C. (2011). Factors Impacting The Project's Life Cycle. *Retrieved from G-Casa. Com*.
45. Shafiei, M. W. M., & Said, I. (2011). The competency requirements for QS's: Enhancing continuous professional development. *Sri Lankan Journal of Human Resource Management*, *1*(2).

46. Sheridan, P. (2003). Claims and disputes in construction. *Construction Law Journal*, *12*(1), 3–13.
47. Vee, C., & Skitmore, Cm. (2003). Professional ethics in the construction industry. *Engineering,* Al-Khalil, M. I., & Al-Ghafly, M. A. (1999). Important causes of delay in public utility projects in Saudi Arabia. *Construction Management & Economics*, *17*(5), 647–655.
48. Yates, D. J. (1998). Conflict and Dispute in the Development Process: A Transaction Cost Economic Perspective http://www.prres. net/proceedings/proceedings1998/Papers/Yates3Ai. PDF.
49. Yogeswaran, K., Kumaraswamy, M. M., & Miller, D. R. A. (1998). Claims for extensions of time in civil engineering projects. *Construction Management & Economics*, *16*(3), 283–293.
50. Zakaria, I. B., Mohamed, M. R. Bin, bt Ahzahar, N., & bt Hashim, S. Z. (2015). A Study on Leadership Skills of Project Manager for a Successful Construction Project.
51. Zaneldin, E. K. (2006). Construction claims in United Arab Emirates: Types, causes, and frequency. *International Journal of Project Management*, *24*(5), 453–459. https://doi.org/10.1016/j.ijproman.2006.02.006



SIGNIFICANCE OF DEFECTS NOTIFICATION PERIOD

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ABSTRACT

The paper discusses about Defects Notification Period (DNP). DNP is beneficial for the Contractor in order to overcome liability of liquidated damages. However, the Contractor has to substantially complete the Project in order to receive Defects Notification Certificate. When there is stage handing over the Engineer has to issue DNP for each and every stage completion. After partial completion of a Project, the Contractor cannot count DNP from the date of partial completion.

Key words - *Defects Notification Period, Partial Completion and Stage Completion*

1. INTRODUCTION

Most Construction Contracts contain a prescribed period of time within where the Contractor has a contractual obligation to remedy any defects in the construction work. DNP is a set period of time after the project has been completed during which a Contractor has an obligation to return to the site to remedy defects. DNP can benefit both parties in a sense that the Contractor also will be relieving his responsibility by receiving the Defects Notification Certificate and the balance payment and the Employer also will be benefiting, by the Contractor attending to defects.

In Engineering Contracts, it is a responsibility of the Contractor to complete the project in time as agreed between the parties. Unlike in the other industries it is impossible for a Contractor to finish the entire project and hand-over the Project free of defects to the Employer within the agreed duration. In Engineering Projects always there will be minor items that has to be completed which is going to take some time.

Receiving a Defects Notification Certificate by the Contractor is an important event in order to measure duration of the Contract. However, for a Contract to receive the Defects Notification Certificate the Contractor shall substantially complete the work.

For an example if the Contractor has to construct a five storey building constructing three stories of the building does not qualify the Contractor to receive Defects Notification Certificate. Similarly if the project consists of three blocks, completion of one block will not suffice for the Contractor to obtain Defects Notification Certificate.

2. CONTRACTOR'S RESPONSIBILITY

From the Contractor's perspective, Defects Notification means that payment of any milestone payment or final progress claim which it is entitle to be paid is not held up by minor defects in the works as it has the ability to rectify this post practical completion.[1] By carrying out any defects rectification work itself, the Contractor can take comfort that the integrity of any fitness for purpose warranties or design life warranties it has given under the Contract is maintained and

[1] Ayodeji S. Ojo, 'Defects Liability Period; Employer's Right and Contractor's Liability' 467 <https://mail-attachment.googleusercontent.com/attachment/u/0/?ui=> accessed on 27th September 2018

for the Contractor, it is likely to be more economical and efficient for it to carry out remedial works itself than to pay the costs of another Contractor hired by the Employer.

3. EMPLOYER'S ASPIRATION

From the Employer's perspective,DNP is useful for the following reasons;[2] even if minor defects in the works exist, DNP can help the Employer to be comfortable with the grant of practical completion and taking over the works with the knowledge that the Contractor has an obligation to remedy any snag list items and any defects that come to light during the DNP. It ensures that the Contractor is incentivized to perform the works to the required standard as it will not be entirely off the hook. Once practical completion has been achieved and the Employer does not have the added burden of managing the interface risk and added cost that would result from engaging a third party Contractor for defects rectification work and also any new Contractor will be unfamiliar with the Original Construction work and resources, the nature of the defect and the best method of rectification. So the Employer will not need to hire an alternative Contractor to carry out the work and reclaim the cost.

If there is a contractual obligation for the Contractor to rectify defects, and the Employer either does not notify the Contractor that rectification is needed or refuses access to the site, then the Employer may be in breach of Contract.[3]

4. STATUS OF DNP

DNP will only arise if it is included in the Contract.[4]The Contract may provide that the DNP shall be extended for any defects which are remedied during the DNP. However, in every Engineering Contracts the Employer also includes the clause defining DNP. Therefore, Contractors need to be aware that they do not have the automatic right to return to the site to fix any defects.

5. DURATION OF DNP

However, Construction Contracts usually include a DNP during which the Contractor is responsible for repairing or rectifying defects that appear in the works. The period usually commences upon Practical Completion of the works and runs for a specified time frame (usually 12 months).[5]

Under a Construction Contract, one of the Contractor's main obligations is to carry out and complete the works to the standards set out in Contract. Also the DNP provides a practical mechanism to the Employer for the repair or making good of defects which may not be apparent before completion, without resorting to dispute resolution.

In most Contracts, the Employer will retain either a proportion of the Contract sum or a reduced performance bond as surety for performance of the Contractor's obligations during the DNP. The Defect Notification Clause will set out the length of DNP, the scope of defects the Contractor is

[2] *Ibid.*
[3] Anne Marie Friel, 'Defects Liability Period' (2011)<https://www.out-law.com/en/topics/projects--construction/construction-claims/defects-liability-periods> accessed on 27th September 2018
[4] *Ibid.*
[5] *Supra note* 1

obliged to remedy and any part of the Contract sum retained by the Employer as surety for the performance of the remedial work.

6. SECTIONAL TAKING OVER

If the works are taken by the Employer in sections, the DNP for each section must commence on the date of Practical Completion for that section. However, Sectional Completion is to the Contractor's benefit. Employer also can use in sections after the completion, which will benefit the Employer as well.An Employer will not want sectional DNPs, but rather will want the period of DNP to commence on completion of the last section.[6]

7. OBLIGATION TO CARRY OUT DEFECTS

Another important consideration is determining whether the Contractor has an exclusive right to remedy defects which appear during the DNP.[7] From the Contractor's perspective, it is beneficial to have the exclusive right to remedy the defects during DNP as the cost of remedying the defects will be cheaper than paying the Employer the cost of another Contractor performing such works. If the Contractor has an exclusive right to repair defects, an Employer who proceeds to remedy the works without offering the Contractor the opportunity to do so will be in breach of Contract.[8] The Employer is generally required to give the Contractor notice of the defects as soon as practicable, stating the nature of the defect and supporting evidence.

The purpose of DNP is threefold.[9] It fixes the period of time when the Engineer's role under the Contract formally comes to an end; the parties are intended to make a final reconciliation of the Contract sum, the unused balance of the Contractor's security (if any) will be returned to the Contractor, subject to the satisfactory resolution of all known defects and disputes.

During the DNP, typically the Contractor has an express contractual right to return to the site to rectify defects or complete unfinished work, the Employer is entitled to continue holding security, to secure the Contractor's obligations in respect of incomplete or defective work, and the Engineer continues to remain involved in the project.

Once the Defects Notification has expired, the Contractor is entitled to make a "Final Claim" for any outstanding monies that may be owing to it, and to request the return of its security.[10]

8. TRANSFER OF RESPONSIBILITY

The completion of an obligation by the Contractor will usually mark the transfer of certain risks or the crystallization of certain rights. Therefore, the term of "completion" may have a number of

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[6] Daminar McNair, 'Australia: Defects Liability Period; An Introduction International Best Practice in Project and Construction Agreements' (2013) Mondaq Connecting Knowledge & people <http://www.mondaq.com/australia/x/219302/Building+Construction/Defects+Liability+Period+an+Introduction> accessed on 26th September 2018

[7] *Ibid.*

[8] *Supra Note* 1

[9] Greg Henry, 'Can a Contractor be liable after the Defects Liability Period' (2018) <https://www.turtons.com/blog/can-a-contractor-still-be-liable-after-the-defects-liability-period> accessed on 27th September 2018

[10] *Supra Note* 1

different meanings in a Contract, depending upon the obligation. The term of "completion" may be used in different parts of a Contract without identifying what state of completion is required. In terms of the whole works, completion may mean completion for the purpose of handover and commencement of the DNP. It may instead mean completion including the remedy of all defects and any outstanding works sufficient for the issue of a Final Certificate. The term of "completion" may be also be used to determine the extent of the right to interim payment in cases of stage payments.

The meaning of "completion" depends upon the proper interpretation of the Contract and the related obligation. Tests on completion vary depending on the nature of the project.[11]

In ***Sumpter v. Hedges***[12], the Claimant agreed to build two houses and stables for the Defendant. It was agreed that £565 would be payable on completion. The Claimant commenced performance and then ran out of money and was unable to complete. He had performed just over half of the Contract. The Defendant completed the work himself. The Claimant sought to recover £333 representing the value of the work he had completed. He argued that in completing the work himself, the Defendant had thereby accepted partial performance and prevented the Claimant from completing the Contract. It was held that the Claimant's action failed. The Court of Appeal held that the Defendant had no choice but to accept partial performance as he was left with a half completed house on his land. The rule is strict so that if work is completed but not in accordance with the Contract no payment is due.

In ***Bolton v. Mahadeva***[13], the Claimant installed central heating in the Defendant's home. The agreed Contract price was £560. The Defendant was not happy with the work and refused to pay. Defects in the work amounted to £174. The action by the Claimant to enforce the Payment failed since the Court of Appeal held that there was no substantial performance.

In ***P & M Kaye Ltd. v Hosier & Dickinson Ltd***[14] Lord Diplock stated that the Contractor is under an obligation to remedy the defects in accordance with the architect's instructions. If he does not do so, the Employer can recover as damages the cost of remedying the defects, even though this cost is greater than the diminution in value of the works as a result of the unremedied defects.

9. COMPLETION SPECIFIC TO ENGINEERING CONTRACT

Construction Contracts involve the fixing and incorporation of the works on land, with the consequent transfer ownership.Therefore,the owner likely to receive substantial benefit even if the works are not entirely complete.The doctrine of substantial performance mitigates the harshness of the above rule and allows the Contractor payment for work if substantially completed with an allowance for defects.

It is a question of fact whether the Contractor has substantially performed his obligation. The Contractor cannot rely on the doctrine to seek payment for work carried out if he has abandoned

[11] Hugh James, 'The 3 Minute Guide: Defects Liability Periods' (2016) <https://www.hughjames.com/news/comment/2016/03/the-3-minute-guide-defects-liability-periods/#.W7L31XszbIV> accessed on 27th September 2018
[12] *Sumpter v Hedges* (1898) 1 QB 673
[13] *Bolton v Mahadeva* [1972] 1 WLR 1009
[14] *P & M Kaye Ltd. v Hosier & Dickinson Ltd* [1972] 1 WLR 146

the works. It applies where the work has been completed except for minor defects or minor outstanding works.

The general meaning of "completion" for the obligation to complete the construction or installation of the works is that the works should be free from known or patent defects and that any outstanding works is minor or *de minimus,* so that the use for the purpose intended is not affected or beneficial occupancy as intended is not prevented.

Completion is normally identified by the date stated in a certificate by the Engineer stating that completion has taken place and also FIDIC based Contracts usually require the Engineer to confirm when completion has occurred.[15]The date stated in the certificate will mark the end of the period for which the Contractor is liable for liquidated damages ceases; mark the changes in responsibility to insure; require the release of retention and mark the commencement of the DNP.

In some standard forms "completion" of the construction or installation stage is defined by achieving specified standards in tests. In other forms of Contracts, completion of construction is defined by the term of "Substantial Completion". The ICE Form is such a form and provides for the Contractor to apply for a Certificate for Substantial completion together with an undertaking to carry out outstanding work in the DNP.[16]It is suggested that the outstanding work may include the making good of defects identified before the issue of the Certificate.

10. CONTRACTOR'S LIABILITY TO CARRY OUT DEFECTS

In order to obtain Defects Notification Certificate, the Contractor has to substantially complete the works or in other words the Employer should be able to utilize the work for its intended purpose.

Substantial Completion Certificate also could be obtained in stages depending on the terms of the Contract. In the aforesaid example, if the Employer wishes to use one storey out of three stories completed he could agree on stage handing over to the term of the Contract when entering into the Contract.

There have been a number of decisions attempting a legal definition of the terms of "Practical Completion" and "Substantial Completion". In ***Jarvis and Sons v Westminster Corporation***[17]Lord Justice Salmon defined practice completion as completion for the purpose of allowing the Employers to take possession of the works and use them as intended. He held that practical completion did not mean completion down to the last detail, however trivial and unimportant.Lord Dilhorne's definition was that practical completion meant almost but not entirely finished.

In ***H.W. Neville (Sunblest) Ltd. v William Press and Son Ltd***[18]it was held that practical completion did not mean that very minor *de minimus* work had to be carried out, but did mean

[15] Mallesons Stephen Jaques, 'Defects Liability Period – An introduction' (2011) AUSTRALIAN CONSTRUCTION LAW NEWSLETTER#92 SEPTEMBER/OCTOBER 2003, 32
[16]Brian Eggleston, '*The ICE Conditions of Contract'* (7th edn,wiley-Blackwell, Aug 2001)
[17]*Jarvis and Sons v Westminster Corporation* (1978) 7 BLR 64 HL
[18]*H.W. Neville (Sunblest) Ltd v William Press and Son Ltd* (1981) 20 BLR 78

that if there were any patent defects the Architect should not give a certificate of practical completion.

In ***Emson Eastern Ltd. v E.M.E. Developments Ltd***[19], Emson were the Contractors and E.M.E. developers under the JCT 80 Form. Practical completion was certified but sometime after Emson went into administrative receivership and his employment in compliance with Clause 27.2 of the Conditions of Contract was automatically determined. The issue was whether Emson were entitled to further payment. The matter turned on whether completion under Clause 27 meant the same as practical completion, or whether it meant that all snagging and remedial works has to be made good at the end of the defects period before the works could be said to be complete.

11. COMPLETION AND PRACTICAL COMPLETION

His Honour Judge John Newey QC, in arriving at a decision, took account of what happens on building sites. He considered that he should keep in mind that building construction is not like the manufacture of goods in a factory. The size of the project, site conditions, use of many materials and employment of various types of operatives made it virtually impossible to achieve the same degree of perfection as can a manufacturer. His view was that it must be rare for a new building to have every screw and every brush of paint correct. Further a building can seldom be built precisely as required by the drawings and specification. Judge Newey in considering the meaning of practical completion thought he stood somewhere between Lord Salmon and Dilhorne in the *Jarvis* case.[20] He concluded that there was no difference in meaning between completion and practical completion. Completion he considered was like practical completion, something which occurs before defects and other faults have to be remedied. Was it otherwise the deduction of liquidated damages under Clause 24 would be unworkable he considered. In view of this reasoning Judge Newey held that the Contractor was entitled to be paid as practical completion has been achieved.

The Court of Appeal of Hong Kong in ***Big Island Contracting (H.K.) Ltd. v Skink Ltd***[21]upheld the decision of the judge at first instance that in deciding practical completion account should be taken of the value of the work outstanding and the importance of defects to the safety of the facility.

In ***Voscroft (Contractors) Ltd. v Seeboard plc***[22], his Honour Judge Humphrey Llyod QC was required to consider the operation of Clauses 14.1 and 14.2 of the COC. Clause 14.1 required the Sub-Contractor to give notice when he considered practical completion of the Sub-Contract works had been achieved. The form made provision for the parties to agree the date of Practical Completion, but in the event of disagreement practical completion was deemed to be the date of Practical Completion of the main Contract works. There was however no provision for the situation which occurred of the Sub-Contractor not giving notice. It was argued that in that situation practical completion was a question of fact to be decided by an arbitrator.

It was held that Sub-Contractor who failed to operate Clause 14.1 could not achieve a result other than the one which would have been achieved had he given notice but not reached agreement. He

[19]*Emson Eastern Ltd. v E.M.E. Developments Ltd* (1991) 55 BLR 114
[20]*Supra Note* 17
[21]*Big Island Contracting (H.K.) Ltd. v Skink Ltd* (1990) 52 BLR 110
[22]*Voscroft (Contractor) Ltd v Seeboard plc* (1996) 78 BLR 132

could not have the benefit of Clause 14 in establishing a date for practical completion other than the deemed date. The date of practical completion was therefore the date of Practical Completion under the Main Contract**.**

12. SUB-CLAUSE 10.1 OF ICTAD/ SDB/O2

In ICTAD/SBD/02, "Completion" is defined by tests and the completion of specified work. The Contractor's obligation under Sub-clause 8.2[23] is to complete the whole of the works including the passing of the Tests on Completion and all the work stated in the Contract as being required for the works to be considered to be completed for the purpose of Taking Over under Sub-clause 10.1[24]. Sub-clause 9.1[25] requires the Contractor to carry out the Tests on Completion within 14 days of the date notified 21 days in advance. The Contractor is required to issue a certified report of the results of the Tests.

Sub-clause 10.1 provides that the Employer takes over the works when the Test have been successfully completed, the specified work has been completed and a Taking Over Certificate has been issued by the Engineer or deemed to have been issued. Sub-clause 11.8[26] provides that the Contractor's obligations are not completed until the Engineer has issued the Performance Certificate. The Engineer is required to issue the Performance Certificate within 28 days after the latest date of the expiry of the DNP, issue of all Contractor's Documents and the completion and testing of all the Works including remedying defects.

Even though the works have not achieved the state to be taken, parties should be aware that the works may be 'deemed' to have been taken over in certain circumstances. For example, Sub-clause 10.2 of the FIDIC 1999 provides that works will be deemed to have been taken over in the event that they are used or occupied (other than temporary basis which is agreed by the parties) by the Employer prior to the issue of the Taking Over Certificate.[27]

This is because of such use or occupation of the works by the Employer demonstrates adequate completion of the facility and the Employer's use or occupation of the works may cause damage or disruption for which it would be unreasonable to hold the Contractor liable.

13. COMPARISON WITH OTHER COCS'

In ICE 7th Edition, Clause 48 provides that when the contractor consider that the whole of the Works has been substantially completed and has satisfactorily passed any test that may be prescribed in the Contract, he may give notice to that effect.[28] The notice must be accompanied by an undertaking to finish any outstanding work in accordance with Sub-clause 49(1). This states that the undertaking may state a specified time, (agreed with the Engineer), for the outstanding work to be completed. If there is no agreement then the work must be completed as soon as practicable during the Defects Correction Period.

[23]ICTAD/SDB/02 (2nd edn, ICTAD,January 2007), 64
[24]ICTAD/SDB/02 (2nd edn, ICTAD,January 2007), 68-69
[25]*Ibid.* 67
[26]*Ibid.* 72
[27]FIDIC 1999 (1st edn, FIDIC,1999), 31-32
[28]Brian Eggleston, 'The ICE Conditions of Contract' (7th edn,wiley-Blackwell, Aug 2001)

Sub-clause 48(2) allows the Engineer to issue a Certificate of Substantial Completion stating the date when the Works were substantially completed or give instructions specifying all the work which in the Engineer's opinion is required to be done before the issue of such a certificate.

Sub-clause 61(1) provides that at the end of the Defects Correction Period and when all outstanding work referred to in Clause 48 and all works of repair etc. have been completed, the Engineer issues to the Employer a Defects Correction Certificate stating the date on which the Contractor completed his obligations to construct and complete the Works to the Engineer's satisfaction.

14. CONCLUSION

If the Employer decides to occupy the project before substantial completion the DNP commences from the date of occupation by the Employer. DNP is generally one year. However, it could be extended for a further period if it is stated in the Contract. In an Engineering Project the Employer cannot anticipate that the Contractor will complete 100% of the project during the Contract duration. Substantial completion could suffice for the Contractor to request for Defects Notification Certificate. There should be an opportunity to the Employer for utilize the works in order to identify latent defects. Therefore the Contractor who has abandoned the Project cannot claim that DNP shall commence one year from the date of abandonment. In such a situation DNP starts from date of substantial completion by another Contractor or the Employer.

AWARD WINNERS 2017 & 2018

Construction Excellence Awards & Construction Merit Awards for Building Projects

Year	Type of Award	Project and Recipient
2017	Excellence	154 roomed five star Hotel for Pease Haven Resort (Pvt) Ltd. at Tangalle by International Construction Consortium (Pvt) Ltd.
	Excellence	Office Complex for RIL Property (Pvt) Ltd. at Colombo 02 by Nawaloka Construction Company (Pvt) Ltd.
	Excellence	Extension to the Treasury Building at Colombo 01 by Maga Engineering (Pvt) Ltd.
	Excellence	Razavi Medical Complex at the Cancer Hospital Maharagama by Nawaloka Construction Company (Pvt) Ltd.
	Excellence	Ani Villas Resort at Dikwella by Salasi Lanka (Pvt) Ltd.
	Excellence	Rainbow Business Centre at Colombo 04 by International Construction Consortium (Pvt) Ltd.
	Excellence	Additions, Alterations, Refurbishments to British Council at Colombo 3 by L H Piyasena & Co. (Pvt) Ltd.
	Merit	Tutory Building for International College of Business & Technology (ICBT) at Colombo 04 by N & A Engineering Services (Pvt) Ltd.
	Merit	Eight Storied Office Building for Wickramaratnes (Pvt) Ltd. at Colombo 03 by Tudawe Brothers (Pvt) Ltd.
2018	Excellence	Construction of Proposed Clearpoint Residencies at Rajagiriya by Maga Engineering (Pvt) Ltd.
	Excellence	Proposed Jetwing City Hotel at Ward Place, Colombo 07 by Maga Engineering (Pvt) Ltd.
	Excellence	Proposed Hotel for Cultural Heritage (Pvt) Ltd at Dambulla by Tudawe Brothers (Pvt) Ltd.
	Excellence	Office Building for People's Leasing Havelock Properties Ltd. at No 07, Havelock Road Colombo 05 by Tudawe Brothers (Pvt) Ltd
	Excellence	Construction of Proposed Migrant Resource Centre at Hali Ela by R N Construction (Pvt) Ltd.

	Merit Merit	Reconstruction & Relocation of Buildings for Auto Mobile Engineering Training Institute due to New Bridge Construction Project Over Kelani River Building Construction at Orugodawatta by Tudawe Brothers (Pvt) Ltd. Construction of Proposed Apartment Building for Living Homes (Pvt) Ltd at Talawathugoda by Sripalie Contractors (Pvt) Ltd.

Electro Mechanical Construction Awards

Year	Type of Award	Project and Recipient
2017	Merit Merit	Electrical Installation (Low Voltage) - Rainbow Business Centre at Colombo 04. by Kent Engineering (Pvt) Ltd. Supply and Installation, Testing & Commissioning of Air Conditioning and Ventilation System - Rainbow Business Centre at Colombo 04. by Kent Engineering (Pvt) Ltd.
2018	Merit Merit	Proposed Marriott Resort and Spa. Weligama Bay , (EI-LV) by Fentons Limited Proposed Marriott Resort and Spa. Weligama Bay , (FDPS) by Fentons Limited

Green Construction Award

Year	Type of Award	Project and Recipient
2017	Merit	Design & Construction of National Environmental Secretariat for Ministry of Mahaweli Development and Environment at Battaramulla by Central Engineering Consultancy Bureau

Construction Performance Awards for Civil Engineering Projects (assessed after completion)	
2017	**Category I - value exceeding Rs: 1000 million** Rehabilitation and upgrading of Bibile – Pitakumbura – Namaloya – Inginiyagala Road (from 0+000 to 60+310 km) Contract No.W/UVA/GOSL/2011/731 by Tudawe Brothers(Pvt) Ltd. ADB funded Northern Roads Connectivity Project – Additional Fencing – Rehabilitation / Improvements of AB019 Jaffna – Pannai – Kayts Road (from 0+000 to 10+000 km) Contract No. RDA/NRCP(AF)/ICB/ADB/CP-18 by Maga Engineering (Pvt) Ltd. Rehabilitation and Improvements to Haputhale – Boralanda – Keppetipola Road (B353) (from 0+000 to 27+000 km) Contract No. RDA/DW/UVA/LBFP/2012/271 by Consulting Engineers & Contractors (Pvt) Ltd. Rehabilitation of National Highways with Concrete Surfacing through Domestic Contractors Anamaduwa – Uswewa – Galgamuwa Road (from 0+000 to 39+100 km) Contract No. RDA/DW/CP/GOSL/2011/347 by Edward & Christie (Pvt) Ltd. Rehabilitation and Improvements to Ambepussa – Kurunegala – Trincomalee Road f Dambulla to Galewela (from 75+000 to 90+100 km) Contract No. RDA/DW/CP/LBFP/STAGE 2/2013/02 by International Construction Consortium (Pvt) Ltd. Rehabilitation & Upgrading of Thoppuwa – Dankotuwa – Naththandiya – Madampe Road (B419) (from 0+000 to 26+650 km) Contract No. RDA/DW/NWP/GOSL/2011/454(B) by CML - MTD Construction Ltd. Rehabilitation and Improvements to Polonnaruwa – Hingurakgoda Road (from 2+000 to 13+650 km) Contract No. RDA/DW/NCP/LBFP/2013/032(A) by NEM Construction (Pvt) Ltd. **Category II - valued between Rs: 500 million & 1000 million** Rehabilitation & Improvements to Mallawapitiya – Rambodagalla – Keppitigala Road (from 0+000 to 10+000 km) Contract No. RDA/DW/NWP/LBFP/STAGE-02/2013/45 by A M S K Constructions (Pvt) Ltd. Rehabilitation of Secondary Distribution System in Slave Island and Hultsdorf Area in Colombo – Kalu Ganga Water Supply Project (Phase I Stage II) Contract No. WSDP/CIVIL/JICA/KGWSP-P1 S2/2013/NCB-Package (A) by Squire Mech Engineering(Pvt) Ltd.

Construction Performance Awards for Civil Engineering Projects (assessed after completion)	
	Category III - valued between Rs: 100 million & 500 million Construction of Treatment Plant and Design, Fabricate, Supply & Installation of Steel Pipe Rack for Bottlig Plant Complex for Distilleries Company of Sri Lanka at Seeduwa by R H Steel Building Systems (Pvt) Ltd. Remedial Works of Nalanda Dam Contract No. DSWRPP-1/WORKS/ NCB/06 by CML - MTD Construction Ltd. Improvements to Hatton – Nuwaraeliya Road Project Construction of Kotagala Tunnel & Ancillary Works of Kotagala Railway Underpass Contract No. RDA/MFAP/EDCF/HNE/WKS/IV by E L S Constructions(Pvt) Ltd. Asphalt paving works for Colombo Port Expansion Project – East Container Terminal – Phase I Sub Contract No. CILP-SC-E-012 by Access Engineering PLC Construction of Canal Bank Protection Works of St. Sebastian South Canal Contract No. MCUDP/SLLRDC/W/03-A by Access Engineering PLC Widening of Bridge No. 2/1 on Narahenpita – Nawala – Nugegoda Road Contract No. RDA/MFAP/ICB/OFID-2/14 by CML - MTD Construction Ltd.
2018	**Category I - value exceeding Rs: 1000 million** Rehabilitation and Extension of Ambepussa- Kurunegala-Trincomalee Road (A006)From Ambepussa to Galewela (0+000 to 75+110 Km) , Contract No. RDA/DW/NWP/LBFP , STAGE 2/2013/03 by Maga Engineering (Pvt.) Ltd. Rehabilitation of Labugama & Kalatuwawa Water Treatment Plant Project. Contract No P&P/WS/HUN/KALAUWAWA/2010/01 by Access Engineering PLC. Rehabilitation & Improvements to Mallawapitiya – Rambodagalla – Keppitigala Road (From 10+000 to 15+750 Km & From 20+250 to 37+810 Km) by Consulting Engineers and Contractors (Pvt) Ltd. Rehabilitation of Warakapola–Anguruwell –Karawanella Road ,0+000 to 22+300 Km, Contract No : RDA/DW/SAB/LBFP/2012/163 by Nawaloka Construction Company (pvt) Ltd. Rehabilitation and Improvements to seeduwa katunayake Road From 0+000 to

Construction Performance Awards for Civil Engineering Projects (assessed after completion)	
	3+900Km and Seeduwa – Udugampola Road from 0+000 – 11+700 Km Contract No : RDA/DW/WP/LBFP – stage II /2013/06 by Edward And Christie. **<u>Category III - valued between Rs: 100 million & 500 million</u>** Design And Construction of Jetty at Kapporatota,Weligama by Access Engineering PLC. Northern Road Connectivity Project –Additional Financing ADB loan 2890 [SF] 2891 [SRI] NP works, contract Package: NRCP/NP/NCB/MU 03 Improvements to Vattapalai – Keppaipilavu – Puthukkudiyiruppu road (0+00 to 12+850 Km)– MUC011 by Maga Engineering (Pvt.) Ltd. Improvements to Storm Water Drains in Catchment 2 & 3, Marine Drive Contract No : MCUDP/CMC/W/MD/02 by Edward And Christie. On shore Portion of the Works for Ganemulla fly over by by Access Engineering PLC. Nahalwathura Mini Hydropower Project – 400 Kw by Nimna Holdings (Pvt) Ltd. Construction of Sub Structure, Transportation & Erection of Steel Super Structure And Construction of Immediate Approaches of Bridge , No : 1 /1 on Badulla Station Road (B27-19), Contract No. RDA/MFAP/FR/BR/46 by ELS Construction (Pvt) Ltd.

Awards for Environmental Friendly Innovative Construction Related Technology	
2017	Expanded Polystyrene Light Weight Concrete Sandwich Panel by Ekala Prestressed Concrete Industries (Pvt) Ltd.

Awards for Construction Performance (Building & Civil Engineering) (Awards to Overseas Projects by Domestic Construction Contractors)	
2017	Construction of Channel and Aqueducts (from 1+100 to 2+047), Forebay & Spillway, Power House, Tailrace & related Civil Works of Muvumbe Small Hydro Power Project, Uganda by Sanken Overseas (Pvt) Ltd. Construction of Building & Associated Works - Mombasa Port Development Project, Kenya by Sanken Overseas (Pvt) Ltd. Design & Construction of 120 room Amari Havodda Resort, Maldives by Sanken Overseas (Pvt) Ltd.
2018	20 Nos. Water villas and Walkway Jetty at Robinson Club Maldives by Sanken Overseas (Pvt) Ltd. 10 Storey Residential Building at M.Mist by Sanken Overseas (Pvt) Ltd.

AWARD WINNING CONSULTANTS - 2018

(for Excellence Award winning projects)

Type of Award	Name of the Projects	Contractor
Excellence	Proposed Jetwing City Hotel at Ward Place, Colombo 07	Maga Engineering (Pvt) Ltd.
Engineering Eng. R M Ananda Senarath STEMS Consultants (Pvt) Ltd.		
Excellence	Proposed Hotel for Cultural Heritage (Pvt) Ltd at Dambulla	Tudawe Brothers (Pvt) Ltd.
Architectural Archt. N A A L Nikapitiya Vinod Jayasinghe Associates QS VFORM Consultants (Pvt) Ltd, Chartered Quantity Surveyours, Consultants in Project Management & Dispute Resolution. No. 23/1, 5th lane, Nawala.		
Excellence	Office Building for People's Leasing Havelock Properties Ltd. at No 07, Havelock Road Colombo 05	Tudawe Brothers (Pvt) Ltd.
Architectural Archt. Rohitha Peiris The Design Group Five International (Pvt) Ltd.		
Excellence	Construction of Proposed Migrant Resource Centre at Hali Ela.	R N Construction (Pvt) Ltd.
Architectural Archt. R Nadesapillai M/S Ranjan Nadesapillai Associates QS M/S Ranjan Nadesapillai Associates, No. 16, Rathnayaka Mw, Pelawatta, Battaramulla.		

NATIONAL AWARDS FOR CONSTRUCTION EXCELLENCE & CONSTRUCTION MERIT – 2018

(FOR BUILDING PROJECTS)

NATIONAL AWARD FOR CONSTRUCTION EXCELLENCE – 2018

Category I - value exceeding **Rs: 750 million**

Proposed Hotel for Cultural Heritage (Pvt) Ltd at Dambulla

Contractor: Tudawe Brothers (Pvt) Ltd.

NATIONAL AWARD FOR CONSTRUCTION EXCELLENCE – 2018

Category I - value exceeding **Rs: 750 million**

Construction of Proposed Clearpoint Residencies at Rajagiriya

Contractor: Maga Engineering (Pvt) Ltd.

NATIONAL AWARD FOR CONSTRUCTION EXCELLENCE – 2018

Category I - value exceeding **Rs: 750 million**

Proposed Jetwing City Hotel at Ward Place, Colombo 07

Contractor: Maga Engineering (Pvt) Ltd.

NATIONAL AWARD FOR CONSTRUCTION EXCELLENCE – 2018

Category II - value in between **Rs: 450 million & 750 million**

Office Building for People's Leasing Havelock Properties Ltd. at No 07, Havelock Road Colombo 05

Contractor: Tudawe Brothers (Pvt) Ltd.

NATIONAL AWARD FOR CONSTRUCTION EXCELLENCE – 2018

Category II - value in between **Rs: 450 million & 750 million**

Construction of Proposed Migrant Resource Centre at Hali Ela

Contractor: R N Construction (Pvt) Ltd.

NATIONAL AWARD FOR CONSTRUCTION MERIT– 2018

Category I - value exceeding **Rs: 750 million**

Reconstruction & Relocation of Buildings for Auto Mobile Engineering Training Institute

Due to New Bridge Construction Project Over Kelani River Building Construction at Orugodawatta

Contractor: Tudawe Brothers (Pvt) Ltd.

NATIONAL AWARD FOR CONSTRUCTION MERIT– 2018

Category III - value in between **Rs: 150 million & 450 million**

Construction of Proposed Apartment Building for Living Homes (Pvt) Ltd at Talawathugoda

Contractor: Sripalie Contractors (Pvt) Ltd.

NATIONAL AWARDS FOR ELECTRO MECHANICAL CONSTRUCTION – 2018

National Award for Construction Performance 2018

Category I - value ***in between Rs. 100 million & 250 million***

Proposed Marriott Resort and Spa, Weligama Bay . (EI-LV)

by **Fentons Limited**

National Award for Construction Performance 2018

Category I - value ***in between Rs. 50 million & 100 million***

Proposed Marriott Resort and Spa, Weligama Bay . (FDPS)

by **Fentons Limited**

NATIONAL AWARDS FOR CONSTRUCTION PERFORMANCE - 2018

(FOR CIVIL ENGINEERING PROJECTS)

(Assessed after completion)

National Award for Construction Performance 2018

Category I - value exceeding Rs: 1000 million

Rehabilitation and Extension of Ambepussa- Kurunegala-Trincomalee Road (A006)From Ambepussa to Galewela (0+000 to 75+110 Km) ,
Contract No. RDA/DW/NWP/LBFP , STAGE 2/2013/03
by **Maga Engineering (Pvt.) Ltd**

National Award for Construction Performance 2018

Category I - value exceeding Rs: 1000 million

Rehabilitation and Improvements to seeduwa katunayake Road From 0+000 to 3+900 Km and Seeduwa – Udugampola Road from 0+000 – 11+700 Km,
Contract No: RDA/DW/WP/LBFP – stage II /2013/06
by **Edward And Christie**

National Award for Construction Performance 2018

Category I - value exceeding Rs: 1000 million

Rehabilitation & Improvements to Mallawapitiya – Rambodagalla – Keppitigala Road (From 10+000 to 15+750 Km & From 20+250 to 37+810 Km)
by **Consulting Engineers and Contractors (Pvt) Ltd.**

National Award for Construction Performance 2018

Category I - value exceeding Rs: 1000 million

Rehabilitation of Warakapola – Anguruwella – Karawanella Road ,0+000 to 22+300 Km , Contract No : RDA/DW/SAB/LBFP/2012/163
by **Nawaloka Construction Company (pvt) Ltd.**

National Award for Construction Performance 2018

Category I - value exceeding Rs: 1000 million

Rehabilitation of Labugama & Kalatuwawa Water Treatment Plant Project.
Contract No P&P/WS/HUN/KALAUWAWA/2010/01
by **Access Engineering PLC.**

National Award for Construction Performance 2018

Category III - valued between Rs: 100 million & 500 million

Northern Road Connectivity Project –Additional Financing ADB loan 2890 [SF] 2891 [SRI] NP works,
contract Package: NRCP/NP/NCB/MU 03 Improvements to Vattapalai – Keppaipilavu – Puthukkudiyiruppu road (0+00 to 12+850 Km) – MUC011
by **Maga Engineering (Pvt.) Ltd**.

National Award for Construction Performance 2018

Category III - valued between Rs: 100 million & 500 million

Improvements to Storm Water Drains in Catchment 2 & 3, Marine Drive
Contract No : MCUDP/CMC/W/MD/02
by **Edward And Christie**

National Award for Construction Performance 2018

Category III - valued between Rs: 100 million & 500 million

Construction of Sub Structure, Transportation & Erection of Steel Super Structure And Construction of Immediate Approaches of Bridge ,
No : 1 /1 on Badulla Station Road (B27-19),
Contract No. RDA/MFAP/FR/BR/46
by **ELS Construction (Pvt) Ltd.**

National Award for Construction Performance 2018

Category III - valued between Rs: 100 million & 500 million
Nahalwathura Mini Hydropower Project – 400 Kw
by **Nimna Holdings (Pvt) Ltd.**

National Award for Construction Performance 2018

Category III - valued between Rs: 100 million & 500 million
Design And Construction of Jetty at Kapporatota,Weligama
by **Access Engineering PLC**

National Award for Construction Performance 2018

Category III - valued between Rs: 100 million & 500 million
On shore Portion of the Works for Ganemulla fly over
by **Access Engineering PLC**

NATIONAL AWARDS FOR CONSTRUCTION PERFORMANCE - 2018
(Building & Civil Engineering)
(Awards to Overseas Projects by Domestic Construction Contractors)

National Award for Construction Performance 2018

10 Storey Residential Building at M.Mist,
by **Sanken Overseas (Pvt) Ltd**.

National Award for Construction Performance 2018

20 Nos. Water villas and Walkway Jetty at Robinson Club Maldives
by Sanken **Overseas (Pvt) Ltd.**

CIDA AWARD OF EMINENCE

- ***CIDA Award of Eminence - 2016***

Chartered Architect
Prof. Chitra Weddikkara

for her life time contribution to the upliftment of the Construction Industry & the profession of Architecture

Professional experience encompasses fields of Architecture, Quantity Surveying, International Construction Management Dispute resolution, Arbitration, Value management and Project Management.

Work experience also encompasses working as the Professor of Building Economics, Head of Department of Building Economics, Dean, Faculty of Architecture, University of Moratuwa Sri-Lanka and Senior lecturer in University of Western Sydney in New South Wales Australia, President of the Institute of Quantity Surveyors, President Sri Lanka Institute of Architects /Chairman/ Member of many technical and advisory committees of the Sri Lanka Institute of Architects and the Government of Sri-Lanka

ACADEMIC QUALIFICATIONS

- Ph.D. in Dispute resolution College Law, Murdoch University Perth Western Australia
- Master of Science Building Studies, Curtin University of Technology, WA
- Bachelor of Applied Science in Quantity Surveying, Curtain University of Technology, Perth, Western Australia
- Associate Diploma in Quantity Surveying Western Australian Institute of Technology, Perth, Western Australia.
- Associate ship in Architecture , Western Australian Institute of technology, WA
- Bachelor of Science in Built Environment University of Colombo Sri Lanka
- Part I Royal Institute of British Architects, University of Colombo, Sri Lanka
- Certificate in International Construction Management, Sweden

PROFESSIONAL MEMBERSHIPS

- Fellow of the Institute of Architects Sri- Lanka (FIA) SL Sri Lanka
- Assoc member of Royal Australian Institute of Architects (ARAIA)
- Fellow member of the Australian Institute of Quantity Surveyors (FAIQS)
- Fellow of Royal Institute of Chartered Surveyors (FRICS) 199
- Fellow of the Institute of Quantity Surveyors (FIQS) SL Sri Lanka 1998
- Mediator- LEADR' Centre for Commercial Mediation, Australia
- Fellow Member of Institute of Project Mangers (SL)

OTHER COMMITMENTS

- Member of the National Procurement Commission
- Member of the CIDA Advisory Board
- Vice President of Chamber of Construction Industry

- ***CIDA Award of Eminence - 2016***

Eng. C H De Tissera

for his life time professional contribution to the upliftment of the Construction Industry

- B Sc. (Engineering) – University of Sri Lanka - 1965
- Post Graduate Diploma in Housing Planning & Building – Bowcentrum (IHS) Rotterdam, Holland - 1969
- M Sc. (Soil Mechanics & Foundation Engineering) - University of New Castle upon Tyne, U.K - 1979
- Post Graduate Certificate course in Construction Management for from University of California, Berkeley, USA - 1982
- Member, Institution of Engineers, Sri Lanka
- Director General – ICTAD – 1986 to 1989
- Additional Secretary (Technical), Ministry of Urban Development, Housing & Construction - Dec. 1989 to Aug.
- Additional Secretary (Development), Ministry of Science & Technology - Aug. 1999 to May 2001
- Project Management Consultant - JBIC and UNDP - May 2001 to Feb. 2005
- Habitat Programme Manager, UN-Habitat Sri Lanka - March 2005 to December 2008
- National Consultant to UN-Habitat Sri Lanka - January 2009 to Sept 2009
- Free- lance Consultant - UN-HABITAT Projects - Oct.2009 to date
- Chairman - Sri Lanka Land Reclamation and Development Corporation
- Director General - National Building Research Organisation (NBRO)
- Chairman – CIDA - Feb. 2015 to April.2016

- ***CIDA Award of Eminence - 2016***

Eng. K L S Sahabandu

for his life time contribution to the upliftment of the Construction Industry & the profession of Engineering

- **B.Sc. Eng. Hons**, University of Peradeniya, Sri Lanka, 1980
- **Pg. Dip. (Hydraulic Engineering)**, University of Moratuwa, Sri Lanka, 1985
- **M.Sc. (Structural Engineering)**, University of Newcastle upon Tyne, UK, 1988
- **Chartered Engineer,** UK, 1985
- **Chartered Engineer,** Sri Lanka, 1985
- **M.I.C.E. (UK)**, 1985
- **M.I.E. (S.L.)**, 1985
- **M.S.S.E (S.L.)**, 1993
- **M.Cons.E (S.L.)**, 2004
- **F.S.S.E. (S.L.)**, 2015
- **Visiting Lecturer**-City School of Architecture, Colombo, 2005 to date
- **President**, Society of Structural Engineers, Sri Lanka, 2016
- **Vice President**, Sri Lankan Geotechnical Society, 2015 to date
- **Vice President**, National Committee of Large Dams, Sri Lanka, 2006 to date
- **Chairman**, Subcommittee for preparing Design Guidelines at Disaster Management Centre, 2011-2014
- **General Manager**, Central Engineering Consultancy Bureau (CECB), 2013 to date
- **Director**, Central Engineering Services (Pvt) Ltd. (CESL), 2011 to date
- **Director**, Mahaweli Consultancy Bureau, 2015 to date
- **'Award for the Best Paper'** at the "**7th International Conference on Inspection, Appraisal, Repairs & Maintenance of Structures**" organized by the University of Nottingham and the Institution of Structural Engineers, UK in September 2001 for the paper on "**Damage Assessment and Repair Techniques used in Bomb and Fire Damaged Central Bank Building in Sri Lanka** ".
- **'Patrick Parson's Prize – 1987/88' – For the best all-round academic record in the M.Sc. course in Structural Engineering –** University of Newcastle upon Tyne - UK.
- **'NECTTA/TRADA Structural Timber Award Competition – 1988' - UK - Second Place.**

- ***ICTAD Award of Eminence - 2014***

Eng. S A Karunaratne

for his life time contribution to the upliftment of the Construction Industry & the profession of Engineering

- BSc Eng. (University of Peradeniya) 1967
- MICE (UK) 1970
- Chartered Engineer
- MIE (SL) 1971
- MIStructE (UK) 1974
- FIStructE (UK) 1990
- FIE (SL) 1990
- HF (SSE-SL) 2009
- HLF (SL) 2014
- President SSE (SL) 2004, 2005, 2006, 2007, 2008
- Visiting Lecturer (MSc Structural – University of Moratuwa) 2006 to 2015
- Chairman - EuroCodes National Annexes (SLSI)
- Managing Director – STEMS Consultants (Pte) Ltd

- ***ICTAD Award of Eminence – 2014***

Archt. Jayantha Kithsiri Perera

for his life time contribution to the upliftment of the Construction Industry & the profession of Architecture

- FIA(SL) 1992
- M.Sc.(Arch.), B.Sc (BE)
- SLIA First Membership 1981
- President SLIA 2007/2009
- Chairman SAARCH 2009/2012
- Deputy Chairman ARCASIA Zone A 2010/2011
- Chair Communication CAA 2014/2017
- Director UIA Work Programme on Responsible Architecture 2014/2017

- ***ICTAD Award of Eminence – 2014***

Dr. (Eng.) Ananda Ranasinghe

for his life time contribution to the upliftment of the Construction Industry in General

- PhD, MEng, MTech, LLM, BScEng,
- CEng, FIStructE, FICE, FIESL,MSSE,
- Attorney-at-Law
- President IESL 2011/2012

- ***ICTAD Award of Eminence – 2013***

Eng. W J R De Mel

for his life time contribution to the upliftment of the Construction Industry & the profession of Engineering

- BSc Eng, C Eng
- M.Sc.(Construction Management)
- MICE, MIE

- ***ICTAD Award of Eminence – 2011***

Dr. E M G de Zylva

for his life time professional contribution to the upliftment of the Construction Industry

- MBA (Const. Mgt.) USA
- Doctoral Fellow – Institute of Professional Financial Managers (UK)
- Professional Member – Dispute Board Federation (Geneva)
- Fellow – Institute of Dispute Management Professionals (SL)
- Hon. Fellow – Institute of Quantity Surveyors (SL)

- Fellow – Institute of Project Managers (SL)
- Member Board of Governors of the National Arbitration Center (SL)
- Lecturer/ Examiner (Arbitration Diploma Courses) of the Institute of Commercial Law & Practice (SL)

- ***ICTAD Award of Eminence – 2011***

Vidyajyothi Prof. Lakshman Alwis

for his life time contribution to the upliftment of the Construction Industry & the profession of Architecture

- B. Arch. (Melbourne) 1967
- ARAIA 1967
- RIBA (UK) 1968
- FIA (SL) – 1980
- Chartered Architect
- D. Sc (Honaris Causa) University of Moratuwa
- PG Diploma Architectural Conservation of Monuments & Sites, ICCROM Rome 1983
- President SLIA 1987/1988, 1988/1989
- Dean Faculty of Architecture, University of Moratuwa 1991 to 1999
- Professor of Architecture, University of Moratuwa 1991 to 2004
- Chairman, Board of Education, ARCASIA 94/95, 95/96
- President of ICOMAS 1995
- Director Conservation of Cultural Triangle Project, Dambulla 1995
- President, Rotary Club of Colombo 1996/1997
- Deputy Chairman ARCASIA 2001 – 2002
- Chairman, ICTAD 2004 to 2007
- Honorary Fellow, SLIA 2005
- Vidyajyothi (National Award) by the President of Sri Lanka 2005
- ICTAD Award of Eminence 2011
- SLIA Gold Medalist 2013
- Principal Architect / Chairman – Design Consortium Ltd

- ***ICTAD Award of Eminence – 2011***

Mr. H D Chandrasena

for his life time contribution
to the upliftment of the
Construction Industry &
the profession of Quantity Surveying

- Fellow of the Institute of Quantity Surveyors Sri Lanka (F.I.Q.S. SL)
- Fellow of the Australian Institute of Quantity Surveyors (F.A.I.Q.S.)
- Fellow of the Royal Institution of Chartered Surveyors (F.R.I.C.S.)
- Fellow of the Institute of Dispute management Professionals (F.I.D.M. P)
- Associate of the Institute of Arbitrators Australia A.I.Arb (Aus) 1979
- Present Position – Chairman, Cost Consultancy Services (Pvt.) Ltd. Rajagiriya.
- Previous Position Asst. General Manager Consultancy Services and Chief Quantity Surveyor – State Engineering Corporation. Sri Lanka.
- Representative for Sri Lanka of the Australian Institute of Quantity Surveyors.
- Member, Board of Governors Sri Lanka National Arbitration Centre.
- Executive Committee Member Chamber of Construction Industry Sri Lanka.
- Past President Institute of Quantity Surveyors Sri Lanka
- Visiting Lecturer and Lesson Writer Open University Sri Lanka
- Member of the Dispute Adjudicators Panel – Institute for Construction Training and Development – Ministry of Housing Construction and Common Amenities.
- Member of the Executive Committee of the Institute of Dispute Management Professionals-Sri Lanka
- External Examiner Royal Institution of Chartered Surveyor Accreditation Panel 1998-2003 & 2008– to date (Department of Building Economic University of Moratuwa)
- Member of the main Planning Committee of the Urban Development Authority representing the Chamber of Construction Industry Sri Lanka.
- Visiting Lecture of Board Member of the Faculty of Architecture University of Moratuwa. (1974 to 1998)
- Member of the Consultative Committee and Steering Committee Member (Technical Publications) - Institute for Construction Training and Development (ICTAD)
- Member of the Construction Cluster of the National Council for Economic Development.
- Member of the Committee for Drafting Procedure for Contract Adjudication and Setting up of National Adjudication Centre- Sri Lanka.

CONSTRUCTION INDUSTRY DEVELOPMENT AUTHORITY

CETRAC
TO GO BEYOND

නිවාස හා ඉදිකිරීම් අමාත්‍යාංශය

ඉදිකිරීම් කර්මාන්ත සංවර්ධන අධිකාරිය



පාසැල් හැර යන සිසුන් සඳහා තුන් අවුරුදු පූර්ණ කාලීන පාඨමාලාවක් නොමිලේ

ඉදිකිරීම් යන්ත්‍රෝපකරණ නඩත්තුව පිළිබඳ පැවැත්වෙන වාර්ෂික පුහුණු පාඨමාලා

- ඉදිකිරීම් යන්ත්‍රෝපකරණ කළමනාකරණය
- ඉදිකිරීම් යන්ත්‍රෝපකරණ නඩත්තු අධීක්ෂණය (ද්‍රාවබල සහ සම්ප්‍රේෂණ පද්ධතිය)
- ඉදිකිරීම් යන්ත්‍රෝපකරණ නඩත්තු අධීක්ෂණය (එන්ජිම සහ මෙකාට්‍රොනික් පද්ධතිය)
- ද්‍රාවබල සහ මෙකාට්‍රොනික් පද්ධති නඩත්තුව
- ඉදිකිරීම් යන්ත්‍රෝපකරණ විද්‍යුත් පද්ධති නඩත්තුව
- ඩීසල් එන්ජින් නඩත්තුව
- ද්‍රාවබල පද්ධති නඩත්තුව
- ඩීසල් ජෙනරේටර් නඩත්තුව
- ස්ටියරින් බ්‍රේක් සහ ක්ලච් පද්ධති නඩත්තුව
- ටෝක් කන්වර්ටර් සහ සම්පීඩන පද්ධති නඩත්තුව
- ඉදිකිරීම් යන්ත්‍රෝපකරණ මූලික ඉලෙක්ට්‍රොනික් සහ මෙකාට්‍රොනික් පද්ධතිය
- ජල පොම්පය සහ වායු සම්පීඩන පද්ධති නඩත්තුව
- ඉදිකිරීම් යන්ත්‍රෝපකරණ සේවා කිරීම
- මූලික ඉදිකිරීම් යන්ත්‍රෝපකරණ කාර්මික පාඨමාලාව (තුන් අවුරුදු පූර්ණකාලීන)

ශ්‍රී ලංකාවේ ඉදිකිරීම් යන්ත්‍රෝපකරණ තාක්ෂණික ශිල්පි පුහුණුවට ඇති එකම රාජ්‍ය ආයතනයෙන් ජාත්‍යන්තර සුදුස්සෙකු වන්න.

ඉදිකිරීම් යන්ත්‍රෝපකරණ පුහුණු මධ්‍යස්ථානය

අංක. 17, ඩී.පී. විජේසිංහ මාවත, පැලවත්ත, බත්තරමුල්ල.
ටෙලි. 011 2784413 / 2786829
ෆැක්ස් : 011 2784411
ඊ-මේල් : cetrac@sltnet.lk වෙබ් : www.cida.lk

CONSTRUCTION INDUSTRY DEVELOPMENT AUTHORITY

OTC

නිවාස හා ඉදිකිරීම් අමාත්‍යාංශය

ඉදිකිරීම් කර්මාන්ත සංවර්ධන අධිකාරිය

1982 වසරේ ලෝක බැංකු ආධාර මත ආරම්භ කරන ලද ගල්කුලම ඉදිකිරීම් යන්ත්‍රෝපකරණ මෙහෙයුම් ශිල්පී විදුහල මෙහෙයුම් ශිල්පීන් පුහුණු කිරීම සඳහා ශ්‍රී ලංකාවේ ඇති එකම රාජ්‍ය ආයතනයයි.

දේශීය සහ විදේශීය ඉහළ රැකියා ඉල්ලුමක් ඇති ඉදකිරීම් යන්ත්‍ර ක්‍රියාකරුවන් පුහුණු කිරීම සදහා පාඨමාලා පවත්වයි.

මෙම ආයතනයේ පාඨමාලා හදාරා පුහුණුව අවසන් කරන ආධුනිකයින් සහ දැනට වෘත්තියේ යෙදී සිටින අය හට දක්ෂ ඉදිකිරීම් යන්ත්‍ර ක්‍රියාකරුවකු වී නිපුණතා ශිල්පී සහතිකය සහ හැඳුනුම්පතක් ද අවශ්‍ය න්‍යායික දැනුම හා ප්‍රායෝගික පුහුණුව කාර්යශූර ආචාර්යවරුන් හා නිලධාරීන් විසින් ලබාදේ.

රාජ්‍ය ආයතනයක් වශයෙන් කිසිම ලාභ පරමාර්ථයකින් තොරව රජය විසින් විශාල වියදමක් දරා නේවාසික පහසුකම් සමග මෙම පුහුණු කටයුතු සිදුකරන අතර, පුහුණු ලාභියාගෙන් අයකරනු ලබන්නේ පුහුණුව සඳහා වැයවන පිරිවැයෙන් ඉතා සුළු කොටසකි.

පාසල් හැරගිය රටේ දහසක් දුවා දරුවන්ට ගල්කුලම බරවාහන මෙහෙයුම් ශිල්පී පුහුණු මධ්‍යස්ථානය මෙම කෙෂ්ත්‍රයේ ජාත්‍යන්තර පිළිගැනීමකින් යුතු නිපුණතා සඳහා මග විවර කර දී තිබේ.

ශ්‍රී ලංකාවේ ඉදිකිරීම් යන්ත්‍රෝපකරණ මෙහෙයුම් ශිල්පී පුහුණුවට ඇති එකම රාජ්‍ය ආයතනයෙන් ජාත්‍යන්තර සුදුස්සෙකු වන්න.

ඉදිකිරීම් යන්ත්‍රෝපකරණ මෙහෙයුම් ශිල්පී පාඨමාලා

- මූලික ඉදිකිරීම් යන්ත්‍ර නඩත්තු ශිල්පය
- සැහැල්ලු ඉදිකිරීම් යන්ත්‍ර මෙහෙයුම් ශිල්පය
- ට්‍රැක්ටර් පුහුණු පාඨමාලාව
- ගල් රෝලර් පුහුණු පාඨමාලාව
- ලෝඩර් බැකෝ
- වීල් ලෝඩරය
- ඒක්ස්කැවේටරය
- මෝටර් ග්‍රේඩරය
- ඩෝසරය
- ජංගම දොඹකරය
- ඩම්ප්ට්‍රක් රථය
- යන්ත්‍රෝපකරණ ප්‍රවාහකය
- ෆෝක්ලිෆ්ට් ට්‍රක්
- ස්කිඩ් ලෝඩරය
- බුම්ට්‍රක්/ක්‍රේන්ට්‍රක්
- ඉදිකිරීම් යන්ත්‍ර කළමනාකරණ පාඨමාලාව

ඉදිකිරීම් යන්ත්‍ර මෙහෙයුම් ශිල්පී විදුහල

ගල්කුලම, අනුරාධපුර.
දුරකථන : 025-2050520, 025-2050521
ෆැක්ස් : 025-2050522
ඊ-මේල් : cidaotc@sltnet.lk වෙබ් : www.cida.lk

CONSTRUCTION INDUSTRY DEVELOPMENT AUTHORITY

CENTRE FOR HOUSING PLANNING & BUILDING

CHPB - The Centre for Housing Planning & Building is a multi disciplinary institute coming under the managerial jurisdiction of CIDA under Ministry of Housing & Construction. CHPB is emphatic in conducting courses aimed to career development of professionals. CHPB presently conducts wide range of courses covering the following subjects and fields.

CONSTRUCTION MANAGEMENT

*	Certificate (Full Time) - 01 Year 5 Months - Institutional Training 7 Months - Internship at recommended work site
*	Certificate (Part Time) - 01 Year Institutional Training Only
*	Diploma (Part Time) - 01 Year

QUANTITY SURVEYING

*	Certificate (Part Time) - 06 Months
*	Diploma (Part Time) - 1 Year
*	Diploma (Full Time) -1 Year
*	Advanced Diploma - 1 Year
*	Short Courses Pricing of BOQ & Rate Analysis - 05 Days Measurements (SLS 573) - 06 Days Contract Administration - 05 Days MEP Quantity Surveying - 04 Days Construction Law - 04 Days FIDIC/SBD 2 Contracts - 02 Days Use of Level Instruments - 04 Days Total Station (EDM) - 03 Days Training Programme on GNSS (GPS) -03 Days

INTERIOR DESIGN TECHNOLOGY

*	Foundation Course (Part Time) - 03 Months
*	Diploma (Part Time) - 18 Months
*	Certificate (Part Time) -10 Months

LANDSCAPING GARDENING & HORTICULTURE

*	Certificate (Part Time) - 12 Months
*	Diploma (Part Time) - 24 Months
*	Short Courses - 05 Days

BUILDING SERVICES TECHNOLOGY

*	Plumbing Technology - 05 Days
*	Electrical Technology - 04 Days
*	Building Management Systems (BMS) - 04 Days
*	Lightening Protection Systems - 03 Days
*	Waste water collection , Treatment, Disposal & Reuse. - 04 Days
*	Air Conditioning Refrigeration Installation and Maintenance - 04 Days

COMPUTER COURSES RELATED TO CONSTRUCTION FIELD

*	Training Course on AUTO CAD 2D & 3D - 10 days
*	Training Course on Microsoft Project 2013 - 07 days
*	Intensive Project Management Primavera P6 - 04 days

Custom designed programmes according to the requirement of the employees engaged in the construction industry

Refer - Training Plan for the year 2019 (www.cida.gov.lk)

Centre for Housing Planning & Building (CHPB)
No. 33, Parliament Rd, Pelawatta, Battaramulla
For more details :- 011-2787661, 011-2785712
Fax :- 011-2785629
Email:-cida.chpb@gmail.com Web:- www.cida.gov.k

Head office :- Construction Industry Development Authority (CIDA)
"Savsiripaya", 123, Wijerama Mawatha, Colombo 07
T P :- 011-2699801,2686092,2686856
Fax :- 011-2699738
E-mail:- cida@sltnet.lk Web:- www.cida.gov.k

ප්‍රතිචක්‍රීකරණය - හෙට දින උදෙසා ප්‍රතිඋත්තරය

நாளை மறுகழற்சி செய்யுங்கள்

Reply tomorrow with recycling

Ministry of Housing & Social Welfare

Construction Industry Development Authority

"Savsiripaya" No.123, Wijerama Mawatha, Colombo 07